TREND AND FACTORS ASSOCIATED WITH NEONATAL MORTALITY AMONG NEONATES ADMITTED AT THE WOMEN AND NEWBORN HOSPITAL OF THE UNIVERSITY TEACHING HOSPITALS, LUSAKA, ZAMBIA

By

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APPROVAL

The University of Zambia approves this dissertation by Deborah Tembo in partial fulfilment of the requirements for the award of the degree in Master of Science in Epidemiology.

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DECLARATION

This dissertation is the original work of **DEBORAH TEMBO**. It has been done in accordance with the guidelines for dissertations for the University of Zambia. It has not been submitted for a degree at this University or another University.

Signature……

Date…….

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DEDICATION

This dissertation is dedicated to my lovely daughter Annette Shiprah Mutinta Mukonka who had to be deprived of motherly care as I spent long hours away from home during my research, my husband Fred Mukonka who had been very supportive throughout my studies, my late mum for being my source of inspiration and role model, and to my friend Nedah C Musonda who has always encouraged me in all my endeavours. My children Eric and Elvis for the understanding.

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ABSTRACT

Neonatal mortality is a global problem especially in resource-poor settings such as sub-Saharan African Countries. Trends and factors associated with neonatal mortality vary in different settings. The study sought to investigate the trends and factors that are associated with increased neonatal mortality amongst neonates admitted to Neonatal Intensive Care Unit (NICU) at Women and New-born Hospital with a view of identifying pointers that can be modified to help improve neonatal survival.

Medical records of all neonates admitted to the NICU in 2018 and 2019 were reviewed using a cross-sectional study. The Mortality rates were calculated using WHO standard and Microsoft excel 2010 was used to construct monthly trends analysis using monthly totals. Univariate and multivariate logistic regression analysis was used to determine the factors associated with neonatal deaths at the tertiary facility using Stata version 14.2. Model fit was evaluated using Hosmer and Lemeshow test (chi2=13.90, P =0.0845), implies the model's estimates fit the data at an acceptable level.

A total of 7,581 admissions were seen and 2340 files were extracted for analysis, of which 940 (40.2%) died. The overall Neonatal mortality percentage during the study period was 31.8%. There was relatively similar trends overtime in neonatal mortality during the study period with differences in case fatality rates as 2019 had increased case fatality rate compared to 2018. Factors associated with an increased odds of dying were not attending antenatal care (AOR=2.09, 95% CI [1.46 - 2.99] p <0.0001), parity (AOR=1.09, 95% CI [1.02 – 1.16] p=0.0013) and age of the neonate in days (AOR=0.92, 95% CI [0.91- 0.94] p <0.0001).

Neonatal mortality is high among hospitalized neonates at the Women and New-born Hospital in Zambia. Associated Factors included antenatal attendance, parity, and age of the neonate. This can lead to lagging on the Sustainable Development Goals No 3 of 2030 on neonatal health, hence emphasis is on early Antenatal Care for easy monitoring of mother and neonates for fast actions in case of complications

Keywords: Neonate, neonatal mortality, trends, risk factor

ACRONYMS AND ABBREVIATIONS

CSO	Central Statistical Office
MDG	Millennium Developmental Goals
MoH	Ministry of Health
MPDSR	Maternal Prenatal Death Surveillance and Response
NICU	Neonatal Intensive Care Unit
NMR	Neonatal Mortality Rate
SSA	Sub-Saharan Africa
SDGs	Sustainable Developmental Goals
UNICEF	United Nations Children Fund
UTH	University Teaching Hospital
WHO	World Health Organization
ZDHS	Zambia Demographic Health Survey

CHAPTER ONE: INTRODUCTION

1.1 Background

Neonatal mortality is the death of a live born baby within the first 28 days of life and remains a public health concern worldwide especially in developing countries. It is estimated that 2.5 million neonates die every year worldwide (Estimation *et al.*, 2018). There are some regional differentials with some regions such as sub-Saharan African disproportionately affected with an estimated at 27 deaths per 1000 live births in 2017 (Estimation *et al.*, 2018), which is an unacceptably high. While a trend is said to be a general direction in which something is developing or changing. Over the years there has been some neonatal trends, and this has not been evenly distributed. In Africa, WHO (2018) estimates that on average about 15% of newborn babies are expected to die before the age 28 days. The corresponding figures for many parts of the world which are developed such Europe, and USA are much lower ranging from two to 3% or even less (Hug *et al*., 2019). Neonatal mortality is by far highest in sub-Saharan Africa due to underdevelopment which could partly be explained by armed conflict and the spread of HIV/AIDS which seriously hamper efforts to improve neonatal survival. If current trends continue, more than 50 countries will fall short of the Sustainable Development Goal (SDG) target on child survival, some 60 million children below the age of five will die between 2017 and 2030 – and half of them will be newborns with sub-Sahara Africa and Asia contributing the most (Oestergaard *et al.*, 2011, Estimation *et al*., 2018)

The estimated neonatal mortality rate is more than 27 per 1000 live births in a number of countries and about three in ten countries in this region (Estimation *et al*., 2018). Neonatal mortality deaths are high in Zambia, they account for 41% of the total under-five mortality. The country's neonatal deaths burden was estimated 24 deaths per 1000 live births (Central Statistical Office and International, 2014). However, the preliminary results of the 2018 demographic health survey report on key indicators of has recorded an ascending trend in neonatal mortality rates at 27 per 1000 live births (Zambia Statistics Agency - ZSA *et al*., 2020). Extensive training of health workers in essential newborn care, Emergency obstetric and newborn care and infrastructure development has been done in an effort to promote newborn survival in turn reduce neonatal deaths (Serbanescu *et al*., 2019) Despite the government of Zambia and its stakeholders' efforts to mitigate the problem, the burden of neonatal mortality does not seem to

reduce. Several factors contribute to Neonatal deaths; such as poor maternal health, inadequate care during pregnancy, inappropriate management of complications during pregnancy and delivery, poor hygiene during delivery and the first critical hours after birth, and lack of new born care (Lukonga and Michelo, 2015). Neonatal mortality differs from one setting to setting depending on how developed a country is and the trends are not well known. Some of the factors associated with this change from place to place this study was conducted to assess the trends factor associated with neonatal mortality at women and newborn hospital UTH, Zambia.

1.2 Statement of the problem

In Zambia, many strategies are being implemented to help reduce neonatal deaths and improve neonatal survival. Programs such as helping baby breath campaign, emergency obstetric and neonatal care training of health workers, (Chomba *et al*., 2008), are being implemented to help achieve legacy goal No 1 of 2020 to reduce neonatal mortality rate to 12 per 1000 live birth. Moreover, the Zambia University teaching hospital (UTH) in 2017 was divided into 5 hospitals which included the women and newborn hospital to decentralise the management and improve client care. However, there is limited evidence of studies conducted at facilities using routinely collected hospital data to examine the impact these strategies in improving newborn survival. Yet analysis of routine data is useful in monitoring performance and progress made towards a goal. For this study, we aimed at answering the following questions: - (1) What are the trends and factors are associated with neonatal deaths at NICU -women and newborn hospital UTH in Zambia. (2) When did most of these deaths occur, which places contributes most to the referrals at the facility?

1.3 Justification

This study may provide evidence on the most recent trends in newborn deaths and bridge the knowledge gap on associated factors to neonatal deaths at NICU- women and newborn hospital Zambia. The study hopes to contribute to guidance on prevention and treatment strategies for management of neonates at the facility. Scientific evidence provided by this study might give milestones on neonatal deaths, key to measuring progress to drive accountability and knowing

the factors will help to know where to channel the energies in order to reach the intended targets since evaluation of progress made mostly is done when implementing funded programs. The study also has potential to inform policy and implementers on need to re-design and re-strategize interventions to meet set goals.

1.4 Research Question and Objectives

1.4.1 Research question

What is the trend and what are the predictors of neonatal mortality overtime at NICU Women and Newborn Hospital UTH- Zambia?

1.5 Objectives

1.5.1 General objective

To investigate the trend and factors associated with neonatal deaths at Neonatal intensive care Unit (NICU), Women and Newborn Hospital – at the University Teaching Hospital (UTH), Zambia over the past 2 years

1.5.2 Specific objectives

1. To estimate the neonatal mortality rates at NICU women and newborn hospital UTH over the past two years (January 2018 to December 2019)
2. To assess the monthly trends in neonatal deaths at NICU women and newborn hospital UTH over the past two years for a two-year period between 2018 to 2019
3. To determine the associated factors in neonatal deaths at NICU women and newborn hospital UTH over the past two years, Zambia between 2018 to 2019

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview of Neonatal Deaths

The burden of neonatal deaths cannot be underestimated. A neonate is an infant who is born live and is only hours, days, or up to 28 days old. Care is critical at this stage to promote child survival. Neonatal death is the death of a live born baby within the first 28 days of life. Inadequate and lack of specific responsiveness characteristic of humanity usually make the new-born prone to death. Neonatal mortality rate is said to be the number of deaths within the first 28 days of life per 1000 live births (Hug *et al*., 2019). Most of the deaths during the neonatal period occur at home and often go unregistered even in transition countries. This leads to under reporting of the deaths. Social invisibility is linked to an expectation of high mortality; many traditional societies do not name new-borns for up to six weeks (Mason *et a*l., 2014). In addition, a mother who loses a baby is asked not to cry as it can make her not to conceive again hence the poor mother will not even mourn her baby and end up suffering the distress quietly. Mental and emotional needs of the woman are not tended to. The old women in the village are the only ones allowed to bury the child. Hence things will be done quietly with no publicity. On top of the suffering the poor woman who had just given birth will be made to bath charms and go through a lot of different traditions in the name of maintaining her fertility (community case reports).

A survey by Flenady, on health care professionals in low income settings showed that disposal of the baby's body frequently occurs without any recognition or rituals such as naming, funeral rites or baby being held or dressed by the mother. Responding to the survey, women across different countries largely high income, reported that grieving is not accepted in public and that undivided support for her loss was not provided (Flenady *et al.,* 2014). Observing a woman who had just had a loss in the community shows a woman who is disturbed, depressed blaming herself of failing, unlike others who are holding and playing with their babies. The impact is long term which will never go away easily, topped by societal rejection and stigmatization through everything. Society usually blames the death on the woman for negligence unless she is lack, they have suspects who might be a health care worker, a wizard or witch (Burden *et al.,* 2016).

2.2 Burdens of Neonatal mortality

Globally, reduction of maternal and neonatal mortality remains a high priority in the sustainable development targets as unfinished millennium development goals of 2015 agenda. The global burden of neonatal deaths was estimated at 2.7 million deaths in 2015 and a similar number of still births occur (Hug *et al.*, 2019). Studies have shown that neonates are at high risk of dying in the first 28 day of life. Worldwide each year, neonatal deaths constitute 40% of all under-five mortality and approximately 57% of infant mortality (Bishai *et al*., 2016). In the recent survey the globally prevalence of neonatal deaths has increased to 46 per cent of all under-five deaths, increasing from 41% in 2000 (Safari *et al*., 2018). The number of neonates that dies in the early days of life is higher than the total number of under-five mortality (Estimation *et a*l., 2018).

The neonatal mortality burden in sub-Saharan Africa is high and most of the neonatal deaths that are in the global portal occur in sub-Saharan Africa. It is estimated that 99% of neonatal deaths arise in low-income and middle-income countries, and approximately half occur at home, which makes it difficult for the data to be captured (Lawn *et al*., 2008). There are some variations between countries depending on their care configurations. Among new-borns in sub-Saharan Africa, about 1 in 36 dies in the first month, while in the world's high-income countries the ratio is one in three hundred and thirty-three. Neonatal mortality rates in sub-Saharan Africa was estimated at 27 deaths per 1000 live births in 2017 (Hug *et al.*, 2019). Two regions accounted for almost 80 % of the new-born deaths in 2017 which were the largest globally; sub-Saharan Africa accounted for 39 % of all such deaths and Southern Asia accounted for 38% (Hug *et al*., 2019).

Disparities in new-born survival shows that a neonate in sub-Saharan Africa or in Southern Asia is nine times more likely to die in the first month than a child in a high-income country (Estimation *et al*., 2018). Across countries, neonatal mortality rates ranged from one death per 1,000 live births to forty-four deaths per 1000 (Ranjeva *et al*., 2018). The risk of dying for a neonates in the first month of life is about 50 times larger in the highest mortality country than in the lowest mortality country and the burden of neonatal deaths is also unevenly distributed across regions and countries, (Liu *et al.*, 2015).

The Zambia demographic health survey estimates neonatal mortality rate at 27 deaths per 1000 live births in 2018 (Zambia Statistics Agency - ZSA *et al*., 2020). Therefore, there is need to intensify continued advocacy on sound new-born services and invocations.

