DETERMINANTS OF NEONATAL MORTALITY IN MARGARET KENYATTA MOTHER BABY WING AT NAKURU LEVEL 5 HOSPITAL, NAKURU COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or for any other award.

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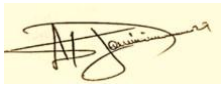
Signature:  **Date:** 19.06.2023

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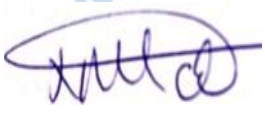
Signature:  **Date** 19th June 2023

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DEDICATION

This thesis is dedicated to my late dad, my loving mother and to my siblings who always wonder when I will finish schooling.

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I recognize the guidance and mentorship that I have constantly relied on from my supervisors Dr. Dominic Mogere and Dr. Kerochi Atei from initial concept to complete development of this thesis. The Knowledge I gained through the lecturers from the university faculty and the supportive learning environment provided by Mount Kenya University has provided significant insights and support in developing this paper, the support has been remarkable. In addition, I sincerely acknowledge the County Government of Nakuru for allowing me time to undertake my studies and giving approval to carry out this study within the county health facilities. Above all I thank the Almighty God for good health and sufficient grace.

ABSTRACT

In Nakuru county, neonatal mortality rate is 41.9 per 1000 live babies born every year, which is more than twice the national mortality rate of 19 deaths per 1000 live births. This study investigated the risk factors associated with neonatal mortality at Nakuru level 5 hospital. The study design was unmatched case control study. The sample size was 429 neonates (143 cases and 286 controls) calculated using epi info version 7.3.2.1 assuming case to control ratio of 1:2 and prevalence of exposure among controls at 18%. The results of the study showed that high parity (OR<1.623), high number of still births (OR<8.399), positive HIV status (OR<3.49), HBsAg status (OR<2.57), syphilis status (OR<25.69), pregnancy induced hypertension (OR<2.5), antepartum hemorrhage (OR<2.1), PROM 18hours (OR<5.09), and maternal peri-partum (OR<4.6) increased the risk of neonatal. Similarly, the data show that mothers who had fewer ANC visits throughout their pregnancy had a greater risk neonatal mortality compared to mothers who attended more than three ANC clinics with mortality risk reducing by 69% (OR 0.389) and 59% (OR 0.418) for 1-2 visit and more than 3 visits compared to noneattendance of ANC. From the data, the mode of delivery affects the risk of mortality with vaginal assisted delivery having an OR of 2.188 while vaginal unassisted OR 4.533 as compared to caesarian delivery. Mother treatment with antibiotics (OR 0.658) and mother treatment with antenatal dexamethasone (OR .578) reduced the risk of mortality. Similarly, treatment with antibiotics reduced NMR by OR 0.381. New-born of mothers admitted to the facility from a referral facility or labor ward had a higher risk of mortality of OR 1.11 and OR 6.220. Other factors that increased mortality include low birth weight, low weight on admission, gain weeks, and congenital anomalies. These factors remained substantially linked with infant mortality in this study; the findings indicate that increasing birthweight reduced the risk of neonatal mortality by; 1>=2 OR .247, 2>=3 OR, and 3>=4.5 OR .160. Similarly, the age of admission to the NBU reduced to the risk of mortality by 1>=2 OR 0.836, 2>=3 OR 0.236, and 3>=4.5 OR 0.441. The data also show that increasing gestation period reduced neonatal mortality by; 32>37 OR 0.401, and 37>42 OR 0.227. The study concluded that maternal characteristics, neonatal complications are key determinants of neonatal outcomes. The study recommends regular training of staff working in the maternity and newborn unit on emergency care and neonatal resuscitation.

TABLE OF CONTENTS

DECLARATION.....ii

DEDICATION..... iii

ACKNOWLEDGEMENTS iv

ABSTRACT.....v

TABLE OF CONTENTS v

LIST OF TABLES ix

LIST OF FIGURES x

LIST OF ABBREVIATIONS AND ACRONYMS xi

CHAPTER ONE 1

INTRODUCTION 1

1.0 Introduction 1

1.1 Study Background 1

1.1.1 Neonatal Mortality in Africa 4

1.1.2 Neonatal Mortality in Kenya 5

1.2 Statement of the Problem 6

1.3 Purpose of the Study 7

1.4 Objectives of the Study 8

1.5 Research Questions 8

1.6 Significance of the Study 8

1.7 Research Scope 9

1.8 Limitations of Study 10

1.9 Delimitations of the Study 10

1.10 Definition of Terms 12

CHAPTER TWO 15

LITERATURE REVIEW 15

2.0 Introduction 16

2.1 Demographic Overview 17

2.2 Theoretical Background 21

2.2.1 Modernization Theory 21

2.2.2 Dependency/World Systems Theory 21

2.2.3 Gender Stratification Theory 22

2.2.4 Economic Disarticulation Theory 23

2.2.5 Developmental State Theory 23

2.3 Neonatal Risk Factors 24

2.4 Maternal Risk Factors 24
2.5 Facility/Hospital Risk Factors 26
2.6 Conceptual Framework 27
CHAPTER THREE 31
RESEARCH METHODOLOGY 31
3.0 Introduction 31
3.1 Study Design 31
3.2 Study Location 32
3.3 Study Target Population 33
3.4 Inclusion and Exclusion Criteria 33
3.5 Sample size determination 34
3.6 Research Instruments 35
3.6.1 Pre Testing of the Instrument 36
3.7 Reliability and Validity 38
3.8 Procedure and Methods of Collecting Data 38
3.9 Techniques of Data Analysis and Presentation 39
3.10 Study Ethical Considerations 40
CHAPTER FOUR 42
RESULTS AND DISCUSSIONS 42
4.0 Introduction 42
4.1 Data Validity and Reliability 42
4.2 Prevalence 44
4.3 Factors Associated with Neonatal Deaths 46
4.3.1 Logistic Regression Findings 46
4.3.1.1 Maternal Factor 46
4.3.1.2 Hospital factors 52

4.3.1.3 Neonatal Factors 55
4.3.2 Qualitative Findings 57
4.3.2.1 Maternal Factors 57
4.3.2.2 Hospital factors 59
4.3.2.3 Neonatal Factors 60
4.4 Challenges in the New-born Unit 61
CHAPTER FIVE 63
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 63
5.1 Summary 63
5.2 Conclusions 64
5.3 Recommendations 66
5.3.1 Recommendation for the Study 66
5.3.2 Recommendation for Further studies 69
REFERENCES 70
APPENDICES 76
Appendix I: Introductory Letter 76
Appendix II: Consent Form for Participants 78
Appendix III: Research Instruments 79
Appendix IV: Letter of Introduction 84
Appendix V: Authorization 85
Appendix VI: Research Permit from NACOSTI 86
Appendix VII: Similarity Index 88

LIST OF TABLES

Table 1: Discriminant Validity 43

Table 2: Confirmatory factor analysis of the final model 44

Table 3: Maternal factors 50

Table 4: Hospital factors 54

Table 5: Neonatal factors 57

Table 6: The respondents supported the pregnancy related conditions 58

Table 7: hospital factors contributing to neonatal mortality 59

Table 8: Neonatal factors associated with neonatal mortality..... 60

Table 9: Challenges experienced in the NBU. 61

LIST OF FIGURES

Figure 1: Theoretical framework..... 29

Figure 2: Conceptual Framework 30

Figure 3: Relationship of the variables 30

Figure 4: Pregnancy related conditions 59

Figure 5: Hospital factors 60

Figure 6: Neonatal factors 61

Figure 7: Challenges experienced in the New-born unit 62

LIST OF ABBREVIATIONS AND ACRONYMS

ANC	Antenatal care
AOR	Adjusted Odds Ratio
CI	Confidence interval
COR	Crude Odds Ratio
KDHS	Kenya Demographic Health Survey
MCH	Maternal Child Health
MKMBW	Margaret Kenyatta Mother Baby Wing
MMR	Maternal Mortality Rate
MOH	Ministry of Health
NBU	New-born Unit
NMR	Neonatal Mortality Rate
NPR	Neonatal and paediatric resuscitation
OR	Odd ratio
PET	Pre-eclampsia/Eclampsia
PMTCT	Prevention of Mother to Child Transmission of HIV
RMNCAH	Reproductive Maternal, Neonatal, Child and Adolescent Health
TBAs	Traditional Birth Attendants
U5MR	Under 5 Mortality Rate
UNFPA	The United Nations Population Fund
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter of the study entail background information, problem statement, study objectives and research scope among other subsections of the study.

1.1 Study Background

Globally, it is estimated that close to 75% of all the deaths of neonates occur within seven days after being born (Hug et al., 2019). Worldwide, millions of new borne babies die within the first 4 weeks of life each year; which explains forty percent of the mortality rate for children aged five years and below (Liu et al, 2016). Studies have projected that if countries across the world maintained their 2017 Neonatal Mortality Rates (NMRs), the annual NMR globally would rise from eighteen deaths to nineteen deaths in every 1000 live births rather than decline to the global target of 12 deaths per 1000 live births by the year 2030. In addition, the expected total neonatal deaths would be 2.7 Million in 2030 (Hug, Alexander, You & Alkema, 2019). It is also projected that by 2030, neonatal mortality would account for 50% of all under 5 deaths in the world (Hug et al., 2019). According to United Nations Children's Fund [UNICEF] (2018), the first 28 days of life are the most critical to the wellbeing of the baby. Loss of a New-born is highly dreaded and it is the most harrowing post-natal occurrence among mothers (WHO, 2017) and it is common in third world nations. Deaths occurring within the first month of life account for 41 percent of deaths in children below 5 years worldwide (UNICEF,2018). Ngongo et al., (2020) argues that in comparison to children aged above one month, neonates are forty-five times more likely to lose their lives. According to UNICEF (2018), the global NMR is 18 deaths per 1000 live births on average. In 2018 alone, 2.5 Million children lost their lives across the world before 28th day of life (UNICEF, 2018).

According to a study by Hug et al. (2019), neonatal mortality has been declining across the world in the period 1990 to 2017. The Study argues that though there is observable decline in neonatal mortality Rate (NMR) over the years, the deceleration rate is less pronounced in neonatal deaths as compared to the observed decline in mortality of children below five years. Though there has been modest improvement in neonatal health within the south of Sahara in Africa between 1990 and 2017, the current

NMR of 30 deaths in a thousand live birth is still higher than the targeted rate (Hug et., 2019). Besides, at most, only 30 percent of the countries in the region are likely to attain SDG NMR target by 2030 if the current trend continues (Hug et al., 2019).

The essential goal of decreasing under five mortality rate has been to target reducing NMR globally. The United Nations (UN) Secretary General Ban Ki Moon Initiated strategy for women's and Children's Health and Every Woman Every Child' movement in 2010 (UN Secretary General Ban Ki moon, 2010), the A promise renewed commitment to child survival in 2012 (UN, 2012), and Every New-born Action Plan (WHO, 2014) in 2014. These initiatives developed a strategic plan to address the challenge of mortality among children below five years and deaths of neonates which was later mirrored in the Sustainable Developed Goals (SDGs) targets. The target of the SDGs strategies is to lower neonatal deaths to twelve in 1000 new-borns in 15 years. In an effort to address the problem of neonatal mortality and morbidity, health departments across the world have introduced several tools in their healthcare programs in order to mitigate upon the influencer and improve quality of mother and new-born health. The

WHO, for instance, developed the Integrated Management of New-born and Childhood Illnesses (IMNCI) protocol to aid in assessing and detecting danger signs during examination of neonates and children presenting at primary healthcare centres especially in the developing countries. IMNCI manual is a guide for primary healthcare givers for

identifying specific preliminary signs that are an indication of a health problem after birth before instituting any treatment or referral. This initiative by WHO further emphasizes on the need for the family support system to have basic knowledge on maternal and neonatal care and early seeking of medical advice whenever a mother experiences any of the identified health problems during the postnatal care period (WHO, 2013). This has since been replicated severally (WHO, 2018).

The rate of neonatal deaths in Africa is forty-five deaths in 1000 live births, the globally (World Bank Report, 2016). The report further reveals that seventy six percent of the deaths among neonates occur within the first week of life. In addition, the findings indicates that 34 countries out of the 47 countries that will not attain the targeted neonatal mortality rate by 2030, 3rd SDG, are located south of Sahara desert in Africa. There has been an observable decline in mortality rates over the years, the deceleration rate is less pronounced in neonates as compared to that observed in children below five years (World Bank Report, 2016). Though there has been modest improvement in neonatal health within south of Sahara between 1990 and 2017, the current NMR is still higher than the targeted rate at above 30 deaths in 1000 live births in 2017 (Hug et al., 2019). Besides, at most only 30 percent of the countries in the region are likely to attain SDG NMR target by 2030 if the current trend continues (Hug et al., 2019).

Evidence based reports have argued that the setting surrounding delivery and skills of the delivery attendant contributes to neonatal deaths especially in the poor resource countries. A health demographic survey in Bangladesh indicated that new-born babies were hardly examined by a skilled healthcare professional. The study found out that one out of five new-borns had been attended to by a healthcare expert within the first 6 weeks of birth (Bangladesh Demographic Health Information System [BDHIS], 2014).

1.1.1 Neonatal Mortality in Africa

Africa has 6 times more deaths among neonates as compared to the European region (WHO, 2017). This is the highest in the world with neonatal mortality rate of 51 per 1000 live births. West and Central Africa had the highest neonatal mortality rate of 30.2 deaths per 1000 live births by the year 2017 which was higher by 9 times as compared to that in high income countries of 3 deaths per 1000 live births a and accounting for 23 % neonatal deaths globally (Hug et al., 2019). The study further reveals that East and South Africa regions accounts for 18% of global deaths among neonates. Hug et al. (2019) argues that nations with the highest rate of neonatal deaths are concentrated in Sub-Saharan Africa as well as East South Asia. Though there has been substantial reduction in the annual rates of neonatal mortality, Africa continues to record increase in the ratio of neonatal mortality rate to under 5 mortality rate ((Hug et al., 2019) since 1990. East and South Africa had an annual reduction rate in neonatal mortality rate of 11% which was 5 times lower than that recorded globally (50%) (Hug et al., 2019). Hug et al. (2019) argues that Sub Sahara Africa has the least chances of meeting the global target of 12 deaths per 1000 livebirths among neonates by the year 2030 since two thirds of countries with NMR and above 30 deaths in 1000 live births are within the region with a slowing rate of 1.9% in reduction of NMR.

The fundamental components of preventative strategies for neonatal mortality in Sub Saharan Africa are established around early diagnosis of danger signs in new-borns and focus on using prompt, appropriate and professional referral systems (Bhutta et al, 2015). Features of illness in neonates can only be identified by a skilled healthcare giver. The Possible danger signs such as restlessness, persistent fever, difficulty in feeding or signs of jaundice are sometimes the only signs that could be present to indicate that the neonate is ill and in need of urgent medical attention.

There are several danger signs that include history of chronic convulsions, stopped/delayed feeding, fast breathing rate that is more than 60 breathes/min, severe chest in drawing, lack of spontaneous movement, fever with temperatures over 37.5℃, low body temperatures below 35.5℃, any form of jaundice within the first 24 hours of life, or yellowing of the palms and soles at any age. In a study done by Young Neonates Clinical Signs Study Group (YICSSG), it was found out that the assessment of the early danger signs improved awareness, sensitivity and specificity in predicting the need for hospitalizing the new borne within the first week of life (Lancet, 2018). In a study done by Matendo et al (2016) in the Democratic Republic of Congo (DRC), most neonatal deaths occurred soon after birth out of which almost three quarters were caused by birth asphyxia, low birth weight or prematurity.

1.1.2 Neonatal Mortality in Kenya

Kenya is one of the countries with fastest growing economies within East Africa with a total population of approximately 47 Million spread across 47 Counties (Kenya National Bureau of Statistics [KNBS], 2019) with a female population of 24 Million.

