# ANALYSIS ON SURVIVAL RATE OF PREMATURE AND CRITICALLY SICK NEW-BORN BABIES ADMITTED AT WINDHOEK CENTRAL HOSPITAL (WCH), NAMIBIA

A thesis submitted in partial fulfilment of the
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by

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**DECLARATION**

I Selma Ndapandula Kashele hereby declare that the work contained in the thesis entitled analysis on survival rate of premature and critically sick new-born babies admitted at Windhoek Central Hospital (WCH) Neonatal Intensive Care Unit (NICU), Namibia is my own original work and that I have not previously in its entirety or in part submitted it at any university or other higher education institution for the award of a degree.

Signature: Date: 07 February 2020

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**DEDICATION**

This thesis is dedicated to my family for their support and encouragement. I dedicate this thesis to you guys (Francis Muyunda Mutonga and our three kids, Rodney, Chad and Abigail).

## ABSTRACT

**Introduction:** Prematurity is the major cause of neonatal death world-wide, Namibia included. In Namibia, the neonatal mortality has increased dramatically from 19 deaths per 1000 live births in 2000 to 30 deaths per 1000 live birth in 2014.

**Objectives:** To determine the survival rate of premature and critically sick new-born babies and assess the risk factors associated with death of these babies (premature babies – are babies born before 37 weeks of gestation, counting from the first day of the Last Menstrual Period (LMP); critically sick new-born babies – are babies born with life-threatening birth defects such as gastrointestinal, heart and lung conditions, as well as other complex diseases that require intensive care. ) in the Neonatal Intensive Care Unit (NICU) of Windhoek Central Hospital (WCH), Namibia from 1$^{st}$ January 2018 – 31$^{st}$ December 2018. To analyse the data obtained according to birth weight, gestational age, risk factors and causes of death.

**Method:** The study was a hospital based cross-sectional retrospective chart review analysis; files for all premature babies known admitted and discharged at WCH NICU from 1$^{st}$ January 2018 to 31$^{st}$ December 2018 were analysed. The Statistical Package for Social Sciences (SPSS), Version 25 was used to analyse the data and Kaplan Meier survival estimator was used to estimate the survival rate of premature and critically sick new-born infants.

**Results:** A total of 509 available files for infants admitted at Windhoek Central Hospital – Neonatal Intensive Care Unit (NICU) were analysed. Overall, a high survival rate was observed (68.4% survived, 31.6% died). Low survival rates were observed in lower gestational ages (GA) (1. extremely premature and 2. very premature category) and lower birth weight (1. ELBW and 2. SLBW), 74.3% and 42.5% non-survivors in lower GA category and 92.9% and 43.7% for lower birth weight respectively. Fifty percent of infants referred from district hospitals (referrals) did not survive and the percentage of **survivors** versus **resuscitation given** are: 36.2% (n = 177) placed on ventilator; 48.5% (n = 101) given surfactant; 60.1% (n = 278) oxygen therapy; 66.1% (n = 387) put on Continuous Positive Airway pressure (CPAP); 71.7% (n = 184) on phototherapy.

While for those given antibiotics the followings survival rates were obtained: L1- 67.9%; (n = 190) L2 - 64.4% (n = 45); L3 – 50% (n = 2); L1 + L2 – 63.5% (n = 85); L1 + L2 + L3 – 56.7% (n = 30).

**Conclusion:** The survival rate of premature and critically sick new-born babies in our study was high (68.4%), similar to the findings from comparable studies in other resource-limited settings. Our findings suggest respiratory distress syndrome, sepsis, and asphyxia are the main causes of death of premature and critically sick new-born babies. The findings also concluded that the lower the gestational age and birth weight the lower the chance of new-borns to survive.

**Contents**

**LIST OF FIGURES**

**LIST OF TABLES**

**ABBREVIATIONS**

| | |
|---|---|
| Amik | Amikacin |
| Amp | Ampicillin |
| BBA | Born Before Arrive |
| BW | Birth Weight |
| CPAP | Continuous Positive Airway Pressure |
| CRP | C-Reactive Protein |
| C-section | Caesarian section |
| ELBW | Extremely Low Birth Weight |
| EPI | Expanded Programme on Immunization |
| GA | Gestational Age |
| Gent | Gentamycin |
| Hep B | Hepatitis B |
| HIV | Human Immunodeficiency Virus |
| KM | Kaplan Meier |
| KMC | Kangaroo Mother Care |
| LBW | Low Birth Weight |
| LMIC | Low Middle Income Countries |
| MDG | Millennium Development Goal |
| Mero | Meropenem |
| MoHSS | Ministry of Health and Social Services |
| NEC | Necrotizing Enterocolitis |
| NICU | Neonatal Intensive Care Unit |
| NIDCAP | Newborn Individualized Developmental Care and assessment Program |
| NIVT | Non-Invasive Ventilation Techniques |
| NVD | Normal Vaginal Delivery |
| Pen G | Penicillin G |
| RDS | Respiratory Distress Syndrome |
| RPR | Rapid Plasma Regain |
| Sig. | Significance value |

| | |
|---|---|
| SLBW | Severe Low Birth weight |
| SPSS | Statistical Package for Social Science |
| TSB | Total Serum Bilirubin |
| TT | Tetanus Toxoid |
| Vanco | Vancomycin |
| VLBW | Very Low Birth Weight |
| WCH | Windhoek Central Hospital |
| WHO | World Health Organization |

## DEFINITION OF KEY CONCEPTS

*Birth weight*: The birth weight of a newborn is the first weight recorded after birth, preferably measured within the first hours after birth, before considerable postnatal weight loss has occurred (Cutland, Lackritz, Mallett-Moore, Bardají, Chandrasekaran, Lahariya, Brighton Collaboration Low Birth Weight Working Group (2017).

*Complications*: a circumstance that complicates something. In this study complications that are linked to high neonatal deaths are obstructed labour, foetal distress, prolonged labour, haemorrhage, pre-eclampsia, eclampsia, shoulder dystocia or malpresentation.

*Treatment*: Any compound used in the management, cure, and prevention of disease or other irregular condition. For the purposes of this study, treatment refer to required antibiotics, phototherapy, CPAP, oxygen and ventilation that should be given to neonate during resuscitation.

*Early neonatal death*: The death of neonate occurring during the first 7 days of life (Kidanto, 2009).

Gestational age: indicates the duration of pregnancy, dated from the first day of the last menstrual period

*Late neonatal death*: Death of a neonate occurring after 7 days of life but before 28 completed days of life (Kidanto, 2009).

*Neonatal death*: Death of a neonate that was born alive, during the first 28 concluded days of life (Kidanto, 2009).

*Survival rate*: defined as the number of premature and critically sick new-born babies that survived 28 days of their life or discharged from NICU.

*Neonatal resuscitation*: A set of interventions at the time of birth to maintain the initiation of breathing and circulation of the neonate

*Unavoidable factors*: Those factors that could not be avoided by any means of treatment or available care at the time. In this study unavoidable factors are associated with congenital abnormalities.

# CHAPTER 1

## INTRODCTION

### 1.1 BACKGROUND OF THE STUDY

The under-five year's old death rate is one of the health indicators utilized by the World Health Organization (WHO) to survey a nation's advancement with improving the health of its citizens (UNICEF, 2010). More than 9 million children consistently died during the perinatal and neonatal periods worldwide. About 98% of these deaths happen in developing nations (Hoque, Haaq & Islam, 2011). Neonatal mortality contributes between 40-70% of infant mortality (Shahidullah, et al., 2017).

Perinatal and neonatal mortality are declining less quickly when compared to new-born child and under 5-year-old infant mortality rate (Hoque, Haaq & Islam, 2011). In most developing nations, about 50% of perinatal death happen during the antepartum or intrapartum period and the rest during the primary seven-day stretch of life (Hoque, Haaq & Islam, 2011).

In Africa, great advancement toward diminishing death rate of children under 5 years was observed auxiliary to the actualized measures. However, according to the Millennium Developmental Goal (MDG) there is no significant improvement observed with regards to decrease in neonatal deaths. Sudden death representing 40% of all children deaths is the evoked reason for early neonatal death in South Africa (LLOYD, Georgi, DE WITT, & Wilma, 2013).