2.3 Trends in neonatal deaths

Studies done around the world have evidenced that trends in neonatal deaths are usually of different patterns. Sometimes there is an increase or reduction and sometimes it's stagnant. A study done in the United States (U.S.) by MacDorman on recent trends in mortalities discovered that, the U.S. infant mortality rate (inclusive of neonates) did not decline from 2000 to 2005. Prior to the study, data from the preliminary mortality file had suggested a 2% decline in the neonatal mortality rate from 2005 to 2006. The study evidenced that the U.S. infant mortality rate was higher than those in most other developed countries, and the gap between the U.S. infant mortality rate and the rates for the countries with the lowest infant mortality appeared to be widening (MacDorman *et al.*, 2013).

In another study conducted in Peru: Examining national and district-level trends in neonatal health in Peru through an equity lens: a success story driven by political will and societal advocacy indicated that neonatal mortality rates fell by 51 % from 2000 to 2013. Reduction was higher in rural and poorest segments (52 and 58 %) (Huicho *et al*., 2016). The findings provided compelling evidence that proactive measures to reduce health disparities accompanied by socioeconomic progress can result in measurable improvements in the health of new-borns relatively short interval (Lawn *et al*., 2010). On the contrary Brazil's neonatal mortality rates showed an important decrease in the period, from 23.1 per 1000 live births in1990 to13.6 in 2007 with an average yearly decline was 3.2%, but the consequence of the lower rate of decline in neonatal mortality, increased infant mortality (Lawn *et al.*, 2010).

However, sub-Saharan Africa has shown stagnated neonatal deaths, despite the modest 41% decline in the neonatal mortality rate from 2000 to 2017 in sub-Saharan Africa. The number of deaths stagnated around neonatal one million deaths per year due to an increasing number of births (Hyder *et al*., 2003). In 23 countries in sub-Saharan Africa, the number of neonatal deaths did not decline from 1990 to 2017 even though the rates of neonatal mortality fell over the same

period (Hug *et al*., 2019). Findings of a study in Ghana on trends showed an overall, the neonatal mortality rate declined at an average of 2.5 per 1000 live births per year: down by nearly 50% from 40.9 in 1995 to 20.5 in 2002 (Baiden *et al.*, 2006). A study conducted in Ethiopia on neonatal mortality in Ethiopia: trends and determinants discovered that; neonatal mortality rate declined by 1.9% per annum from 1995 to 2010, logarithmically. The early neonatal mortality rate declined by 0.9% per annum and was where 74% of the neonatal deaths occurred (Mekonnen *et al*., 2013)

Locally not many studies have looked at the trends in neonatal deaths. Measures of childhood Data from the 2013-14 Zambia Demographic Health Survey show that neonatal mortality has declined by 17% over the 15-year period preceding the survey, from 29 to 24 deaths per 1,000 live births. Examination of neonatal mortality rates in Zambia over the past 15 years reveals that neonatal death rate has decreased at a slower pace than infant and child mortality. Specifically, neonatal deaths have reduced only by five deaths per 1,000 live births compared with other childhood mortality indicators (Central Statistical Office and International, 2014).

Reducing global new-born preventable deaths relies on improving the quality of care delivered in low resource countries where 99% of deaths occur (Bishai *et al*., 2016). Trends examinations are needed to understand the magnitude of the problem in order to implement strategies that will improve the quality of the life of mothers to reduce neonatal deaths.

2.4 Factors Associated with Neonatal Deaths

Neonatal death is a crucial indicator of a country's socio economic development and quality of life, as well as its health status (Serbanescu *et al*., 2019). Causes of neonatal deaths are largely preventable and treatable using proven, cost-effective and currently available interventions (Mengesha and Sahle, 2017). Recent series in The Lancet have estimated that around two-thirds of both new-born and child deaths could be prevented with low cost, low-technological and existing interventions (Estimation et al., 2018). Many factors are usually at play in causing neonatal deaths. According a study done in Zambia, a complex chain of factors are associated with neonatal deaths (Lukonga and Michelo, 2015). These include but not limited to socio-economic, biological, and healthcare-related factors.

2.4.1 New-Born Factors

Several studies have been conducted worldwide to ascertain the specific causes of neonatal. Existing literature shows similar findings on neonatal factors attributed to neonatal deaths. According to a study by, Three conditions: infection, birth asphyxia, and consequences of premature birth/low birth weight, are responsible for majority of these deaths (Qazi and Stoll, 2009). More than one-third of estimated neonatal death were due to severe infections and a quarter is due to the clinical syndrome of neonatal sepsis/pneumonia. Case fatality rates for neonatal infections remain high among both hospitalized neonates and those in the community (Qazi and Stoll, 2009). In another study in Tigray region Prematurity, asphyxia, and infections were the leading causes of neonatal deaths but causes of neonatal deaths identified during early and late neonatal periods differed, which clearly indicates the need for responsive and evidence-based interventions and policies (Mengesha *et al.*, 2016).

Findings from studies conducted in sub-Saharan Africa show that the major causes of neonatal deaths were birth defects, neonatal asphyxia which could be during delivery or after birth and neonatal infections affecting the blood (sepsis) and affecting the lungs (pneumonia). Neonatal infections accounted for 26% of annual neonatal deaths, with mortality rates highest in sub-Saharan Africa (SSA), (Ranjeva *et al*., 2018). In addition, a study by Reyes, concluded that Preterm birth, low birth weight, respiratory distress, Apgar score less than seven, congenital malformations, and a history of less than five antenatal care visits were associated with a higher risk for death (Reyes *et al*., 2018).

The relationship between the sex differentials in the nutritional status of the young children has been explored. Findings shows that the most common causes of neonatal deaths in Zambia are sepsis, birth asphyxia, and prematurity/low birth weight and most of these deaths occur within the first 24 hours of life (Lukonga and Michelo, 2015), (Mason *et al*., 2014).

On consensus new-born factors are the leading direct causes of neonatal deaths globally. Shefali elaborated that the proportion of deaths attributable to neonatal infection is even greater in high mortality settings. Neonates surviving infection may also experience long-term, neurocognitive impairment; for example, about 15 % of neonates surviving from meningitis developed mild or severe impairment (Liu *et al.*, 2015). While data is sparsed, it is plausible that there may be

similar levels of impairment among neonates surviving sepsis. Infectious diseases and neonatal complications are responsible for the vast majority of under-five deaths globally. A study done in the US to evaluate the epidemiology of sudden unexpected infant death (SUID) over a 20-year period (1995-2014), discovered that though mothers were trained on baby sleep positioning, SUIDs have failed to decrease, and the percentage of SUIDs attributed to unsafe sleep conditions has increased significantly in both periods. They concluded that there should be an on-going attention to all circumstances contributing to this category of deaths (Paudel *et al*., 2018)

2.4.2 Maternal factors

Maternal health is another very important factor in survival of a neonate. If the mother is healthy there is a high possibility that the baby will be healthy. Studies have shown that maternal factors can either positively or negatively affect pregnancy outcomes. Maternal factors that affect the new-borns includes; age of a mother, birth spacing, malnutrition, health conditions like hypertension hereditary, intrapartum fever, HIV status and other diseases, bad habits like use of illicit drugs, Smoking and alcohol drinking, psychological stress and tetanus toxoid immunization and other factors affect new-born survival (Huang *et al*., 2017, Sartorius *et al*., 2010).

A study in Myanmar showed that being a teenager, low educational level, multiparty and low level in the household wealth index were negatively associated with adequate contact with healthcare providers for Antenatal Care and Postnatal Care (Okawa *et al.,* 2019). Analysis of data in a study in Ethiopia showed increased neonatal mortality risk was associated with male sex, neonates born to mothers aged than less 18 years and those born within two years of the preceding birth. Winter birth increased the risk of dying compared with spring births, while giving two tetanus toxoid Injections (TTI) to the mothers before childbirth decreased neonatal mortality risk (Mekonnen *et al.,* 2013, Starnes *et al.,* 2018). On the contrary a study done in Iraq Babylon province concluded that the mother's age and residency, it has not influenced their neonatal death and the Respiratory Distress Syndrome (RDS) was considered the common causes of death (Abed *et al*., 2018). The United nation report Inter-agency Group for child mortality estimation report, indicated that Mothers who were less than 20 years old were about 1.5 times more likely to have their babies die in their first month of life compared to children of

20–29-year-old mothers (Estimation *et al*., 2018). Likewise, children born less than two years after their mother's previous birth are 2.7 times more likely to die within the first 28 days of life than children born four or more years after their mother's previous birth. Antenatal care utilization, BPCR practice, self-preference of a hospital for labour and delivery service, and mode of delivery were statistically significant factors for good maternal birth outcomes(Gudayu *et al*., 2019)

2.4.3 Environmental factors

Several studies have shown that the residence, political systems, cultural systems, religious systems contribute to new-born deaths. The high incidence of infections and consequent mortality, are said to be due to lack of antenatal care, unsupervised or poorly supervised home deliveries, unhygienic and unsafe delivery practices and cord care, prematurity, low birth weight, lack of exclusive breast-feeding, and delays in recognition of danger signs in both mother and baby (Ranjeva *et al.,* 2018). Underlying factors such as health system inefficiencies, infra-structural, logistic, or economic constraints also contribute to high rates of infection and infection-associated mortality (Liu *et al*., 2015). In addition, wide inequities exist in health service provision; such that the lowest coverage rates of known effective maternal and child interventions exist within the poorest income groups, (Thaver and Zaidi, 2009)

In a recent study in Nepal findings revealed that cultural and religious factors still play a major role in health seeking behaviours. Three key themes emerged from the study: (1) 'Everyone has gone through it': perinatal death as a natural occurrence; (2) Dewata (God) as a factor in health and sickness: a cause and means to overcome sickness in mother and baby; and (3) Karma (Past deeds), Bhagya (Fate) or Lekhanta (Destiny): ways of rationalising perinatal deaths *(*Paudel *et al.,* 2018) (Upadhyay *et al.*, 2014). The study concluded that religio-cultural interpretations underlie a fatalistic view among villagers in Nepal's mountain communities about any possibility of preventing perinatal deaths. This perpetuates a silence around the issue, and results in severe under-reporting of on-going high perinatal death rates and almost no reporting of stillbirths. The study identified a strong belief in religio-cultural determinants of perinatal death, which demonstrates that medical interventions alone are not sufficient to prevent these deaths and that broader social determinants which are highly significant in local life must be considered in policy making and programming (Paudel *et al.,* 2018)

Studies done in Zambia concluded that; there were marked differentials by residence in the way factors affected neonatal survival both at national and rural and urban level (Lukonga and Michelo, 2015). While in another study at Ndola s Arthur Davison hospital, the results clearly indicated that factors such as birth weight, level of education were had more significant influence in rural than urban areas (Chatupa *et al*., 2016)

2.4.4 Health care related factors

Health care is vital in the survival of a neonate. Many of the direct causes of neonatal deaths are because of inadequate care. In a study done in Zambia, by Turnbull , showed that it was difficult to ascertain the cause of neonatal deaths in Zambia because numerous factors conspire to make their ascertainment a challenge. In rural areas, for example, clinics are often understaffed and have inadequate systems for data collection or disease monitoring. Causes of death may be recorded without a verbal autopsy, laboratory data or clinical examination (Turnbull *et al.*, 2011). The reliability of mortality estimates depends on the accuracy and completeness of reporting and recording of births and deaths. Under reporting and misclassifications are, however, common amongst deaths occurring early in life, (Mwansa-Kambafwile *et al.*, 2010).

The transition to extra uterine and initial adaptations are crucial to the baby's subsequent wellbeing and should be understood and facilitated by the health care providers at the time of birth and after birth by giving essential new-born care (ENC). A study done in Ethiopia to assess the knowledge and practice of essential new-born care and associated factors discovered there was poor knowledge and practice on some components of essential new-born care. Level of education, interest, in-service training, and level of knowledge were found to be independent predictors of practice. Hence, strengthening of in-service training, priority should be given for those trained to give delivery and new-born care service, and incorporation of all components of essential new-born care in curriculum was recommended (Debelew *et al*., 2014), (Bereka *et al.*, 2017). Knowledge regarding new-born danger signs should be given at the time of every ANC visit and also at follow up visit after delivery to promote early health seeking behaviours that will enable early treatment to prevent new-born deaths (Lal and Research, 2019).

2.5 Summary

Literature has shown that neonatal mortality is still a problem globally. Factors that contributed to the increased neonatal mortality rates were not limited to neonatal factors but included maternal, service delivery and environmental factors. Meanwhile if every country achieves the SDG target on child survival by 2030, an additional 10 million lives of children under age 5 will be saved throughout the period 2017–2030 – about half of them will be new-borns *(*Tunçalp *et al.,* 2015) Proper care and management of labour showed to be able to prevent most of the deaths because majority of the deaths occurred in the first few days of life which has been attributed to preventable factors like neonatal sepsis, asphyxia and many more (Estimation *et al*., 2018).

However, if current trends continue many countries may fail to meet the Sustainable Development Goal (SDG) target on child survival and sadly some 60 million children under the age of five may die between 2017 and 2030 - of which half of them may be new-borns. Strategies to address neonatal survival require a multifaceted approach that encompasses health-related and other measures. Addressing short birth interval and preventing early pregnancy must be considered as interventions. Strategies to improve neonatal survival must address inequalities in neonatal mortality by women's education and region. Further reductions in neonatal deaths depend on building stronger health services, ensuring that every birth is attended by skilled personnel and making hospital care available in an emergency. Cost-effective interventions for new-born health cover the antenatal period, the time around birth and the first week of life, as well as care for small and sick new-borns (Serbanescu *et al.*, 2019).