The average births per woman stands at 3.9 with variation across the counties (Kenya Demographic Health Survey [KDHS], 2014). Nakuru County has the third largest population after Nairobi and Kiambu counties with total population of approximately 2.2 Million of which 1.1 Million are Females.

According to KDHS (2014) the childhood mortality rate in Kenya has declined gradually between 2003 and 2014.The under 5 mortality rate has decreased by 50% between 2003 and 2014. The neonatal mortality rate decreased by 33% from 32 deaths per 1000 live births in 2003 to 22 deaths per 1000 live births in 2014. (KDHS, 2014). According to KDHS (2014) 60% deliveries occurred in a healthcare facility with 46% in the public hospitals. Sixty percent of the total deliveries are conducted by xfcxzskilled healthcare

personnel with 36% being delivered by midwives and 26% by doctors. Breastfeeding is the most common type of feeding with 91% of new-born being introduced to breast milk within the first day of life. Kenya has not attained the targeted Neonatal mortality rate according to the third SDG for the last five years, which is currently at 20 deaths per a thousand live births. However, Nakuru county is one of the counties with the highest neonatal mortality rate currently at 41 neonatal deaths per 1000 live births (Irumi, 2021). Counties across the country have developed various strategies to address the challenges of maternal and neonatal health. Nakuru County proposed a Maternal, New-born and Child Health Bill, 2014 which is mainly aimed at providing a legal policy framework for effective advancement of the maternal, newborn as well as the child health with a focus on the modalities of enhancing safe motherhood and women's health. The bill, upon full implementation will address the issue of overall maternal health with a goal of reducing deaths related to childbirth and generally improving the quality of care to mothers and children. The bill underlines the call for a legal frame work that establishes regulations on the maternal, new-born and child healthcare rights and to lay a foundation for operationalization of reproductive health rights. All this was meant to protect the mothers, new-borns and children from hazardous unhealthy medical practices in order to meet the milestones on universal healthcare (Nakuru County, 2014).

The researcher assessed the factors related with neonatal mortality and suggested initiatives that can be implemented by the ministry of health to reduce neonatal deaths and attain the targeted NMR by 2030.

1.2 Statement of the Problem

Rift Valley Region which is the location of Nakuru county among others has a Neonatal Mortality Rate of 20 deaths in 1000 live births and under 5 mortality rate of 45 deaths per 1000 live births. The total number of deliveries registered in Nakuru County between

October 2018 and September 2019 (one year duration) was 55,448 and neonatal deaths were 688 Ministry of Health (Irumi, 2021). This indicates that for every 100 mothers who delivered in Nakuru County at least one mother lost her baby during the first 28 days of live. Nakuru level 5 hospital recorded a total of 12,757 deliveries which accounts for over 23% of the total deliveries in Nakuru County. The total number of babies born alive were 11610 and the total neonatal deaths were 394 for the same period which indicates a neonatal mortality rate of 34 per 1000 live births which is approximately twice the country neonatal mortality rate. This implies that three percent of the mothers were discharged out of the hospital without their live babies. The Ministry of Health report shows that 2364 from a total of 11610 babies who were born alive were admitted in the newborn unit for various health problems which accounted for 20% of the total babies born alive (Irumi, 2021). The report further reviews that 16% (394) of the total babies admitted at Nakuru Level 5 hospital newborn unit died within the first 28 days of life. The records from the facility shows that 18% of neonates who were discharged from the hospital after admission and 30% of those who died were born before 37 weeks of pregnancy. This study, therefore sought to assess factors that could be associated with neonatal mortality in Margaret Kenya Mother Baby Wing at Nakuru level five hospital. Comparing the trend in the decline of the under 5 mortality rate and neonatal mortality, this study denotes that the under 5 mortality rate records a higher rate of decline (55%, 115 in 2003 and 52 in 2014) against neonatal mortality rate of 33% (33 in 2003, 22 in 2014). According to KDHS (2014), it is further argued that there should be more focus on the health of the new-borns in order to accelerate positive change in the survival of a child.

1.3 Purpose of the Study

To assess the factors contributing to mortality of the new-born babies admitted to the Margaret Kenyatta Mother Baby Wing (MKMBW) at Nakuru level five hospital, in

Nakuru County

1.4 Objectives of the Study

i. To determine the prevalence of neonatal deaths at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital.

ii. To investigate maternal factors associated with neonatal deaths at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital iii. To investigate neonatal factors associated with neonatal deaths at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital iv. To investigate hospital factors associated with neonatal deaths at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital

1.5 Research Questions

i. What is the prevalence of neonatal death at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital?

ii. What are the maternal factors associated with neonatal mortality at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital? iii. What are the neonatal factors associated with neonatal mortality at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital? iv. What are the hospital factors associated with neonatal mortality at Margaret Kenyatta Mother Baby Wing, Nakuru level five hospital?

1.6 Significance of the Study

This study was carried out at Nakuru Level 5 Hospital which is the main Referral facility in Nakuru County and the entire Central and South Rift Valley Region. The facility serves a catchment population of over 10 Million with a maternity unit that conducts over 1500 deliveries per month and overall patient flow of more than 30,000 per month. The maternal and Child Health department serves an average of 1800 mothers in the ANC who are booked

for delivery in the same hospital. The facility houses Margaret Kenyatta and Baby Wing which has both Maternity and New-born Units that will be the site for this study. The new-born unit has a capacity of 40 cots and occupancy rate of more than 35 neonates per day and reports more than 40 neonatal deaths per month. This investigated the risk factors that are associated with neonatal deaths in the new-born unit with focus on the maternal, neonatal and hospital related factors that are either documented in the patient files or observed during the period of this study. The study findings expressed insights that would be pivotal in developing strategies for reducing incidences of neonatal deaths and improve the quality of maternal and neonatal services in the maternity and new-born unit of Nakuru Level 5 hospital. In addition, it will aid in improvement of neonatal and maternal health service delivery and performance in the referral public hospitals which take care of the majority of low-income earners in the county. The study findings are benchmark to guide the county and national government in developing policy guidelines and public health programs to improve efficiency and effectiveness of maternal and neonatal care, referral systems and primary healthcare services.

1.7 Research Scope

The main focus of this study was the neonatal mortality at the Nakuru Level 5 Hospital in Kenya. The study targeted neonates who had died between October 2018 and September 2019 at the hospital. Broadly, this study used case control retrospective study design to investigate maternal and neonatal factors associated with neonatal mortality at Nakuru Level Five Hospital. Nakuru Level Five Hospital was the preferred study site because of its role as a referral facility, the high rate of neonatal deaths reported monthly from the facility new-born unit and the evidence provided by previous studies that have shown that though the antenatal services had improved at the facility the neonatal mortality rate is persistently high (Kulei, 2016). In addition, the public health department

of Nakuru County had expressed concerns on the high number of deceased and abandoned neonates in the hospital mortuary and instituted investigations on the measures to prevent neonatal deaths and mitigate against the increasing neonatal morbidity in the hospital maternity department.

1.8 Limitations of Study

This study targeted neonatal deaths that had occurred between October 2018 and September 2019 at Nakuru Level 5 Hospital. The study was designed to audit patient data that was recorded for both the mothers who had delivered either through referral or booking in the facility and their babies who had been admitted in the new-born unit and died during the study period. The study focussed on the documented procedures and activities that were performed and recorded in the patient files during this period. The study was also limited to neonates who were admitted and died in Nakuru Level 5 hospital new-born unit and their mothers whose records of delivery were recorded in the hospital maternity unit during the study period. The study was also limited to the documented procedures and activities that were performed by skilled healthcare workers during the period of neonates' admission in the hospital new-born unit. The study did not put into consideration the prevailing at the study setting and the ongoing state of care in the maternity and new-born unit but rather retrospectively analysed and attempted to understand the conditions surrounding the deaths of neonates at the hospital that had occurred in the past.

1.9 Delimitations of the Study

This study was carried out at Nakuru Level Five Hospital in Nakuru county and did not include other facilities that offer maternity and neonatal services within the county. The research focus was only on maternal, neonatal and hospital factors that defined the environment during delivery in the maternity unit, admission and process of care in the

new-born unit till the time of death or discharge of the neonates. The study also looked into the neonatal deaths that had occurred within a period of one year preceding the date of visit at the study site.

1.10 Definition of Terms

Assessment: This is the provision of healthcare services to the neonates by the healthcare providers (HCP) that is evidence based. HCPs follows a standard protocol when doing an assessment; Initial examination, identification of the problem; management plan and monitoring. The HCPs are expected to follow documented standard guidelines and procedures when caring for the neonates and any form of noncompliance is recorded as a problem of the healthcare provider.

Booked: The mothers who were on follow up at Nakuru Level 5 hospital and were admitted at MKMBW unit for management of labour and delivery.

Complications: These are health problems that affect the wellbeing and functioning of the human body. This study will evaluate two categories of complications:

Maternal and neonatal complications that rise during and after child birth. Conditions such as eclampsia, haemorrhage, birth asphyxia and birth defects will be studied.

Drugs: This are tested and approved compounds administered to the human body in order to treat, cure and prevent diseases and improve quality of life. This study will only study drugs that were given to neonates who had died when being resuscitated.

Early neonatal death: Early neonatal death occurs within one week of life (Burke et al., 2016). This study will seek to carry out subset analysis of the neonatal mortality rate and the associated risk factors for the new-borns who had died within the first seven days of birth at Nakuru Level 5 Hospital.

Hospital Factors (HF): Acts or omissions by the administration or Health care practitioners (HCP) which cause unwanted health outcomes to the baby (Burke

et al., 2016). The researcher will refer to hospital factors as those factors that are related to the skills of the healthcare workers, staffing levels and medicines and supplies (stock levels) at New-born and Maternity unit.

Inpatient: This describes Mothers who had been admitted in Nakuru Level 5 hospital, prior to onset of labour, for medical treatment or pregnancy related complications.

Late neonatal death: This is the death of neonate that occur during second and fourth week after birth (Lehtonen et al., 2017). This study will seek to carry out subset analysis of the neonatal mortality rate and the associated risk factors for the new-borns who had died after seven days of birth at Nakuru Level 5 Hospital.

Maternal Factors (MF): These are factors that are associated with the mother's condition during pregnancy, at delivery and after delivery. This study will assess the maternal factors documented at childbirth and during admission of the neonate. The study also defines the condition of the mother after delivery as follows: Alive and Well this is the mother who did not suffer from any health problem while giving birth and is medically fit for discharge from the hospital, Alive and Stable This refer to a mother who after delivery suffered some health problems but is fit for discharge from the hospital, Alive and Unstable refers to a mother who is not fit for discharge after delivery and had developed medical problem that requires active health interventions and also prohibit the mother from being discharged home and Dead refers to a mother who died after delivery of a life neonate who was later admitted in the new-born unit.

Maternal characteristics: These are demographic features of the mothers who delivered within the study period. They include maternal age and parity.

Maternal complications: These are complications associated with the mother experienced during delivery or after delivery before discharge of the new-born.

They include medical conditions such as pre-eclampsia/eclampsia and premature rupture of membranes.

Neonatal characteristics: These are the new-born features such as sex, gestation age and birthweight.

Neonatal complications: The are unhealthy conditions/diseases affecting the new-born at birth or during admission period in the new-born unit. These complications include birth asphyxia, respiratory distress syndrome and congenital abnormalities.

Neonatal Death: This is the death of a neonate occurring within the first month of life (Lehtonen et al., 2017).

Neonatal resuscitation: Theses are emergency health interventions that are performed by skilled health care workers to restore and maintain breathing and circulation of the neonate (Sawyer et al., 2016).

Neonatal Mortality Rate (NMR): This is the number of neonatal deaths occurring per 1000 live births annually. In this study NMR will be determined by the number of neonatal deaths occurring between September 2018 and August 2019.

Neonatal Factors (NF): These are factors that are associated with the neonate's condition at birth and during the process of admission and care at the new-born unit.

Occurrence of danger signs (DS): Danger signs in new-borns are nonspecific and any sign can be an indicator of almost any form of disease or illness. According to UNICEF and WHO (2018) the following were highlighted as the main danger signs among new-borns; poor feeding or inability to feed, convulsions, respiratory rate (RR) above 60 breathes per minute (BPM), severe chest in drawing, core body temperatures of above 37.5 degrees Celsius, inactivity, yellowing of the skin,

reddened or pus draining umbilicus, skin boils and pus draining eyes. This study will assess the documented danger signs that occurred during admission of the neonates in the new-born unit.

Prematurity: According to WHO (2018), prematurity is defined as the babies born alive before 37 weeks of pregnancy are complete. Prematurity has three subcategories based on the gestation age: Extremely preterm (Less than 28 weeks), Very preterm (28 to 32 weeks) and moderate preterm (32 to 37 weeks). This study will adopt prematurity to mean all the neonates between 28 and 37 weeks of gestation.

Referred: Mothers who had been referred from other healthcare facilities, admitted and delivered in the maternity unit at Nakuru Level 5 Hospital

Staff levels and skills mix. This is the number of staff required to perform the functions of a particular department or section in an organization while skills mix is the required combination of different cadres or professions. In the study staffing levels will mean the number of professional staff working at the new-born unit within the period of this study while skills mix will be defined by various disciplines of healthcare workforce working within the new-born unit. The staff cadres include doctor specialist, medical officers, physiotherapists, nurses, clinical officers and nutritionist. The study will refer to the duty rotas and staff personal files from the human resource determine to identify the level of staffing and skills mix during the study period.

Self: Mothers who visited the facility for examination and admission in the maternity and subsequently delivered at the Nakuru Level 5 Hospital.

CHAPTER TWO

LITERATURE REVIEW

This section has a comprehensive summary of past studies that address the issues surrounding neonatal mortality at the Nakuru Level 5 Hospital, Nakuru County, Kenya.

This chapter reviews the empirical literature, critical analysis of the literature, theories that are directly applicable to this study, and the conceptual framework. This section gives an in depth look at the rate of neonatal mortality, the maternal risk factors, the facility/hospital risk factors to neonatal mortality and the danger signs associated with neonatal mortality.

2.0 Introduction

NMR is the comparative ratio of total number of deaths of neonates within 28 days of life for the babies born alive in one year, multiplied by 1000 (NDPS, 2015). Mortality among neonates is a major health determinant of the state of health of the respective society. Neonatal mortality provides a method for reporting death of neonates losing their lives in the first four weeks after birth (Kpedekpo, 2016).

$$\text{NMR} = \frac{\text{Number of Neonatal Deaths in a Year}}{\text{Number of Live Births in a Year}} \times 1000$$

Neonatal mortality can result from a range of factor; however, there are indications of new-born illness and require immediate medical attention that can be used to map their occurance. These signs are not specific, they can predict any form unhealthy condition. According to UNICEF (2018) poor nurturing or inability to feed, convulsions, respiratory rate above 60BPM, severe chest in drawing, core temperatures of above 37.5 degrees Celsius, inactivity, yellowing of the skin, reddened or pus draining umbilicus, skin boils and pus draining eyes are some of the danger signs occurring in new-borns. These danger signs must be understood and easily identifiable by the mother and healthcare givers in order to provide immediate remedies and prevent adverse health outcomes. Knowledge of neonatal danger signs and the features that influence their manifestation are crucial in reduction of NM (WHO, 2017). A study done by Tariku Nigatu et al (2016) found a strong correlation between neonatal danger signs and neonatal deaths. The study suggested that

knowledge on the factors contributing to neonatal danger signs could aid in reduction of neonatal mortality in countries like Ethiopia. The study was conducted in Kebeles in Amhara region Gondar zone of Ethiopia between 3 18 march 2016 with a sample size of 1150 mothers and new-borns born during the period of study. The study emphasized on the tactics to expand maternal healthcare services and strengthen the community health extension programs in order to alleviate neonatal morbidity (Nigatu et al., 2016). Nigatu et al. (2016) argues that due to heterogeneous nature of clinical manifestations of neonatal illnesses, healthcare workers experienced challenges in making early diagnoses resulting in delayed definitive care and treatment and increased chances of death.

