APPROVAL

The University of Lusaka approves this dissertation by Kasakula Kaunda in partial fulfillment of the requirements for the award of the degree in Master of Science in Epidemiology and Biostatistics.

Examiner 1…………………… Signature ……………………... Date ……………….

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Chairman – Board of Examiners

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To my family, words cannot fully express how grateful I am for your unwavering love and encouragement.

Finally, I am thankful to everyone who contributed to this study. This research would not have been possible without you.

DECLARATION

This dissertation is Kasakula Kaunda's original work. The research was done following the guidelines for dissertations for the University of Lusaka. It has not been submitted for a degree at this University or another University.

DEDICATION

This work is dedicated to the countless newborns who never got the chance to grow, and to the families who carry their memory with love and strength.

To my parents, family, and friends, for their endless support and belief in me, and to my mentors, whose guidance has shaped my path.

To the healthcare workers who give their all to save tiny lives every day—you are the true heroes.

And to everyone fighting for better neonatal care, may this research be a small step toward a world where every baby has a chance to survive and thrive.

Chapter 1- Introduction

1.0. Introduction to the study

This chapter will lay the foundation of the study by providing the background of the topic at hand, the problem statement, research questions or hypotheses, and the aims and objectives that guide the study. Furthermore, the significance of the study, as well as its aims, objectives, and limitations, are addressed in this chapter. Finally, terms frequently used in this study will be highlighted.

Despite the global progress in reducing neonatal mortality, Sub-Saharan Africa and Southern Asia continue to experience the highest rates of neonatal deaths, largely due to preventable and treatable conditions. In Zambia, the developing regions of the country have limited information to show rates and This study delves into facility-based factors that affect neonatal mortality in the year 2024.

1.1. Background to the study

The neonatal period is defined as the first 28 days of life and is a critical time for a child’s survival. Neonatal mortality (NM) refers to the death of an infant within the first four weeks after birth (World Health Organization, 2024).

According to the World Health Organization, globally, there are approximately 6500 newborn deaths every day, amounting to 47% (2.8 million) of all child deaths under the age of 5 years which was 3.3 million as of the year 2022 (World Health Organization, 2024). Sub-Saharan Africa has one of the highest rates of neonatal mortality, with newborn deaths making up 57% of global cases with some degree of variation across its countries (Akombi, Ghimire, and Renzaho, 2019). This translates to 27 deaths for every 1000 live births. This starkly contrasts the region's 30% contribution to global live births as of 2022. This hardly meets the Sustainable Development Goal 3 set in 2015 which aims to reduce neonatal mortality to 12 or less per 1000 live births (Tamir et al., 2024). Studies show that in Sub-Saharan Africa, three-fourths of neonatal deaths are early neonatal deaths, occurring within the first week of life, with around one million babies dying on their first day alone (Moges et al., 2024).

Zambia being a Sub-Saharan country faces similar neonatal mortality rates as the region. Compared to other countries globally, it ranks 162 out of 195 for neonatal mortality as 1 in 37 neonates die within their first month of life (Kamanga et al., 2022). This places the neonatal mortality rate at 27 per 1000 live births which is more than double the target. Neonatal mortality rates differ from one area to another, and many cases go undocumented. However, most of these deaths can be prevented and treated with simple, cost-effective, and widely available interventions (Tembo et al, 2023).

Various strategies are being put in place to reduce neonatal deaths and improve newborn survival. Programs like the Helping Babies Breathe campaign and Emergency Obstetric and Neonatal Care (EmONC) training for health workers are being rolled out to ensure newborns get the care they need right from birth (Tembo et al 2023).

Despite causing nearly half of all under-five child deaths and more than half of infant deaths, neonatal mortality still doesn't get the attention and urgency it truly deserves (Lukonga & Michelo, 2015). Even though multiple strides and efforts have been made to reduce neonatal mortality, it remains a public health concern in Zambia and Sub-Saharan Africa as a whole. This study focuses on facility-based factors that influence neonatal mortality, thereby identifying key areas for improvement in resource-limited settings to enhance neonatal survival.

1.2. Problem Statement

Neonatal mortality is a significant public health issue, especially in areas with limited healthcare resources. At Mansa General Hospital (MGH) in Zambia, there is a notable lack of studies highlighting neonatal mortality rates, complicating efforts to address and reduce this problem effectively.

Without detailed mortality studies, the contributing factors to neonatal deaths such as medical conditions, socioeconomic influences, and healthcare system limitations remain unclear. This absence of data hinders the development of targeted interventions and improvements in neonatal care.

This study aims to address this gap by systematically gathering and analyzing data on neonatal mortality at MGH. By identifying key factors associated with neonatal deaths and comparing survival rates between premature and term neonates, the study will provide crucial insights into the challenges faced at MGH. The results will support the formulation of evidence-based recommendations to enhance care practices, address systemic issues, and ultimately decrease neonatal mortality at the hospital.

1.3. Aims and Objectives

1.3.1. Aim of the study

This study aims to investigate the factors associated with neonatal mortality at Mansa General Hospital in 2024.

1.3.2. Objectives

1. To determine the incidence and prevalence of neonatal mortality among infants admitted to the NICU at Mansa General Hospital in 2024.
2. To establish the clinical risk factors associated with neonatal mortality at Mansa General Hospital.
3. To establish the socio-demographic risk factors associated with neonatal mortality at Mansa General Hospital.