The Ministry of Health and Social Services is addressing the neonatal deaths through various workshops and in-service instructional meetings, reproductive health perspectives for enrolled and registered nurses in Namibia. Nevertheless, there is still an expansion in the number of neonatal deaths.

Mdala & Mash (2015) monitored trends on the number of deaths in children under 5-years of age and concluded that the causes of death in Namibia could be avoided by paying attention to the modifiable factors.

According Mdala & Mash (2015) the interventions that have been executed in South Africa to improve under-five year infants' survival include the followings:

- Changes such as change from level I to level II of nurseries;
- Making use of Kangaroo Mother Care regions;

- Placement of essential equipment, including Continuous Positive Airway pressure (CPAP) machines at hospitals;
- Allocation of specific staff for infant children and maintaining key experienced staff in
- Change of mindset, education of health care workers about the need for infant's particular care;
- Utilization of the Perinatal Problem Identification Program (PPIP).

Intrapartum asphyxia and birth injury are key foundations of neonatal mortality in less developed nations. Buchmann (2014) argued that neonatal death including foetal distress, which were unnoticed during the intrapartum period, were significant in sub-Saharan Africa. Liu, et al. (2014) demonstrated that most neonatal deaths are considered to be health workers- related factors.

When investigating on the experiences of mothers who delivered preterm babies in state hospitals of northern Namibia, Velikoshi-Indongo (2012), stated that the figures of premature births in Namibia was very high, making prematurity a public health setback, not only for the mothers who delivered and are caring for premature babies, but also for the health-providing institutions.

This was confirmed in a report by the Demographic and Health Survey (2014) demonstrating that babies and infants under-5-years of age death rates in the previous five years were between 39 to 54 for each 1000 live births. Prematurity was concluded to be among the main five significant reasons for death in these children.

The death rate of these premature and critically sick new-born babies' increases proportionally with declining gestational age or birth weight (Ibrahimou, Kodali, & Salihu, 2015) and that makes gestational age and birth weight a good indicator for survival rate of premature and critically sick new-born babies. However, there is no study conducted in Namibia regarding the survival rate of premature and critically sick new-born babies. This study will therefore look at the survival rate of premature and critically sick new-born babies admitted in WCH NICU Namibia from January 2018 to December 2018.

## 1.2 PROBLEM STATEMENT

The Ministry of Health and Social Services (MoHSS) often shares information through publications and conferences on the mortality and morbidity of new-born babies. However, little or no information about the survival rate of the premature and critically sick new-born babies in state hospitals across Namibia is available as it has not been researched in detail. A report by Demographics and Health Survey (DHS, 2014) from the MoHSS stated that neonatal mortality in the most recent stage is 20 deaths per 1,000 live births. This rate is comparable to the post neonatal rate (19 deaths per 1,000 live births) during the same period. Furthermore, the infant mortality rates in the five years preceding the survey were 39 deaths per 1,000 live births, and in the under-5-years group 54 deaths per 1,000 live births respectively. This means that one in every 26 Namibian children dies before reaching the age of one (1), while one in every 19 do not survive to their fifth birthday. Thus, this study will investigate the risk factors associated with death and the survival rate of premature and critically sick new-born babies admitted in WCH NICU, Namibia.

## 1.3 JUSTIFICATION OF STUDY

The study was designed to identify the causes or factors that have effects on the death of premature and critically sick new-born babies and the management thereof and to help in addressing the survival of new-borns in Namibia.

This study focused on investigating the survival rate of premature and critically sick new-born babies admitted in the WCH NICU (according to gestational age and birth weight) and evaluated the survival rate between the different birth weight categories. The survival rate was subsequently analysed regarding confounding factors and obstetrical factors such as place of birth, HIV exposure, reason for prematurity, socio-demographic and birth weight.

## 1.4 OBJECTIVES OF THE STUDY

**Aim of the study:** The main purpose of this study was to determine the survival rate of premature and critically sick new-born babies and assessing the risk factors associated with their death in the WCH NICU, Namibia from 1$^{st}$ January 2018- 31$^{st}$December 2018.

#### *1.4.1 Specific Objectives*

(a) To investigate the number of neonates admitted and treated in the WCH NICU according to life status at birth, gender, mode of delivery and survival rate;

(b) To analyse the impact of gestational age and birth weight on survival rate of all neonates admitted in WCH NICU;

(c) To analyse the effect of medical interventions given to infants on the survival rate of all babies admitted and treated at the WCH NICU;

(d) To analyse the effect of medical risk factors, confounding factors and obstetrical factors on the survival rate of neonates.

#### 1.4.2 Research Questions

This study was focused on answering the following research questions*:*

- How many neonates according to life status at birth, gender, mode of delivery were admitted, treated and survived until discharged in the WCH NICU?
- What is the impact of gestational age and birth weight on survival rate of neonates admitted to the WCH NICU?
- What is the effect of medical interventions given to mothers and infants on the survival rate of premature and critically sick new-born babies admitted in the WCH NICU?
- What are the medical risk factors, confounding factors and obstetrical factors associated with poor survival of neonates?

### 1.5 SIGNIFICANCE OF THE STUDY

The outcome of this study may help in the prognosis of birth weight and gestational age limits and the chance of survival at the WCH NICU.

It may help to determine the correlation between risk factors such as gender, referral distance, neonatal sepsis, birth asphyxia, and the survival rate of new-borns at the WCH NICU. This study might also serve as an educative and awareness tool on care and treatment for premature and critically sick new-born babies. This study will provide guideline and serve as basis for decision making for both the WCH NICU management team and the

Ministry of Health and Social Services. Finally, the study will contribute to the body of scientific knowledge and provide a degree to the researcher.

## 1.6 SCOPE OF RESEARCH

The outcome of study determined the epidemiology of prematurity and low birth weight babies treated in the WCH NICU and analyse the survival rate according to gestational age and birth weight from January 2018 until December 2018, plot the results on survival analysis graph to correlate the survival rate to the associated risks and symptoms. All other private Hospitals and state Clinics in Windhoek were not part of this study.

The determination of gestational age can be potential limitations as some patients do not know when they fell pregnant or when they had their last menstrual period. The uncertainty of the gestational age and/or missing data regarding gestational age will perhaps make the researcher to focus the analysis more on birth weight than on gestational age. Birth weight is not a perfect replacement for gestational age, nor a perfect indicator as low birth weight can be caused by other pathology than prematurity (e.g. placenta insufficiency, retroviral disease exposure, sepsis and socio demographic causes).

# CHAPTER 2:

## LITERATURE REVIEW

### 2.1 INTRODUCTION

The previous chapter dealt with the background of the study, problem statement, purpose and objectives of the study. This section presents the literature review that is relevant to the topic under investigation with regards to existing information. De Vos, Strydom, Fouche, and Delport (2011) stated that literature review is defined as a process that involves finding, reading, understanding and framing decisions about the published research and theory on a particular topic.

### 2.2 GLOBAL OVERVIEW ON NEONATAL SURVIVAL RATE

As per the WHO, premature birth is defined as all births before 37 completed weeks of gestation or fewer than 259 days since the first day of a woman's last menstrual period (WHO, 2016). The study by Quinn, et al. (2016) indicated that around 15 million infants are born prematurely globally, affecting low and middle income countries (LMIC). It contributes directly to estimated one million neonatal deaths annually and is a significant contributor to childhood morbidity. By using gestational age, prematurity can be further sub-divided into extremely premature (<28 weeks), very premature (28 - < 32 weeks) and moderate or late premature (32 - < 37 completed weeks). The study emphasis on the guidelines to be used in order to categorise prematurity by calculating complete weeks of gestational age and how it varies widely.