2.1 Demographic Overview

According to a study done by Hug, Alesander, You and Alkema (2019), a systematic analysis of National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario based 2030 projections, a total of 103M newborns lost their lives between 1990 and 2017. NMR has decreased by 51% between 1990 and 2017 from 36.6 to 18 deaths in a thousand livebirths worldwide. The total deaths of neonates have reduced to 2.5M in 2017 from a peak of 5.0M in 1990 with 58% decrease in death rate of children below 5 years from ninety-three (93.6) deaths in a thousand births to thirty-nine (39.1) in the same period. West and Central Africa and South Asia had the highest annual NMR in 2017, 30.2 deaths in 1000 babies born alive and 26.9 respectively. The neonatal mortality rate in these regions was 9 times higher than that found in developed countries. Sub Saharan Africa and south Asia accounted for 79% of the total burden of neonatal deaths and South Asia alone contributed 38% of neonatal deaths, West and Central Africa 23% and East and South Africa 18 % of neonatal deaths. The NMR per country ranges from 44.2 to 0.9 deaths a thousand babies born alive South of Sahara and South Asia having the most concentration.

In all regions across the world except East Asia and the pacific, the ratio of NMR to U5MR has considerably risen from 1990. In 2017, the ratio of NMR to U5MR was more than 0.5 in all regions apart from those in Sub Saharan Africa, which still have the World's highest U5MRs. Neonatal mortality rate was observed to have stagnated between 1990 and 2017 as compared to U5MR in nations with low income hence increasing the ratio NMR to U5MR in these regions. Forty Seven Percent (47%) of Global under 5 deaths was attributed to neonatal deaths in 2017 as compared to forty percent (40%) in 1990.

The study projected that if countries across the world continued to record 2017 NMRs then there would be yearly increase of 19.0 deaths in a 1000 babies born alive globally and the expected total neonatal deaths would be 2.7 Million by 2030. It is also projected that by 2030, neonatal mortality would account for 50% of all under 5 deaths in the world. The study describes that though there has been observed decline in neonatal mortality over the years the acceleration is less pronounced in neonates as compared to that observed in under five-year children. Though there has been modest improvement in neonatal health within South of Sahara between 1990 and 2017, the current NMR is still higher than the targeted rate at above 30 deaths in 1000 live births in 2017 (Hug et al. 2019). Besides, at most only 30 percent of the countries in the region are likely to attain SDG NMR target by 2030 if the current trend continues (Hug et al., 2019).

Seid et al., (2018) studied common predictors and predisposing factors related to death of neonates in the new-born Unit at Liaquat University Hospital in Hyderabad and concluded that low birthweight and prematurity pose a greater threat to neonatal deaths in the health facilities. The study was carried out between July 2006 and December 2007 with a target of 1203 neonates who had been admitted in the study site within the period of research. Two hundred and eighty-four neonates died from a population of 1204 admitted in the hospital within the period of research. The study recommended that the

healthcare systems must be well equipped and endowed with the requisite capacity to provide skilled birth attendance and quality care to preterm and low birth weight babies.

A demographic survey in North Ibadan LGA in six residential areas showed neonatal deaths of 1431 neonates out of a total population of 306,795 residents. The study was carried out between 2006 and 2010 with correlation of the national census of 2006.

Focused group discussions were conducted to assess peoples' perceptions and behaviours towards neonatal mortality. There was significant relationship between housing and immediate environmental conditions and neonatal mortality rate. The study indicated that poor toilet facilities and general waste management practices were associated with neonatal mortality. The research concludes that improvement of the state if sanitation and household conditions by the local authorities could have positive impact on the maternal and neonatal wellbeing.

According to KDHS (2014), Kenya has a child mortality rate of 45.6 deaths per 1,000 live births. The child mortality rate in Kenya has been gradually decreasing to 45.6 deaths by 2014 from 156.4 deaths per 1,000 live births in 1968 (World Data Atlas,2017).

A retrospective study done in Moi Teaching and Referral hospital (MTRH) to analyse maternal and neonatal mortality by Irimu et al. (2021), found out that neonatal mortality rate was 68 per 1000 live births in the teaching hospital for the period between January 2004 and December 2011. This was a case control study carried out MTRH which is a level 6 hospital located with Rift Valley region Western side of Kenya. The research sampled and audited 150 current deaths of mothers and 200 deaths of neonates that had occurred within the study period. The study also sampled and audited records of 300 mothers (control cases) whose babies had survived during the same period in order to determine difference in prevalence of the risk fathers and neonatal mortality rates.

Maternal mortality and neonatal mortality rates were determined and considered annually for the study period January 2004 and December 2011.

Data retrieved from the health facility files for mothers entailed maternal complications, age and gestational maturity, stage of labour during admission, the person conducting delivery and status of the mother during admission. Mothers referred from other healthcare facilities or had been delivered by a non-skilled personnel were categorized as booked while those who had been attended at the MTRH maternal and child health clinic were categorized as booked. Neonatal hospital records provided information on the results of childbirth, APGAR score, birthweight, and maternal and neonatal conditions when being allowed home from the hospital. Classification of the diseases was done based on the WHO classification of diseases. The results of the study showed NMR of 68 in every 1000 babies born alive and MMR of 426 in every 100,000 deliveries. Fifty one percent (51%) of deaths among new-borns were reported among mothers age between 15 24 years. Multigravid women had higher percentage of both neonatal and maternal mortalities, 53% and 71% respectively. A high proportion of mothers who lost their babies were admitted in active stage of labour (87%) and 73% of neonatal deaths were from mothers who had vaginal type of delivery. Maternal illnesses had a stronger correlation with maternal and neonatal deaths with Eclampsia 22%. Dystocia 4% and haemorrhage 14%. The study concluded that pre term birth and asphyxia were the leading causes of neonatal deaths.

The literature on neonatal mortality has put emphasis on the risk factors associated with the antenatal period. There is less attention on the factors associated with neonatal mortality during childbirth and admission in the new-born unit. Therefore, this study will focus on investigating factors that attributed to the wellbeing of the new-borns during birth and care and management in the new-born unit.

2.2 Theoretical Background

This section of literature review contains reviewed theories that have attempted to explain neontal mortality as a healthcare outcome. The theories include Modernization theory, dependency/world systems theory, gender stratification thery, economic disarticulation theory and development theory (Arceo et al., 2016).

2.2.1 Modernization Theory

This theory is based on the argument that modernization is as a result of industrialization which contributes to improvement in economic status of a country hence better health among other basic human needs of the country's population. Arceo et al., (2016) suggest that improvement in provision of basic human needs such as housing, nutrition, education and heath are as a result of economic growth and significantly reduces neonatal mortality rate of a country. An economy that is modernized and with positive output boosts the living conditions among the population fostering positive energy and improved morale in the society which has a positive impact on the health of population. Inadequacy of resources creates an environment that is unstainable with inequalities to the wellbeing of the children. Children living in poor environmental conditions especially in low income countries are more likely to suffer from health problems as compared to their counterparts in high income countries

2.2.2 Dependency/World Systems Theory

Though the modernization theory argues that economic development improves the living conditions and general wellbeing of the population, this theory denotes the effect of global inequalities that arise when some countries become dominant economic players while others become economically dependent on others. The dominant countries become richer and well developed and continue to draw resources from the dependent and poorer countries for continued commercialization and industrialization. Global relationship

between nations have negative impact of making the dependent countries poorer and more resource deprived as compared to the dominant world economies. The relationships deplete the low income countries the required resources for investments and innovations and continuously endow the dominant countries with enough resources to sustain their economic growth and sustainability. These dependent relations deprive the poorer countries the opportunities and resources that they could otherwise plough back and improve their economic status and public programs that increase the general state of wellbeing (Arceo et al., 2016). The theory argues that this kind of relationship create uneven tug of war between those who have and those who do not. The rich countries continue to win and develop while the poor countries continue to lose and decline in economic developments.

Newborns represent the future of a nation and their survival rate is an important reflection on the quality of life. A society can hardly alter the poverty level with nine months of pregnancy but good and subtle public health policy can significantly influence the pregnancy outcomes. The causes of mortality are extremely diverse among the varied human population and increases with decline in economic status of a country (Arceo et al., 2016).

2.2.3 Gender Stratification Theory

This theory suggests that the role of a mother improves if she is an appreciated as a female gender in the society. Education especially to the female gender has been seen as one of the ways of improving quality of life amongst women which in essence plays a key role in improve health outcomes among mothers and children. Mothers who are educated have better health seeking behavior as compared to the illiterate counterparts and also education in itself impact positively on family relationships in connection to child care (Arceo et al., 2016). Education boosts self-esteem among mothers which translates into

better healthy habits and lifestyle that assures better health outcomes and healthy babies. Ware et al. (2019) supports this theory by concluded that increasing the percentage of educated women in the society increase the immunization coverage among children, reduces diarrheal diseases, increases uptake of modern family planning methods, improves the household nutritional status and raises the utilization of health faculties.

2.2.4 Economic Disarticulation Theory

This theory argues that uneven distribution of development programs and inequalities in economic status creates a disorder within a country that affects its humanitarian efforts especially during allocation of funds and resources. The economic activities are not well aligned to the immediate needs of the population which results in stagnant economic growth and poor developments in public programs. This creates competition between the rich and the poor for the available resources making the rich richer and poor poorer. This theory is supported by studies that have showed the relationship between cultural, socio economic, and political factors and neonatal mortality rate (Lamichhane et al.,

2017).

2.2.5 Developmental State Theory

Developmental state theory provides an integrated concept of the economic and demographic evolution across the world (Arceo et al., 2016). This theory argues that countries that are wealthy and economically developed can support wellbeing and overall health status of the less developed countries and subsequently decrease the neonatal mortality rate (Molitoris et al., 2019). Molitoris et al., (2019) further argues that the developed states can help fund post-natal and peri natal programs in poor nations through direct funding and technical assistants or through investment initiates in the public health and welfare programs hence reducing inequalities in accessibility of healthcare services, nutrition, education and housing.

2.3 Neonatal Risk Factors

Neonatal risk factors are the conditions associated with the new-born that pose a threat to survival of the baby after birth. These factors include Prematurity, low birthweight, birth asphyxia, congenital abnormalities and poor APGAR score (Seid et al., 2019). Policy makers must focus on the causes of neonatal mortality which are unique as compared to those associated with order children (Hug, Alexander, You & Alkema, 2019). Prematurity and both maternal and neonatal complications and infections occurring during the intrapartum period are the dominant causes of neonatal deaths. Thirty Five percent (35%) and Twenty four percent (24%) of all neonatal deaths in 2017 were as a result of complications associated with preterm birth and intrapartum events such as birth asphyxia, respectively, while 14% and 11% were due to sepsis or meningitis and congenital birth defects in that order (WHO, 2018). According to WHO

(2018), The number of deaths associated with infectious diseases decreased between 2000 and 2017 while those associated with prematurity ad congenital anomalies increased in the same period. Even in those countries with low NMR, prevention of prematurity and birth defects can help improve global trends in NMRs. Efforts must be put in place to address the impact of prematurity and congenital anomalies on neonatal mortality even in poor resource settings in order to address the effects of disparities in

NMRs within countries (Sousa, Hill & Dal, 2010.p.17)

2.4 Maternal Risk Factors

Maternal risk factors are defined as those factors that are associated with the mother's wellbeing and their predisposition to the wellbeing of her baby during perinatal period (WHO, 2016). According to Hurt, Butut, and Simpson (2013) argued that antenatal clinic visits, mothers' inclination to deliver at home, social and economic status and perinatal health of the mothers are some of the influencers of neonatal outcomes associated with

the mother. Moreover, complications during childbirth, late initiation of breastfeeding and lack of information on the signs that indicate illness in neonates are major health risks that contribute to death of the babies born with expected birthweight. Maternal risk factors pose a great threat to the health of both the mother and baby after birth.

Hurt et al. (2013) studied maternal, neonatal and delivery setting factors that predicted neonatal outcomes and found out that childbirth complications; health problems in the antenatal period; health problems occurring within the first four weeks of birth; unskilled birth attendance and inadequate knowledge on danger were predicators of deaths of new-borns within the first one week of life. These factors further contributed to neonatal mortality. A research by Gathoni and Otara (2016) established that ill health was a major contributor to neonatal mortality. Healthcare givers and mothers have been sensitized on the neonatal danger signs especially by the use of mother and child booklet though its utilization and impact on the expected patient outcomes is questionable (BMC Research, 2016). WHO (2016) argued that the standards of healthcare services offered to the mother and baby has been jeopardized by mothers' social and economic status, society norms and practices and ignorance among mothers especially in the under resourced parts of the world. Maternal factors such the mother's age at the time of delivery have effect on the wellbeing of the baby with risk of neonatal mortality being higher among very young and elderly mothers (Machio 2017). Hort et al. (2013) argue that the likelihood of survival among closely spaced neonates is significantly low due to competing needs among siblings and physiological and psychological depletion of the mother's strength. The study further argues that women with closely spaced children experience challenges of giving full attention and required care to the children and this might further compromise their ability to adhere to perinatal norms that are needed for better healthcare to the children.

2.5 Facility/Hospital Risk Factors

Hospital risk factors are the conditions within the hospital which are known to compromise the wellbeing of a new-born and the mother and they include staffing levels, medicines and supplies, equipment and skills mix of the staff working within the hospital (Lassi & Bhutta, 2015). The impact of the risk factors posed by the health facility during and after delivery are dependent on the staff capacity, availability of medicines, equipment and supplies. Globally, poor conditions at the hospital of birth have been linked to neonatal deaths especially among neonates born prematurely, those born with less than 2.5Kilograms (KGS), birth asphyxia and sepsis. Healthcare facility pose the greatest threat to survival of the new-borns in Pakistan (Abdullahi, 2016). The risk factors associated with the hospital include quality of care during pregnancy including antenatal visits, skills of the person conducting delivery; quality of antenatal visits; qualification of the birth attendant; treatment of maternal problems such as premature rapture of membranes (PROM), haemorrhage and dystocia, use of APGAR scores and management of congenital malformations. Studies have supported the fact that education of the mothers during ANC visits, screening and detection of common health problems and close monitoring of the pregnant and lactating mothers could significantly lower the incidences of death among neonates (Irimu et al., 2021).

Availability of a qualified and skilled personnel, medical equipment for resuscitation and implementation of the standard operating procedures in the new-born unit increases the chances of survival among neonates beyond the first week of birth, (Irimu et al., 2021). Efforts must be put in place to address the impact of prematurity and congenital anomalies on neonatal mortality even in poor resource settings in order to address the effects of disparities in NMRs within countries (Hosseinpoor et al., 2016). Hosseinpoor et al., (2016) argues that children in poorly resourced settings experience challenges in their

wellbeing as compared to their counter parts in well-resourced settings. Each gravid mother and new-born must have right to emergency healthcare services in order to increase the chances of survival among neonates (Lassi $ Bhutta, 2015) suggest that neonatal deaths can be avoided or significantly reduced by offering prompt and effective healthcare services throughout pregnancy period, intrapartum and postpartum to both mother and the new-born. New-born babies require focused and immediate care with the necessary nutritional support in order to maximize their survival rate. Improved quality of care in connection to maternal health, education, nutrition and antenatal care can help in mitigating upon the risk of premature birth and low birthweight which largely contribute to neonatal deaths across the globe. According to Memon et. Al (2015) the higher the number of deliveries occurring under skilled birth attendance and high-quality care setting, the lower the chances of neonatal mortality.