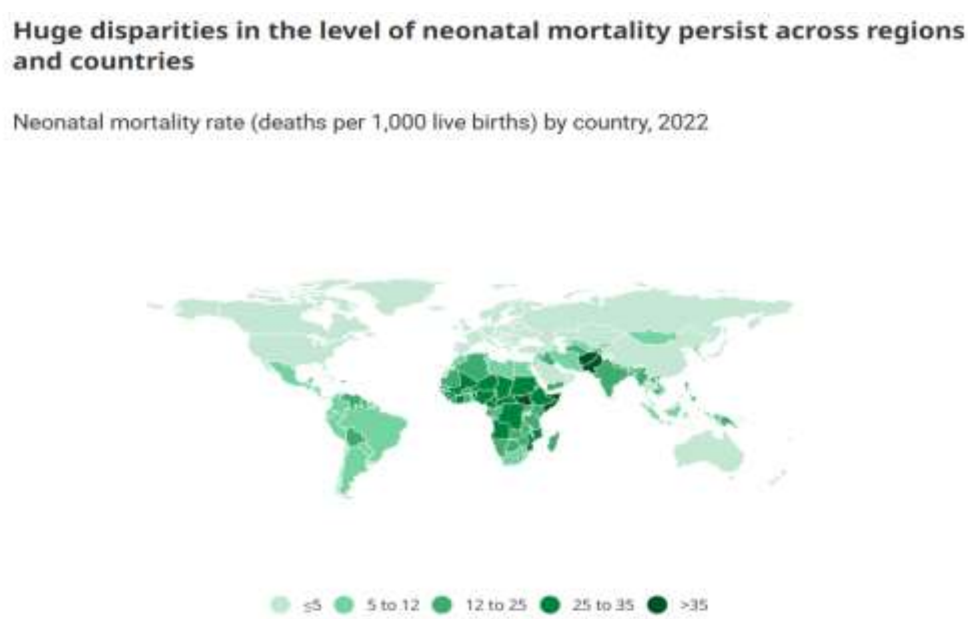
1.3.3. Research questions

1. How many neonates admitted to NICU die on average per month at Mansa General Hospital?
2. What are the clinical and social-demographic factors associated with neonatal mortality at Mansa General Hospital?

Chapter 2. Literature Review

2.0. Understanding Neonatal Mortality

The World Health Organization (WHO) report on Newborn Mortality (2024) defines newborn mortality as the number of infants who do not survive the first 28 days of life. According to the report, 2.3 million children died within the first 28 days of life globally in 2022, representing approximately 47% of all child deaths under five years of age, equating to about 6,500 newborn deaths each day. The report highlights that although global efforts to reduce child mortality between 1990 and 2022 have made progress—decreasing from 5.0 million deaths in 1990 to 2.3 million in 2022—the pace of improvement remains slower than that of post-neonatal mortality. Furthermore, the likelihood of newborn survival varies significantly depending on geographic location, with sub-Saharan Africa and southern and central Asia experiencing the highest rates of newborn deaths. In 2022, sub-Saharan Africa had the highest neonatal mortality rate, with 27 deaths per 1,000 live births, followed by central and southern Asia at 21 deaths per 1,000 live births. The risk of dying in the first month of life in sub-Saharan Africa was 11 times higher than in regions with the lowest mortality, such as Australia and New Zealand. (World Health Organization, 2024).



Source: United Nations Inter-agency Group for Child Mortality Estimation (UN IGME), 2024

2.1. Neonatal Mortality in Sub-Saharan Africa

Tadesse et al. (2024) conducted a study which revealed that 23 neonates per 1,000 live births in sub-Saharan Africa died within the first week of life. The study emphasized the importance of considering factors such as maternal age, birth weight, antenatal care service utilization, mode of delivery, multiple pregnancies, complications during pregnancy, and community poverty when developing policies and strategies aimed at reducing early neonatal mortality in the region. (Tadesse et al., 2024).

A study by Masaba and Mmusi-Phetoe (2020) reported that Kenya's neonatal mortality rate in 2018 was 19.6 deaths per 1,000 live births, showing a gradual decline from 35.4 deaths per 1,000 live births in 1975. In contrast, South Africa's neonatal mortality rate decreased from 27.9 deaths per 1,000 live births in 1975 to 10.7 deaths per 1,000 live births in 2018. In both countries, preterm birth complications were the leading cause of neonatal deaths, followed by intrapartum-related events. However, there is a notable disparity within the sub-Saharan region, as neonates born in South Africa are more likely to survive the neonatal period compared to those born in Kenya (Masaba & Mmusi-Phetoe, 2020).

In a separate study, Moges et al. (2024) found significant variation in early neonatal mortality rates across sub-Saharan African countries. Their analysis revealed that Ethiopia had the highest rate at 20.1%, while Cameroon had the lowest at 1.3%. Other countries such as Nigeria, Ghana, Tanzania, Malawi, and Zambia reported varying rates between 1.3% and 3.2%. These differences may be attributed to disparities in birth tracking systems, which could lead to underreporting of early neonatal mortality in some countries. (Moges et al., 2024).

2.2. Examining the Causes and Determinants of Neonatal Mortality

The World Health Organization (WHO) report (2024) highlights that the majority of neonatal deaths (75%) occur during the first week of life, with approximately 1 million newborns dying within the first 24 hours. Premature birth, birth complications such as birth asphyxia and trauma, neonatal infections, and congenital anomalies are the leading causes of neonatal death, together accounting for nearly 40% of all deaths in children under five years of age. Despite a global decline in the rates of these leading causes of neonatal death since 2000, they have continued to account for the same proportion of under-five deaths, remaining at 40% in both 2000 and 2022. The report underscores that access to and availability of quality healthcare remain critical factors in the survival of mothers and newborns worldwide (World Health Organization, 2024).

The study by Masaba and Mmusi-Phetoe (2020) also revealed that in South Africa, preterm birth complications were the leading cause of neonatal death, followed by intrapartum-related events, whereas in Kenya, intrapartum-related complications were the primary cause. Neonatal sepsis, congenital abnormalities, and pneumonia ranked third, fourth, and fifth, respectively, in both countries, with diarrhoea being an insignificant cause of neonatal death. South Africa has been more effective in managing intrapartum-related complications compared to Kenya, yet continues to face challenges with preterm births. Despite South Africa's more developed economy, the higher death rate from preterm births was unexpected. Typically, more economically developed countries have better neonatal intensive care services for preterm births, which might explain the disparity when compared to less developed countries like Kenya (Masaba & Mmusi-Phetoe, 2020).