2.6 Conceptual Framework

The conceptual framework on the causes of newborn deaths illustrates health outcomes that are determined by interrelated factors, encompassing maternal, environmental, health-care services and newborn factors, among others. These factors are defined as proximate (individual), underlying (household, community, and district) and basic (societal). All factors elaborated at different aspects influence other levels and have been put together to come up with the conceptual framework below. The framework is devised to be useful in assessing and analysing the causes of newborn mortality and morbidity, and in planning effective actions to enhance neonatal health. The framework adapted is from the UNICEF and cited studies in this document.

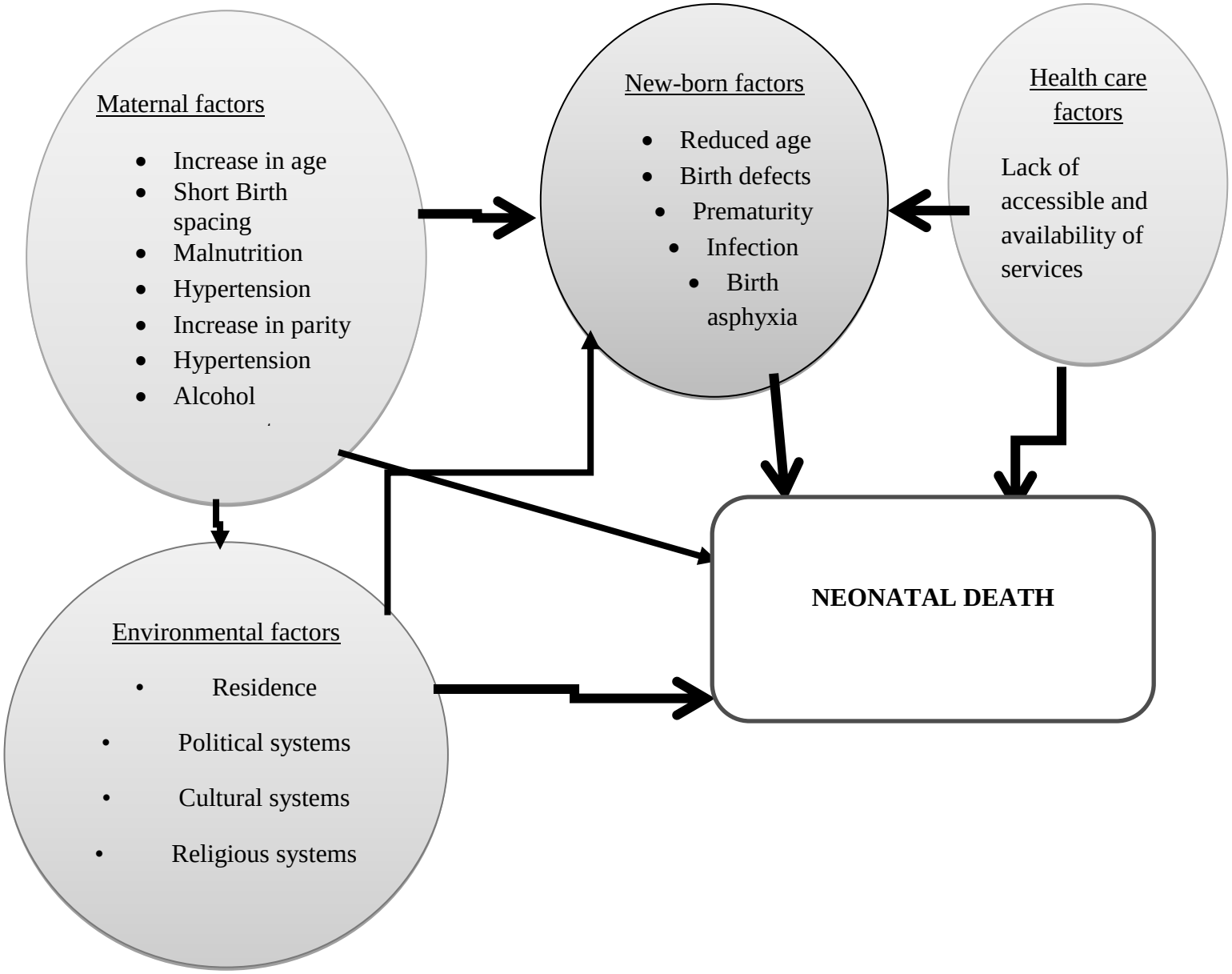
Figure 2.1 illustrates how the factors relate to cause newborn deaths. Globally is the direct result of three main causes: severe infections – including sepsis/pneumonia, tetanus, and diarrhoea – asphyxia and preterm births. They can occur at any point during the first month of life but are the main cause of neonatal death after the first week. Clean delivery practices are clearly important in preventing infection, but maternal infections also need to be identified and treated during pregnancy.

Asphyxia (difficulty in breathing after birth) causes 23% of newborn deaths and can largely be prevented by improved care during labour and delivery. The condition can be alleviated by a trained health worker who is able to detect its signs and resuscitate the newborn. Preterm birth (delivery at less than 37 weeks of completed gestation) directly causes 27 % of newborn deaths. Infants born prematurely find it more difficult than full-term babies to feed, maintain normal body temperature and with stand infection.

In addition to the direct causes of newborn mortality and there are several underlying factors at the household, community and district levels that also serve to undermine the health and survival of mothers and newborns. They include lack of education and knowledge, inadequate maternal and newborn health practices and care seeking, insufficient access to nutritious food and essential micronutrients, poor environmental health facilities and inadequate basic health-care services and limited access to maternity services – including emergency obstetric and newborn

care. There are also basic factors, such as poverty, social exclusion and gender discrimination that underpin both the direct and underlying causes of neonatal mortality

CONCEPTUAL FRAMEWORK



Source: Adapted from the UNICEF, the state of the world's children and new-born health 2009 https://www.unicef.org/sowc/[i]

FIGURE 2.1. Conceptual Framework: Relationship of factors that cause new-born deaths

CHAPTER THREE: METHODOLOGY

3.1 Study Setting

The study was conducted at the neonatal intensive care unit (NICU)-women and newborn hospital, University teaching hospital, Zambia. It is the largest tertiary hospital and main referral health institution in Zambia. The University Teaching Hospital is located in the capital city of Lusaka approximately 4km to the east of the city centre and has five hospitals. These are: children hospital, adult hospital, eye/ear hospital, cancer disease hospital and the women and new-born hospital where the study was done.

3.2 Study design

This study was a cross-sectional study. Data for all the neonatal admissions reported in the data bases and case files were extracted at the Neonatal Intensive Care Unit from January 2018 to December 2019.

3.3 Study Population

The study population were newborn babies admitted at Neonatal Intensive Care Unit (both discharges and deaths) between 2018 January to December 2019. All the neonatal admissions reported in the data bases at Neonatal Intensive Care Unit were analysed. The cases of the deaths of all the babies that were born live and died within 28 days of life were analysed.

3.4 Inclusion Criteria

Complete enumeration of the data found at the facility on all babies born alive and died within 28 days of life, period from January 2018 to December 2019 were used as study participants.

3.5 Exclusion Criteria

All files with missing and incomplete data of those in the sample was excluded from the study.

3.6 Sample size and sampling methods

A Complete enumeration of all reported cases of neonates admitted at NICU-women and new-born hospital-UTH (all cases in the period under review) during the period of January 2018 to December 2019 were used. Through the case files data was extracted for both alive and died.

However, sample size calculation done manually using the formula below, could have been used as per study requirement**.**

- Formula n = $\frac{Z^2 p(1-p)}{e^2}$
- Used sample size for prevalence.
- Prevalence of 0.27 % (Zambia Statistics Agency - ZSA et al., 2020).
- Confidence interval 95% CI
- Z-1.96 from normal distribution $n = \frac{1.96^2 0.27(1-0.27)}{0.05^2}$
- Alpha level set at 5%. $n = \frac{3.8*0.27(0.73)}{0.0025}$
- Margin error 5%
- P = Prevalence $n = \frac{0.74898}{0.0025}$
- n = Sample size n = 299.592 = 300
- Sample size minimum = 360 considering no response at 20%

=20/100 * 300

= 60 +300 = 360

The above sample size gives a power of about 80%, however a complete enumeration was used to improve substantial power to above 80% which increases the accuracy of the predictions. Total complete files extracted from the two-year admissions were 2340.

3.7 Sources of data

The source of the data were the medical files, registers, and reports at Neonatal Intensive Care Unit department. The data was obtained in a process which began from registry to the ward. Patient medical files were incorporated in the Health Management Information Systems records and the data collected in weekly reporting tools then later aggregated in the monthly and quarterly Health Management Information System tools. The case files contained information on the neonate's individual characteristics including age, sex, diagnosis, and mode of separation i.e.,

alive or died. The clerk's data submits reports to the Hospital information systems officer who are the custodians of case files.

3.8 Data extraction and tools

Data was extracted from all reports and case files found at Neonatal Intensive Care Unit data department from January 2018 to December 2019. The causes of deaths were analysed with respect to clinical information in the files. There was an ongoing multidisciplinary consultation with the information managers, ward in charges and staffs at different levels at Neonatal Intensive Care Unit to verify the data. A data extraction tool was developed to extract relevant information from the data bases. To Ensure validity and reliability data from the medical files and registers both admissions and discharges were compared. The data extracted was used to identify key characteristics of all the neonates used as participants in this study. Data was then coded entered and stored in Microsoft excel then exported to Stata for analysis.

Table 3.1: Variables for factors contributing to neonatal mortality

Type of Variable	Variable	Indicator	Scale
Dependent	Neonatal Mortality	Number of deaths	Count
Independent	Age of the neonate	The age at death	Continuous
	Sex	0.Male 1.female	Nominal
	Reported cause of death	Direct or indirect cause of death of the newborn 1.Sepsis 2.Pneumonia 3.Aspyxia 4. Prematurity 5.Injuries 6. Other causes	Nominal
	Place of delivery	1.Hospital 2.Health centre 3. Home	Nominal
	Gestational age	Gestational age at birth	Continuous
	Mode of delivery	1.Normal delivery 2. Assisted delivery 3.cesarean section	Nominal
	Residence	1.Towns in Lusaka 2. Outskirts of Lusaka 3.Outside Lusaka	Nominal
	Age of mother of the neonate	The age of the mother at birth of the neonate	Continuous
	Maternal Parity	The parity of the mother at birth 1.1-2 2.3-4 3.>5	Count
	Maternal HIV status	1.negative 2.positive	Binary
	Time period of months monthly differences in neonatal deaths	January, February, March April, May, June July August September, October November, December	Discrete

Source: Adapted from the UNICEF, the state of the world's children and new-born health 2009 https://www.unicef.org/sowc/[ii]

3.9 Data collection

Data was collected from departmental, reports, case files and registers. A structured data collecting tool was used to enable the researcher collect data from the records within the stipulated period of time since it was secondary data. Data was collected on a total enumeration basis from the data base on neonatal admissions and case files.

3.10 Data processing and analysis

The data collection tools were used to collect all the data needed. Data stored in excel then cleaned and exported to Stata.The data was then checked for completeness and accuracy by ensuring that, the information answers and addresses all the questions in the data collection tool. Responses were categorized using statistical measuring scales, coded and entered on the data master sheet for easy analysis Data was destringed, entered and analysed in STATA version 14.2 College Station, Texas 77845 USA.

Preliminary data analysis involved description of predictor variables to understand their distribution in relation to dependent variable (neonatal death) through tabulations. In descriptive statistics, median and interquartile range were reported for age of the neonate, gestation at birth, birth weight, maternal age, number of pregnancies and parity. Shapiro-wilk w test for normal data test was used to test the data for skewness of all continuous variables and count variables. The Man-Whitney test was done to check for comparison differences in continuous data and chi-square test was used to check for associations on all categorical data. If the assumptions for the chi-square test have been violated a non -parametric test (fisher s exact) would have been used.

Neonatal mortality rate among the neonates admitted to NICU was calculated using WHO standard of calculation, that is the number of deaths during a certain time interval divided by total number of live births per 1000, the live births in this study were the neonates who were admitted at the unit and excel was used to check the trends over the years in months assuming all the assumptions for the model were met which included Trend should have at least 3 data points, Ttrends should move in the same direction, trend data line graphs do not over lap and trends are repetitive. Both univariate and multivariable logistic regression were done to describe the

relationship between the dependent variable ‘new-born deaths’ with the selected predictor variables with adjusted odds ratios (AOR) at 95% confidence intervals (CI). An investigator lead backwards regression was used according to literature on neonatal deaths and goodness of fit was used to check for the best fit model.