2.6 Conceptual Framework

The theoretical framework was adopted from Mosley and Chen framework for studying child survival in developing countries (Mosley and Chen, 1984).This model is based on the premise that both social and economic factors exert impact on the biological/medical factors to determine the overall child survival as per fig 1. Conceptual framework is the diagramatic representation of the study variables and their relatioship according to the scope of the study. It represents an operational model which is drawn diagrammatically, showing study variables and the relationship of different types of variables including independent, dependent and intervening variables (PremruSrsen et al., 2018). The conceptual framework has been operationalized to reflect the study objectives. This study is focusing on the influence of the medical factors surrounding child delivery in a hospital setting. The model from Mosley and Chen (1984) has been modified to exclude socio economic and community factors which are not within the scope of this study. The

elements and factors associated with neonatal mortality in this study are the Independent Variables (IVs). These IVs are maternal factors (maternal characteristics and maternal complications) and neonatal factors (Neonatal characteristics and neonatal complications). The dependent variable for this study is the neonatal death which is the study outcome. The hospital factors such as staff trainings, human resource policies and government policies will be the intervening variables of the study. The maternal factors consist of the maternal characteristics such as age of the mother, number of pregnancies, stage of labour, type of delivery and maternal complications include pre-eclampsia/eclampsia, haemorrhage and premature rupture of membranes. The neonatal factors will consist of the neonatal characterises such gestation age, sex, birthweight and APGAR score and neonatal complications such as congenital abnormalities, birth asphyxia, low birthweight and respiratory distress syndrome. The relationship among all these variables is shown in the figure 2. The variables in this study will be the neonatal death which is the dependent variable (DV) and the independent variables which are maternal factors (MF) and Neontal Factors (NF) and intervening factors will be government nad human resource policeis and staff trainings. Their relationship has been diagrammatically drawn as per the figure 1 below. The main study outcome will be neonatal death.

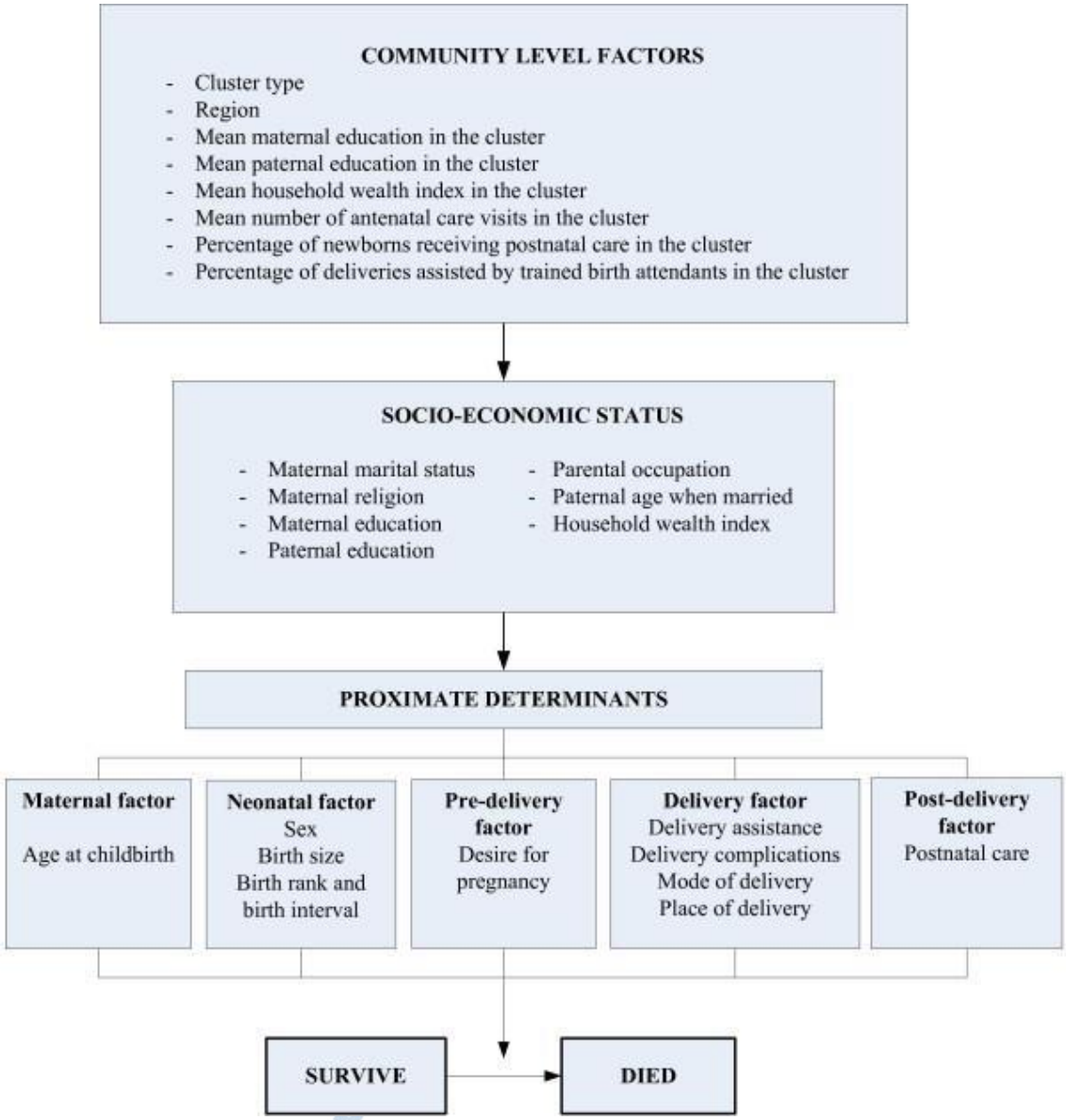


Figure 1: Theoretical framework

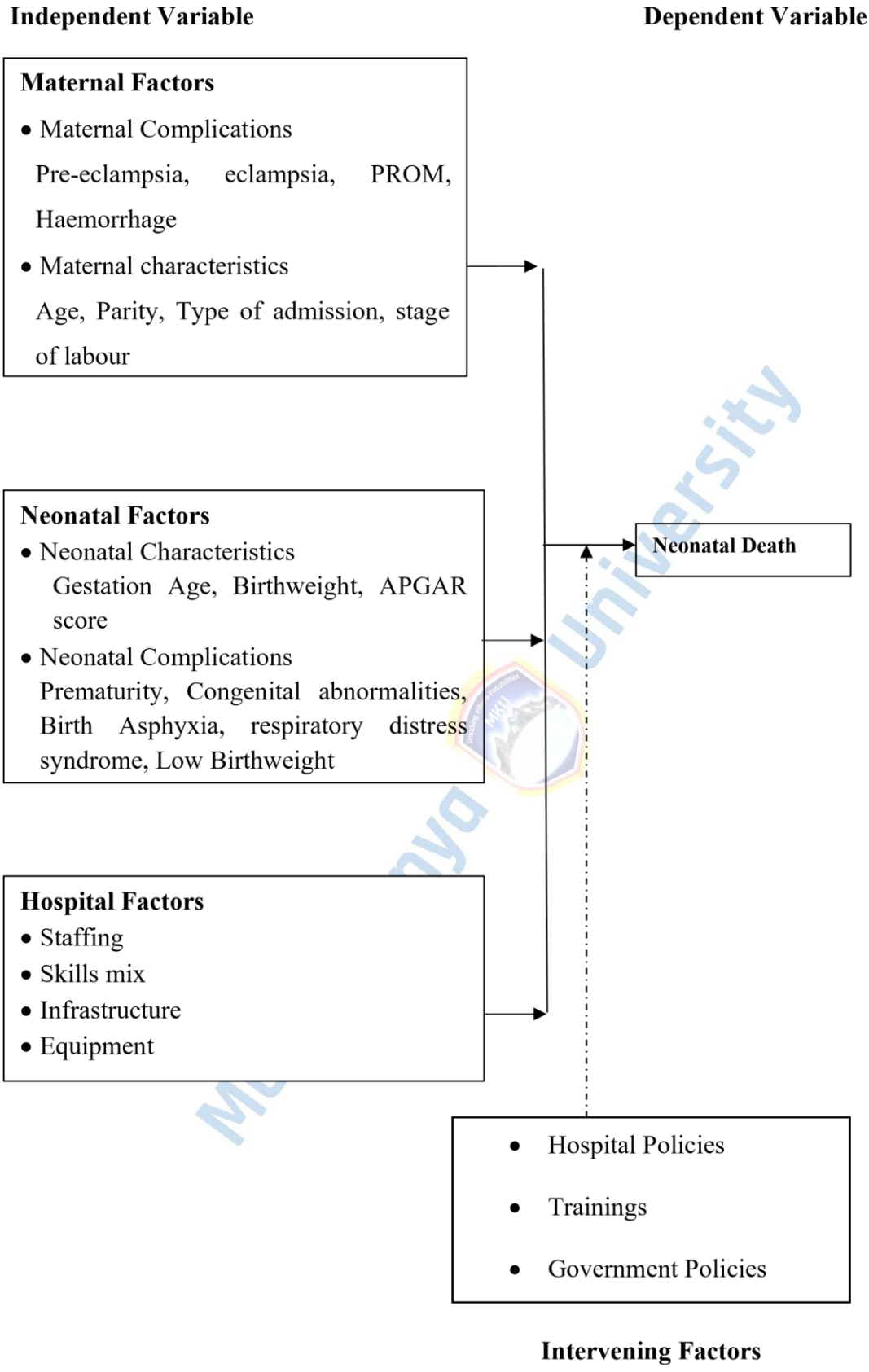


Figure 2: Conceptual Framework

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The chapter describes study methodology including the design of the study, study setting, population targeted, sampling techniques, data collection tools and procedures and how data will be analysed and presented.

3.1 Study Design

The study was an unmatched case control study design. Case control study method is used to determine association between exposure and the outcome of the study (Salvador, 2016). Salvador (2016), further argue that the case control study is designed to aid in establishing the relationship in exposure between participants who express the outcome (cases) of interest and those that are free from the outcome (controls). The study was aimed at investigating factors associated with neonatal deaths which was the main study outcome at Margaret Kenyatta Mother Baby Wing (MKMBW) in Nakuru Level 5 Hospital. Cases were recruited from the babies admitted to the new born unit of the MKMBW and died while the controls were selected from the neonates admitted to the same facility and survived. Data was collected retrospectively from the records of neonates born between October 2018 to September 2019 and admitted in the new-born unit at MKMBW. The sample of cases and controls was calculated using the epi info version 7.3.2.1 with the assumption that prematurity is the commonest risk factor with prevalence of 18% among the controls (KDHS, 2014; Irimu et al., 2021). The study assumed the least odd ratio (2) to aid in constituting a substantive sample size. A ratio of 1.0 for controls to cases was applied in reference to previous studies where for every case one control was selected to arrive at the total sample size. The principal investigator

extracted detailed information from the patient records. The sample size included all the neonates admitted at MKMBW new-born unit during the study period.

3.2 Study Location

The study was based at Nakuru level 5 hospital, Margaret Kenyatta Mother Baby Wing (MKMBW) Nakuru County, Kenya. Nakuru county is located within rift valley approximately 160 Kilometres from the capital city of Kenya and has total population of approximately 2.2 Million, average land area of 7462 Kilometres and population density of 290 per sq.km (KNBS, 2019). The MKMBW comprises of maternity unit and new-born unit which are well equipped with modern technology and human capacity to handle the ever-increasing number of mothers and new-borns admitted at the facility. Nakuru level five hospital has the largest maternity and new-born units within central and south rift region serving over 1500 mothers every month.

The hospital is located in Nakuru County and serves a catchment population of over ten Million people while serving as a referral centre for Central and South rift regions. It has a patient flow of over 30000 per month. Maternity unit alone carries out an average of 1500 deliveries per month and the new-born unit has average bed occupancy of 40 new-borns daily and capacity of 52 cots. The number of mothers attending antenatal clinic in the hospital maternal child health department is also very high, averaging 1800 mothers per day which provides a high footfall for maternity admissions. The MKMBW is equipped with four operating theatres, well established new-born unit and skilled workforce including 4 gynaecologists, 4 paediatricians, 5 medical officers, and 15 nurses in the new-born unit who are skilled in neonatal care. The skilled workforce will be part of the key informants. The maternity unit has a daily workload of over 200 mothers coming for evaluation with an average of 100 admissions daily. The average patient doctor ratio in the maternity wing is 60.0 and that of nurses is 30.8.

3.3 Study Target Population

The study target population as defined by Salvador (2016) as that homogenous discrete number of people, events or objects that a researcher seeks to get data from. This research targeted all the 2364 neonates who had been admitted in the new-born unit in the Margaret Kenyatta Mother Baby Wing of Nakuru Level 5 hospital during the study period. The data reported by the facility during the study period showed that 18% of the neonates were admitted in the new-born unit due to prematurity and survived while 30.5% of those who died in the new-born unit were admitted due to prematurity. A Total of 394 neonates died after admission in the new-born unit while 1970 survived and were discharged home.

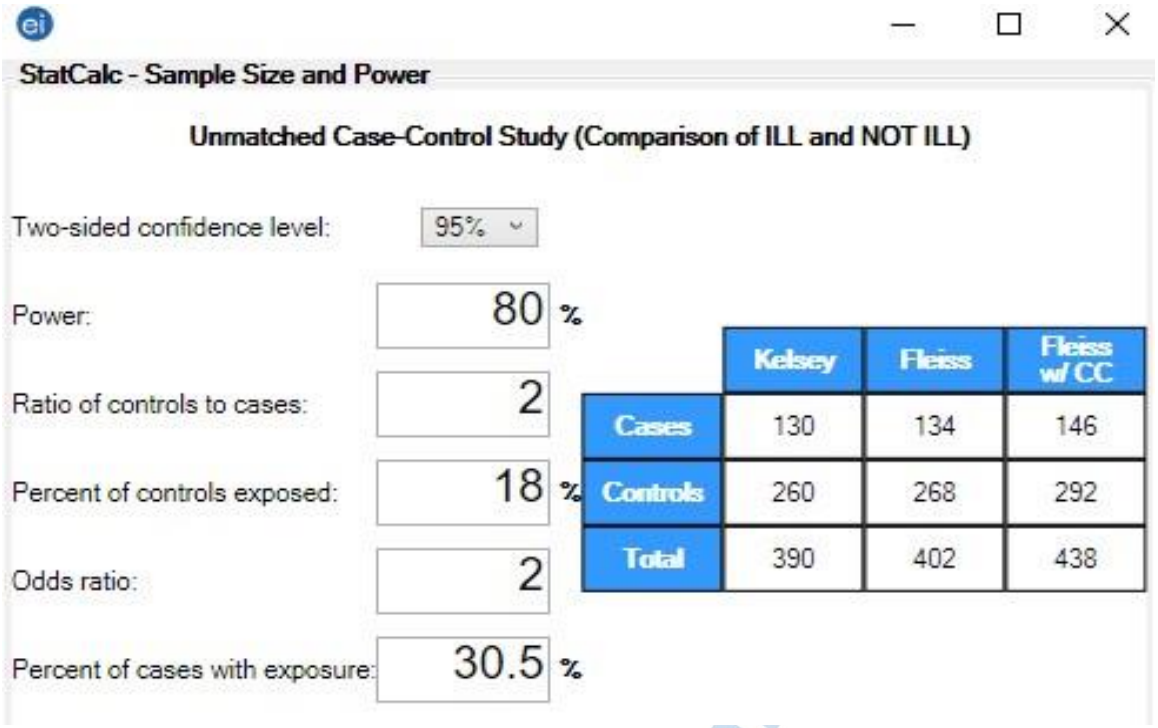
3.4 Inclusion and Exclusion Criteria

Patino and Ferreira (2018) argues that inclusion and exclusion criteria are standard protocols when designing a study. Browner et al., (2022) defined inclusion criteria as the Inclusion criteria are defined as the specific characteristics of the study population that the researcher will apply in providing a solution to the research problem. An inclusion criteria contains geographic, demographic and clinical characteristics of the study participants. On the contrary, exclusion criteria are the supplementary features that the researcher identifies as having a potential risk of interfering with the study outcomes and overall validity of the study though the population of the study possess those characteristics and therefore, they are avoided (Browner et al., 2022). This study included all neonates who were born alive at MKMB Wing of Nakuru Level 5 hospital and admitted in the Hospital New-born unit for the period between October 2018 to September 2019. However, babies born alive and well and discharged home but later admitted and died in the hospital were not included in the study since the hospital practices isolates such cases to special units within the hospital rather than admission into

NBU. Though the study was investigating maternal and neonatal factors associated with neonatal deaths, it did not include antenatal condition of the mother and socioeconomic status due to possible bias in documenting such data and also the fact that this was a retrospective study. According to WHO (2018) prematurity is the leading cause of neonatal deaths. However, for the purposes of this study neonates born before 28 weeks of gestation and those with a birthweight of less than 1000 grams were excluded from the study since the Kenya ministry of health guidelines stipulates that foetal viability among this category is below 10%. Twin or multiple pregnancies were be excluded due to high probability of new-born unit admission and mortality (Owili et al, 2016).