Blencowe et al. (2013) proposed the importance to analyse the epidemiology of premature birth because of it is burden on global health care (around one million neonatal deaths per year). Furthermore, they emphasised that, the best way to assess the survival of premature babies is by measuring the gestational age and by recording both stillborn and live-born babies as these helps to improve comparability by determining the gestational age and birth weight of both stillborn and live-born babies. According to Blencowe et al. (2013) the lower the gestational age, the lower the chance of the baby to survive. The study also indicated that the higher percentage of premature birth in sub-Sahara Africa and South Asia is caused by the high fertility rate and large number of births in these two continents.

The study by Beck, et al. (2010) underlined that out of 115.3 million births (85.8% of the estimated total number of births in the world in 2005), 9.6% were preterm births the incidences of premature and critically sick new-born babies' births are high in Africa and Asia, 31% and 54%, respectively. The study further stated that, an extreme rise in premature and critically sick new-born babies' birth over the past 20 years were observed in the developed countries due to increase in multiple births, greater use of reproduction techniques, increases in the proportion of births among women over 34 years of age and change in clinical practices such as caesarean section. The study also argued that, modern technologies can enhance the survival rates of premature and critically sick new-born babies.

The study by Field, Dorling, Manktelow, & Draper (2005) added that the survival rate of premature babies born at below 26 weeks of gestation are relatively low, while babies born at 22 weeks had no chance of survival even when babies were admitted to intensive care units. Based on reviewed data and information received from specialists on the chances that premature babies born at 22 -23 gestation weeks can survive, triggered the reasons for embarking on this research. According to Patel et al. (2015), prematurity is a leading contributor to neonatal mortality in the United States. Approximately one in four extremely premature infants born at 22 to 28 weeks of gestation do not survive the birth hospitalization; mortality rates decrease with each additional week of completed gestation. Traditionally, most extremely premature and critically sick new-born babies died within a few days after birth. The findings from the study by Patel et al. (2015) indicated that deaths among infants within 12 hours after birth were most commonly attributed to biological or physiological immaturity development. For infants surviving longer than 12 hours, deaths were most commonly attributed to the respiratory distress syndrome.

A study by Luthuli & McKerrow, (2019) indicated that the survival rate of Extremely Low Birth Weight (ELBW) babies tend to escalate with increase in gestational age and birthweight. The study also empasized that the mode of delivery, 5-minute Apgar score and time to admission were not associated with an increased survival rate of Extremely Low Birth Weight (ELBW) neonates.

A study by Ibrahimou, Kodali & Salihu, (2015) assess the survival of premature and critically sick new-born babies with the link to sociodemographic and medical characteristics, sociodemographic like race, smokers, unmarried mothers increases the risk of infant mortality while medical conditions like caesarean section delivery increases infant death due to low gestational age. The study also emphasised that smoking during pregnancies reduce the survival rates of the premature and critically sick new-born babies.

## 2.3 REGIONAL OVERVIEW OF NEONATAL SURVIVAL RATE

According to Martines et al. (2005) the availability of skilled care during childbirth and family/community-based care through postnatal home visits, can improve the survival rate of premature and critically sick new-born babies in South Africa.

Lloyd & De Witt, (2013) argued that, 4 million out of 140 million babies born in South Africa dies within 28 days of their lives, with the highest risk on the first day of life. The authors further indicated that, the early neonatal death account for around 40% of all deaths in children >5 years in South Africa. They identified the risk factors that can reduce the survival of premature and critically sick new-born babies like hospital acquired infections, antenatal steroids not given, multiple pregnancy not diagnosed, inadequate resuscitation, prevention and active management of hypothermia to reduced death among premature and critically sick new-born babies.

Meanwhile, Pascoe, Bissessur, & Mayers, (2016) reported that the survival rate of premature and critically sick new-born babies has increased due to advances in medicines at Groote Schuur Hospital Cape Town. They concluded that technology enhances the survival at younger gestational ages and with lower birth weights, but the survived babies tend to experience lots of difficulties and abnormalities throughout their growing up.

According to Feresu, Harlow & Woelk, (2015) prematurity can cause low weight birth which contribute to increase on infant mortality in Zimbabwe and other developing countries. The study emphasised on the risk factors such as nutrition, prenatal care, maternal risk factors, medical conditions, obstetric complications and malaria contribute to low birth weight in Zimbabwe. More prevention efforts are needed, in order to reduce infant mortality and morbidity.

Demographics and Health Survey (DHS) of 2014) revealed that infant and under-5-year-old mortality rates in the past five years were respectively 39 and 54 deaths per 1000 live births, which means 1 in every 26 Namibian children dies before reaching one years old and 1 in every 19 do not survive to their fifth birthday.

While a study by Velikoshi-Indongo, (2012) has shown how serious and problematic prematurity is in Namibia and world-wide. These statistics revealed the severity of premature and critically sick new-born babies, not only for the mothers who delivered and are caring for premature and critically sick new-born babies, but also for the health-providing institutions globally.

In 2014, Indongo analysed the risks outcomes of neonates in Namibia and highlighted that, 46.4% of low birth weight babies' death had a birth weight less than 1500g and 45.2% of babies' death had a gestational age between 26-32 weeks. The same study further stated that, the most prevalent causes of neonatal death were prematurity 47%, respiratory distress syndrome 23%, birth asphyxia 15% and sepsis 15%. Prematurity was concluded as the major cause of neonatal mortality and morbidity in Namibia (Indongo, 2014).

The findings of the study by Hoque, Haaq & Islam (2015) on the causes of admissions and death of neonatal in KwaZulu Natal concluded that 56.6% of deaths in Empangeni Hospital, South Africa were instigated by prematurity, followed by birth asphyxia and neonatal infections. The authors concluded that considerable number of neonate deaths are avoidable through improved quality of antenatal, intra partum and postpartum care, e.g. Kangaroo mother care (KMC). The study also recommended that to save premature and critically sick new-born babies, hospitals must implement the best possible basic care of these small and critically sick infants, have adequate provision of equipment and well-trained health care workers.

## 3. MAJOR CAUSES OF NEONATAL MORTALITY

The aetiology of premature birth is not completely understood; however, some risk factors are known. Mdala & Mash, (2015) showed that the major causes of mortality rates in neonates at Onandjokwe state hospital during the perinatal period were prematurity, birth asphyxia, congenital anomalies, abruption of placenta and some unknown causes. Like Hoque et al. (2015), the findings of Mdala & Mash, (2015) also highlighted that lack of basic antenatal care, long distance referrals of sick neonates, lack of surfactant in severe premature and critically sick new-born babies and home deliveries contribute immensely to reduction in survival rate of neonates.

Prematurity is regarded as the major cause of neonatal mortality and morbidity in Namibia. The above literature review shows that prematurity is a global problem, Namibia included. Therefore, the purpose of this study is to determine the survival rate of premature and critically sick new-born babies (i.e. the number of premature babies surviving 28 days from birth or discharged from NICU calculated in percentage) in WCH NICU which is the reference hospital for all critical new-born babies.

### *3.1 Prematurity*

Lack of global standard to identify premature and different methodologies to assess gestational age makes it difficult to diagnose prematurity. A study by Quinn, et al. (2016) explained in details different types of prematurity which are; extremely premature (<28 weeks), very premature (28 - <32 weeks) and moderate premature (32 - <37 completed weeks of gestation). The 37 weeks cut off is subjective, and it is now recognized that whilst the risks associated with premature birth are greater the lower the gestational age, even babies born at 37 or 38 weeks have higher risks than those born at 40 weeks.

According to Ananth & Vintzileos (2006), premature birth prevention programmes in United States of America have never succeeded and even among the few that have prospered, the impact of the intervention has only been moderate. Efforts to identify premature birth cases and prevention programmes aimed at reducing premature birth have largely focused on spontaneous premature birth. Other medically indicated premature birth following a labour induction or caesarean delivery at premature gestational ages, is associated with a favourable temporal decline in perinatal mortality.

### *3.2 Gestational age*

According to Blencowe et al. (2013), the lower the gestational age, the lower the chance of the baby to survive. The study also indicated that higher percentage of premature and critically sick new-born birth occurs in sub-Sahara Africa and South Asia is because of the high fertility rate and large number of births in these two continents. Birth weight and gestational age are good measurements or indicators to predict the survival of premature and critically sick new-born babies using a survival graph.