3.11 Ethical considerations

Permission to use data collected routinely at NICU was sought from the Ministry of Health for analysis. Confidentiality was maintained as this data was restricted. Approval was from the University of Zambia Biomedical Research Ethics Committee (Ref. No 244 2019) as there was no contact with the actual individuals. Permission was also sought from the Zambia national research authority who approved the research to be conducted. The data was stored as encrypted files on all computers to prevent access, accidental loss, or destruction. The data will be kept safe for as long as it is necessary for this research purpose only

3.12 Plans for dissemination of findings

The findings of the study were presented at the Graduate forum, disseminated in a report to University of Zambia School of public health and ministry of health as it is one of the key research topics. The results of the study will also be presented through a Policy brief to policymakers and Ministry of Health officials. These results might be disseminated via poster presentation in a local conference and through publication in a Biomedical central (BMC) peer-reviewed journal

CHAPTER FOUR: RESULTS

This chapter presents findings of the study. The main objective of the study was to investigate the trend and factors associated with new-born deaths at neonatal intensive care unit (NICU) women and new-born hospital-UTH, Zambia over the past two years (2018-2019). The Specific objectives were to establish the prevalence of neonatal deaths, to assess the trends in neonatal deaths at monthly for each year and to determine the associated factors in neonatal deaths.

4.1 Descriptive demographic Characteristics of the Mothers and Neonates

There was a total of 7581 admissions, and 2340 complete charts for the neonates were used in the study. The median age of the neonates was 4 days (IQR 2-7) while the median gestational at birth was 36 weeks (IQR 30 - 37). The median birth weight was 2400g (IQR 1500 - 3000). The median maternal age was 25yrs (IQR 21 - 31) while median number of pregnancies for the mothers was 2 (IQR 1 - 4) and the median maternal parity 2 (IQR 1 - 3). In the study there 1,223 (52,26 %) male and 1117 (47.74%) female neonates. Of these, 1400 (59.83%) were discharged alive and 940 (40.17%) were discharged dead. Among the neonates 2134 91.07%) were delivered at the hospital, 104 (4.44%) health centres and 105 (4.49%) at home shown in Table 4.1.

Table 4.1 Basic Characteristics of The Mother and Neonates

Variable		Median/IQR
Age (days)*		1 (2, 7)
Gestational age (weeks)*		36 (30, 37)
Age of Mother(years)*		25 (21, 31)
The number of pregnancies*		2 (1, 4)
Number of children*		2(1, 3)
	Category	**Frequency (%)**
Sex	Male	1,223 (52.26%)
	Female	1,117 (47.74%)
Place of Birth	Hospital	2,134 (91.07%)
	Heath centre	104 (4.44%)
	Home	105(4.49%)
Status	Alive	1,400 (59.83%)
	Died	940 (40.17%)
Type of Birth	Single	2,235 (95.51%)
	Twin	105 (4.49%)
Mode of Delivery	Assisted Breech Delivery	50 (2.14%)
	Caesarean- Section	328 (14.02%)
	Spontaneous Vaginal Delivery	1,949 (83.29%)
	Vacuum-assisted Vaginal Delivery	13 (0.56%)
Maternal HIV Status	Known Negative	1,784 (76.24)
	Known Positive	387 (16.54 %)
	Unknown	169(7.22%)
Attended Antenatal Care	No	220 (9.40%)
	Unknown	154 (6.58%)
	Yes	1,966 (84.02%)
Condition	Mono – condition	598(25.6%)
	Co-conditions	1742(74.4%)

*The median and Interquartile range were reported. Shapiro-Wilk W test for normal data test was used to test the skewness of all continuous variables and count variables

4. 2 Description of primary diagnosis in the Neonates

The common findings for primary diagnosis in the neonates were prematurity 624 (26%), birth asphyxia 533 (22.78%) and the sepsis 338 (15.30%) while the least was jaundice 79 (3.38%), hypothermia 61 (2.6%) and hypoglycaemia 38 (1.62%) as shown in figure 4.1 and table below.

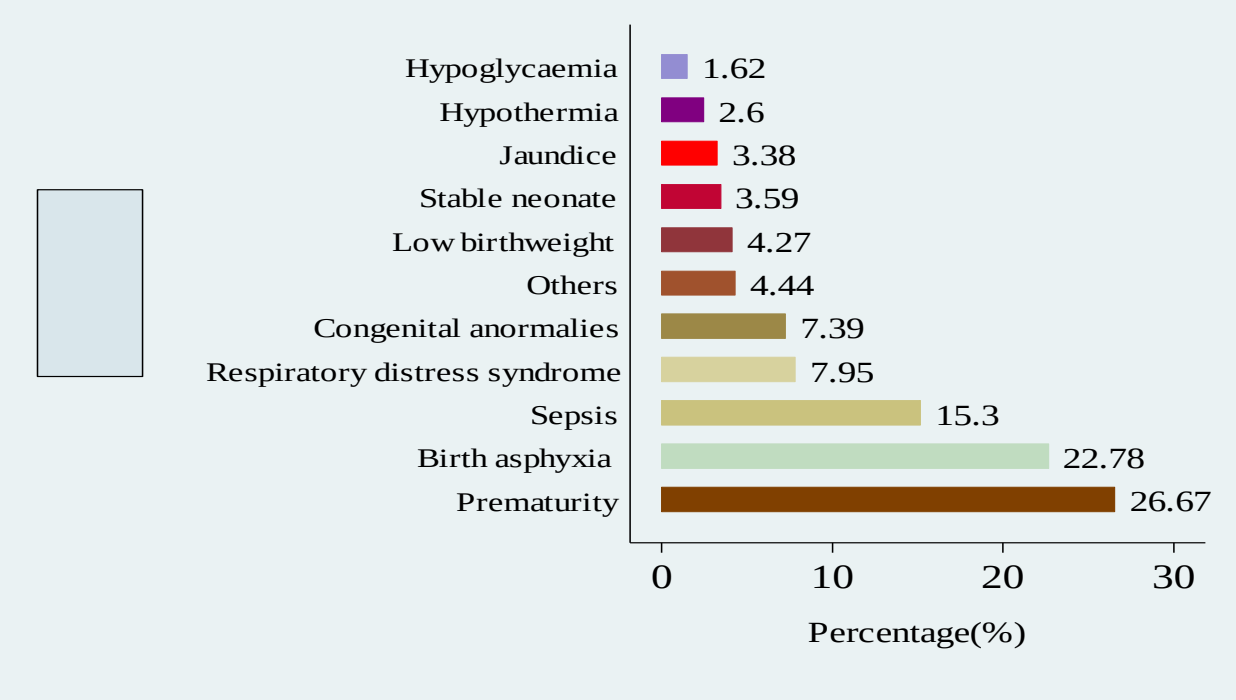


Figure 4.1 primary diagnosis in the neonate

Condition	Number of cases	Percentage (%)
Prematurity	624	26.67 %
Birth asphyxia	533	22.78 %
Sepsis	338	15.3 %
Respiratory Distress Syndrome	186	7.95 %
Congenital anomalies	173	7.39 %
Others	104	4.44 %
Low Birth weight	112	4.27 %
Big for dates / stable neonates	100	3.95 %
Jaundice	71	3.38 %
Hypothermia	61	2.62 %
Hypoglycemia	38	1.6%
Total	**2340**	**100%**

4.3 Description of Secondary diagnosis in the Neonates

The results shows that most of the neonates diagnosed with co-conditions had sepsis 430 (18.4%), births asphyxia 390 (16.7%), respiratory distress syndrome 359 (15.3%) as a secondary diagnosis while the lowest were low birth weight 142 (6.1%), congenital anomalies 103 (4.4%) jaundice 70 (3.0%) as shown in figure 4.2 and table below

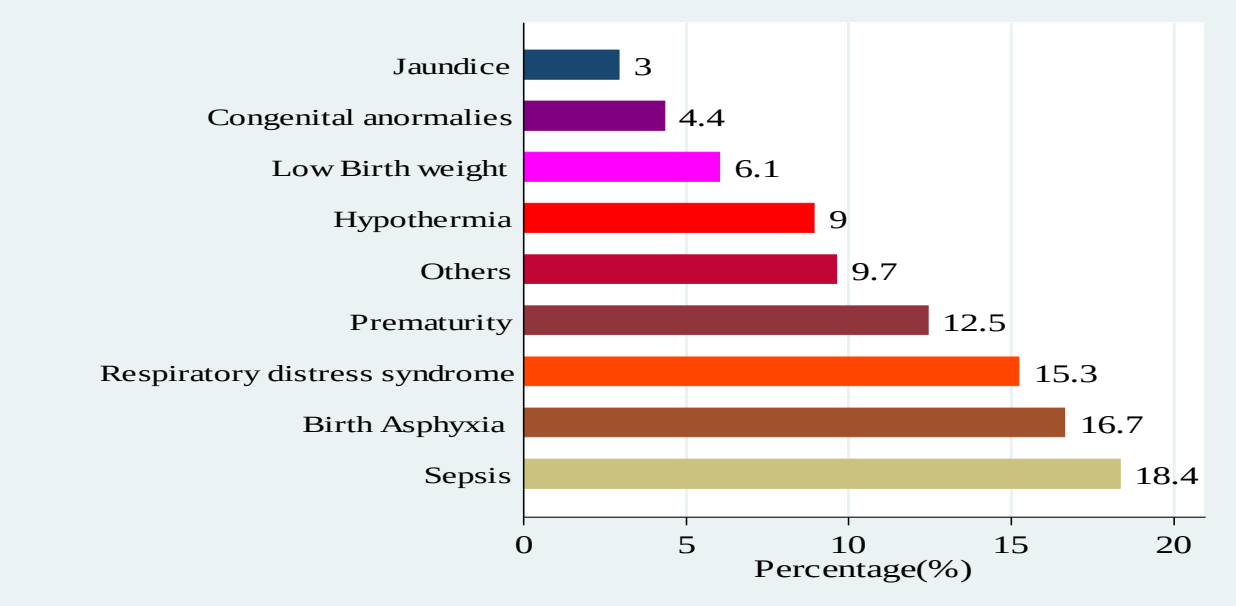


Figure 4.2 Secondary diagnosis in the neonates

Secondary Condition	Number of cases	Percentage (%)
Sepsis	430	18.4 %
Birth Asphyxia	390	16.7 %
Respiratory Distress Syndrome	359	15.3 %
Prematurity	292	12.5 %
Others	227	9.7 %
Hypothermia	210	9 %
Low Birth weight	142	6.1 %
Congenital anormalies	103	4.4 %
Jaundice	70	3 %
Total	2,233	95%

A total of 95 % had secondary diagnosis whilst 5% had only primary diagnosis

4.4 Comparisons and Association between baseline characteristics of the neonates and neonatal mortality

In the study, 1400 (59.83%) neonates were alive and 940 (40.17%) died. When comparison of neonatal ages between those that were alive and those that died was made, those who were alive were significantly older than those that died. The median age for neonates that were alive was 5 days (IQR 3 - 8) and the those that died was 2 days (IQR 2- 5) with the p-value <0.0001. Wilcoxon rank-sum (Mann-Whitney) test was used to test the data for skewness as shown in figure 4.3 below.

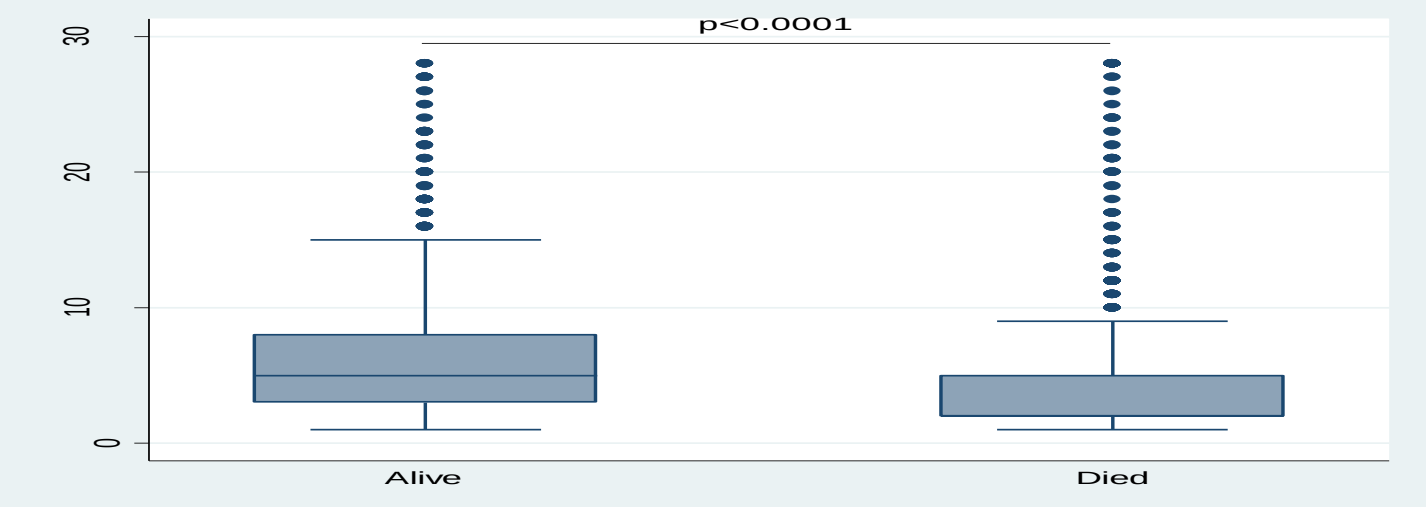


Figure 4. 3 Box plot of Association between Age of neonates that were discharge alive and those that were discharged dead.