Akombi et al. (2019) highlighted that the leading causes of neonatal deaths include preterm birth complications, intrapartum-related complications, birth asphyxia, congenital anomalies, and infections such as neonatal sepsis, tetanus, meningitis, and pneumonia. These causes are often worsened by underlying determinants, which may stem from the newborn's environment—whether influenced by factors like poverty, marginalization, or conflict. These determinants include socioeconomic factors, maternal lifestyle choices, healthcare service access, and environmental conditions. To address these issues, a system-wide approach is needed, one that strengthens health systems to provide quality care. Research indicates that most neonatal deaths are preventable through improved access to high-quality maternal and newborn health services, delivered by skilled health professionals. Other key preventive measures include access to clean water, proper antenatal and postnatal nutrition, disinfectants, and skin-to-skin contact (Akombi et al., 2019).

The World Health Organization (WHO) report (2024) also states that the majority of neonatal deaths (75%) occur within the first week of life, with approximately 1 million newborns dying within the first 24 hours. The primary causes of neonatal death include premature birth, birth complications such as birth asphyxia and trauma, neonatal infections, and congenital anomalies, which together account for nearly 40% of all deaths in children under five years of age. Despite a global decline in the rates of these leading causes of neonatal death since 2000, they have continued to account for the same proportion of under-five deaths—40%—in both 2000 and 2022. The report underscores that access to and availability of quality healthcare remain crucial factors for the survival of mothers and newborns worldwide (World Health Organization, 2024).

2.3. Proven Interventions for Reducing Neonatal Mortality

As highlighted in the studies discussed earlier, low- to middle-income countries, particularly in Sub-Saharan Africa, are at a higher risk of neonatal mortality, posing a significant challenge given that a large portion of Sub-Saharan Africa's population falls within this demographic. However, there are interventions that can help reduce neonatal mortality rates in the region. A study by Takeleb et al. (2019) found that the utilization of at least one antenatal care (ANC) visit with a skilled provider during pregnancy reduces the risk of neonatal mortality by 39% in Sub-Saharan African countries. To accelerate progress in reducing newborn deaths, it is essential that all pregnant women receive ANC. The study also showed that ANC could lower the risk of neonatal death by 51%, likely due to the provision of vital advice, as well as iron, folic acid, and tetanus immunizations, which have a positive impact on neonatal survival. Furthermore, ANC has indirect benefits, as women who attend ANC are more likely to have their deliveries assisted by skilled birth attendants or take place in health facilities (Takeleb et al., 2019).

Efforts to enhance newborn survival should be grounded in comprehensive essential newborn care and should align with the objectives of Every Newborn Action Plan (ENAP) and the Ending Preventable Maternal Mortality (EPMM) framework. These include promoting antenatal care, postnatal care, skilled birth attendance, and emergency obstetric and newborn care. Prioritizing funding and resource allocation for two highly impactful yet costly interventions—care for small and sick newborns, as well as emergency obstetric care—is essential. These interventions yield significant benefits by reducing maternal and neonatal deaths, stillbirths, and associated morbidity. In regions with effective midwifery systems, the implementation of midwife-led continuity of care (MLCC) can lower preterm birth rates by as much as 24%. MLCC involves consistent care provided by the same midwife or a team of midwives throughout pregnancy, delivery, and the postpartum period, with access to medical assistance when required (WHO Report, 2024).

Chapter 3. Methodology

3.0. Study Approach

This retrospective, quantitative study will utilize neonatal admission records from January 1, 2024, to December 31, 2024, from the Neonatal Intensive Care Unit (NICU) at Mansa General Hospital in Zambia. Mansa General Hospital serves as a key healthcare facility, acting as a significant referral center. The hospital is located in Mansa, the provincial capital of Luapula Province.

3.1. Study Population

The study population will consist of all neonates admitted to the NICU at Mansa General Hospital who have complete data on the necessary variables within the first 28 days of life, regardless of whether they are discharged alive, have passed away, or remain admitted up to the 28-day limit. A complete enumeration method will be employed, ensuring that all neonates admitted to the NICU during the study period are assessed for data completeness and included in the study.

Inclusion Criteria

All neonates admitted to the NICU during the study period with complete or sufficient information for the study objectives.

Exclusion criteria

Neonates who were transferred to the NICU from other healthcare facilities after receiving significant prior treatment, that is, more than 24 hours of treatment, and neonates with major congenital anomalies or genetic disorders that are known to have a high mortality risk will be excluded from the study.

3.2. Sample Size

This study's sample size was calculated using standardized cross-sectional Cochran's formula:

$$n = \frac{pqz^2}{e^2}$$

n = desired sample size, z = standard normal distribution at the desired confidence level (1.96), q = 1-p, e = desired level of precision; e = 0.05, and p = prevalence of neonatal mortality (24%) from national statistics of Zambia as of 20225. Therefore, our study required a total sample size of 308 respondents, including 10% non-response.

3.3. Sampling Methods

For this study on neonatal mortality at Mansa General Hospital, Stratified Random Sampling was selected as the most appropriate sampling strategy to achieve the study's objectives. This sampling method will allow the comparison of survival outcomes between key subgroups, such as premature and term babies. The neonatal population at MGH is diverse, with significant variations in factors like gestational age, birth weight, and underlying health conditions. Stratified sampling will ensure that each of these important subgroups is adequately represented in the study, thereby improving the accuracy and generalizability of the findings. The population will be divided into strata based on critical variables, such as gestational age and birth weight. Within each stratum, a random sample will be drawn to ensure that the sample reflects the overall population's structure. This method will not only enhance the precision of the study but will also enable a thorough analysis of the factors associated with neonatal mortality, thereby providing valuable insights that can inform healthcare practices at MGH.