3.5 Sample size determination

The study used double population proportion control method to calculate the sample size using Epi Info version 7.02 statistical package. The research assumed a confidence level of 95% ($Z\alpha/2= 1.96$), a power of 80% ($Z\beta= 0.84$), a case to control ratio of 1:2 ($r=2$), and an odds ratio of 2. The study adapted a prevalence of 18% as determined above. From factors associated with neonatal mortality, percent control exposed was held at 18% and proportion of cases with exposure 30.5% as determined; accounting for a non-response rate of 10%, the maximum sample size was determined as illustrated in the diagram below:



Cases = $130 + \frac{10}{100} \times 130 = 143$

Control = $260 + \frac{10}{100} \times 260 = 286$

Total Sample Population = 429

In addition, the study interviewed 11 key informants to provide data on the factors associated with neonatal mortality. The key informants were the medical superintendent, chief nursing officer, Obstetrician & Gynaecologist, Paediatrician, medical officer maternity department, medical officer interns in the maternity and newborn unit, nursing officer in-charge of maternity and nursing officers in-charge of labour ward, post-natal ward and new-born unit.

Descriptive Statistics

3.6 Research Instruments

A data extraction tool was used as the instrument of study for gathering infromation from the facility records. The tool was developed and adapted from related studies and the training manuals prepared by the Neonatal and pediatric resuscitation (NPR) guidelines of the American Heart Associattion. In addition, some sections of the tool were borrowed

from an instrument used for exploring factors causing deaths of neonates in South Africa by Muchemi et al., (2015) and Ramoboea (2014). This instrument is divided into sections based on the key areas of focus in assessing the risk factors contributing to deaths of neonates. The first section of the data extraction tool was used to investigate maternal factors while the second section was used to extract data in neonatal factors. Maternal age, parity, gestational age, mode of delivery and complications during pregnancy and child birth are some of the maternal factors that were assessed while neonatal factors included condition at birth, birth weight, and condition of the neonate during admission in NBU. The information on the hospital factors such as staffing levels, skills mix in the, availability of medicines and supplies and equipment and days of hospitalization was gathered using key informant interview guide. Quantitative data analysed done using SPSS Version 26 while qualitative data was analyzed with the aid of Nvivo tool for qualitative data analysis.

3.6.1 Pre Testing of the Instrument

The instrument of data collection was tested for consistency and applicability in the study setting. According to Salvador (2016), pretesting of the study instrument is performed before the actual study is undertaken by administering the tool to a smaller number of participants from the larger study population. Piloting of the study is used to detect and eliminate any form of ambiguities in the research tools and forecast for any challenges that may arise in administering the instruments during actual data collection. It also makes the researcher examine study feasibility, anticipate and amend any procedural issues with the items in the instrument after carrying out a preliminary analysis (sample) of the protest data. The pretesting of the tools and pilot of the study was done at Naivasha Level 4 hospital located within Nakuru county. The facility has a similar setting for the new-born and maternity unit to the main study site since they are both designed, organized and

operated to the same standards set by the county government. The pilot study had a sample size of 22 cases (neonates who were admitted and died) and 22 controls (neonates who were admitted and discharged). The study period was October 2018 to September 2019. Random sampling technique was applied to recruit the participants from a sample frame generated using patients' unique numbers assigned during admission in the new-born unit. The study also interviewed a total of 4 key informants to assess hospital. Maternal and neonatal factors. The key informants were hospital medical superintended, gynaecologist, paediatrician and nursing officer in charge of new-born unit.

The instrument of study was examined and compared against each of the objectives to ensure that information collected answered the questions based on the objectives. Expert opinion was sought from the University Ethical review committee, Study supervisors and senior medical team at Nakuru level 5 hospital to ensure that the instruments are relevant in content and their objectives. The tools were adopted from the Neonatal and pediatric resuscitation (NPR) guidelines of American Heart

Association (Bolarinwo, 2015), revised to align with similar study done in Kenya-Moi Teaching and referral hospital (Irimu, et al. 2021) and reviewed by supervisors and key informants to suit the study setting. The piloting of the study supports that the tools capture all the possible data elements intended for this study. The tools record all the aspects of neonatal care including maternal, neonatal and hospital/health systems factors. Analysis of the pilot study findings revealed significant correlations of the main study variables (neonatal and maternal factors) with the study outcomes (Alive/Dead) which reveals similar trends observed in other studies such as maternal and neonatal mortality audit at Moi Teaching and referral hospital by Irimu et al. (2021).

3.7 Reliability and Validity

This is defined by Salvador (2016) as the extent of the ability of a study data collection too to yield internally consistent results upon repeated trials but similar scoring. The instrument used for data collection must be able to measure similar concepts and characteristics regardless of time of the study. The data extraction tool was tested for reliability before actual data collection was carried out using Cronbach's alpha technique. Cronbach's Alpha of 0.7 and above is considered acceptable (Premru-Srsen et al., 2018; Bolarinwo (2015). The proposed measurement instruments' reliability was determined using the Cronbach's alpha coefficient and Average Variance Extracted (AVE). Data is accepted as valid if these values exceeded Hair et al.'s (2010) recommended minimums of 0.70 and 0.50, respectively, to validate the model's internal reliability. In addition, all items must be significant with a confidence level of 95%, and their standardized lambda coefficients must be greater than 0.5, confirming the model's convergent validity. The study determined the discrimination validity by estimating the confidence intervals for construct correlations and comparing them to the unit, as described by Anderson and Gerbben (1998). Satorra-Bentler 2 (S-B 2) (p 0.05) and comparative fit indices, including the NFI, NNFI, IFC, and IFC, were utilized in the analysis. These measurements, which are typically employed for confirmatory tests, were used to assess the fit of the proposed measurement model.

3.8 Procedure and Methods of Collecting Data

Data collection is the procedure of gathering information from the respondents (Saunders & Vehviläinen-Julkunen, 2016). This research extracted information from the health facility patient files in MKMBW of Nakuru Level 5 Hospital. Data was collected from hospital records, and tabulated into excel sheets. The data collection was carried out by the principal investigator who had prior knowledge on the study instrument and its

application on extraction of the data from records of the neonates who had died or survived within the research period at the study setting. The neonatal files were accessed through the designated hospital health records officer and electronic extraction of data from patient files carried out from a designated room, only accessible by authorized personnel within the study setting. The researcher-maintained confidentiality of the patients' records and adhered to the set hospital policy on patient information privacy and confidentiality. Personal details and any information that would identify the participants was not included in the data extraction tool. The study also collected data from the key informants of the hospital who comprised of the Hospital medical superintendent, chief nursing officer, consultant obstetrician &gynaecologist, paediatrician, nurse in-charge in the MKMBW and medical officers in order to gather information on the hospital factors contributing to neonatal mortality. The filled-up data extraction tools and key informant interview guide were coded and serialized for data entry preparation.

3.9 Techniques of Data Analysis and Presentation

Data Analysis is the process of cleaning, transforming, inspecting and modelling data with the goal of uncovering valid information, supporting decision making and suggesting conclusions. The study used both quantitative and qualitative methods to analyze data due to its triangulated design. Descriptive statistics allow the researcher to categorize data for better and deeper understaning (Saunders & Vehviläinen-Julkunen, 2016). Data was edited by the researcher to identify and correct errors and omissions and ensured consistency with the data collection tools, accuracy, completeness, uniformity and simplicity for coding and tabulation. Edited data was coded and entered into SPSS version 25.0 for analysis.

Missing data from the records were assigned a value (99) in order to factor them in the analysis of the variables. The cases missing gestation age, age of the mother, parity,

outcomes of the mother and baby at birth were excluded. The study carried out chisquare tests for the categorical variables to assess the association between predictor and dependent variable. Chi-square tests were performed to test hypothesis; which was, neonatal mortality is not associated with maternal and neonatal factors. The dependent variable was dichotomous given that this was case control study. Binomial logistic regression was carried out to assess the relationship between maternal and neonatal factors and the study outcomes which was neonatal death and neonatal survival after admission in the new-born unit. The odd ratios and confidence intervals were calculated to determine risk factors associating the independent and dependent variables. The study also analysed the influence of the hospital factors neonatal mortality. Multiple regression analysis was carried out to determine the prediction and strength of the independent variables to the dependent variable. The dependent variable was neonatal outcomes (Dead and Alive) while the independent variables were maternal

characteristics, maternal complications, healthcare factors, neonatal characteristics and neonatal complications. Analysed data was presented using tabulations, charts and graphs.

3.10 Study Ethical Considerations

Ethical issues in this study were strictly observed by the researcher. Permission to carry out the study was sought from school of postgraduate studies of Mount Kenya University. National research permit was obtained from National Council of Science, Technology, and Innovation of Kenya (NACOSTI). Data was collected from the hospital records in the new-born and maternity unit in Nakuru Level Five Hospital after requisite permission was granted by Nakuru County Health department and introduction letter sent to the Hospital Medical Superintendent. Informed consent was obtained before collecting data from the key informants. The research provided a detailed explanation of the study to the

key informants before seeking consent for data collection. The patient information gathered from the hospital records, data collected from the key informants and the staff working in the new-born unit was coded and given anonymous identities in order to ensure that the provider/patient records remain confidential. The collection and use of personal data was in compliance to the Data Protection Act of 2019, an Act of Parliament to give effect to Article 31(c) and (d) of the Constitution; to establish the Office of the Data Protection Commissioner; to make provision for the regulation of the processing of personal data; to provide for the rights of data subjects and obligations of data controllers and processors; and for connected purposes.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Introduction

A total of 429 mothers with their respective new-borns (143 cases and 286 controls) were enrolled into the study. This chapter presents results on sociodemographic, maternal health and healthcare-related and neonatal determinants of mortality. Sociodemographic characteristics include the mother's age, level of education, parity, number of still births, reported number visits to the ANC, and foetuses in a pregnancy. Maternal Health and Healthcare factors included HIV status, Hepatitis B surface antigen (HBsAg) status, gestational diabetes, syphilis status, antepartum haemorrhage, pregnancy induced hypertension, PROM-18 hours, maternal peri-partum fever, mother treated with antibiotics, mother received antenatal dexamethasone and mode of delivery. Neonatal factors include birth weight, weight on admission, gestation period, origin of admission to the NBU, prophylactic antibiotics treatment, congenital anomalies, and photo therapy treatment. This section presents the study results, analysis and discussions.

4.1 Data Validity and Reliability

On the basis of including all multi-item constructs, SPSS V3 was used to conduct a confirmatory factor analysis to determine the reliability and validity of the measurement instruments within our theoretical framework. The reliability of the proposed measurement instruments was evaluated using the Cronbach's alpha coefficient and Average Variance Extracted (AVE). These statistics exceeded Hair et al.'s (2010) minimum recommended values of 0.70 and 0.50, respectively, to validate the model's internal reliability. In addition, all items were significant with a 95% level of confidence, and their standardized lambda coefficients exceeded 0.5, confirming the model's convergent validity. By estimating the confidence intervals for construct correlations and

comparing them to the unit, we determined the discrimination validity using the method described by Anderson and Gerbing (1998). The analysis was conducted using Satorra-Bentler 2 (S-B 2) (p 0.05) and numerous comparative fit indices, such as the NFI, NNFI, IFC, and IFC. These measurements, which are commonly used for confirmatory tests, were used to evaluate the proposed measurement model's fit. The fact that none of the confidence interval intervals (as presented in Table 1) contained the value 1 confirmed the accuracy of the model. In addition, all fit indices were greater than 0.9, indicating that the model's fit is adequate. In addition, the S-B 2 statistic is statistically significant with a p-value less than 0.05. Due to its high sensitivity, it may not be a reliable indicator of the suitability of the confirmatory analysis (Hair et al., 2010). Table 2 provides a comprehensive summary of the goodness of fit metrics and other statistical parameters used to evaluate these characteristics. **Table 1: Discriminant Validity**

	OT	MF	HF	NF
OT	**4.76(1.38)**			
MF	[0.733;0.862]	**5.33(1.61)**		
HF	[0.437;0.572]	[0.483;0.635]	**4.28(1.39)**	
NF	[0.479;0.599]	[0.396;0.642]	[0.724;0.854]	**4.88(1.38)**

Note: OT= Outcome; MF=maternal factors; HF=hospital factors; NF= Neonatal factors;

Diagonal represents mean and SD (in parenthesis)

Table 2: Confirmatory factor analysis of the final model

	Cronbach´s α	**AVE**	
OT	0.881	0.528	
	0.891		
MF		0.733	S-Bχ2(106 df) 469.238 (p=0,000)
HF			
	0.862	0.601	NFI=0.933 NNFI=0.942

NF	0.839	0.669	CFI=0.911 IFI=0.928 RMSEA=0.063

4.2 Prevalence

Prevalence refers to the probability that a specified portion of a population is exposed to a medical condition, usually, the unit of measure being a disease or a risk factor, within a specified period. It is calculated by dividing the population with the condition by the total population investigated/ it can be expressed as a fraction, a percentage of the total, or the number of cases per unit i.e., 10,000 or 100,000 people. Depending on time as a variables, it can be classified as time, period or lifetime prevalence. Point prevalence is used when a certain moment in time is taken into account; when tabulated for a certain time period of interest, the measure is termed period prevalence. On the other hand, lifetime prevalence used to report a trait if it occurs at some point in life. In this research, the measure of interest is period prevalence for the study, that is, between
October 2018 and September 2019, calculated as by the formula shown below.

$$prevalence = \frac{Number\ of\ people\ in\ the\ sample\ with\ characteristic}{Total\ number\ of\ people\ in\ the\ sample}$$

Abbreviated as;

$$P = {}^{x}/_{n}$$

For example, to estimate the fraction of new-borns that die following admission to newborn unit (NBU), we consider a death case to be a "success" (i.e., neonates who get the desired outcome) and a living case to be a "failure." X denotes the number of deceased neonates in the sample in this case. The sample proportion, *p,* is calculated by dividing cases by the total sample size, i.e.,

$$P = {}^{x}/_{n}$$

The study established that there were 394 neonatal deaths out of 2364 neonates admitted in the new-born unit during the study period. This indicates that a proportion of 17% of the babies admitted to the new-born unit died during the period under study.

$P = {}^{x}/_{n} = P = {}^{394}/_{2364}$ x 100 = 17%

Statistical 'weights' can be used to verify that a sample can be generalized to total population. The sample characteristics are quantitatively adjusted to fit the target population by weighting the sample; this is expressed in the formula below.

$$P \pm z\sqrt{\frac{p(1-p)}{n}}$$

The *p* is the sample proportion while the product of *z* and the standard error gives the margin of error. This is expressed in the formula below:

$$SEP \pm z\sqrt{\frac{p\ p)}{n}}\ (1 -$$

Substituting the value;

$$0.167 \pm 1.96\sqrt{\frac{0.167(1-0.167)}{2364}} = 0.167 \pm 1.96(0.007)$$

$$= 0.167 \pm 0.015$$

So, the 95% confidence interval (0.182, 0.152, *p-V* 0.007)
Thus, we are 95% confident that neonatal mortality prevalence is between 18.2% and 15.2%. The higher-than-average rate of mortality is attributed to the limits of the study, that is, the focus on NBU rather than the general population. The results closely align with finding by Irimu et al (2021) involving 41 657 neonates admitted to NBUs across the 16 hospitals. The study reported that 4266/41 657 neonates died giving a crude

mortality rate of 10.2% (95% CI 9.97% to 10.55%), with 60% of these deaths occurring within 7 days of admission.