Comparing the baseline characteristics for those that were discharged alive , to those that died, those discharged alive had a significantly older gestational age than those that died. The median gestational at birth for neonates that were discharged alive was 36 weeks IQR (33, 38) and those that died was 32 weeks IQR (28, 36). When the birth weight for the alive was compared to those that died, there was significant evidence of a difference as the alive had increased birthweight compared to those that died, 2700g, IQR (2000 - 3200g) while those that died was 1500 IQR (1000 - 2600g) p<0.0001. Most of the admissions of neonates who died came from Kanyama as shown table 4.2 below.

Table 4.2 Comparison and Association between baseline characteristics and neonatal mortality

Variable		Total sample=2340	
Neonatal status	**Alive** N=1,400 (59.83%)	**Died** N=940 (40.17%)	**P=value**
Gestation at Births (weeks)*	36 (33 - 38)	32 (28 - 36)	<0.0001
Birthweight (grams)*	2700 (2000 - 3200)	1500 (1000 - 2600)	<0.0001
Mother's ages, (years)*	25(21-30)	25(21,32)	0.1603
Number of pregnancies*	2 (1- 3)	2 (1-4)	0.9916
Number of Children*	2 (1-3)	2 (1- 3)	0.1948
Sex**			
Male	758 (62.0%)	465 (38.0%)	
Female	642 (57.5%)	475 (42.5%)	0.026
Place of Birth **			
Hospital	1,321 (61.9%	813 (38.1%)	
Health centre	45 (44.2%)	57 (55.9%)	
Home	34 (32.7%)	70 (67.3%)	<0.0001
Mode of delivery**			
Spontaneous vaginal delivery	1228 (63.4)	709 (36.6%)	
Caesarean section	166 (48.7%)	175 (51.3%)	
Breech vaginal delivery	5 (10.2%)	44 (89.8%)	
Vacuum vaginal delivery	1 (7.7%)	12 (92.3%)	<0.0001
Delivered By **			
Midwife	1197 (63.7%)	682 (36.3%)	
Doctor	168 (47.1%)	189 (52.9%)	
Unskilled	35 (33.7%)	69 (66.3%)	<0.0001
Residence**	245 (58.3%)	175 (41.7%)	
Chipata	241 (57.1%)	181 (42.9%)	
Kanyama	222 (67.5%)	107 (32.5%)	
Chilenje	207 (64.3%)	115 (35.7%)	
Chawama	155(71.1%)	63(28.9%)	
Chelstone	142(55.7%)	113(44.3%)	
Outskirts	139(52.7%)	125(47.3%)	
Matero	49(44.5%)	61(55.5%)	<0.0001
Outside_Lusaka			

Table 4.2 Comparison and Association between baseline characteristics and neonatal mortality

Common Conditions in Neonates **			
Prematurity	183 (29.3%)	441(70.7%)	
Birth asphyxia	297(55.7)	236(44.3%)	
Sepsis	288(80.5%)	70(19.5%)	
Respiratory distress syndrome	116(62.8%)	70(37.6%)	
Congenital anomalies	108(62.4%)	65(37.6%)	
Others	75(72.1%)	29(27.9%)	
Low birthweight	94 (94.0%)	6(6.0%)	
Stable neonate	84(100%)	0(0%)	
Jaundice	72(91.1)	7(8.9%)	
Hypothermia	51(83.6)	10(16.4%)	
Hypoglycaemia	33(86.8%)	5(13.2%)	<0.0001
Second Diagnosis on neonates**			
Sepsis	295(68.6%	135(31.4%)	
Birth Asphyxia	176(45.1%)	214(54.9%)	
Respiratory Distress Syndrome	137(38.2%)	222(61.8%)	
Prematurity	162 (55.3%)	131(44.7%)	
Others	158 (69.9%)	68(30.1%)	
Hypothermia	109 (51.9%)	101(48.1%)	
Low Birth weight	132 (93.0%)	10(7.0%)	
Congenital anomalies	68 (66.0%)	35(34.0%)	
Jaundice	58(82.9%)	12(17.1%)	
Stable Neonates (well babies)	61 (100%)	0(0.0%)	
Hypoglycaemia	45 (80.4%)	11(19.6%)	<0.0001
Conditions**			
Mono-condition	420(70.2%)	178(29.8%)	
Co-conditions	981(56.3%)	761(43.7%)	<0.0001

* The median and Interquartile range were reported for continuous variables and Man-Whitney test for comparisons differences

** chi-square test was used to check for associations on all categorical data

4.5 Neonatal mortality at NICU-Women and New-born Hospital University Teaching Hospital, Zambia

The overall neonatal mortality rate among neonates admitted to NICU Women and New-born hospital for the two years (2018, 2019) was 318 deaths per 1000 live births as shown in the table. The results show evidence of a difference in the neonatal mortality rates between the two years. 2019 had the highest mortality rates of 366 per 1000 live births while 2018 had 272 per 1000 live births or admissions.

Table 4.3 Crude Neonatal mortality rates for NICU-mother and new-born hospital-UTH (2018-2019)

Year	Discharged alive		Died		
	Total discharges	Percentage (%)	Total deaths	Rate per 1000 admissions	Percentage (%)
2018 (**N=3867**)	2815	72.8%	1,052	272	27.2%
2019 (**N=3714**)	2356	63.4%	1,358	366	36.6%
Cumulative (**N=7581**)	5171	68.2%	2,410	318	31.8%

P-value <0.0001*these calculations are based on institutional data only for the neonates admitted to NICU for the two years. The calculation was done using the world health standard of number of deaths divided by the total number of live births for the given period of time per 1000. And the live births in this situation were the total number of live admissions.

4.6 The Trends in New-Born Deaths at NICU-Women and New-born Hospital –University Teaching Hospital monthly for each Year (2018 To 2019)

The figure below shows that the trends in discharges and deaths were similar for the two years and number of deaths have remained relatively similar overtime. There was a spike in case fatality rates for 2019 compared to 2018. The fatality rate to 2019 reached as high as 76.3% while for 2018 it went down to 35.8.

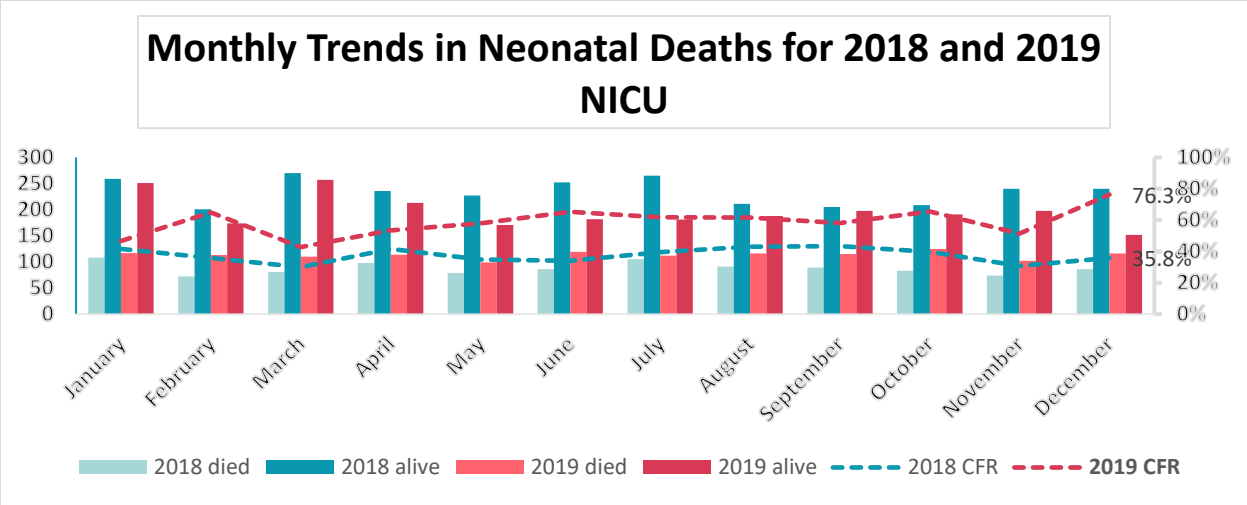


Figure 4.4 Trends in neonatal Deaths from January 2018 to December 2019

4.7 Factors associated with Neonatal mortality at NICU – Women and New-born Hospital, University teaching Hospital

When univariate logistic regression analysis was conducted, an increase in the age of the neonate (days), had 8% reduction in dying (COR= 0.92, 95% CI [0.92,0.94], p<0.0001) while the increase in the number of children increased the risk of neonatal deaths by 94% (COR=1.06, 95% CI [1.00,1.11] p= 0.042). Interestingly the gestational age was associated with reduced odds of new-born deaths (COR= 0.82,95% CI [1.02,1,42], p<0.0001). Prematurity as a primary diagnosis compared to birth asphyxia increased the odds of new-born death three times (97%), (COR= 3.03, 95% CI [2.38,3.87], p<0.001. Birthweight, positive HIV status, place of birth, mode of delivery and some residences were found to increase the odds of neonatal deaths.

At multivariate logistic regression one day increase in the age of the neonate was associated with reduced odds by about 8% (AOR=0.92, 95% CI [0.92,0.94], p<0.0001) likelihood of neonatal death compared to a smaller number of days. An increase in the number of pregnancies was associated with 20% reduced odds of new-born deaths (AOR:0.80,95% CI [0.66,0.98] p = 0.022) and 73% the increase in the number of children was associated with an increased odds of new-born deaths (AOR= 1.27 95% CI [1.04,1,55], p=0.016). Gestational age, Birthweight, place of birth, mode of delivery and some residences were found to associated neonatal deaths

Table 4.4: univariate and multivariate logistic regression analysis of the outcome (Died) with independent variables

	CRUDE			ADJUSTED		
Predictor	OR*	p-value	95%CI*	OR*	p-value	95%CI*
Age Neonate	0.92	<0.001	(0.90, 0.94)	0.92	<0.001	(0.90,0.94)
Sex						
Male	Ref					
Female	1.20	0.030	(1.02, 1.42)	0.99	0.854	(0.78,1.23)
Gestation age at birth	0.82	<0.001	(0.81, 0.84)	0.94	0.004	(0.90,0.98)
Birthweight	1.00	<0.001	(1.00, 1.00)	1.00	<0.001	(1.00, 1.00)
Number of pregnancies	1.02	0.446	(0.97,1.073)	0.80	0.022	(0.66, 0.97)
Number of Children	1.06	0.042	(1.00, 1.11)	1.27	0.016	(1.05,1.55)
HIV status						
Negative	Ref					
Positive	1.44	<0.001	(1.56, 1.80)	0.96	0.803	(0.79, 1.31)
Unknown	1.19	0.277	(0.87, 1.64)	1.15	0.613	(0.69,1.87)
Place of Birth **						
Hospital	Ref					
Health centre	2.06	<0.001	(1.38, 3.08)	2.66	<0.001	(1.55 .4.57)
Home	3.35	<0.001	(2.20, 5.10)	2.43	0.979	0
Mode of Delivery**						
SVD						
C-Section	Ref					
Breech-VD	1.83	<0.001	(1.45, 2.31)	1.74	0.659	(0.15,20.44)
Vacuum-VD	15.28	<0.001	(6.03,38.7)	5.56	0.002	(1.83,16.54)
	20.83	0.004	(2.70, 160.5)	64.36	0.010	(2.71, 1528.11)
Multiple Birth						
No	Ref					
Yes	3.28	<0.001	(2.16, 5.00)	0.99	0.983	(0.57, 1.74)
Delivered by						
Midwife	Ref					
Doctor	1.98	0.001	(1.58, 2.49)	2.33	0.497	(0.20,26.86)
Unskilled	3.47	0.001	(2.28, 5.26)	0.00	0.981	0

Table 4.4: univariate and multivariate logistic regression analysis of the outcome (Died) with independent variables