3.4. Data Collection

Physical copies of individual case files were retrieved from the medical records, and the necessary information was extracted into a predesigned Excel-based data collection tool containing the variables of interest. The data collection process for this study was conducted using a structured questionnaire specifically developed for this research. The questionnaire was meticulously designed by adapting elements from similar studies conducted at the University Teaching Hospital (UTH) in Lusaka, Zambia, and Somalia3,6. These studies provided a robust foundation for identifying relevant variables and structuring questions that are pertinent to exploring factors associated with neonatal mortality. The adapted questionnaire will ensure that the data collected is comprehensive, comparable, and relevant to the specific context of Mansa General Hospital, thereby enhancing the validity and reliability of the study findings (see Appendix 1.6).

Measures:

The outcome variable was neonatal mortality among neonates admitted to the NICU, measured as a binary outcome: survival status at the time of discharge from the NICU or after a maximum of 28 days, categorized as either alive or deceased.

The independent variables were categorized into sociodemographic, maternal, and neonatal factors. Sociodemographic data collected included the mother's age (in years), the neonate's age (in days), the neonate's sex, and the place of residence.

Maternal factors included parity, gravidity, place of birth, antenatal care attendance (yes, no, or unknown), mode of delivery (spontaneous vaginal, cesarean section, breech-assisted, or vacuum-assisted), and the category of staff who conducted the delivery (midwife, doctor, or unskilled staff). The HIV status of the mother was recorded as known negative, known positive, or unknown.

Neonatal factors included the primary diagnosis upon admission to the NICU, gestational age (in weeks), and birth weight (in grams). Gestational age was categorized into preterm (<37 weeks) and term (≥37 weeks), while birth weight was classified as low (<2500 g) or normal (≥2500 g).

3.5. Data Analysis

Data analysis was conducted using a combination of statistical methods to address the study's objectives. The primary parametric test is logistic regression, which was be employed to examine the relationship between neonatal mortality (a binary outcome: alive or deceased) and various independent variables, including sociodemographic, maternal, and neonatal factors

The Chi-Square test of independence was used to investigate the association between categorical variables, such as birth weight categories and neonatal outcomes, providing insights into potential risk factors. Moreover, a Man whitney U test was conducted to compare the mean birth weights between neonates who survived and those who did not, helping to identify any significant differences in birth weight that may be associated with neonatal mortality.

3.6. Ethical Considerations

Prior to the study's commencement Researchers involved had obtained certification from the National Health Research Authority and had obtained certification in good clinical practices.

Permission for waiver of consent was requested from the University of Lusaka Research Ethics Clearance, considering that this was a file review and no contact with the minors was made. The data collected had all patient identifiers removed. No harm was brought to the participants of this study. Furthermore, all computers stored the data as encrypted files to prevent access, accidental loss, or destruction. The data will be kept safe for as long as necessary for this research purpose.

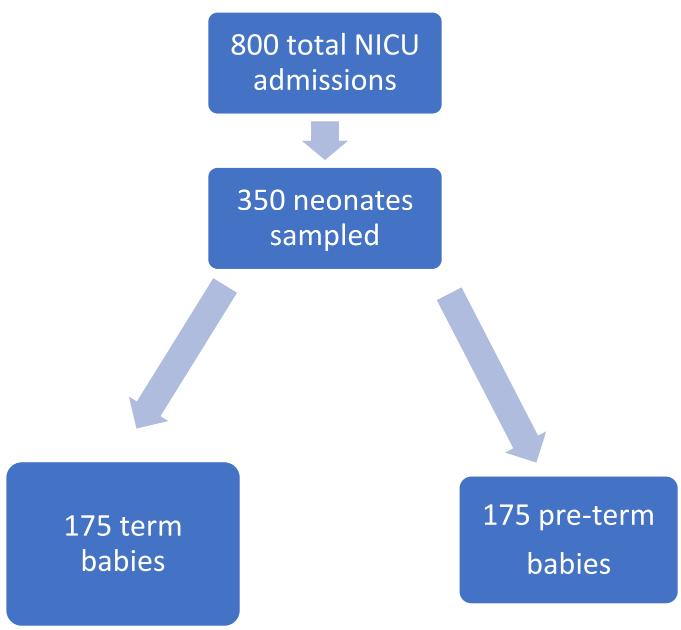
Chapter 4. Results

This chapter will bring to the fore the findings of this facility-based study over the year 2024. Characteristics of the study population are described, and common diagnoses on admission are highlighted. Factors associated with neonatal mortality will then be identified and finally, survival estimates and factors that influence survival are coined.

4.0. Descriptive analysis of mother and neonate characteristics

The facility received 795 admissions over 2024. On average 2 new admissions per day. Of these, 350 were sampled and stratified into two groups: term babies and preterm babies according to gestational age. The figure below gives a graphical representation of the sampling.

Fig 2. Total number of admissions



Of the 350 neonates sampled, 101 died and 249 were discharged alive before or at the 28-day mark. The median age in hours of the neonates admitted was 1hour (IQR 18mins,3hour) while the median gestational age was 36 weeks (33,38). Average birth weight of 2.5kg (IQR1.5kg,3kg). About 52.9% where male and 47% were female. The median age of mothers to these children was 24 years (IQR19,30) while the median number of pregnancies was 2 (IQR1,4) and number of children was 2 (IQR 1,3). The table better lists the characteristics and the frequencies.