Smith et al. (2012) revealed that survival rates for infants at 22 to 24 weeks was very low compared to infants at 25 to 27 weeks. The combined outcomes of death or morbidity for each of retinopathy of prematurity, late-onset sepsis, severe intraventricular haemorrhage, periventricular leukomalacia, necrotizing enterocolitis, and bronchopulmonary dysplasia were higher among 22- to 24-week infants compared with 25- to 27-week infants. The study showed that the lower the gestational age the lower the babies' mortality rates. The lower the gestational age the higher the chances of the premature and critically sick new-born babies to develop Respiratory Distress Syndrome (RDS).

***3.3 Birth weight***

The weight of an infant during childbirth is the most generally utilized result proportion of pregnancy, ordinarily explored in epidemiological investigations, and is broadly connected with mortality and morbidity risks of newborn children (Amosu, 2014). The prevalence of low birth weight is higher in developing nations as compared to developed nations and is related to expanded risks for health results (Shiweda & Amukugo, 2018). A research by Mhlope (2019) has shown that, in Namibia between April 2014 and May 2015, the Windhoek Central Hospital (WCH) admitted 1124 newborn babies and 60% of these babies were low birth weight (LBW) babies.

Premature and critically sick new-born babies weighing less than 1200g (gestational age lower than 30 weeks) experience severe struggle and death is very high among this group.

***3.4 Other Causes of Pre-mature and critically sick new-born birth***

Causes of premature and critically sick new-born births are spontaneous preterm labour (15-20%), preterm premature rupture of membranes (PROM) (30%) or iatrogenic preterm birth (45-50%) (Ananya, Subrat, Ahanthem, Sourabh, & Bhanu-Pratap, 2015, early induction of labour or caesarean birth, whether for medical or non-medical reasons. Other common causes of premature and critically sick new-born birth include multiple pregnancies, infections and chronic conditions such as diabetes and high blood pressure; however, often no cause was identified. There could also be a genetic influence. Better understanding of the causes and mechanisms will advance the development of solutions to prevent premature and critically sick new-born birth. According to Patel et al. (2015) deaths among infants who died within 12 hours after birth were most commonly attributed to immaturity. For infants surviving longer than 12 hours, deaths were most commonly attributed to the respiratory distress syndrome (RDS). From 15 to 60 postnatal days, necrotizing enterocolitis (NEC) was the most common cause of death; after 60 days, bronchopulmonary dysplasia became the predominant cause of death. Deaths related to pulmonary causes, immaturity, infection, and central nervous system injury decreased, while necrotizing enterocolitis–related deaths increased. Some potential misclassification between deaths due to the respiratory distress syndrome and deaths due to bronchopulmonary dysplasia were identified.

A retrospective population -based study by Ibrahimou, Kodali & Salihu (2015) indicated that smoking during pregnancy and caesarean section are the main contribute to premature and critically sick new-born babies' birth. This according to the study increases the chance of death in premature and critically sick new-born babies. Females are at lower risk than males and black are at higher risk than white. The use of antenatal steroids and surfactant therapy enhance the chances of the babies' survival.

Temu, Masenga, Obure, Mosha, & Mahande (2016) concluded that numerous factors were associated with premature and critically sick new-born delivery which includes living alone, no formal education, heavy physical works during pregnancy, being a peasant, businesswomen, and history of still birth. Furthermore, history of miscarriage, preeclampsia, placenta previa, abruption placenta, Caesarean section delivery, inadequate ANC visits, multiple pregnancy, low birth weight and UTIs during pregnancy contribute to premature deliveries.

While Beck, et al. (2010) indicated that give birth at later age (above 35 of age) contribute to prematurity and maternal complications and increase in caesarean sections. This explains high level of prematurity and critically sick new-born babies in Africa.

Meanwhile Quinn, et al., (2016) argued that the causes of premature and critically sick new-born birth are complex and the patho-physiology that causes prematurity are unknown, but some influencing factors were identified. These factors include antepartum haemorrhage or abruption, mechanical factors such as uterine over-distension and cervical incompetence, hormonal changes, bacterial infection and inflammation. Various risk factors for preterm labour are modifiable hence early detection and treatment prevents maternal morbidity and neonatal morbidity and mortality (Mamatha, et al., 2017)

## 4. Neonatal symptoms and risk factor at birth

Infants born from multiple pregnancies are more likely to be born prematurely due to spontaneous labour or PROM, or as a result of maternal conditions such as pre-eclampsia or foetal disorders (Quinn, et al., 2016). The study by Quinn, et al. (2016) indicated that maternal age of less than 17 years or more than 35 years increases risks for premature and critically sick new-born babies' deliveries. Lack of global standard to identify premature and different methodologies to assess gestational age makes it difficult to diagnose prematurity.

According to Resende et al. (2015) premature and critically sick new-born babies in developing countries are at high risk of acquiring infections due to overcrowded neonatal wards, inadequate medical staffing, lack of improper use of basic suppliers and equipment, excessive use of antibiotics, lack of knowledge and difficult in putting into practice infection control like the use of catheter bundles. The study shows that late onset sepsis (LOS) in premature and critically sick new-born babies can be controlled through infection control measures.

Premature babies at 22 – 24 weeks are at high risk of acquiring retinopathy of prematurity, late-onset sepsis, severe intraventricular haemorrhage, periventricular leukomalacia, necrotizing enterocolitis, and bronchopulmonary dysplasia (Smith, et al., 2012).

An article by Doctors (2012) evaluated in their study the complications and risks that might occur to the premature and critically sick new-born babies, and they found out that premature and critically sick new-born babies have little subcutaneous fat therefore they are prone to suffer from hypothermia. Their skin may appear wrinkled, in most cases they develop hypoglycaemia which can result in brain damage, respiratory distress syndrome, jaundice and kernicterus for bilirubin level, infections and necrotising enteritis.

## 5. Interventions

Early intervention in neonatal intensive care units is applied in order to minimize short-term and long-term consequences of prematurity. The most frequently used interventions in neonatal wards are Kangaroo Mother Care (KMC), the use of Continuous Positive Airway Pressure (CPAP), use of mechanical ventilator, Newborn Individualized Developmental Care and Assessment Program (NIDCAP). According to a study by Lawn, Mwansa-Kambafwile, Horta, Barros, & Cousens, (2010) premature and critically sick new-born birth are the major causes of neonatal mortality. The study shed light on the mortality benefit of kangaroo mother care. Countries like Malawi, Tanzania and Ghana have implemented kangaroo mother care in their district hospitals and positive results were noted. Kangaroo mother care is highly effective in reducing severe morbidity, particularly from infection.

The more the neonatal interventions among infants at 22 to 24 weeks e.g. the use of corticosteroids at antenatal care, the higher the survival rate. The study by Smith, et al. (2012) suggests that physicians' willingness to provide care to extremely low gestation infants as measured by frequency of use of antenatal corticosteroids is associated with improved outcomes for the survival of premature and critically sick new-born babies.

In 2014, Polin, Papile, Kumar, & Benitz have shown that the early use of Continuous Positive Airway Pressure (CPAP) with selective surfactant administration in extremely preterm infant's results in lower rate of death compared to treatment with early surfactant therapy (Polin, Papile, Kumar, & Benitz,2014). They further concluded that infants born at 24- and 25-weeks' gestation had a lower death rate in the CPAP compare to the ones given surfactant. Early initiation of CPAP may lead to a reduction in duration of mechanical ventilation and postnatal corticosteroid therapy (Polin et al., 2014).

While the use of early CPAP has reduced the premature and critically sick new-born babies' mortality, Respiratory Distress Syndrome (RDS) management was found to be effective with the combination of INSURE (INtubation SURfactant, Extubation) technique and non-invasive ventilation (NIV) ensures higher success rates (Permall, Pasha, & Chen, 2019). Furthermore, the study confirmed that the use of mechanical ventilator is more effective than the use of CPAP.

Permall, Pasha, & Chen (2019) confirmed the findings of Kirsten, et al. (2012) that the use of NCPAP and InSurE in a neonatal high care ward with limited resources can improve the survival of ELBW infants.