Antenatal Attendance						
Yes	Ref					
No	2.73	<0.0001	(2.04, 3.65)	2.35	<0.0001	(1.56, 3.55)
Unknown	0.39	<0.0001	(0.26. 0.59)	0.19	<0.0001	(0.12, 0.33)
Residence						
Chawama	Ref					
Chelstone	0.73	0.099	(0.50, 1.06)	0.67	0.115	(0.41, 1.10)
Chilenje	0.86	0.347	(0.62, 1.18)	0.66	0.068	(0.42, 1.03)
Chipata	1.29	0.100	(0.95, 1.73)	0.93	0.740	(0.62, 1.40)
Kanyama	1.35	0.048	(1.00, 1.82)	1.14	0.532	(0.76, 1.70)
Matero	1.62	0.004	(1.16, 2.26)	1.11	0.647	(0.70, 1.78)
Outskirts (Chilanga, Mwembeshi, Kafue, Chongwe and Chirundu)	1.43	0.036	(1.02, 2.00)	1.19	0.463	(0.75, 1.87)
Outside Lusaka (other provinces**)**	2.24	0.001	(1.44, 3.48)	1.68	0.075	(0.95, 2.98)
Second Diagnosis						
Birth asphyxia	Ref					
Congenital anomalies	0.42	0.001	(0.27, 0.67)	0.79	0.472	(0.41, 1.51)
Hypoglycaemia						
Hypothermia	0.20	0.001	(0.10, 0.40)	0.25	0.002	(0.11, 0.60)
Jaundice	0.76	0.113	(0.54, 1.07)	0.32	0.001	(0.19, 0.54)
Low birthweight	0.17	0.001	(0.08, 0.32)	0.24	0.001	(0.11, 0.53)
Prematurity	0.06	0.001	(0.03, 0.12)	0.03	0.001	(0.01, 0.08)
Respiratory distress	0.67	0.009	(0.49, 0.90)	0.20	0.001	(0.11, 0.34)
syndrome	1.33	0.054	(0.50, 1.78)	0.63	0.046	(0,40, 0.99)
Sepsis						
Others	0.37	0.001	(0.28, 0.50)	0.41	0.001	(0.27, 0.61)
Stable neonate	0.35	0.001	0.25, 0.50)	0.34	0.001	(0,21, 0.55)
	1			1		
Conditions						
Mono-condition	Ref					
Co-conditions	1.83	0.001	(1.50, 2.23)	1.22	0.263	(0,86, 1. 71)

*OR- odds ratio, CI -confidence interval

** some variables had wider confidence interval but was checked for variance inflation factor and multiple collinearity and could be due to big differences in variable frequencies

4.8 Adjusted logistic regression for the best predictor model for factors associated with neonatal deaths

An investigator lead backwards regression was used and goodness of fit was used to check for the best fit model (Hosmer-Lemeshow chi2=13.90, P =0.0845). In the model it was noted that one-day increase in age of the neonate predicted less chance of neonatal deaths (AOR=0.92, 95% CI [0.91- 0.94] p <0.0001) taking account of gestational age, parity, antenatal attendance, place of birth, mode of delivery and primary diagnosis. A unity increases in parity had an increased chance of having neonatal death by 1.09 which could be as low as 1.02 and as high as 1.16.(p= 0.0013), controlling for all variables in the model. Mothers who did not attend antenatal care had an increased chance of having their neonates dying compared to those who attended antenatal services (AOR=2.09, 95% CI [1.46 – 2.99] p<0.001), controlling for all variables in the model. Delivering from home, complicated delivery i.e. Cesarean-section vacuum or breech all increased the chances of having neonatal deaths controlling for all variables in the model. One-unit increase in gestational age had less chance of having neonatal death taking into account all the variables in the model. Being diagnosed with prematurity as compared to birth asphyxia had increased odds of neonatal death even though a possibility of chance finding could be there (AOR: 1.12, 95% CI [0.80 – 1.56] p=0.502), while all the other diagnoses had reduced chances of neonatal death compared to sepsis controlling for all variables in the model.

Table 4.5 The best predictors model logistic regression for factors associated with new-born deaths.

	Adjusted		
Predictor	OR	p-value	95%CI*
Age of neonate in days	0.92	<0.0001	(0.91,0.94)
Gestational Age	0.84	<0.0001	(0.81, 0.87)
Parity	1.09	0.013	(1.02,1.16)
Antenatal Attendance			
Yes	Ref		
No	2.09	<0.0001	(1.46,2.99)
Unknown	0.24	<0.0001	(0.15, 0.38)
Place of Birth			
Hospital	Ref		
Health centre	2.86	<0.0001	(1.77,4.72)
Home	2.67	<0.0001	(1.61, 4.44)
Mode of Delivery			
SVD	Ref		
C-section	3.10	<0.0001	(2.31,14.16)
Breech VD	8.30	<0.0001	(2.92,23.60)
Vacuum delivery	37.09	0.001	(4.43, 310.30**)
Primary Diagnosis			
Birth asphyxia	Ref		
Congenital anomalies	0.70	0.075	(0.48,1.04)
Hypoglycaemia	0.19	0.002	(0.07,0.55)
Hypothermia	0.16	<0.0001	(0.07,0.36)
Jaundice	0.15	<0.0001	(0.06,0.34)
Low birthweight	0.49	<0.0001	(0.02,0.12)
Prematurity	1.12	0.502	(0.80,1.56)
Respiratory distress syndrome	0.55	0.003	(0.37,0.82)
Sepsis	0.30	<0.0001	(0.21,0.42)
Others	0.53	0.013	(0.31,0.87)

*CI-Confidence interval, OR- odds ratio

** the wide confidence interval in vacuum delivery was due to the very large differences in numbers between those that were delivered via SVD and Those who delivered via Vacuum delivery in the sample

CHAPTER FIVE: DISCUSSION

The study aimed at investigating the trends and factors that are associated with increased neonatal mortality amongst neonates admitted to Neonatal Intensive Care Unit Women and Newborn Hospital, UTH Zambia over the past two years (2018-2019). In this study Neonatal mortality among the admission was significantly high. According to findings of this study, the overall neonatal mortality among the admitted neonates was higher than the findings of a Ghanaian study that had an overall neonatal mortality at 20.2% (Owusu *et al*., 2018). The reason could be due to the high levels of prematurity which was 26.6 % of all the deaths. In a hospital-based study conducted in Ethiopia , the hospital Neonatal Mortality was 5.7% which was much lower than our findings (Elmi Farah *et al*., 2018). Similarly , mortality percentages were still lower than the findings in the current study in studies conducted in Ghana 16.0% (Walana *et al*., 2016), northern Nigeria 16.9% (Mukhtar-Yola and Iliyasu, 2007), Ethiopia at University of Gonder 14.3% , Felege hiwot referral hospital 13.29% and India 11.41% (Demisse *et al.,* 2017, Tewabe *et al.,* 2018, Kumar *et al*., 2019) . This is unacceptably high and might be regarded as one of the contributors to the country's high neonatal mortality rate that showed a 3% increase from 24 deaths per 1000 live per for 2013-2014 Demographic Health Survey to 27 per 1000 live births for the 2018 Demographic Health Survey. World Health Organization targets to reduce neonatal mortality to as low as 12 deaths per 1000 live births according to the Sustainable Development Goals of 2030 targets. Although different researches like that by Hadgu, the lancet collaborators and Owusu have documented evidence that show higher mortality percentages in male than female neonates this study found no significant evidence of the differences, this could be attributed to large differences in samples sizes between the two sexes (Hadgu *et al*., 2020, Collaborators, 2010, Owusu *et al*., 2018).

Taking a glimpse at the graphs of the trend data, it revealed a relatively similar trend in neonatal deaths over the two years. But the case fatality rate was higher for 2019 ending at 76.3% in December 2019 compared to 35.8% for December 2018. This implies an upward adjustment in trends in neonatal deaths for the facility. This increase in the trends might be due to an increase in neonatal admission for the year 2019 or the severity of the cases like increase in prematurity. According to a Tanzanian study the Overall, the neonatal mortality trend demonstrated an apparent stagnation during the 10-year period, with similar patterns observed in 2006–2010 and 2011–2015 despite interventions instituted during the early 2010s (Mangu *et al*., 2021). The

findings in this study indicated clearly that the number of hospital neonatal deaths continued unabated despite the implementation of various interventions like helping the baby breath, , centralized management, and trainings for newborn care (Carlo *et al*., 2010, Mistry *et al*., 2018). In another study the findings indicated no significant decline was observed in neonatal mortality trends in the study period (Gizaw *et al.*, 2014). These signifies the need to move our attention to ways to improve the interventions to achieve the desired pattern of improved trends in neonatal deaths in hospitals which could spill over to help improve neonatal survival and overall attain neonatal mortality goals. In another study at a neonatal intensive care unit in Tehran, Iran, they found that mortality rate was decreasing year by year (Jaberi Zahra *et al*.,2013). Hence there is urgent need for the responsible health personnel to share notes with such facilities to help find lasting solutions to health in attaining the much-needed reduction in neonatal mortalities.

The study also showed that there are several factors that play a role in the huge crude neonatal mortality rates although it is understood that the neonates admitted to the specialized facilities are already having major challenges. The factors associated to neonatal mortality at NICU women and newborn hospital found in this study included: early neonatal age, premature labour, or low gestational age, increase in parity, birthweight, mode of delivery like vacuum deliveries, place of delivery like home, who assisted in the delivery like unskilled birth attendants and diagnoses like prematurity, birth asphyxia and sepsis. These finding were like a study in Zambia by Lukonga were common causes of neonatal mortality in Zambia were sepsis, birth asphyxia, and prematurity/low birth weight and most of these deaths occur within the first 24 hours of life (Lukonga and Michelo, 2015). It seems that the interventions such emergency obstetric care (EMOC), helping the baby breath and other related health messages being implemented over the years have not done much in reducing the burden of neonatal mortality at the highest referral in Zambia.

Neonatal mortality at NICU-women and new-born Hospital University Teaching Hospital, Zambia

The study findings showed that the overall neonatal mortality among the neonates admitted to NICU-women and new-born hospital was high and there was an upward adjustment in the mortality levels when data for the two years was compared. These findings were higher that the findings reported in Felege Hiwot referral hospital in Ethiopia which was at 13.29% (Tewabe *et*

al., 2018). However, the results were similar to Mauritanian study that revealed an extremely high neonatal mortality with more than 1/3 of neonates dying (Weddih *et al*., 2019). Similarly a survey on the global neonatal mortality by Saleem et al, found that neonatal deaths had increased to 46% , from 41% in 2000 (Safari *et al*., 2018). These variations might be attributed to differences in methodologies among studies and dissimilarities in socio cultural, health service utilization and economical variations among study participants of the study areas. While the results of this study might not reflect the national neonatal mortality rates and cannot be compared to the national neonatal mortality rates, they give some insights of where the problem is, which could be masked if we only consider the national neonatal mortality rates. The results are giving a glimpse of where the major contributors to the high neonatal mortality rates are although the neonates in this study were admitted due to health challenges. The differences in percentages of neonatal death for two year gives a direction of interventions currently being implemented including the creation of the mother and new-born for purposes of decentralisation. There is the need for continuous attention and interventions to help reduce the risk of mortality among neonates admitted to the facility. The higher cases of neonatal mortality in this study could be attributed to the referrals systems and the challenges from the community as most of the neonates are admitted to the unity had prematurity with gestational age as low as 24 weeks which makes their chances of survival to be low. Hence there is need to ensure that these neonatal conditions such as prematurity are prevented through prenatal strategies such as antenatal care, including planed pregnancies which could help mothers to prepare for the baby to reduce on case of prematurity. There might still be delays in referral of mothers who are in labour with complications or neonates that presents with condition that need referral. On the other hand, this might be due to the transportation systems of the referred cases to the main highest referral hospital.

The results in this study might also project to Zambia's need to intensify on strategies aimed at improving care of new-borns as it might fail to meet ministry of health legacy goal no one: *To reduce maternal and neonatal mortality. The target for neonatal mortality is to reduce to as low as 10/1000live births by 2021* and the sustainable development goals of 2030 *to reduce neonatal mortality rate to as low as 12 per 1000 live births.*

5.2 The Trends in neonatal mortality at NICU- women and new-born Hospital University Teaching Hospital

Trend analysis is a useful tool in showing the direction of the interventions that have been put in place to reduce the burden of neonatal mortality. The study indicated a relatively similar trend overtime in neonatal mortality among neonates admitted to NICU. However, the case fatality rate was higher for 2019 at 76.3% in December 2019 compared to 35.8% for December 2018. Similarly, studies conducted in 23 countries in sub-Saharan Africa, results revealed that the number of neonatal deaths did not decline from 1990 to 2017 even though the rates of neonatal mortality fell over the same period (Hug *et al*., 2019). Similar to our findings though involving a long period of time, an in-hospital neonatal mortality recorded in Tanzania demonstrated an apparent stagnation during the 10-year period (Mangu *et al.,* 2021). This showed that the neonatal survival indeed needs more concerted efforts to meet the intended reductions. In contrast, the findings of a study in Ghana on trends showed an overall neonatal mortality rate decline at an average of 2.5 per 1000 live births per year: down by nearly 50% from 40.9 in 1995 to 20.5 in 2002 (Baiden *et al*., 2006). The Ghana findings were consistent with the finding of a study in Nepal which showed that neonatal mortality reduced considerably from 2001 to 2016, with an accelerated rate of reduction between 2010 and 2015. They attributed the greater reduction among the wealthiest families and to babies born by educated women. This might help us understand the contextual differences at women and new-born hospital which receives neonates from all parts of Zambia as it is the highest specialised referral facility in the country with most of the families are economically challenged as more of the referrals were coming from the low economic places like Kanyama and George compounds. Moreover, this might also indicate that the interventions that had started to be implemented in 2018 like creating the mother and new-born hospital for centralised management and strengthening health services might have relented.