4.3 Factors Associated with Neonatal Deaths

4.3.1 Logistic Regression Findings

This section is a summary of the maternal, hospital and neonatal factors associated with child mortality. Maternal age, mode of delivery, gestational age and parity, maternal complications during admission, and neonatal factors correlated to NMR. The logistic regression results in this section highlights the link between the predictor variables and the outcome measured in terms of the COR, AOR, CI and the *p-Value*.

4.3.1.1 Maternal Factor

According to the study findings, parity, maternal age, level of education, were significant determinants of neonatal mortality. Maternal age has significance influence on neonatal death. Factors such as parity and age of the mother are linked to an increased risk of unfavourable new-born outcomes such as intrauterine growth restriction (IUGR), preterm, and death (Kaplanoglu et al., 2015). Previous researcher found an association between nulliparity and likelihood of or complications at childbirth such as obstructed labour; high parity positively correlated with increased likelihood of hypertension, uterine rupture, and placenta previa (Waldenström et al., 2017). These literatures support findings from this study indicating that high parity increased NMR

1.87 times (COR=1.87 1.046-3.342, and a *p-V* 0.035), 3.196 times (CI1.745-5.851, and p-Value 0.000, and 15.56 times (CI7.95-30.471, p-Value 0.000) for a parity of 2,3 and 4 respectively compared to a parity of 1.

The combined effect of mother age and education on NMR was discussed by Fonseca et al., (2017). The study found that without taking into account the age impact, a low level of education raised the risk of new-born mortality by 25%. The independent impact of

age on new-born mortality was greater in adolescent/younger mothers (OR = 1.39) than in mother aged 35 or more (OR = 1.16). When compared to women aged 20-34 and with a 4-year/advanced education, children of born to mothers at the extremes of age and the level of mother's education had a 1.7-fold increased risk of new-born mortality. However, the study resolved that only for women older than 35, there a

significant interaction between education and mother's age in new-born mortality, albeit with age having low statistical significance (p = 0.06). These finding agrees with results from this study indicating that mothers who were more educated had lower rates of neonatal mortality than those without education. Although not significant, mothers with primary school education have a 22% lower NMR (COR 0.771 CI 0.203-2.486 *p-V* 0.593). Similarly, neonates of mother with secondary, post-Secondary and university education were 0.03 times (COR 0.039 CI 0.011-0.132 *p-V* 0.928), 0.028 times (COR 0.028 CI 0.009-0.085 *p-V* 0.000) and 0.05 times (COR 0.057 CI 0.057-0.013 *p-V* 0.000) respectively less likely to die. Similar observation was made for age whereby increasing age coincided with decreasing mortality rates, but mortality rose at the extremes of age. While older age is protective as the findings indicate that neonates of maternal age 2024 years were at 64% (COR= 0.340, CI 0.187-0.619 and P-value=0.000) and 25-29 years 71% (COR=0.309, CI0.172-0.554 and p-value=0.000) lower risk of mortality compared to neonates born to mothers between 15 and 20 years. Similarly, although not significant (P-value=0.172), neonates whose mothers maternal age is 30-34-29 are 21% (COR= 0.787, CI0.465-1.330) have lower risk levels compared to neonates born to mothers aged 15-20 years old. Although the data showed a decreasing rate of mortality with maternal age, and education, the data was not statistically significant in both cases. According to findings by Akobirshoev et al., (2021), having an HIV-positive mother increases the chance of mortality by 2.9. The key risk factors for high NMR were direct infection of

the neonate. This is reflected in the results showing that HIV positive status increased the risk of mortality (OR 2.286 CI 1.103-4.735 *p-V* 0.026). Neonatal hepatitis B virus infection is often occurring at childbirth and is asymptomatic in nature; newborns often suffer from lethargy, jaundice, abdominal distention and failure to thrive (Boucheron et al., 2021). According to the CDC, neonates with HBsAg positive mothers are at 70%-90% risk of perinatal HBV infection, out of which 85%-90% of cases evolve to become chronic HBV carriers (Schillie et al.,2018). More than 25% of carriers are expected to suffer from primary hepatocellular cancer or cirrhosis of the liver (Schillie et al.,2018). According to the results in this study, HBsAg positive status increased the risk of neonatal mortality by OR 5.656 (CI2.239-14.289 *p-V* 0.000).

According to Kanyangarara et al., (2018), 15% neonates both to women with positive syphilis status resulted in mortality attributed to congenital syphilis while another 27% showed signs of syphilis. Similarly, the risk of new-born death among mothers diagnosed with gestational diabetes was 1.63 times greater than

those without (Deryabina et al., 2020). According to Khanam et al., (2017), pregnancyinduced hypertension (PI) was a substantial risk factor by an OR1.8, and a significant contributor to early neonatal deaths by OR 1.5. The population attributable to infant death owing to APH was 6.2%, whereas the that attributable to PI was 7.8% (Khanam et al., 2017). The data also showed that increasing number of still birth coincided with increasing risk of neonatal mortality compared to no still birth; 1 stillbirth of 1-2 has an 11 times risk (COR 11.60 CI 6.302- 21.351 *p-V 0.000*) while ≥3 had a 19 times risk (COR19.246 CI 8.096-45.838 at *p-V* 0.000). The findings from these studies are consistent with the findings from this research, indicating high NMR with syphilis status (OR 6.635 CI 1.871-23.523 *p-V* 0.003), gestational diabetes (OR 3.384 CI 1.7336.609, *p-V* 0.000), pregnancy induced hypertension (OR 1.661 CI 1.031-2.674 p-V

0.037), antepartum haemorrhage (OR 1.782 CI 1.131-2.808 p-V 0.013), and maternal peri-partum fever (OR3.138 CI 1.518-6.485 *p-V* 0.002).

Table 3: Maternal factors

Variable	Case N (%)		Control N (%)		Crude Odds Ratio				Adjusted Odds Ratio			
					OR	**CI- 95%**		***pvalue***	**OR**	**CI- 95%**		***pvalue***
Maternal age												
15-19 years	63	44.1%	75	26.3%	**1**				**1**			
20-24 years	20	14.0%	70	24.6%	**0.340**	0.187	0.619	0.000	**0.339**	0.129	0.888	0.028
25-39 years	21	14.7%	81	28.4%	**0.309**	0.172	0.554	0.000	**0.292**	0.108	0.792	0.016
30-34 years	39	27.3	59	20.7%	**0.787**	0.465	1.330	0.371	**0.576**	0.241	1.378	0.215
Education level												
None	37	14%	3	2%	**1**				**1**			
Primary	74	29%	5	4%	**0.771**	0.203	2.486	0.593	**0.986**	0.209	4.653	0.986
Secondary	25	10%	30	21%	**0.039**	0.17	0.132	0.000	**0.073**	0.015	0.343	0.001
post-Secondary	88	34%	101	72%	**0.028**	0.009	0.085	0.000	**0.032**	0.008	0.129	0.000
University	32	13%	2	1%	**0.057**	0.013	0.234	0.000	**0.141**	0.022	0.885	0.037
Parity												
1	30	21.0%	147	51.4	**1**				**1**			
2	29	20.3%	76	26.6	**1.87**	1.046	3.342	0.035	**1.623**	0.668	3.941	0.285
3	30	21.0%	46	16.1	**3.196**	1.745	5.851	0.000	**3.119**	1.243	7.824	0.015
4	54	37.8 %	17	5.9	**15.56**	7.95	30.471	0.000	**21.96**	7.711	62.59	0.000
Number of still births												
0	250	91%	131	92%	**1**				**1**			
1-2	20	7%	10	7%	**11.60**	6.302	21.351	0.000	**8.399**	3.519	20.04	0.000

≥3	4	1%	2	1%	**19.24**	8.096	45.838	0.000	**17.15**	5.135	57.31	0.000
HIV status												
Negative	215	87%	106	95%	**1**				**1**			
Positive	33	13%	6	5%	**2.286**	1.103	4.735	0.026	**3.490**	0.379	32.160	0.270
HBsAg status												
Negative	98	75%	56	95%	**1**				**1**			
Positive	33	25%	3	5%	**5.656**	2.239	14.289	0.000	**2.557**	0.272	24.005	0.411
Syphilis status												
Negative	118	80%	38	95%	**1**				**1**			
Positive	30	20%	2	5%	**6.635**	1.871	23.523	0.003	**25.69**	2.073	318.45	0.011
Gestational diabetes												
No	171	81%	127	94%	**1**				**1**			
Yes	41	19%	8	6%	**3.384**	1.733	6.609	0.000	**0.293**	0.019	4.531	0.379
Pregnancy induced hypertension												
No	18	72	119	85%	4 %		**1**				**1**	
Yes	71	28%	21	15%	**1.661**	1.276	3.747	0.037	**2.564**	0.398	16.501	0.322
Antepartum haemorrhage												
No	20	78	126	89%	4 %		**1**				**1**	
Yes	57	22%	16	11%	**1.782**	1.131	2.808	0.013	**2.103**	0.165	26.843	0.567
Maternal peri-partum fever												
Negative	21	83	124	93%	2 %		**1**				**1**	
Confirmed	42		17%	10	7%	**3.138**	1.518	6.485	0.002	**4.659**	0.344	63.055	0.247

4.3.1.2 Hospital factors

Further, this study found that mother who had fewer ANC visits throughout their pregnancy had a greater risk neonatal mortality compared to mothers who attended more than three ANC clinics. Mortality risk reduced by 69% (COR 0.389, CI of .250.606*p-V* 0.000) and 59% (COR 0.418, CI 0.232-0.751 *p-V* 0.004) for 1-2 visit and more than 3 visits compared to none-attendance of ANCs. This conclusion was similar with a research based on the 2014 Kenya Demographic and Health Survey by Arunda, Emmelin, & Asamoah (2017), which found that lack of proper ANC care correlates with higher NMR compared to expert-guided ANC care. Similarly, this study noted that mothers who do not receive regular check-ups from ANC had 2.5 times risk than those who did; this may be associated to the roles of maternal care in improving women's knowledge, awareness, health status, and monitoring of risks. Prolonged rupture of membranes (PROM) is a common and serious cause of preterm labour, with serious consequences for infant morbidity and death. The findings also demonstrate a robust link between PROM and new-born infection. Prolonged rupture of membranes (PROM) is a common and serious cause of preterm labour, with serious consequences for infant morbidity and death (Gupta, 2020). The researchers found a substantial link between PROM and new-born infection. Maternal fever was also noted as a covariate factor for birth asphyxia and NMR in a prospective community-based research in rural Nepal (Aftab et al., 2021). The findings in this research agrees with these findings, PROM18hours increased the risk of mortality by 2.61 times (OR2.614 CI 1.412-4.839 *p-V* 0.002).

A study by Iyanda & Osayomi (2019) suggest that caesarean section births reduces neonatal mortality by OR = 0.996 (p 0.05). On the other hand, vaginal delivery increases the mortality risk risk of both new-born OR = 1.005 (p 0.05) and mother OR =

1.002, (p > 0.05). Similarly, from the data in this study, the mode of delivery affect the risk of mortality with vaginal assisted delivery having an OR of 2.188 CI 1.406-3.405 *p-V* 0.001 while vaginal unassisted OR 4.533 CI 2.261-9.090 *p-V* 0.000. The type of treatment given to a mother affects the risk of neonatal mortality. According to Duby, Lassi, & Bhutta, (2019), when compared to hospital referral solely, communitybased antibiotic administration for new-born reduced infant mortality by OR= 0.82. Similarly, WHO Action Trials Collaborators (2020) found that dexamethasone treatment to women at risk lowered the frequencies of neonatal mortality and stillbirth without increasing the risk of bacterial infection. The conclusion aligns with the finding in this study indicating that mother treatment with antibiotics (OR 0.658 CI

.433- 1.000 *p-V* 0.050) and mother treatment with antenatal dexamethasone (OR .578 CI .328-1.019 *p-V* 0.058) reduced the risk of mortality. With reference clinical care, previous research affirm that neonatal mortality rates were twice as high in new-borns whose mothers did not receive TT injection compared to those who received the injection (Arunda, Emmelin, & Asamoah (2017). Similarly, this study found that treatment with antibiotics reduced NMR by OR 0.381 (CI .251-.577 *p-V* 0.000). While the research found a relationship between the origin of admission and neonatal mortality. Factors explaining the origin of this pattern were not explored. New-born admitted to the facility from a referral facility or labour ward had a higher risk of mortality of OR 1.113 (CI0.696-1.781 p-V 0.655) and OR 6.220 (CI 3.319-11.653 *p-V*

0.000). The table below highlights the results of this analysis.

Table 4: Hospital factors

Variable	**Case N (%)**	**Control N (%)**	**Crude Odds Ratio**			**Adjusted Odds Ratio**
			O	**CI- 95%**	***pv***	**CI- 95%**

					R			*alue*	OR			*pvalue*
Number of ANC visits												
0	134	47%	40	28%	**1**				**1**			
1-2	110	38%	73	51%	**.389**	.250	.606	0.000	**0.373**	0.181	0.770	0.008
≥3	42	15%	30	21%	**.151**	.240	.847	0.013	**0.137**	0.040	0.468	0.002
Mother treated with antibiotics												
No	152	57%	62	49%	**1**				**1**			
Yes	113	43%	64	51%	**0.658**	.433	1.000	0.050	**0.442**	0.087	2.257	0.327
Prophylactic antibiotics given												
No	161	58%	59	41%	**1**				**1**			
Yes	119	43%	84	59%	**0.381**	.251	.577	0.000	**0.240**	0.116	0.498	0.000
Mother received antenatal dexamethasone												
No	218	84%	112	83%	**1**				**1**			
Yes	40	16%	23	17%	**.578**	.328	1.019	0.058	**0.273**	0.030	2.502	0.251
Mode of delivery												
CS	91	32%	71	50%	**1**				**1**			
vaginal assisted	164	56%	69	45%	**2.188**	1.406	3.405	0.001	**2.651**	1.721	3.405	0.001
vaginal unassisted	36	13%	8	6%	**4.533**	2.261	9.090	0.000	**4.312**	2.301	9.090	0.000
Admitted to NBU from												
Home	106	37%	73	51%	**1**				**1**			0.000

Labour ward	100	35%	60	42%	**1.113**	.696	1.781	0.655	**2.347**	1.176	4.683	0.015
Referral facility	80	28%	10	7%	**6.220**	3.319	11.65	0.000	**27.674**	8.754	87.488	0.000
Prom 18hours												
No	213	82%	130	93%	**1**				**1**			
Yes	46	18%	10	7%	**2.614**	1.412	4.839	0.002	**5.092**	0.423	61.255	0.200

4.3.1.3 Neonatal Factors

Atif et al (2021) found that suboptimal birth/admission weight increased and shorter gestational periods increases the risk of neonatal mortality by AOR 9.59 (4.41, 20.84) and AOR 5.13 (CI 2.19, 12.04) respectively. These factors remained substantially linked with infant mortality in this study; the findings indicate that increasing birthweight reduced the risk of neonatal mortality by; 1>=2 OR .247 CI .139-.437 p-V 0.000, 2>=3 OR 0.170 CI .084-.347 p-V 0.000, and 3>=4.5 OR .160 CI .085-.301 p-V 0.000. Similarly, the age of admission to the NBU reduced to the risk of mortality by 1>=2 OR 0.836 CI .486-1.437 p-V 0.516, 2>=3 OR 0.236 CI .123-.453 p-V 0.000, and 3>=4.5 50 OR 0.441 CI .242-.804 p-V 0.007. The data also show that increasing gestation period reduced neonatal mortality by; 32>37 OR 0.401 CI .229-.702 p-V 0.001, and 37>42 OR 0.227 CI .139-.369 p-V 0.000. Both of the variables were statistically significant and had the effect of reducing neonatal mortality rates as indicated in a multivariate analysis. Congenital abnormalities and other comorbidities such as gestational diabetes and hypertension common in mothers with underlying medical condition, are linked to high risk of mortality (Liu et al., 2016). This study agrees with the literature on the impact of congenital anomalies on neonatal mortality, it found that congenital anomalies increased the risk of mortality by OR 1.857 (CI 1.082-

3.187 p-V 0.025).