Apart from CPAP and surfactant, other intervention like phototherapy can be used to save the lives of premature and critically sick new-born babies. The use of phototherapy on infants with the birth weight ≤ 1000 g has a 19% decrease mortality rate and decrease kernicterus which translate in overall improvement in the care of premature and critically sick new-born babies with hyperbilirubinemia (Maisels, Watchko, Bhutani, & Stevenson, 2012). The study further indicated that effective phototherapy administering can dramatically decreased the need for exchange transfusion in preterm infants due to reduction in bilirubin.

**6. The Apgars score**

The Apgar score, which stands for Appearance, Pulse, Grimace, Activity, and Respiration, is a useful method used to assess the overall health status of a new-born babies immediately after birth. A study carried out by Hatupopi (2016) showed that sixteen percent of neonates who died at the hospital under study had an Apgar score of 3–6/10 at 1 minute and remained the same at 5 minutes. This indicated that these neonates had a high probability of surviving if proper care, such as appropriate resuscitation, was rendered to them.

**7. Conclusion**

Prematurity is a global problem, an estimated 15 million babies are born prematurely (before 37 completed weeks of gestation), and this number is rising. Preterm birth complications are the leading cause of death among children under 5 years of age, responsible for approximately 1 million deaths in 2015 (WHO, 2016).

# CHAPTER 3

## METHODOLOGY

The following chapter focused on the methodology that was used in this study. The research methodology can be defined as a systematic way of solving the identified research problem. It presents the research approach, design and study area, sampling method, material used, data collection, data analysis, validity, reliability and ethical considerations.

### 3.1 Approach

The approach used to arise to the research topic was, through consultations with paediatricians and neonatologist in the neonatal wards. The search for journals or articles about the "survival rate of premature and critically sick new-born babies in state hospital in Namibia" or similar researches were search through NUST Library resources search under Science Direct, Google scholar, African journals, British Medical Journals, Medline, PLOS ONE, South African Medical journals, SCOPUS and PubMed. Then start searching from the above-mentioned database all journals and articles by using words in our search like “survival rates of premature”, “preterm outcomes and risk factors”, “neonatal morbidity”, “outcomes of premature and critically sick new-born or preterm babies” to narrow our search. The search was also limited to all publication between the years of 2010 to 2019. To our knowledge, very few articles were published about the survival rate of premature and critically sick new-born babies in Namibia. This might have a negative effect due to insufficient literature to use in our literature review as an overview of Namibia.

### 3.2 Design

WCH is currently the main reference Hospital to other district hospitals. It is also house to Antenatal Maternity Ward (ANW). Under ANW, there is a NICU which admit premature and critically sick new-born babies. WCH NICU is a reference hospital for all critical premature and critically sick new-born babies from all the state hospitals in Namibia. The study was a hospital based cross-sectional retrospective chart review analysis; files for all pre-mature babies known admitted and discharged at NICU from the 01$^{st}$ January 2018 to the 31$^{st}$ December 2018 were analysed.

### 3.3 Study Area

The medical registry data log which record all the pre-mature babies admitted discharged and death registers at Neonatal Intensive Care Unit was used to collect data. This was the only source of official log, which records all information on date of birth, gestational age, birth weight, risk associated, etc. in the unit. All available files for pre-mature babies known admitted and discharge in this neonatal ward from the 01$^{st}$ January 2018 to the 31$^{st}$ December 2018 were recorded.

### 3.4 Sampling method

This study collected data that deals with the past (retrospectively) which are records of both surviving and deceased infants that were admitted at WCH NICU; all genders included (male or female). The data for the research were collected from all available files of premature and critically sick new-born babies admitted at WCH NICU. The term "available files" was used because, WCH NICU accommodates infants that are in critical conditions from all district hospitals in Namibia. When the infant's condition improves but still need to be under observation for some days, the medical personnel refer them to Katutura neonate ward with their medical record until when they are discharged. The retrieving of these medical records was a challenge therefore only available files were used. For the total number of infants admitted, the infants who were more than two years at the time of the audit and were still admitted in the ward were not included. Infants that died in the delivery room and recorded in the registry book were also included.

### 3.5 Materials

A comprehensive checklist was created to be used to extract required data from a medical registry. The data collection tool was drawn-up with comparison from literature and in consultation with experienced neonatologist. The data collection tool was shared with the study supervisors for evaluation who also approved it. The checklist included the following information's:

***Maternal details*** – gravida, para, medical conditions, Rhesus (RH) results, Rapid Plasma Reagin (RPR) result, Human Immunodeficiency Virus (HIV) result, Hepatitis B (Hep B) result, Cytomegalovirus (CMV) and maternal immunization.

***Gestational age aider*** – ballard score, number of miscarriages / stillbirths, sonar expected delivery date, estimated gestational age and last menstrual date.

***Birth weight aider***: date of birth, sex, length of the baby, birth weight and discharged date or date of death (if baby did not survive).

Medical interventions to the mother such as antenatal steroids (corticosteroids) given during pregnancy, HIV, Hepatitis B and RPR booking results were used to correlate the outcome of the premature and critically sick new-born babies.

The effect of perinatal interventions taken such as the use of surfactant therapy, CPAP, use of Mechanical ventilator, use of Oxygen therapy given, the Apgars score were assessed against the survival of premature and critically sick new-born babies. The use of active interventions were recorded "yes" as used and "none" as not used. Antibiotics given to the babies as form of intervention for infection was used to determine the survival rate. The babies' symptoms at birth or 24 hours after birth e.g. jaundice which translate on the phototherapy and total serum bilirubin in the data collection tool; suspect of infection which is indicated by C-reactive Protein (CRP) values were used to correlate with the outcome of the baby (discharged/survived or died). The associated risk factors were assessed based on the outcome (survived or dead). Other risk factors e.g. location of birth, distance of referral, were recorded and used to assess the outcome of the premature and critically sick new-born babies on whether the relocation of these infants from one hospital to Windhoek Central Hospital – neonate ward can have an impact on the survival of the baby.

For infants died, the causes of the deaths were retrieved as per record and grouped according to the following categories: a) breathing (intubated) and prematurity problems, b) infections (viral and bacterial), c) congenital malformations and digestive system e.g. necrotizing enterocolitis; d) Blood problems and e) cardiac disease, nervous system (intracranial bleed) and other conditions, in order to validate which disease causes more death in premature and critically sick new-born babies.

### 3.6 Data Analysis

Data were collected in the records section, where all files of patients are kept under lock and key. Files were not removed from the records section to maintain confidentiality. The total number of premature and critically sick new-born babies admitted in NICU were determined from available file. Survival rate of premature and critically sick new-born babies was defined as the number of premature and critically sick new-born babies survived 28 days of their life or discharged from NICU. The total number of babies survived or rather discharged from the ward were determined by counting the number of babies survived from the total number of babies admitted in the ward. Continuous variables were described using mean and standard deviation (SD). Categorical variables were described using frequencies and percentages.

Survival analysis of the infants were determined by plotting the risk factors on Kaplan-Meier survival estimator in order to assess the chances of premature and critically sick new-born babies' survival. The following factors were accessed on the survival analysis graph (Kaplan-Meier graph): gestational age, birth weight, HIV, HEP B, RPR, CPAP, Ventilator, surfactant, oxygen administration, location of delivery, Apgar score, Antibiotic given, CRP level, phototherapy given and Total Serum Bilirubin (TSB). The following criteria were used to determine the severity of premature: Gestational Age (GA), Birth Weight (BW), Date of birth, Discharged date or the death date and age.

The birth weight and gestational age were calculated. Survival rate was than analysed according to gestational age categories (<25 weeks, 25-28 weeks, 28-30 weeks, 30-32 weeks, 32-35 weeks, 35-37 weeks, >37 weeks), birth weight categories <600 grams as Extremely low birth weight (ELBW), 600-900 grams as Severe Low Birth Weight (SLBW), 901-1500 grams as Very Low Birth Weight (VLBW), 1501-2500 grams as Low Birth Weight (LBW) and >2500 grams as Normal Birth Weight (NBW)). Data were analysed using Microsoft Excel and survival analysis was done by using survival analysis graphs.