5.3 Factors associated with neonatal mortality at NICU -mother and new-born Hospital University Teaching Hospital

A larger number of neonatal deaths are associated with events surrounding delivery, pregnancy, and neonatal care following birth. In our study, early neonatal age was significantly associated with most of the neonatal deaths and is consistent with other studies like Tewabe concluded that Early age (< 7 days) of the new-born and being preterm were significantly associated with neonatal mortality (Tewabe *et al*., 2018). This could be due to the immaturity of most of the vital organs that support life in a neonate hence much care is needed in these early life stages. Moreover, most of the studies that have been caried out have revealed that most of the neonatal deaths occur in the early neonatal period, >75% of neonatal deaths occurred during the first seven days of life (Mangu *et al.*, 2021, Mason *et al.*, 2014). This could be so because the neonatal organs are more immature in the first days of life as the neonate is trying to adapt to life changes from the womb hence, some neonates fail to thrive ending in death. However, our study findings revealed that a day increase in the age of neonates was significantly with an increase in neonatal survival. These findings were consistent with other studies like Lukonga and Michelo who revealed that there were more early neonatal deaths especially within the first 24 hours of life as compared to late neonatal age (Lukonga and Michelo, 2015). This signifies that there is much need of care and attention to be given to neonates in their early days, and to attend to factors that can promote normal delivery and full-term births which can translate to reduced early neonatal deaths.

According to findings of this study being male or female did not significantly influence neonatal mortality. This finding was similar to a Ghanaian study that found no significant difference in the mortality of males and females (Owusu *et al.,* 2018). On the contrary to a study in conducted in Ethiopia that revealed that sex of the neonates significantly influenced the rate of dying. They found females had a lower risk of mortality than males during the first month of life *(*Mangu *et al.,* 2021). Moreover, a study by Zhao who confirmed that male neonates had a higher risk than females of dying during the early neonatal period (Zhao *et al.,* 2017). Similarly, a study by Courtney, revealed that the effect of male gender on mortality increased significantly (Townsel *et al*., 2017). Nevertheless, the reasons for such contrast in the results could not be explained

from the results. However, these results might be due to certain factors like changes in genetics which were not investigated in this study

This study demonstrated that increase in parity was significantly associated with neonatal mortality. This could be related to increase in responsibilities that comes with having more children which may divert the caretakes s attention and the daily stresses that comes with it. However, a meta-analysis by Kozuki demonstrated that Nulliparous women had significant associations with adverse outcomes of pregnancy compared to multiparas (Kozuki *et al.*, 2013). This was supported by Several studies that reported increase in rates of preterm delivery and/or neonatal mortality among young mothers. A plausible biological explanation may be incomplete maternal physical growth and relative malnutrition, which is related to the mother's gynecological age rather than chronological age (Annan and Asiedu, 2018) Our study has demonstrated that gestational age and birthweight are significantly related to new-born deaths. The older the pregnancy (gestational age) the lesser the chance of new-born deaths. These findings are similar to the study conducted by Annan which revealed statistically significant relationship between birth weight and child survival (Annan and Asiedu, 2018). The findings of a study revealed that factors affecting the survival of "at risk" new-born at Korle Bu Teaching Hospital, in Accra, Ghana, included gestational age (GA), (Annan and Asiedu, 2018). Scientifically the older the gestational age the mature the neonatal organs, which is not the case in prematurity. Prematurity is usually associated with a lot of challenges as vital organs like the lungs, heart is not fully matured to support life. A study by Miyoshi suggested that the majority of these deaths can be prevented by reducing the incidence of preterm labour through regular antenatal check-ups, screening of high-risk cases and use of short-term glucocorticoids for improving lung maturity (Miyoshi *et al*., 2019). In another study they found that there was 51% mortality reduction in those with steroid exposure in comparison with other studies where they had found a 53% reduction (Lawn *et al*., 2010).This suggests that providing the needed care before and during pregnancy to avoid factors that are related to premature labour and increase at term birth, we can have a tremendous reduction in neonatal deaths associate with the gestational age of the pregnancy.

In contrast this study found no evidence to relate maternal age and the number of pregnancies to neonatal mortality. These results are similar to a study conducted in Iraq Babylon province which revealed that the mother's age and residency, had no influence on neonatal death *(*Abed *et*

al., 2018). On the contrary an Ethiopian study showed that increased neonatal mortality risk was associated with neonates born to mothers aged less than 18 years and those born within two years of the preceding birth (Mekonnen *et al.,* 2013, Starnes *et al.,* 2018).This could be so as the younger the age of the mother, the more likely the risk of in-experiences in child care and two preceding births implies increase in maternal duties. However, the study showed that the number of children (parity) was associated with an increased risk of neonatal mortality. These findings are the similar to the Ghana study by Annan on predictors of neonatal survival which revealed that there was a significant association between mothers' parity and child survival (Annan and Asiedu, 2018). Babies who did not survive were found more likely to be of primigravida and multigravida mothers, respectively. Other studies have also shown that children born after a short interval are likely to have mothers in poor health, and such children tend to have low birth weight and increased chances of neonatal mortality. Kayode revealed that adequate birth spacing was another important maternal factor noticed to have a protective effect on neonatal survival. The length of the birth interval was inversely related to neonatal mortality; suggesting that the longer the mothers waited before having the next pregnancy the better their chance of being recuperated well from maternal depletion associated with the prior pregnancy (Kayode *et al*., 2014). Good child spacing will ensure an adequate supply of essential nutritional support for the growth and well-being of a subsequent pregnancy.

One of the key findings of the current study was in-line with antenatal care. Most of the neonatal deaths occurred in mothers who never attend antenatal care services. This was similar to an Ethiopian study that found that inadequate number of ANC visit were significantly associated with neonatal mortality (Tewabe *et al*., 2018). This implies that most of the associated factors of neonatal mortality are preventable and treatable conditions that could be addressed by identifying high-risk pregnant mothers, the provision of proper and timely interventions and intensifying neonatal care. This also showed there is a relationship between antenatal attendance and neonatal mortality. The neonates with mothers who had at least attended antenatal care even once had increased chances of survival compared to those who did not. Antenatal care helps to monitor the health of both the mother and neonate for prompt detection and management of pregnancy related complications to promote and protect their lives. These finding are consistent with a recent study by Alemu who indicated the need for further strengthening activities aimed at encouraging mothers for regularly attending antenatal care as well as delivering their new-borns

at health facilities, as these are key factors in reducing the neonatal morbidity and mortality (Alemu *et al*., 2020).

Contrary to our Expectation, the study showed significant evidence of neonates born from health centres (clinics) and referred to the facility dying as compared to those born from hospital, these includes both private and public hospitals. Moreover, those born from homes were at a greater risk of dying compared to those born from both the hospital and the health centres. This was consistent with a study conducted in Ghana were the percentage of mortality among new-borns referred to the facility was very high compared to those born at the facility (Owusu *et al*., 2018). They concluded that because most new-borns referred to hospital are usually very sick and required specialist care that is not provided by primary health facilities hence the increase in mortality levels. In another study done by Ajaari in Tanzania revealed that neonatal mortality was significantly higher (43.3/1000 live births) in neonates born outside the health facilities compared to those born in health facilities (27.0/1000 live births) (Ajaari *et al*., 2012). In Zambia the increased risk of neonatal mortality among those referred from heath centres (clinics) might be attributed to delays in referral both at a home and referral facility settings. Home deliveries are usually affected with lack of hygiene, lack of medical equipment unskilled attendants which increases the risk of infections, maternal and neonatal deaths. Working as a nurse, I have experienced situations were mothers who have neonates not feeling well delay taking them to seek medical care. To top it all there has been further delays at health care facilities which are usually congested before they are referred to the tertiary referral facility. The challenges with the transportation systems (such mode of transport, distance to the facility and congestions on our main roads for referrals within Lusaka) has also been seen to expand the delays in reaching the hospital .The recent strategies currently running of situation analysis of first level referral hospitals and all facilities referring to University Teaching Hospital to help open mini neonatal intensive care wards may help to reduce neonatal mortalities related to delays in referral (Ackers *et al*., 2016).

Neonatal deaths may also stem from numerous medical diagnoses. A study by Turnbull, showed difficult to ascertain the cause of neonatal mortality in Zambia because numerous factors conspire to make ascertainment a challenge (Turnbull *et al*., 2011). In the current study, there was increased risk of neonatal death associated with birth asphyxia, respiratory distress,

prematurity, and sepsis. Similar to our findings, birth asphyxia, prematurity, and neonatal sepsis account for the majority of early neonatal deaths while infections cause most of the late neonatal deaths in other regions of the world. According to Serbanescu associated factors to new-born deaths can be categorised in to New-born factors; birth defects, prematurity, infection, birth asphyxia (Serbanescu *et al.*, 2019), which was consistent with findings of the current study. Maternal factors; age, birth spacing, malnutrition, hypertension, hereditary, drugs, smoking /alcohol psychological stress, intrapartum fever, tetanus toxoid immunization, environmental factors: residence political systems, cultural systems, religious systems and health care factors; lack of accessible and availability of services.

A Zambian study by Lukonga (2015), demonstrated that the common causes of neonatal mortality in Zambia were sepsis, birth asphyxia, and prematurity/low birth weight and most of these deaths occur within the first 24 hours of life. It seems that the interventions such emergency obstetric care (EMOC), helping the baby breath and other related health messages being implemented over the years have not done much in reducing the burden of neonatal mortality The present study found that compared to birth asphyxia conditions like respiratory distress syndrome, sepsis and congenital anomalies had reduce odds of resulting in the former while prematurity had increased odds of the outcome. In another study conducted in Eritrea, sepsis, respiratory distress syndrome and birth asphyxia were the major causes of neonatal admissions to specialised care facilities and complications of prematurity was the major cause of neonatal mortality. Prematurity has been found to be a major contributor to increased admission and the high neonatal mortality prevalence at the facility. Most of neonates who died had prematurity as their primary diagnosis. The others close to this were those diagnosed with birth asphyxia and sepsis. These findings are consistent with many studies conducted worldwide on factors associated with neonatal mortality as well as analysis World Health Organisation. Important to note, prematurity causes the baby to fail to do most of the activities that support life due to immature lungs, difficulties in regulating body temperature, poor feeding and slow weight baby. A study conducted in Zambia on preterm births concluded that hypoxic ischemic encephalopathy as a cause of early neonatal death not only in term neonates but also common in preterm. Sepsis was also commoner in preterm neonates as a cause of early neonatal death (Miyoshi *et al*., 2019). This shows that prematurity renders the neonate susceptible to many fatal conditions. In order to reduce the number of neonatal mortality at our specialised facility , there

is great need to re-strategize current programs target current running programmes targeted at improving neonatal survival (Kipp *et al*., 2016). To further reduce neonatal mortality, it is important that the quality of care provided, particularly skilled birth attendance, emergency obstetric care, and neonatal care during the first month of life is improved

CHAPTER SIX: CONCLUSION AND RECOMENDATION

6.1 CONCLUSION

The study findings have revealed the need to evaluate the strategies that are currently being implemented to reduce neonatal mortality. There is urgent need to restrategise if we are to attain the targets of the sustainable development goals of 2030.The 2018–2019 Neonatal intensive care data at University Teaching Hospital, Women and New-born Hospital has demonstrated no significant changes in neonatal mortality trend. Early Neonatal age, low gestational age, increased parity, not attending antenatal care and prematurity were found to be main predictors of neonatal mortality. These findings need appropriate attention for care of women in childbearing before pregnancy, during pregnancy and after delivery to enable prompt care in cases of high risky conditions. Institutional delivery should be promoted and strengthened to reduce home delivery. The findings in this study provides substantial evidence for the care providers; program implementers and policymakers and help them to pass evidence-based decisions and take timely interventions within the facilities of neonatal intensive care.

6.2 RECOMMENDATION

This study has found that there is no change in neonatal mortality rates among neonates admitted to NICU women and new-born hospital and that the trends have remained relatively similar for the two years. The following are the recommendations:

1. Redesigning strategies to look at what can work in reducing the high mortality rates among neonates admitted to the specialized facility. According to Lassi, redesigning strategies have proven to potentially help to improve and strengthen the existing strategies to achieve maximum outcomes for neonatal survival (Lassi *et al*., 2015).
2. Improve Community involvement through undertaking of large-scale community-based interventions focusing on ensuring proper care before and during antenatal, delivery and postnatal period can help in reduction of premature labour and increase at term deliveries which is protective.