Characteristic	Category	Frequency
Mother's age	Median (IQR)	24 (19, 30)
Mother's educational status	Primary Secondary Tertiary	173 (49.3%) 151 (43.1%) 26 (7.4%)
Pregnancy number	Median (IQR)	2 (1, 4)
Number of children	Median (IQR)	2 (1,3)
Neonates age at admission (hours)	Median (IQR)	1 (0.3,3)
Gestational age	Median (IQR)	36 (33,38)
Sex	Male Female	185 (52.9%) 165 (47%)
Apgar Scores (1st minute)	No asphyxia (8-10) Mild asphyxia (5-7) Moderate asphyxia (3-4) Severe asphyxia (0-2)	118 (34.3) 117 (34.0) 80 (23.2) 29 (8.4)
Apgar Scores (5th minute)	No asphyxia (8-10) Mild asphyxia (5-7) Moderate asphyxia (3-4) Severe asphyxia (0-2)	193 (56.1%) 110 (32%) 33 (9.6%) 8 (2.3%)
Birth weight	Extremely low birth weight Very low birth weight Low birth weight Normal birth weight	16 (4.6%) 64 (18.3%) 95 (27.14%) 175 (50%)
Resuscitation	Yes No	346 4
Place of birth	Home	7 (2%)

	Ambulance Local Clinic Hospital	7 (2%) 45(12.9%) 291 (83.1%)
Mode of delivery	SVD Cesarean Section Assisted Vacuum Delivery	176 (50.1%) 170 (48.5%) 4 (1.1%)
Staff conducting delivery	Unskilled Medical officer Medical licentiate Midwife Registered Nurse	7 (2%) 190 (54.3%) 3 (0.9%) 148 (42.3%) 2 (0.6%)
Antenatal Care	Yes No	348 2
Number of visits	Median (IQR)	4 (3,5)
Gestational age at booking	Median (IQR)	14 (12,18)
Maternal HIV status	Positive Negative unknown	29 (8.3%) 320 (91.4%) 1 (0.29%)
Years on ARVs (years)	Median (IQR)	4 (3,5)
Non treponemal pallidum specific test (mother)	Reactive Non-reactive Unkown	23 (6.6%) 319 (91.1%) 8 (2.3%)
Status	Dead Alive	101 (28.9%) 249 (71.1%)

4.1. Principle diagnosis of Neonates admitted to Mansa General Neonatal Intensive Care Unit.

The most common diagnoses made on children admitted to the neonatal intensive care unit at Mansa General Hospital were Neonatal Sepsis (31%), Prematurity (30%), macrosomia (8%), and congenital lues (6.6%). The figure 1 below shows a graphical representation of the commonest condition seen over the year.

Fig1. Principle diagnosis of neonates admitted to NICU

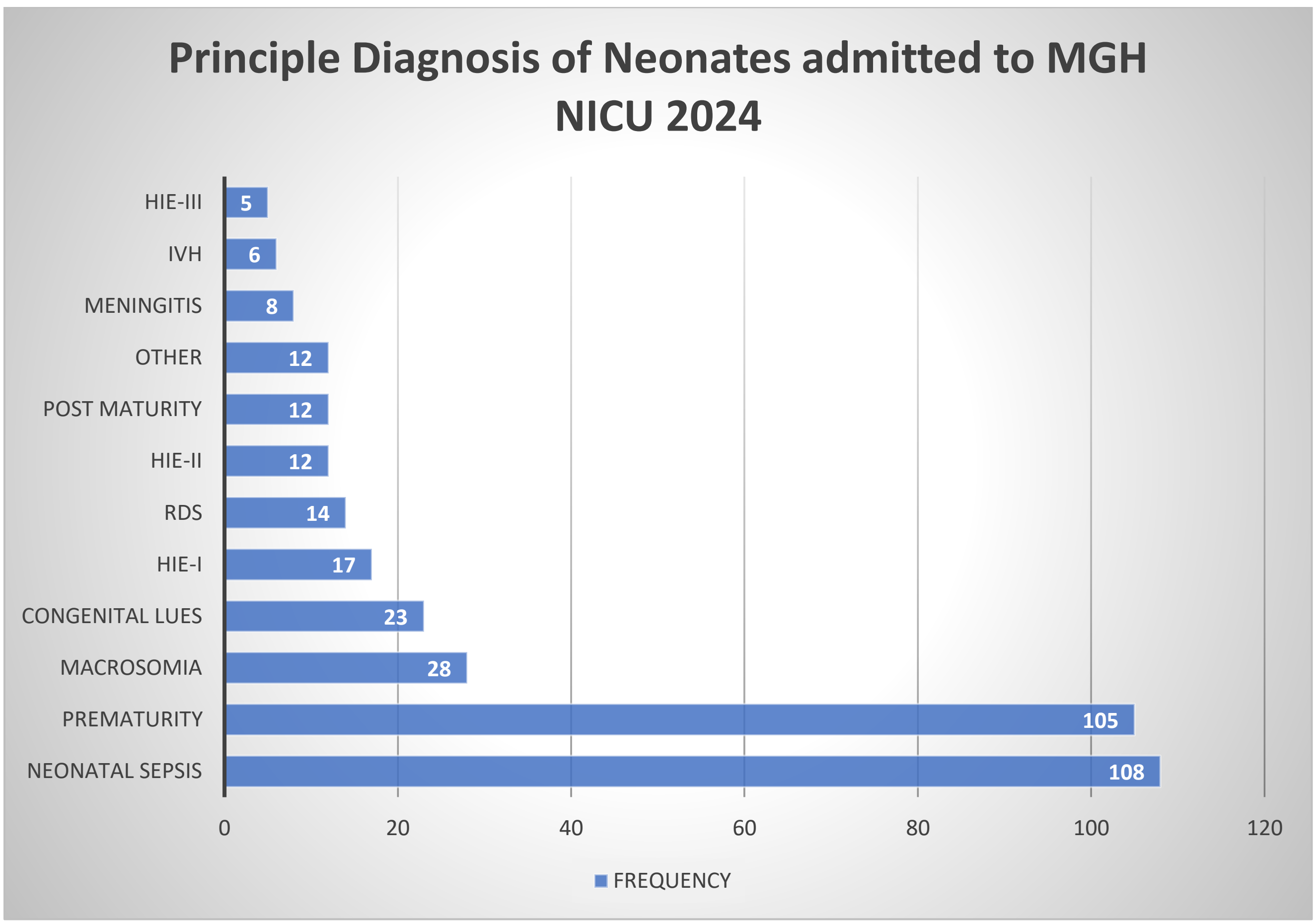


Table 2. Principle diagnosis of Neonates

Diagnosis	**Frequency**	**Percentage (%)**
Neonatal Sepsis	108	31
Prematurity	105	30
Macrosomia	28	8
Congenital Lues	23	7
HIE-I	17	5
RDS	14	4
HIE-II	12	3
Post maturity	12	3
Other	12	3
Meningitis	8	2.3
IVH	6	2
HIE-III	5	1