Data from the audit tool were entered and analysed using the Statistical Package for Social Science (SPSS), data analysis software (Version 25) with the help of a qualified Biostatician. Frequencies and proportions were used to describe categorical data and means, and standard deviation were used for continuous data. Tables were presented on Microsoft Excel and survival analysis graphs were plotted using Kaplan-Meier survival estimator graph.

### 3.7 Ethical and confidentiality

Permission to carry out the study was obtained from NUST, faculty of Health and Applied Sciences and the NUST Higher Degree Committee (HDC; Number REC-00020/2017). Since the data of the study was to be obtained from neonatal ward (PREM Unit Ward), permission to get access to the medical registry was applied from Ministry of Health and Social Services and the Superintendents of Windhoek Central Hospitals (ethical clearance number Ref: 17/3/3 **SK**). Ethical clearance was requested from the ward matron and sister in charge of the ward through the Ministry of Health and Social Services. After collection of data, all documents used were archived properly to ensure confidentiality and to make sure no third person have access to the data. Restricted access to researcher only was used (access pin code). No Data fabrications and falsifications was allowed.

# CHAPTER 4

# RESULTS

This chapter presents the findings of the study based on the original research objectives, which were:

(a) To investigate the number of neonates admitted and treated in the neonatal unit according to life status at birth, gender, mode of delivery and survival rate from January 2018 to December 2018;

(b) To analyse the impact of gestational age and birth weight on survival rate of all neonates admitted to the neonatal unit;

(c) To analyse the effect of medical interventions given to infants on the survival rate of premature and critically sick new-born babies admitted and treated at the Windhoek Central Hospital Neonatal Intensive Unit;

(d) To analyse the effect of medical risk factors, confounding factors and obstetrical factors on the survival rate of neonates.

Demographic and clinical information were extracted from medical records. Gestational age at birth was determined by identifying the dates of the mothers last menstrual period and Ballard score technique.

## 4.1 Life status at birth, gender, mode of delivery and survival rate

Neonatal Intensive Care Unit (NICU) is a reference intensive unit for critical premature and critically sick new-born babies from all health facilities in Namibia. The unit has a staff compliments of 5 paediatricians, 55 registered nurses (for the whole maternity ward, NICU is under maternity ward) and 39 enrolled nurses (maternity ward). Ten registered nurses and seven registered nurses are allocated at NICU rotating on a monthly basis. The unit consist of 31 beds and admit 30 – 45 infants monthly.

Table 4.1.1 Personnel and accommodation statistics

| Staff categories | Number of staff |
|---|---|
| Paediatricians | 5 |
| Registered nurses | 55 (whole maternity ward) |
| Enrolled nurses | 39 (whole maternity ward) |
| | |

A total of 509 available files for premature and critically sick new-born babies admitted at WCH NICU were reviewed. Out of 509 *(see results on Tables 4.1.1 and 4.1.2)*, 348 premature and critically sick new-born babies were declared stable therefore were discharged from the ward (survived) while 161 did not survived (died). The total number of 231 (45.4%) female and 278 (54.6%) male infants were admitted in the ward. The results indicated that 54% were delivered through Normal Vaginal Delivery (NVD) while 46% were through caesarean-section (C-section) and a higher survival rate was observed with infants delivered through C-section (76.4% (n=233) compared to 62%, (n=274) for NVD. There was a significantly high NVD as compared to the C-section.

The strength of associations was determined by means of the chi-square test. This test merely indicates whether there is a statistically significant difference between certain factors. There was no statistical association between the survival rate based on gender: (sig. = 0.960) (68.4%) female versus (68.3%) male. A statistically significant difference was observed between NVD and C-section on the survival of premature and critically sick new-born babies (sig. = 0.001< 0.05).

Table 4.1.2 Gender at delivery.

| Gender | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| Female | 231 | 73 | 158 | 68.4% |
| Male | 278 | 88 | 190 | 68.3% |
| Overall | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 0.003 | 1 | 0.960 | |

Table 4.1.3 Mode of delivery

| Mode of delivery | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| NVD | 276 | 104 | 172 | 62.0% |
| C-section | 233 | 55 | 178 | 76.4% |
| Overall | 509 | 159 | 348 | 68.6% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 11.592 | 1 | 0.001 | |

**Table 4.1.4 Survival of new-born babies on HIV positive and negative mothers**

| HIV status | Child is alive | Summary | Mode of delivery | | |
|---|---|---|---|---|---|
| | | | NVD | C-section | Total |
| Positive | Babies died | Count | **18** | **7** | 25 |
| | | Row N % | 72.0% | 28.0% | 100.0% |
| | | Column N % | 51.4% | 28.0% | 41.7% |
| | Babies survived | Count | **17** | **18** | 35 |
| | | Row N % | 48.6% | 51.4% | 100.0% |
| | | Column N % | 48.6% | 72.0% | 58.3% |
| | Total | Count | **35** | **25** | 60 |
| | | Row N % | 58.3% | 41.7% | 100.0% |
| Negative | Babies died | Count | **72** | **39** | 111 |
| | | Row N % | 64.9% | 35.1% | 100.0% |
| | | Column N % | 33.6% | 20.4% | 27.4% |
| | Babies survived | Count | **142** | **152** | 294 |
| | | Row N % | 48.3% | 51.7% | 100.0% |
| | | Column N % | 66.4% | 79.6% | 72.6% |
| | Total | Count | 214 | 191 | 405 |
| | | Row N % | 52.8% | 47.2% | 100.0% |

Furthermore, the analysis results as indicated in Table 4.1.4, shows that 51.4% of babies delivered by HIV positive mothers through NVD died and 48.6% survived, for babies delivered through C-section by HIV positive mothers 28% died and 72% survived. While the survival rate of babies from HIV negative mothers were 33.6% babies died and 66.4% survived babies born via NVD; 20.4% babies died and 79.6% survived babies born via C-section. A higher survival rate was observed on babies born via C-section.

## 4.2 The impact of gestational age and birth weights on survival rate

As per our second objective, the results were grouped according to their gestational age and birth weight subgroups.

Out of 509 cases registered 12 cases on gestational age were not reported in the hospital files, therefore, the overall number became 497. The analysis results on Gestational Age (GA) (presented on Table 4.2.1 and Figure 4.2.*1*,) showed that out of 35 extremely premature (GA- <25 weeks), 26 (74.3%) died and 9 (25.7%) survived. The very premature babies (25-32 weeks) had 103 (57.5%) survivors and 76 (42.5%) deaths out of 179 infants. The moderate premature and critically sick new-born babies (37-39 weeks) had 89 (77.8%) survivors and 28

(22.2%) deaths out of 126 infants. Likewise, the percentage of survival for Premature (40-41 weeks) and Full term are respectively 79.6% and 85.2%. Interestingly, there is a statistical association between the survival rates based on gestational age (sig. 0.001 < 0.05).