3. Conduct a systematic review on home-based neonatal care by community health workers for preventing mortality in neonates in low- and middle-income countries by Gogia, concluded that home-based neonatal care is associated with a reduction in neonatal and perinatal mortality in South Asian settings with high neonatal-mortality rates and poor access to health facility-based care. Therefore the adoption of a policy of home-based neonatal care interventions by provided by community health workers is justified (Gogia and Sachdev, 2016) .
4. Enhancing in service training of health care workers can help to maximize the expertise and improve skills to improve care provided by the staffs to effect the needed change in improving neonatal survival. A study in Ethiopia by on health care knowledge on resuscitation concluded competency and simulation-based in-service training and refresher training complemented by supportive supervision and mentorship are helpful ways to put up provider's capability to perform neonatal resuscitation.
5. Increase surveillance of neonatal morbidities and mortality at all levels including the community and intensify implementation of strategies to promote neonatal survival and reach the intended goals of the sustainable development goals.

6.3 STUDY LIMITATIONS

The study was being done using secondary data from the Health Management Information system which was not necessarily designed to determine factors and trends associated with neonatal deaths. The limitations include inconsistencies, incompleteness, missing information which may paused as a challenge to the research. Certain important factors may have been omitted. Since the study is cross sectional and the researcher had no control over the data it may not permit one to draw causal association between neonatal deaths and the associated factors.

However, the Scientific evidence provided by the study might give milestones on neonatal deaths which may be important to measuring progress made in achieving neonatal mortality goals. Knowing these factors will help to know where to channel the energies in order to reach the intended targets since evaluation of progress made mostly is done when implementing funded programs.

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Appendices

Appendix 1: Data Extraction Tool

STUDY CODE NO----------

A. Demographics

1. Age in weeks: ----------
2. Sex
   a) Male [ ]
   b) Female [ ]
3. Residence: ----------
4. Town ----------
5. Province----------

B. Birth characteristics

1. Place of delivery
   a) Hospital [ ]
   b) Clinic [ ]
   c) Health post [ ]
   d) Home [ ]
2. Mode of delivery
   a) Normal delivery [ ]
   b) Assisted delivery [ ]
   c) Cesarean section [ ]
3. Delivered by
   a) Midwife [ ]
   b) Traditional birth attendant [ ]
   c) Unskilled birth attendant [ ]

4. Date of birth: ----------

5. Gestational age at delivery

   a) 27 to 30 weeks[ ]
   b) 31 to 34 weeks[ ]
   c) .35 to 38 weeks[ ]
   d) 39 to 40 weeks[ ]

C. Medical Information

1. Place Of Death

   a) Hospital [ ]
   b) Clinic [ ]
   c) health post[ ]
   d) home [ ]

2. Reported cause of death

   a) Infection [ ]
   b) Pneumonia[ ]
   c) Asphyxia [ ]
   d) Prematurity [ ]
   e) Congenital abnormality [ ]

D. Maternal characteristics

1. Age of the mother: ----------
2. Parity of the mother: ----------
3. HIV status

   a) Negative [ ]
   b) Positive [ ]

Appendix 2: Work Plan

YEAR	2019							2020						
MONTH	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Research Proposal Development														
Graduate forum presentation														
Submission of proposal														
Approval by UNZABREC														
Clearance by MoH														
Data extraction and Cleaning														
Data analysis and report writing														
Submission of draft copy to supervisor														
Graduate forum result presentation														
Submission of dissertation														

Appendix 3 Budget

S/N	Activity	Unit Cost	Qty	Total cost ZMK
1	Stationary	600	2	1200
2	Local transport and travel	200	2	400
3	UNZABREC	1000	1	1000
4	Human Resource (Data extractors)	1000	2	2000
5	Binding	300	4	1200
6	Publication	3500	1	3500
7	Poster presentation	1000	1	1000
8	Contingency	2000	1	2000
Totals				12,300

Appendix 4: National Health Research Authority

NATIONAL HEALTH RESEARCH AUTHORITY

Ref No:..... **Date: 14th November, 2019**

The Principal Investigator
Ms. Deborah Tembo
University of Zambia
School of Public Health
Department of Epidemiology and Biostatistics
P.O Box 50110,
Lusaka

Dear Ms. Tembo,

Re: Request for Authority to Conduct Research

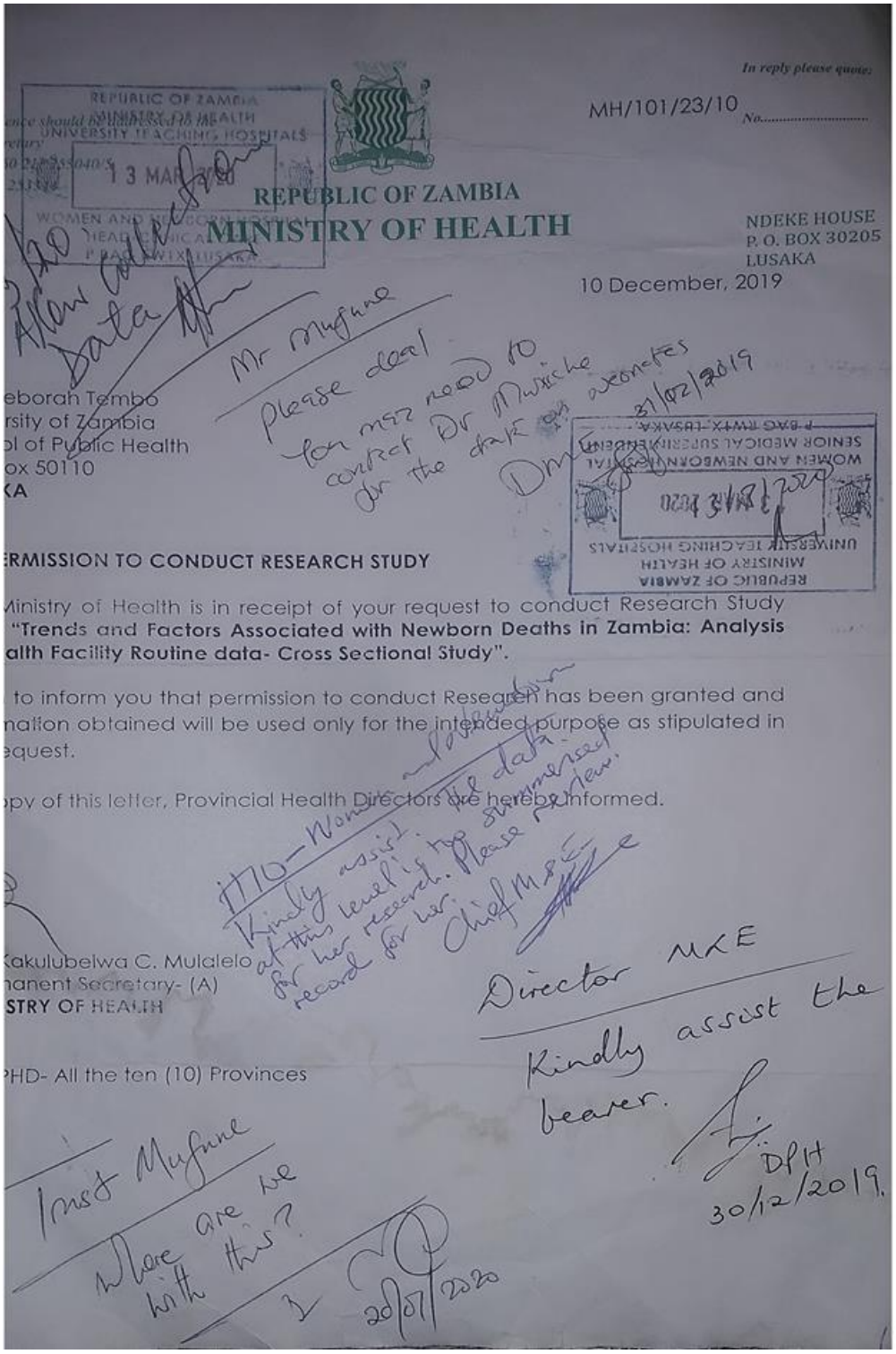
The National Health Research Authority is in receipt of your request for authority to conduct research titled **"TRENDS AND FACTORS ASSOCIATED WITH NEWBORN DEATHS IN ZAMBIA: ANALYSIS OF HEALTH FACILITY ROUTINE DATA - CROSS SECTIONAL STUDY."** I wish to inform you that following submission of your request to the Authority, our review of the same and in view of the ethical clearance, this study has been **approved** on condition that:

1. The relevant Provincial and District Medical Officers where the study is being conducted are fully appraised;
2. Progress updates are provided to NHRA quarterly from the date of commencement of the study;
3. The final study report is cleared by the NHRA before any publication or dissemination within or outside the country;
4. After clearance for publication or dissemination by the NHRA, the final study report is shared with all relevant Provincial and District Directors of Health where the study was being conducted, University leadership, and all key respondents.

Yours sincerely,

Dr. Godfrey Biemba
Director/CEO
National Health Research Authority

Appendix 5: Ministry of Health Approval Letter



In reply please quote:

MH/101/23/10 No.....

REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH

NDEKE HOUSE
P. O. BOX 30205
LUSAKA

10 December, 2019

eborah Tembo
rsity of Zambia
ol of Public Health
ox 50110
KA

ERMISSION TO CONDUCT RESEARCH STUDY

Ministry of Health is in receipt of your request to conduct Research Study "Trends and Factors Associated with Newborn Deaths in Zambia: Analysis alth Facility Routine data- Cross Sectional Study".

to inform you that permission to conduct Research has been granted and nation obtained will be used only for the intended purpose as stipulated in equest.

py of this letter, Provincial Health Directors are hereby informed.

Kakulubelwa C. Mulalelo
nanent Secretary- (A)
STRY OF HEALTH

PHD- All the ten (10) Provinces

Appendix 6:Ethics Approval

UNIVERSITY OF ZAMBIA
BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
Federal Assurance No. FWA00000338

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia
E-mail: unzarec@unza.zm
IRB00001131 of IORG0000774

30th September, 2019.

REF. No. 244-2019.

Your **REF. No. 244-2019**.

Ms. Deborah Tembo,
University of Zambia,
School of Public Health,
Department of Epidemiology and Biostatistics,
P.O Box 50110, **Lusaka.**

Dear Ms. Tembo,

RE : "TRENDS AND FACTORS ASSOCIATED WITH NEWBORN DEATHS IN ZAMBIA: ANALYSIS OF HEALTH FACILITY ROUTINE DATA-CROSS SECTIONAL STUDY" (Ref. No. 244-2019)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 29th September, 2019. The proposal is **approved**. The approval is based on the following documents that were submitted for review:

a) Study proposal
b) Questionnaires
c) Participant Consent Form

APPROVAL NUMBER : REF. 244-2019
This number should be used on all correspondence, consent forms and documents as appropriate.

- **APPROVAL DATE : 30th September 2019**
- **TYPE OF APPROVAL : Standard**
- **EXPIRATION DATE OF APPROVAL : 29th September 2020**
  After this date, this project may only continue upon renewal. For purposes of renewal, a progress report on a standard form obtainable from the UNZABREC Offices should be submitted one month before the expiration date for continuing review.
- **SERIOUS ADVERSE EVENT REPORTING**: All SAEs and any other serious challenges/problems having to do with participant welfare, participant safety and study integrity must be reported to UNZABREC within 3 working days using standard forms obtainable from UNZABREC.
- **MODIFICATIONS**: Prior UNZABREC approval using standard forms obtainable from the UNZABREC Offices is required before implementing any changes in the Protocol (including changes in the consent documents).
- **TERMINATION OF STUDY**: On termination of a study, a report must be submitted to the UNZABREC using standard forms obtainable from the UNZABREC Offices.
- **NHRA:** You are advised to obtain final study clearance and approval to conduct research in Zambia from the National Health Research Authority (NHRA) before commencing the research project.
- **QUESTIONS**: Please contact the UNZABREC on Telephone No.256067 or by e-mail on unzarec@unza.zm.

Appendix 7: National Health Research Approval

NATIONAL HEALTH RESEARCH AUTHORITY

Ref No:……..…… **Date: 14th November, 2019**

The Principal Investigator
Ms. Deborah Tembo
University of Zambia
School of Public Health
Department of Epidemiology and Biostatistics
P.O Box 50110,
Lusaka

Dear Ms. Tembo,

Re: Request for Authority to Conduct Research

The National Health Research Authority is in receipt of your request for authority to conduct research titled **"TRENDS AND FACTORS ASSOCIATED WITH NEWBORN DEATHS IN ZAMBIA: ANALYSIS OF HEALTH FACILITY ROUTINE DATA - CROSS SECTIONAL STUDY."** I wish to inform you that following submission of your request to the Authority, our review of the same and in view of the ethical clearance, this study has been **approved** on condition that:

1. The relevant Provincial and District Medical Officers where the study is being conducted are fully appraised;
2. Progress updates are provided to NHRA quarterly from the date of commencement of the study;
3. The final study report is cleared by the NHRA before any publication or dissemination within or outside the country;
4. After clearance for publication or dissemination by the NHRA, the final study report is shared with all relevant Provincial and District Directors of Health where the study was being conducted, University leadership, and all key respondents.

Yours sincerely,

Dr. Godfrey Biemba
Director/CEO
National Health Research Authority