4.2. Antepartum Complications

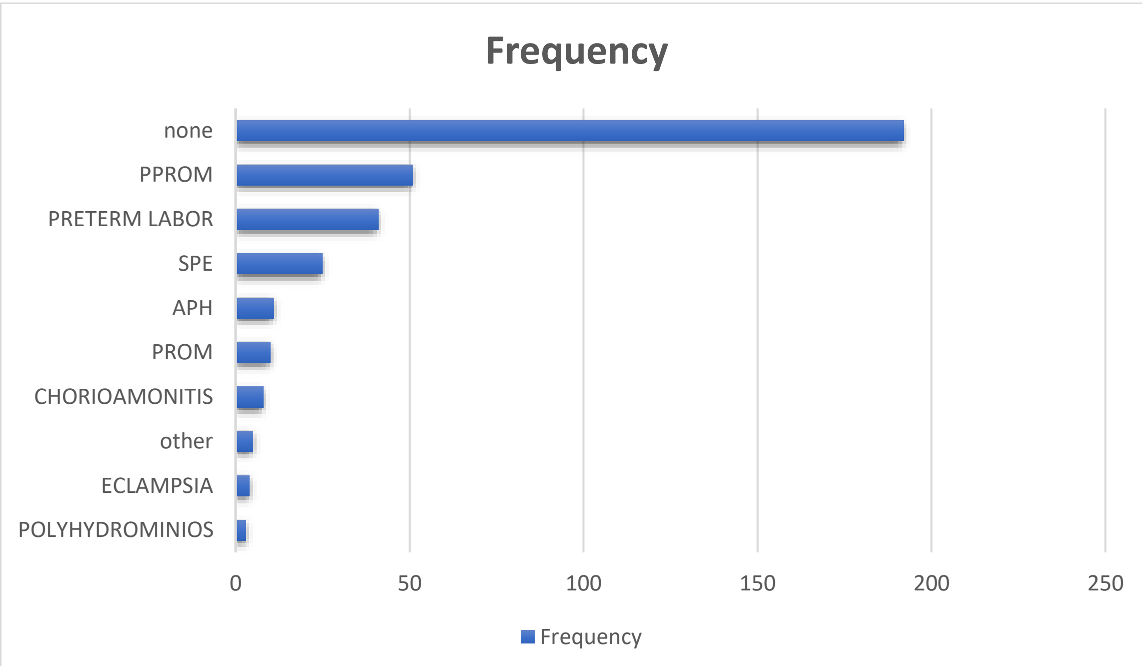
The majority of the neonates admitted to NICU had no complications antepartum. But those that did, had PPROM (15%), Preterm labor (12%), and hypertensive disorders in pregnancy (8%) as the commonest complications. The figure2 below gives a graphical representation of the complications of antepartum and Table 2 shows the percentages.

Table2. Antepartum complications postpartum

Condition	**Frequency**	**Percentage**
POLYHYDROMINIOS	3	.8%
ECLAMPSIA	4	1.1%
Other	5	1.4%
CHORIOAMONITIS	8	2.3%
PROM	10	2.9%
APH	11	3.1%
SPE	25	7%
PRETERM LABOR	41	11.7%
PPROM	51	15%

None	192	54.9%

Fig 2. Common antepartum conditions.



4.3. Intrapartum complications

About 58% of the neonates admitted to NICU had no intrapartum complications. Of those that did however, prolonged first stage of labor was the most common complication accounting for 13%. This was seconded by Prolonged second stage of labor (9.4%) then fetal distress (8.9%) and cephalopelvic disproportion (8.3%).