The study found that phototherapy treatment reduced NMR by OR 0.475 (CI 0.313-.722 p-V 0.000). This effect can be inferred from findings by Olusanya, Kaplan & Hansen, (2018) indicating that blue light phototherapy treatment is required to reduce morbidity and death caused by high levels of new-born jaundice. Phototherapy aids in the absorption bilirubin, which is subsequently broken, allowing the new-born to expel excess bilirubin before it causes lifelong kernicterus or death. With reference to number of foetuses in a pregnancy and the mother's age, the studies proposed that mother-foetus resource rivalry for nutrition and/or the mother's physical immaturity may lead to poor new-born outcomes in young mothers and high NMR (Hamese et al., 2020). Similar observation was made in the case of number of foetuses whereby increasing number of foetuses increases the risk of mortality by an OR 1.215 at a CI of .729-2.025 at a *p-V* 0.455. The table below highlights the results of this analysis.

Table 5: Neonatal factors

	(%)		**(%)**		**Ratio**							
Variable	**Case N**		**Control N**		**Crude Odds Ratio**			***p-value***	**Adjusted Odds Ratio**			***p-value***
					OR	**CI- 95%**			**OR**	**CI- 95%**		
Birth weight												
=<1	90	33 %	18	15%	**1**				**1**			
1>=2	97	36 %	30	24%	**0.247**	.139	.437	0.000	**0.092**	0.033	0.255	0.000
2>=3	38	14 %	35	28%	**0.170**	.084	.347	0.000	**0.041**	0.003	0.494	0.012

	3	%			**75**	3	2		**92**	37	29	00
Number of pregnancy	**Foetuses in the**											
1	228	80 %	129	91%	**1**				**1**			
2	57	20 %	13	9%	**1.215**	.729	2.025	0.455	**1.848**	0.713	4.786	0.206
3>=4.5	48	18 %	41	33%	**0.160**	.085	.301	0.000	**0.002**	0.000	0.055	0.000
Weight admission	**on**											
<=1	84	30 %	16	11%	**1**				**1**			
1>=2	102	36 %	33	23%	**0.836**	.486	1.437	0.516	**0.025**	0.001	0.746	0.033
2>=3	46	16 %	49	34%	**0.236**	.123	.453	0.000	**0.045**	0.001	1.399	0.077
3>=4.5	50	18 %	45	31%	**0.441**	.242	.804	0.007	**0.032**	0.003	0.391	0.007
Gestation period (weeks)												
28-32	144	52 %	34	24%	**1**				**1**			0.000
32>37	58	21 %	29	21%	**0.401**	.229	.702	0.001	**0.239**	0.094	0.607	0.003
37>42	77	28 %	77	55%	**0.227**	.139	.369	0.000	**0.154**	0.066	0.362	0.000
Congenital anomalies												
No	215	76 %	123	86%	**1**				**1**			
Yes	68	24 %	20	14%	**1.857**	1.082	3.187	0.025	**1.341**	0.609	2.955	0.467
Photo therapy												
No	179	63 %	75	53%	**1**				**1**			
Yes	10	37	66	47%	**0.4**	.31	.72	0.000	**0.0**	0.0	0.2	0.0

4.3.2 Qualitative Findings

4.3.2.1 Maternal Factors

The study interviewed key informants on the maternal factors that contributed to neonatal mortality. Pregnancy related conditions and complications and the level of knowledge among mothers were the commonest factors contributing to neonatal mortality with 18% response rate as compared to other factors. Late seeking of care by the mother, inadequate ANC coverage, young maternal age, labour related complications and social economic status were reported as the second commonest factors associated with neonatal mortality with response rate of 9%. Other factors associated with neonatal mortality included cultural practices, pre-existing conditions and geographical location.

Table 6: The respondents supported the pregnancy related conditions

Maternal Factors	Responses	Percent response rate
Pregnancy related conditions/illness	6	18%
Low education background/knowledge deficit	6	18%
Late seeking of care	3	9%
Inadequate ANC coverage	3	9%
Young maternal age	3	9%
Difficult/prolonged labour	3	9%
Social Economic factors	3	9%
Traditional cultural practices	2	6%
Pre-existing maternal conditions	2	6%
Long distance from the hospital	2	6%

The diagram below illustrates the emerging pattern in respondents' feedback on the maternal factors associated with child mortality.

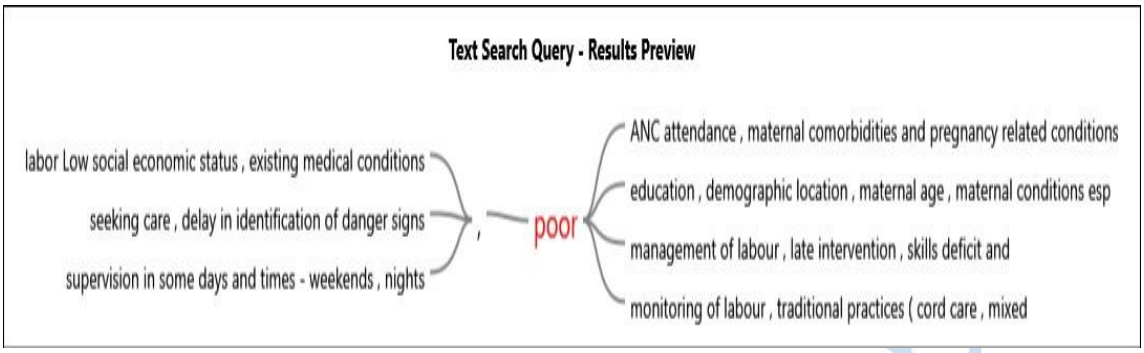


Figure 4: Pregnancy related conditions

4.3.2.2 Hospital factors

Majority of the respondents 12(18%) argued that inadequate staffing in the new-born unit was the most common cause of neonatal mortality, followed by human resource practices such regular staff rotations and management of the rotas and lack of skills in neonatal care and treatment at 16% and 15% respectively.

Table 7: hospital factors contributing to neonatal mortality

Hospital Factors contributing to Neonatal mortality	Responses	Percent Responses
Inadequate staffing in New-born Unit	12	18%
Human resource policies/practices within the hospital-Staff rotation and Rota management	11	16%
Lack of skills in neonatal care and treatment	10	15%
Delayed resuscitation and emergency care	9	13%
Poor referral systems	8	12%
Delayed referrals	7	10%
Inadequate staffing in maternity	5	7%
Poor management of labour	3	4%
Lack of Essential equipment and suppliers	2	3%
Lack of essential drugs	1	1%

The diagram below illustrates the emerging pattern in respondents' feedback on the

hospital factors associated with child mortality.

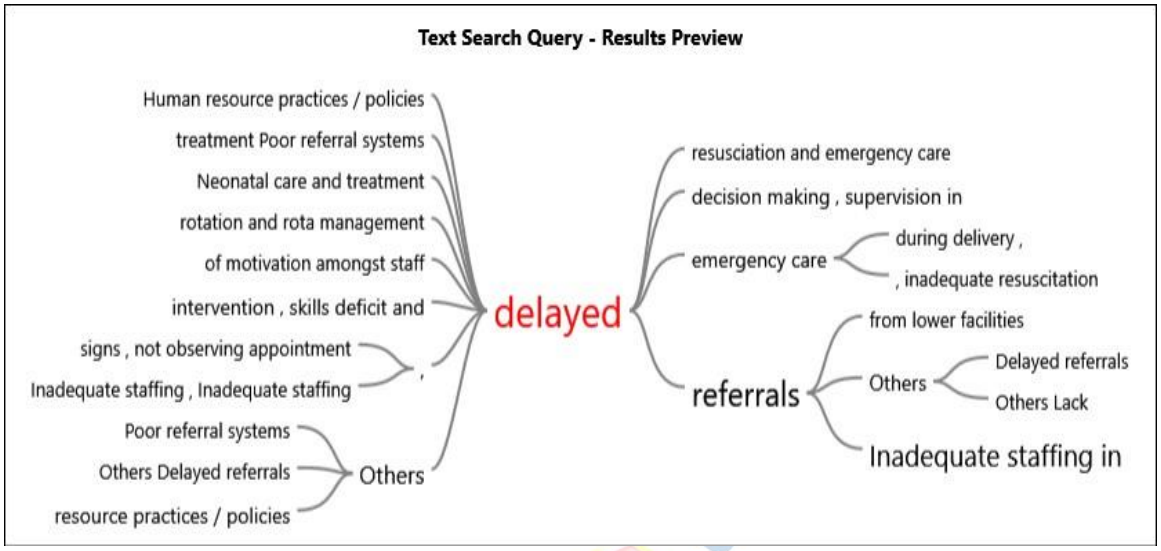


Figure 5: Hospital factors

4.3.2.3 Neonatal Factors

Prematurity was reported as the commonest cause of high NMR (37%) as compared to birth asphyxia 22% and low birth weight 26%. The survival rate of babies born prematurely was significantly low. The responses from the key informant supported data extracted from the files that showed prematurity as one of the commonest cause of admission in the NBU, 35% of the neonates were admitted due to prematurity and 51.4% were among the cases. The findings support the observations made by Irimu et al., (2021) from a study on NMR risk factors at Moi Teaching and Referral hospital. **Table 8: Neonatal factors associated with neonatal mortality**

Neonatal Factors	Responses	Percent Responses
Prematurity	10	37%
Birth Asphyxia	6	22%
Low Birth Weight	7	26%
Congenital Abnormalities	4	15%
	27	**100%**

neonatal factors associated with child mortality.

The diagram below illustrates the emerging pattern in respondents' feedback on the

Figure 6: Neonatal factors

4.4 Challenges in the New-born Unit

Majority of the key informants argued that the most critical challenges in the new-born unit was staff shortages and frequent reshuffling of the staff as the per table 13. The study revealed that transfer of staff and reshuffling contributed to lose of skilled and experienced staff within the unit. Lack of adequate skills on neonatal care among the staff working in the NBU compounded with the effect of staff shortage on new-born survival. Delayed emergency care during delivery and admission to the NBU contributed to neonatal deaths.

Table 9: Challenges experienced in the NBU.

Challenges in the NBU	Responses	Percent Responses
Frequent staff reshuffle	8	22%
Staff shortage	8	22%
Inadequate capacity-Overcrowding	8	22%
Inadequate Skills	6	17%
Inadequate skills in resuscitation	4	11%
Delayed emergency care	2	6%
	36	**100%**

The diagram below illustrates the emerging pattern in respondents' feedback on the NBU factors associated with child mortality.

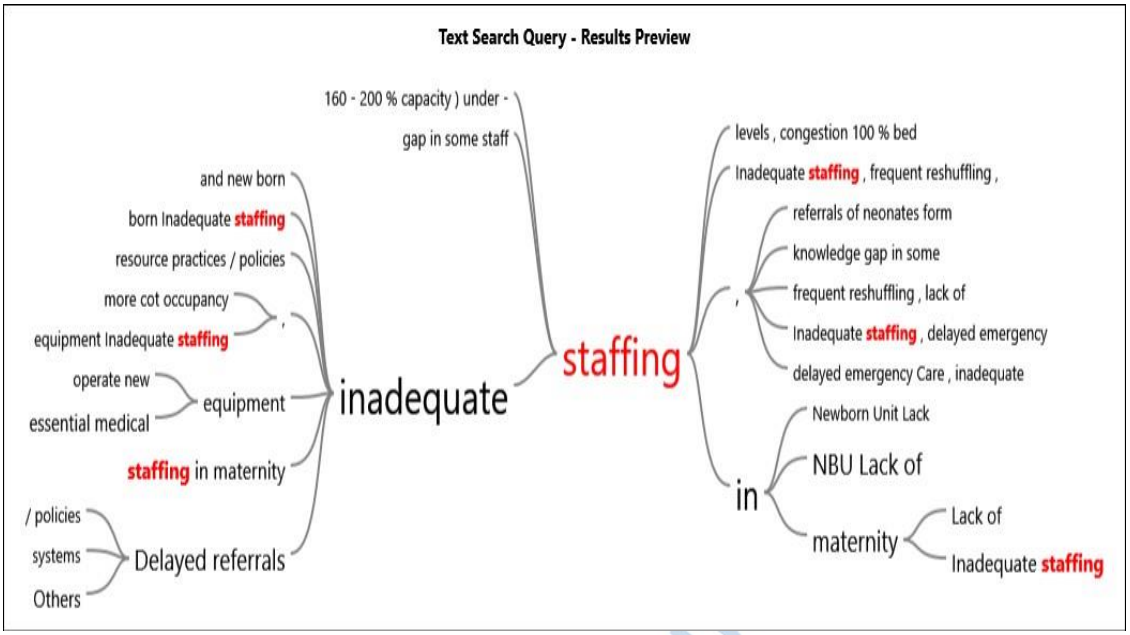


Figure 7: Challenges experienced in the New-born unit

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Neonatal mortality accounts for 40% deaths in under-fives worldwide with 4 million neonates deaths occurring before the first month of birth annually. Though neonatal mortality in Kenya remains significant health burden. In Nakuru county, neonatal mortality rate is 41.9 per 1000 live babies born every year, which is more than twice the national mortality rate of 19 deaths per 1000 live births. Nakuru level 5 hospital is the main referral facility within central and South Rift regions serving a catchment population of over 10 million. The facility reports over 1500 deliveries and over 200 new-borns admissions monthly. The study investigated the risk factors associated with neonatal mortality at Nakuru level 5 hospital among neonates who had died between October 2018 and September 2019.

According to the results, too young or advanced maternal age, low level of education, high parity, high number of still births, fewer ANC visits, and higher number of foetuses in the pregnancy increased the risk of neonatal mortality. Similarly, positive HIV status, HBsAg status, syphilis status, gestational diabetes, pregnancy induced hypertension, antepartum haemorrhage, PROM 18hours, maternal peri-partum increased the risk of neonatal mortality. On the other hand, mother treated with antibiotics, mother received antenatal dexamethasone and the use of CS as a mode of delivery reduced the risk of neonatal mortality. Neonatal factors include birth weight, weight on admission, gain weeks, source of admission to NBU, prophylactic antibiotics treatment, congenital anomalies, and photo therapy treatment affected neonatal outcome. From the respondents' feedback, hospital factors were also noted to contributes to neonatal mortality. Maternal characteristics, maternal complications during admission and

delivery such as labour dystocia and haemorrhage and neonatal complications at birth were significant contributors of neonatal mortality. The study recommends regular training of staff working in the maternity and new-born unit on emergency care and neonatal resuscitation. The research also recommends on improving referral systems to ensure that they are more efficient and compliant with protocol for management of maternal and neonatal complications. The hospital should also ensure that skills gained amongst staff working in the maternity and new-born unit are retained through well planned transitions, reshuffles and transfers. The study proposes prospective case studies on the staff and hospital practices in the management of the mothers and new-born admitted in the new-born and maternity units

5.2 Conclusions

From the discussions, the logistic regression highlights the predictor factors including maternal age, level of education, parity, number of still births, ANC visits and the number of foetuses in the pregnancy as the main factors for neonatal mortality. The study showed that increasing parity came with increasing odds of neonatal mortality. Increasing frequency of ANC visits reduced the NMR. Similarly, it was observed that as the number of foetuses in a pregnancy increases, there is a concomitant increase NMR. The study showed that mothers who were more educated had lower rates of neonatal mortality compared to less educated. Similar observation was made for age increasing age coincided with decreasing mortality rates. Although the data showed a decreasing rate of mortality with maternal age, and an increasing risk with increasing number of still birth, the data was not statistically significant in both cases and were not adopted for further analysis.