Table 4.2.1. Different levels of GA and survival rates

| GA category (dates, Sonar or Ballard) in weeks | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| Extremely premature babies (25-32 weeks) | 35 | 26 | 9 | 25.7% |
| Very premature babies (32-37 weeks) | 179 | 76 | 103 | 57.5% |
| Moderate premature babies(37-39 weeks) | 126 | 28 | 98 | 77.8% |
| Critically sick full term babies (40-41 weeks) | 103 | 21 | 82 | 79.6% |
| Critically sick full term (>41 weeks) | 54 | 8 | 46 | 85.2% |
| Overall | 497 | 159 | 338 | 68.0% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 63.997 | 4 | 0.0001 | |

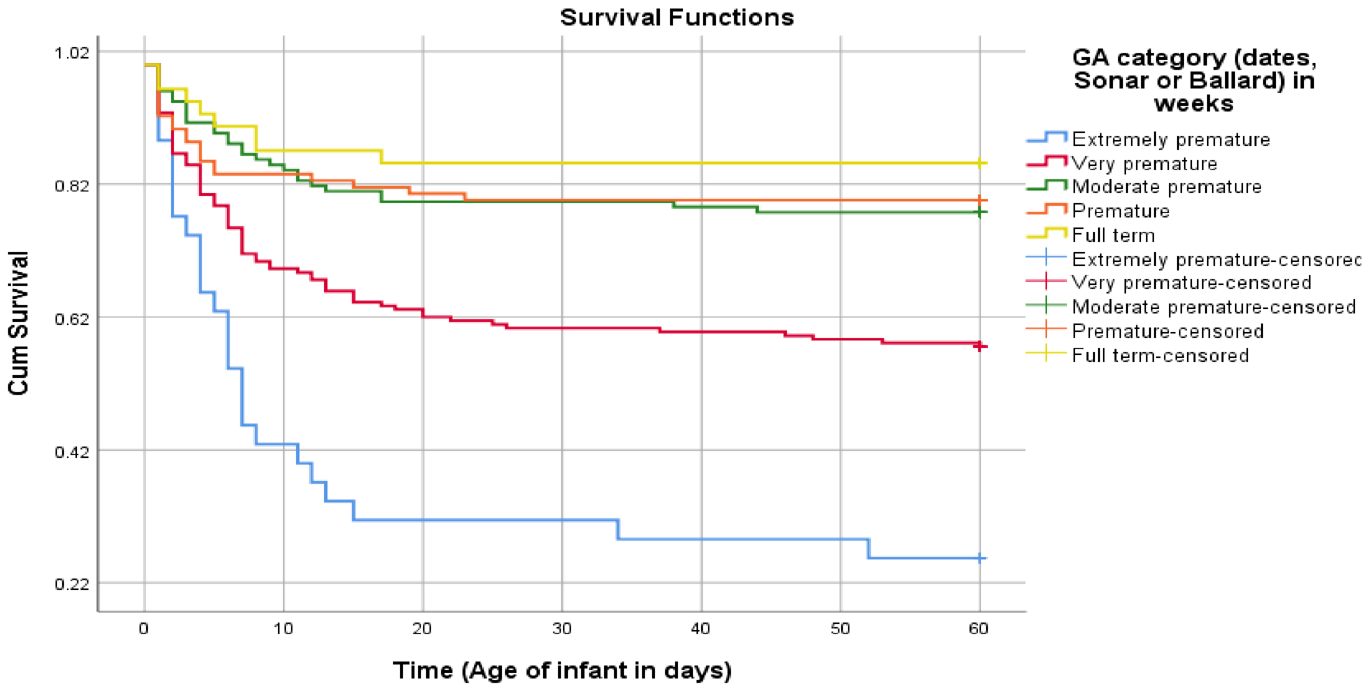


*Figure 4.2.1. Kaplan Meier on Gestational age (GA)*

Table 4.2.2 *(below)* indicates the percentage of infants survived in each subgroup. Out of 4 extremely Low birth weight (ELBW) <600g, 1 (25%) died and 3 (75%) survived. The severe Low birth weight (SLBW: 600 - 900 g) had 39 (92.9 %) deaths and 3 (7.1 %) survivors out of 42 infants. The Very low birth weight (VLBW: 901-1500 g) had 67 (56.3%) survivors and 52 (4.7%) deaths out of 119 infants. Likewise, the percentage of survival for Low birth weight (LBW: 1501 - 2500 g) and Normal birth weight (>2500 g) are respectively 80.1% and 79.8%. In addition, there is a significant correlation between the weight at birth and the survival rate (sig. 0.0001< 0.05)

Table 4.2.2 Weights at birth

| **Weight at birth (g)** | **Total N** | **Died** | **Survived** | |
|---|---|---|---|---|
| | | | **N** | **Percent** |
| Extremely Low birth weight (ELBW) <600g | 4 | 1 | 3 | 75.0% |
| Severe Low birth weight (SLBW) 600 - 900 g | 42 | 39 | 3 | 7.1% |
| Very low birth weight (VLBW) 901-1500 g | 119 | 52 | 67 | 56.3% |
| Low birth weight (LBW) 1501 - 2500 g | 141 | 28 | 113 | 80.1% |
| Normal birth weight >2500 g | 203 | 41 | 162 | 79.8% |
| **Overall** | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| **Log Rank (Mantel-Cox)** | 158.747 | 4 | 0.0001 | |

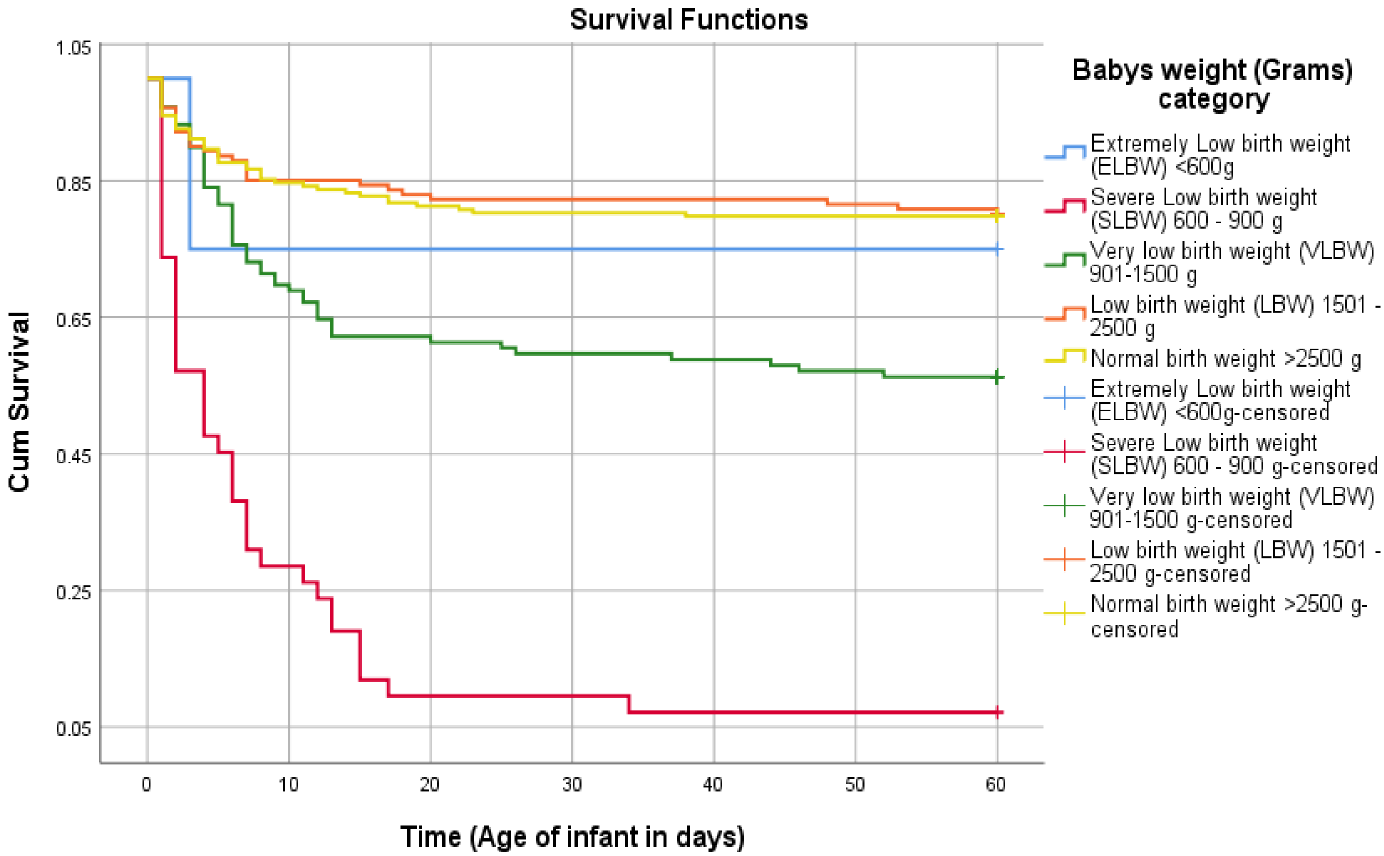


*Figure 4.2.2. Kaplan Meier on Weight at birth*

From figure 4.2.2 above, the analysis results indicated that ELBW babies had a higher survival rate from day one up to day 3, while other categories had a lower chance of survival; the chance of survival for other categories increased after day 3 while for ELBW categories decreased drastically.