Fig 3. Complications during delivery of neonates admitted to NICU

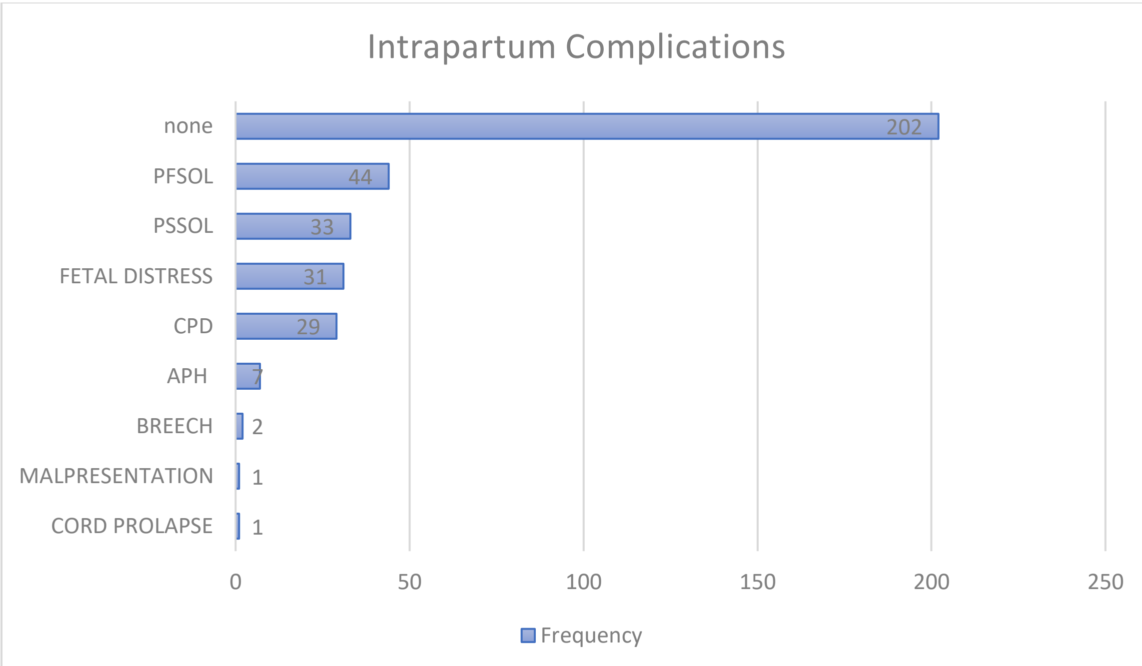


Table 3. Percentages of intrapartum complications

Complication	**Frequency**	**Percentage (%)**
CORD PROLAPSE	1	
MALPRESENTATION	1	
BREECH	2	
APH 7	7	
CPD	29	
FETAL DISTRESS	31	
PSSOL	33	
PFSOL	44	
None	202	

4.4. Associations between characteristics of neonates admitted to NICU and discharge status.

Comparing the characteristics of those that died and those that were discharged alive (using Man whitney U and chi square tests) there was no significant difference between neonates age on admission, neonates' age, mother's age and educational status. The number of pregnancies, number of children had no statistical differences.

The variables with statistical differences were gestational age (P=0.00), APGAR scores at 1 minute (P=0.002) and APGAR scores at 5^{th} minute (P=0.00). Gestational age was higher for those discharged alive (37weeks) than for those that died (34 weeks). Birth weight also had significant differences with statistical significance (P=0.00). Place of birth also showed significant difference as 4 of the 7 babies delivered in an ambulance died, 6 of the 7 children born at home died. 47% of the babies alive were delivered by a medical officer compared to 13% who were discharged dead. The differences in this categorical variable were all statistically significant. The table below shows the further shows associations between the outcome variable and the other independent variables.

Table 4. Neonatal mortality vs independent variables of the neonates.

Variable			**N=350**
Discharge status	Alive N= 249	Dead N=101	P=value
Mother's age	24(20,30)	24(19,29)	0.33
Mother's educational status			0.24
Primary	116 (33%)	57 (16.3%)	
Secondary	114 (32.6%)	37 (10.6%)	
Tertiary			

	19 (5.4%)	7 (2%)	
Pregnancy number	2 (1,4)	2 (1,4)	0.67
Number of children	2 (1,3)	2 (1,4)	0.82
Neonates age at admission	1hr. (18min,3hr)	1hr (30min,3hr)	0.48
Gestational age	37 (34,38)	34 (30,37)	0.00
Sex			0.39
Male	128 (36.6%)	57 (16.3%)	
Female	121 (34.6%)	44 (12.6%)	
Apgar Scores (1st minute)			0.002
No asphyxia	94 (26.8%)	24 (6.8%)	
Mild asphyxia	90 (25.7%)	27 (7.7%)	
Moderate asphyxia	49 (14%)	31 (8.9%)	
Severe asphyxia	15 (4.3%)	14 (4%)	
Apgar Scores (5th minute)			0.000
No asphyxia	36	157	
Mild asphyxia	36	74	
Moderate asphyxia	18	15	
Severe asphyxia	6	2	
Birth weight			0.000
ELBW			1.00
VLBW			0.04
LBW			0.03
NBW			0.64
Resuscitation			0.20
Yes	4	0	
No	245	101	

Place of birth			0.00
Ambulance	3	4	
Home	1	6	
Clinic	27	18	
Hospital	218	73	
Mode of delivery			0.15
Assisted vacuum delivery	3 (0.8%)	1 (.2%)	
Cesarean section	129(36.9%)	41(11.7%)	
Spontaneous vaginal delivery	117(33.4%)	59 (16.9%)	
Staff conducting delivery			0.002
M.O	144(41.1%)	46 (13.1%)	
ML	1 (.2%)	2 (.6%)	
Midwife	101(28.9%)	47(13.4%)	
RN	2 (.6%)	0	
Unskilled	1 (.2%)	6 (1.7%)	
Antenatal Care			0.51
Yes	248	100	
No	1	1	
Number of visits	4(3,5)	3(2,5)	0.007
Gestational age at booking	14(12,17)	16(12,20)	0.05
Maternal HIV status			0.28
Reactive	24	5	
Non-reactive	224	96	
Years on ARVs (years)			0.92

Non treponemal pallidum specific test			0.49
Reactive	15	8	
Non-reactive	227	92	
Unknown	7	1	
Principle diagnosis			0.000
Neonatal Sepsis	81	27	
Prematurity	68	37	
Macrosomia	27	1	
Congenital Lues	14	9	
HIE-I	13	4	
RDS	9	5	
HIE-II	6	6	
Post maturity	11	1	
other	8	4	
Meningitis	6	2	
IVH	0	5	
HIE-III			
Antepartum Complication			0.000
Polyhydraminos	1	2	
Eclampsia	4	0	
other	5	0	
Chorioamnionitis	8	0	

Intrapartum complications			**0.58**
Cord prolapse	**1**	0	
Malpresentation	**1**	0	
Breech	**1**	1	
APH	**5**	**2**	
CPD	**26**	**3**	
Fetal Distress	**22**	**9**	
PSSOL	**23**	**10**	
PFSOL	**30**	**14**	
None	**140**	**62**	

PROM	4	6
APH	7	4
SPE	20	5
Preterm labor	34	7
PPROM	21	30
None	145	47

4.5. Multivariate logistic regression establishing the relationship between the discharge status and independent variables.

A multivariate logistic regression analysis was done to establish the relationship between neonatal mortality and independent variables. Both the direction and magnitude of the association was ascertained using this statistical tool.