The study findings show that HIV status, HBsAg status, syphilis status, gestational diabetes, pregnancy induced hypertension, antepartum haemorrhage, prom 18hours, and

maternal peri-partum fever significantly increased NMR. Similarly, the mode of delivery used had an effect on NMR. On the other hand, mother treatment with antibiotics and mother treatment with antenatal dexamethasone reduced NMR. With reference to neonatal factors, increasing birthweight reduced NMR. Similarly, increasing age at admission to the NBU reduced to the risk of mortality. The data also show that increasing gestation period reduced NMR. New-borns whose mothers are admitted to the facility from a referral facility or labour ward had a higher NMR. Treatment with antibiotics and phototherapy reduced the risk while congenital anomalies increased NMR.

Mothers who were admitted through the hospital high risk clinic had better outcomes as compared to those who were self-referrals and walk-ins in the maternity. Mothers referred from lower-level healthcare facilities were mostly due to foetal distress. Maternal chronic conditions such as diabetes and hypertension contributed to poor neonatal outcomes. The study findings suggest that healthy mothers who had no chronic illnesses or complications during pregnancy period were also likely to lose their babies after delivery due to hospital and neonatal factors that contributed to poor neonatal outcomes. Dystocia which includes obstructed and prolonged labour was the most common maternal complication occurring during birth. The other complications experienced by mothers at the time of delivery were haemorrhage and PET. Neonatal characteristics such as birthweight and gestation age and the existence of complications were linked to NMR. Prematurity and birth asphyxia were the commonest conditions among the neonates in the new-born unit with prematurity having the highest risk of neonatal death. Other neonatal complications included neonatal sepsis, respiratory distress syndrome and low birthweight. Hospital factors such as staffing, skills mix and capacity of the new-born unit further contributed to neonatal outcome. Lack of skills on neonatal resuscitation and lack of emergency preparedness for high-risk babies gravitated poor neonatal outcomes in the new-born unit. Mothers who

were referred from other facilities due to pregnancy or foetal complications were at a higher NMR. The referral systems for mothers in the maternity and the new-born unit was established as a contributor to neonatal deaths.

5.3 Recommendations

5.3.1 Recommendation for the Study

The study recommends improvement in referral systems, training of staff on neonatal emergency and resuscitation care and retention of staff working in the maternity and new-born unit. It is also imperative to strengthen the high-risk clinics for the mothers who reported bad obstetrics history including previous neonatal mortality and maternal chronic complications. The study also recommends the hospital medical team to carry out regular clinical and quality audits in the new-born and maternity units in order to develop corrective measures of minimizing medical errors. Summative, the study recommends:

1. High prevalence of neonatal mortality among mothers in extremes of ages, low level of education, HIV positive, confirmed cases of HBsAg status, syphilis, gestational diabetes, pregnancy induced hypertension, antepartum haemorrhage, prom 18hours, and maternal peri-partum fever suggests the need for targeted solutions for early identification and reduction of the risk factors.
2. Policies should focus on factor behind high NMR from a communal perspective. Sociodemographic, maternal health, healthcare quality and neonatal complications occurring during pregnancy and arising at birth are critical determinant of NMR that can be addressed through proper care practices. Efforts must be put in place to mitigate the effect of congenital anomalies on neonatal mortality even in poor resource settings in order to address the effects of disparities in NMRs.

3. Neonatal Mortality Audit- A systematic audit of neonatal mortality patterns, the events and mediating factor that led to death, can assist in identifying healthcare system problems and inspiring local remedies to prevent similar cases in the future. When accompanied with a defined action plan and specific objectives, neonatal mortality audit and reporting has a stronger influence on health care procedures and outcomes by aiding in quality improvement initiatives. Mortality audits for neonatal mortality and events leading to stillbirths may assist contribute to quality of care and data generation for decision-making, policy development and preventive action.
4. Systems strengthening strategy- In Kenya, poor prenatal care results in a failure to recognize and manage high-risk pregnancies. Coupled with the poor access to prenatal treatment, as well as obstetric problems, the result is a high rate of early new-born fatalities, including stillbirths. Underfunding, operational and administrative inefficiencies, poor quality of services, imbalances in health worker distribution, and poor governance, planning and budgeting define healthcare in the country. Contextual variables such as a political influence, unpredictable economic conditions, and fast population expansion impede efforts to enhance the functioning of the health sector. Rising disease load, particularly re-emerging and new epidemics burden the already poor health system. In preventing neonatal mortality, building health system that responds to the changing population healthcare needs necessitates the innovative use of technologies as well as an interdisciplinary response to policy and practices addressing the goals of efficient, equitable, effective, sustainable, and ultimately improving neonatal outcome.

5. Skills upgrade and retention- In addition to attaining initial proficiency, skill retention over time is critical to the quality of care received. The loss of information and practical skills after initial training, on the other hand, is a risk factors in majority of healthcare contexts. The findings on personnel knowledge and practical abilities indicate that additional attention should be placed on the workers' mastery of their roles and self-efficacy in order to enhance neonatal outcomes. Skills reductions after training imply that stand-alone instruction without follow-up initiatives for healthcare workers to exercise gained skills may be insufficient in resource-constrained contexts. Training programs that include planned follow-up initiatives to reinforce information gained during primary training, including such refresher courses and mentorship, can increase care quality. Continuous training should be accompanied with employee retention, thereby, increasing the pool of skilled employee to offer safe motherhood, which the neonatal outcome by preventing risk factors associated with skill insufficiency.
6. Expansion of facilities-. There is a need to increase mother and child care facilities in order to offer safer antenatal care. The study emphasizes the significance of expanding healthcare facilities in terms of infrastructure and resource access to accommodate growing healthcare need; larger capacities grant prompt response to complications that may arise at birth. The expansion of healthcare facilities is based on the belief that receiving the needed care during birth significantly improves new-born survival. The study found that the New Born Unit had an bed occupancy of 150 percent and hence the need to expand the infrastructure.

5.3.2 Recommendation for Further studies

This study focused on the maternal and neonatal factors that were documented during admission and management in the maternity and new-born units. This was a retrospective study that relied on the previous practices in the new-born unit in regards to management of neonatal care. The study proposes further prospective exploratory studies in the maternity and new-born units in identifying hospital and healthcare workers factors that determine neonatal and maternal management. However, there is still room for improvement;

1. To attain SDG NMR target of 12 deaths per 1000 live births or less by 2030, there is a need for further studies into the significance of documentation and implementation of standard guidelines in the new-born unit will prospectively identify gaps in neonatal care that if addressed will mitigate the risk factors associated with high NMR.
2. In the UN report (2015), deaths of neonates accounted for 45% of the 5.9 M children who had died in 2015 with the highest rates recorded in the African region (NMR 28.0). Kenya needs to put more emphasis on evidence-based studies of neonatal risk factor in order to achieve every New-born Action Plan's aim of a neonatal mortality rate of below 10 deaths per 1000 live births by 2035 as the current NMR of 22 deaths per 1000 live births is an indication of poor progress in achieving this goal (UNICEF, 2018).
3. Neonatal risk factors cut across different domains of healthcare, ranging from system to professionalism. Realizing the common goal of reducing neonatal mortality calls for multi-disciplinary studies of underlying healthcare factors.

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APPENDICES

Appendix I: Introductory Letter

Key informant guide

Information sheet for participants

Dear Participant

You are hereby invited to participate in a study on determinants of neonatal mortality in Nakuru level 5 hospital as one of the key informants. The purpose of this study is to investigate factors that contributes to neonatal mortality at Nakuru Level 5 hospital. The objectives of the study are to determine the prevalence of neonatal deaths and the factors contributing to neonatal deaths at Margaret Kenyatta Mother Baby Wing of Nakuru Level 5 hospital. The information gathered from this study will guide the policy makers at both the hospital and the county to put in place interventions to address the problem of neonatal mortality. The information will also help the healthcare workers in the facility to generate guidelines and protocols that would mitigate the risk of neonatal death. Your honesty and willingness to provide information will help in identifying strengths and weaknesses of the current practices and develop solutions. The key informants participating in the study have been selected based on their role in the hospital administrative and clinical functions. The instructions on the study expectations to the key informants are as outlined in the consent form below.

General Instruction for the study

Participation in this research requires you to take part in filling questionnaire form.

Your opinions are extremely worthwhile so please understand that there aren't wrong or right answers. The questions should take approximately 10 minutes to answer. To maintain anonymity and privacy please do not indicate your personal details or any confidential information that may reveal your identity anywhere in the form, only your

responses to the questions in the questionnaire are expected. Please note that your participation in this research is completely voluntary, there will be no action taking against you if you do not participate or answer the questionnaire. Having read and understood the aim of this project, your role as a participant in the study and the benefits of the information provided please provide your consent and proceed to the data collection questionnaire to provide your responses.

Appendix II: Consent Form for Participants

I understand the aims of the project, the benefits and potential risks and that my participation is completely voluntary. I realise that I can withdraw at any time and that I am not obligated to answer questions. I understand that any information I provide will remain confidential and my identity will not be revealed in anyway and the collected data will not be used for purposes other than this research project.

Signature of the respondent**: …….**

Date**: …….....**

a) Department
b) Years of experience
c) Professional Qualification
d) Role
e) Training Level
f) Date lastly trained on Neonatal care
g) What are maternal factors contributing to neonatal mortality at Nakuru Level 5 hospital?
h) What are the neonatal factors contributing to neonatal mortality at Nakuru Level 5 hospital
i) What are the hospital factors contributing to neonatal mortality at Nakuru level 5 hospital?
j) In your own opinion, are there policies that affect the outcome of neonatal care in your facility?
k) What measures would you recommend towards improvement of neonatal outcomes.

Appendix III: Research Instruments

Data Extraction Tool

Kindly indicate "Not Recorded" where a procedure or activity was not documented in the patient file.

A. <u>Maternal Hospital Records</u>

1. Age of the Mother

……. Years Not Record

2. Date of admission _____ Time_____

3. Date of delivery _____ Time_____

4. Type of Admission

Booked ☐ Referral ☐

5. The patient referring facility/location

Community ☐ Lower-Level Facility ☐

6. Reason for Referral …….

7. Parity

Pregnancies ☐ Not Recorded ☐

8. Gestational Age at birth

Weeks ☐ Not Recorded ☐

9. Number of births (Singleton, twins, multiple)

Not Recorded ☐

10. Maternal chronic condition or related illness during pregnancy

Anaemia ☐ Pre-eclampsia/Eclampsia ☐ APH ☐ Diabetes Mellitus ☐

Other (Specify) ……

11. Maternal Complications/conditions during Delivery

Pre-eclampsia/Eclampsia ☐ Haemorrhage ☐ Prolonged Labour ☐

Premature Rupture of Membranes (PROM) ☐ Others (Specify)…….

12. Stage of Labour on Admission

Latent ☐ Active ☐ Second Stage ☐ Not Recorded ☐

13. Birth Attendant at Delivery

Obs/Gyn ☐ M.O ☐ Midwife/Nurse ☐ Clinical Officer ☐ Not Recorded

14. Condition of the mother after delivery

Alive and Well ☐ Alive and Stable Alive and Unstable ☐ Dead ☐ Not Recorded ☐

15. Type of Admission

Self-Referred Inpatient ☐ Not Recorded ☐

16. Type of Delivery

Normal Vaginal Delivery	Assisted Vaginal Delivery	Breach delivery	Caesarean Section	Not Recorded

B. Neonatal Hospital Records

17. APGAR Score

APGAR SCORE		Answer	Not Recorded
I minute	5 minutes		
<3/10	<3/10		
3 6/10	3 6/0		
>7/10	>7/10		
Not Recorded			

18. Birth Weight

Kgs ☐ Not Recorded ☐

19. Gender

Male ☐ Female ☐ Not Recorded ☐

20. Neonatal Complication at Birth

Congenital Anomalies ☐ Birth Asphyxia ☐ Respiratory Distress Syndrome ☐

Any Other (Specify)…….

21. Cause of Admission in NBU

☐ Prematurity LBW ☐ Sepsis ☐ Birth Asphyxia ☐

Not ☐ Recorded

Any Other (Specify) …….

22. Type of Feeding on Admission

Breastfeeding ☐ Expressed Breast Milk ☐ Infant Formula ☐

Not Recorded ☐

23. Type of Feeding at the Time of death

Breastfeeding ☐ Expressed Breast Milk ☐ Infant Formula ☐

Intravenous Feeding ☐ Not Recorded ☐

24. Documented certified cause of Death (Final Diagnosis)

Not Recorded ☐

25. Occurrence of Danger Signs (Tick for YES and Cross for NO)

Sign	Present On Admission (Documented)	Observed After Admission & Documented	Number Days present/observed during admission period	Observed of time Death

Not/stopped feeding (Breast/formula)				
Fever				
Convulsions				
Reddened/pus in the Umbilicus				
Jaundice				
Chest in drawing				
Vomiting				
Any other (Specify)				

Not Recorded ☐

26. Date and time of Discharge from NBU

Date……..Time……Not Recorded_____

Appendix

IV: Letter of Introduction

Mount Kenya University

REF: **MKU/ERC/1630** Date: 24 July 2020

TO: **WAINAINA DANIEL NDUNG'U** REG: **MPH/2018/22921**

Dear Sir/Madam,

RE: DETERMINANTS OF NEONATAL MORTALITY IN MARGARET KENYATTA MOTHER BABY WING AT NAKURU LEVEL 5 HOSPITAL, NAKURU COUNTY, KENYA: A CASE CONTROL STUDY

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **703.** The approval period is **24/07/2020 – 23/07/2021.**

This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 0100, Thika

Prof. Francis W. Muregi
Chairman, Mount Kenya University IERC

Appendix

V: Authorization

DEPARTMENT OF HEALTH SERVICES
NAKURU COUNTY

Email:cohealth.nakuru@gmail.com
When replying please quote

COUNTY DIRECTOR
ADMIN & PLANNING
P.O BOX 2060-20100
NAKURU

Ref:No.NCG/CDAP/GEN/VOL.1/2020

Received for HR to give Consent Letter Issued.

12th August, 2020

TO THE MEDICAL SUPERINTENDENT
NAKURU LEVEL 5 HOSPITAL

RE: PERMISSION TO COLLECT DATA AT NAKURU LEVEL 5 HOSPITAL

I would like to introduce to you Dr. Daniel Wainaina who is currently pursuing a Masters in Public Health at Mount Kenya University.

He is supposed to collect data for his study titled Determinants of Neonatal Mortality at Margaret Kenyatta Mother and Baby Wing. He has the necessary approvals for the same, so please accord him the necessary assistance for him to collect data.

COUNTY DIRECTOR OF PLANNING & ADMINISTRATION HEALTH SERVICES
12 AUG 2020
P.O. BOX 2060-20100 NAKURU KENYA

DR. B.OSORE
COUNTY DIRECTOR ADMINISTRATION & PLANNING
NAKURU COUNTY

Appendix

VI: Research Permit from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **319714**

Date of Issue: **07/August/2020**

RESEARCH LICENSE

This is to Certify that Dr.. Wainaina Daniel Ndungu of Mount Kenya University, has been licensed to conduct research in Nakuru on the topic: DETERMINANTS OF NEONATAL MORTALITY IN MARGARET KENYATTA MOTHER BABY WING AT NAKURU LEVEL 5 HOSPITAL, NAKURU COUNTY,KENYA: A CASE CONTROL STUDY for the period ending : 07/August/2021.

License No: **NACOSTI/P/20/6111**

319714

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

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1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies
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7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one of completion of the research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice

National Commission for Science, Technology and Innovation off Waiyaki Way, Upper Kabete,
P. O. Box 30623, 00100 Nairobi, KENYA
Land line: 020 4007000, 020 2241349, 020 3310571, 020 8001077
Mobile: 0713 788 787 / 0735 404 245
E-mail: dg@nacosti.go.ke / registry@nacosti.go.ke
Website: www.nacosti.go.ke

Appendix VII: Similarity Index

DETERMINANTS OF NEONATAL MORTALITY IN MARGARET KENYATTA MOTHER BABY WING AT NAKURU LEVEL 5 HOSPITAL, NAKURU COUNTY, KENYA: A CASE CONTROL STUDY

by Daniel Wainaina

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