Gestation age the neonate was delivered had a statistically significant relationship with neonatal mortality as a unit increase in gestational age(weeks) reduced the odds of neonatal mortality by 34.8% holding all factors constant.

Those with preterm labor had a protective effect on neonatal mortality as those with preterm labor were less likely to die by 93%. Other variables statistically significant were antennal complications like polyhydramnios, severe asphyxia at 5 minutes mark, sex of the neonate, education status of mother, and place of delivery.

	Crude			**adjusted**			
Predictor	**OR**	**P-value**	**95 %**	**OR**	**P-value**	**95% CI**	
Admission age (hours)	.99	0.41	0.95 ,1.0	1.014156	0.768		
Birth weight	0.46	0.00	0.34 - 0.60	.6068657	0.331	0.22,1.66	1.659803
Gravidity	1.00	0.869	0.89 ,1.13	1.079947	0.739	0.68-1.69	1.698514
Parity	1.00	0.938	0.88 ,1.14	.8536003	0.546	0.51-1.42	1.427522
ANC care							

Yes	0.40	0.522	0.02 ,6.50	3.151	0.51	0.10-96.18	96.17973
ANC visits	0.80	0.007	.69,.94	1.091644	0.548	0.81-1.45	1.453544
Gestational age at booking	1.05	0.014	1.01 ,1.10	1.078391	0.063	0.996-1.17	1.167853
Gestational age (weeks)	0.77	0.00	0.71 ,0.83	.6522776	0.001	0.50-0.84	0.8432282
APGAR Scores 1min							
Mild Asphyxia	1.175	0.611	0.63 ,2.1	.9350693 .4846054	0.897	0.34-2.58	2.582167
Moderate Asphyxia	2.478	0.005	1.31 , 4.68	2.115193	0.303	0.51-8.79	8.790115
Severe Asphyxia	3.66	0.003	1.55 , 8.59	.5498541	0.548	0.078-3.86	3.863536
APGAR scores 5 min							
Mild Asphyxia				2.409885	0.106	0.83-7.01	7.011515
Moderate Asphyxia				3.982111	0.13	0.66-23.85	23.85164
Severe Asphyxia				110.	0.01	3.14-3862	3862.1
Antenatal Complications							
Chorioamnionitis				1			
Eclampsia				1			
Polyhydraminos				89.8	0.077	0.60-13239	13239.02

PPROM				.76	0.831	0.062688	9.251757
Preterm labor				.066	0.04	0.0049949	0.8837726
PROM				4.5	0.362	0.1767821	114.6646
SPE				.34931	0.439	0.0243389	5.013493
None				.3970975	0.455	0.035292	4.46805
Other				1			
Intrapartum complications							
Breech				15.65078	0.487	0.0066758	36691.59
Cord prolapse				1			
CPD				39.96	0.143	0.2857027	5589.631
Fetal distress				17.56	0.236	0.1534564	2009.962
Malpresentation				1			
PFSOL				18.30	0.223	0.170564	1963.739
PSSOL				35.68	0.139	0.3134296	4049.719
None				14.63	0.262	0.1350367	1592.211
Diagnoses							
HIE-II				1.075842	0.947	0.1266203	9.140996
HIE-III				1			
IVH				1			
Macrosomia				.6418586	0.757	0.0388645	10.60047
Meningitis				.332	0.438	0.02046	5.38933
NNS				.4242053	0.31	0.0809208	2.223779

Post Maturity				.9012	0.942	0.0537504	15.11091
RDS				.4797467	0.52	0.0511822	4.496815
congenital lues				7.01	0.226	0.3002145	164.056
Other				.663878	0.808	0.0244824	18.00205
prematurity				.2197758	0.108	0.0346813	1.392722
Education status							
Tertiary				4.345836	0.049	1.00573	18.77869
primary				.9882882	0.978	0.43061	2.268209
Sex							
M				2.028423	0.066	0.9555145	4.306056
Mode of delivery							
C/S				1.18402	0.919	0.0454411	30.85101
SVD				.8664842	0.926	0.0420647	17.84859
Delivery staff							
ML				2.070186	0.648	0.0913997	46.88931
MO				.63743	0.53	0.1563677	2.598471
RN				1			
Unskilled				1			
Place of Delivery							
Clinic	0.50	0.399		.4659316	0.565	0.0345266	6.287678
Home	4.49	0.256		1			

hospital	0.25	0.075		.1038	0.081	0.0081866	1.317385
rvd_num							
R	0.48	0.154	0.18, 1.31	.67669	0.613	0.1489238	3.074838
Unknown				1			
Syphilis							
Reactive	1.31	0.55	0.53, 3.20				
Unknown	0.35	0.33	0.04,2.91				
_cons	0.41	0.000	0.32,0.51	1561593	0.01	32.36487	7.53E+10

Chapter 5. Discussion

The aim of this study was to determine the facility-based factors associated with neonatal mortality over the year 2024 of neonates admitted to the neonatal intensive care unit. Specifically, to establish what clinical and social economical risk factors are associated with neonatal mortality at Mansa general hospital.

Of the 350 neonates admitted, 101 died. This translated to a neonatal mortality of 28.9%, that is, of every 100 neonates admitted to NICU, approximately 29 of them died. This is higher than the facility-based mortality at the University teaching hospital neonatal Intensive care unit, Zambia, of 4.2 deaths in every 100 patients (Tembo, 2024). The variations in mortality rates at the two institutions despite being in the same country may be 1 of four things: (1) differences in infrastructure technology and manpower between Mansa general hospital and a tertiary level hospital: (2) decentralization of UTH which has led to increased quality care (3) better health seeking behavior of patients and a much advanced and robust referral system at the tertiary hospital. However, this facility based neonatal mortality rate is unacceptably high and may be regarded as one of the major contributors to the country's overall high neonatal mortality rate.