### 4.3 Reason for admission

The majority of infants were admitted due to breathing and prematurity problems (72.3%). (results presented in Table 4.3.1).

Table 4.3.1 Reason for admission

| | | | No (dead) | | Yes (discharged) | | Total | |
|---|---|---|---|---|---|---|---|---|
| | | | Count | % | Count | % | Count | % |
| Reason for admission | **Breathing and Prematurity problems** | No | 39 | 27.7 | 102 | 72.3 | 141 | 27.7 |
| | | Yes | 122 | 33.2 | 246 | 66.8 | 368 | 72.3 |
| | **Infections (bacterial and viral)** | No | 149 | 33.4 | 297 | 66.6 | 446 | 87.6 |
| | | Yes | 12 | 19.0 | 51 | 81.0 | 63 | 12.4 |
| | **Digestive and Congenital problems** | No | 149 | 31.1 | 330 | 68.9 | 479 | 94.1 |
| | | Yes | 12 | 40.0 | 18 | 60.0 | 30 | 5.9 |
| | **Blood problems** | No | 155 | 34.8 | 291 | 65.2 | 446 | 87.6 |
| | | Yes | 6 | 9.5 | 57 | 90.5 | 63 | 12.4 |
| | **Cardiac, Nervous systems and other conditions** | No | 136 | 31.6 | 295 | 68.4 | 431 | 84.7 |
| | | Yes | 25 | 32.1 | 53 | 67.9 | 78 | 15.3 |

## 4.4 Impact of medical interventions given to Mothers and infants on the survival rate

In order to answer the third objective which is "To analyse the effect of medical interventions given to infants on the survival rate of premature and critically sick new-born babies admitted and treated at the Windhoek Central Hospital Neonatal Intensive Unit." We look at the prenatal and perinatal interventions given. The variables for the prenatal interventions are **antenatal care** (antenatal corticosteroid given during pregnancy), **maternal immunization** (Tetanus Toxoid, (TT)) and **booking results** (HIV, Hep B and RPR). While the variables for perinatal are the use of phototherapy, mechanical ventilator, surfactant therapy, oxygen masks, monitoring of serum total bilirubin and C-Reactive Protein level (CRP). The use of Apgar score at 1 minute, 5 minutes and 10 minutes is another intervention used to assess the new-born's status or the clinical condition after delivery.

### 4.4.1 The prenatal conditions

***a. Maternal factors on survival rate***

For the purpose of this study we will include in the theme of maternal factors Gravida, Para, miscarriage, spontaneously/modifiable factors, Labour conditions, HIV status, RPR and Hepatitis B. The mean gravida on survivors was 2.47 while on non-survivors was 2.70 with a mode of 1 in both cases *(as shown in the below Table*

*4.4.1.1)*, this indicate that the majority of infants died are those ones from mothers who carried more than 2 pregnancies (gravida), the range was from 1 – 9 pregnancies. While for Para it was discovered that most infants who died their mothers have 1 – 2 survived infants.

Table 4.4.1.1 Gravida and para statistics

| | Child is alive | Mean | Minimum | Maximum | Standard Deviation | Mode |
|---|---|---|---|---|---|---|
| Gravida | No (Dead) | 2.70 | 1.00 | 9.00 | 1.69 | 1.00 |
| | Yes (Discharged) | 2.47 | 1.00 | 10.00 | 1.62 | 1.00 |
| Para | No (Dead) | 1.82 | 0.00 | 9.00 | 1.72 | 0.00 |
| | Yes (Discharged) | 1.62 | 0.00 | 8.00 | 1.48 | 0.00 |

Table 4.4.1.2 below revealed that of infants from mothers who had only one miscarriage have 73.2% rate of survival followed by infants born from mother who never have any miscarriage (69.2%), then mother with one miscarriage (57.1%).

Table 4.4.1.2 Survival rate according to mother's condition and history of miscarriage

| | | | Died | | Survived | | Total | |
|---|---|---|---|---|---|---|---|---|
| | | | Count | % | Count | % | Count | % |
| **Miscarriages** | | Only once | 11 | 26.8 | 30 | 73.2 | 41 | 8.2 |
| | | More than once (>=2) | 6 | 42.9 | 8 | 57.1 | 14 | 2.8 |
| | | None | 136 | 30.8 | 306 | 69.2 | 442 | 88.9 |
| **Mother's condition** | **Maternal factors** | No | 139 | 32.1 | 294 | 67.9 | 433 | 85.1 |
| | | Yes | 22 | 28.9 | 54 | 71.1 | 76 | 14.9 |
| | **Spontaneously/ Modifiable factors** | No | 146 | 30.9 | 326 | 69.1 | 472 | 92.7 |
| | | Yes | 15 | 40.5 | 22 | 59.5 | 37 | 7.3 |
| | **Labour conditions** | No | 155 | 32.0 | 330 | 68.0 | 485 | 95.3 |
| | | Yes | 6 | 25.0 | 18 | 75.0 | 24 | 4.7% |
| | **Others** | No | 37 | 31.4 | 81 | 68.6 | 118 | 23.2 |
| | | Yes | 124 | 31.7 | 267 | 68.3 | 391 | 76.8 |

Booking medical status of mothers were used to measure the survival rate of premature and critically sick new-born babies. For this purpose, the researcher looked only at HIV, Hepatitis B and RPR status of the mothers. The analysis results *(presented in Tables 4.4.1.3, 4.4.1.4 and 4.4.1.5 and Figures 4.4.1.1, 4.4.1.2 and 4.4.1.3)* indicated that there was higher survival rate of infants from HIV negative mother (72.4 %) compared to infants of HIV positive mothers (57.4%). While survival rate of infants from Hepatitis B (70.5%) and RPR (70.9%) negative mothers, were lower compared to infants of Hepatitis B (78.3%) and RPR (75.0%) positive mothers. Fascinatingly, there are statistical association between the HIV status (sig. = 0.0001< 0.05), Hepatitis B and RPR status of the mother to the survival rate (sig. = 0.013 and 0.009 < 0.05).

The Kaplan analysis on Figure 4.4.1.1 and Figure 4.4.1.5 indicated that, from day 2 the infants born by HIV positive and RPR positive mothers had higher survival rate up to day 8 whereby the survival rate starts to decrease while the infants' survival rate from HIV and RPR negative mother's increased.

It can be seen from Figure 4.4.1.2 that the survival rate for infants born by Hepatitis positive mothers had greater survival rate than infants born by Hepatitis negative and unknown mothers.

Table 4.4.1.3 Survival rates according to HIV booking results (mothers)

| | | | Survived | |
|---|---|---|---|---|
| HIV | Total N | Died | N | Percent |
| Unknown | 42 | 23 | 19 | 45.2% |
| Negative | 406 | 112 | 294 | 72.4% |
| Positive | 61 | 26 | 35 | 57.4% |
| Overall | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 20.782 | 2 | 0.0001 | |

Table 4.4.1.4 Survival rates according to Hepatitis B booking results (mothers)

| Hep B | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| Unknown | 90 | 39 | 51 | 56.7% |
| Negative | 396 | 117 | 279 | 70.5% |
| Positive | 23 | 5 | 18 | 78.3% |
| Overall | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 8.644 | 2 | 0.013 | |

Table 4.4.1.5 Survival rates according to RPR booking results

| **Case Processing Summary** | | | | |
|---|---|---|---|---|
| RPR | Total N | Died | Survived | |
| | | | N | Percent |
| Unknown | 116 | 49 | 67 | 57.8% |
| Negative | 333 | 97 | 236 | 70.9% |
| Positive | 60 | 15 | 45 | 75.0% |
| Overall | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 9.373 | 2 | 0.009 | |

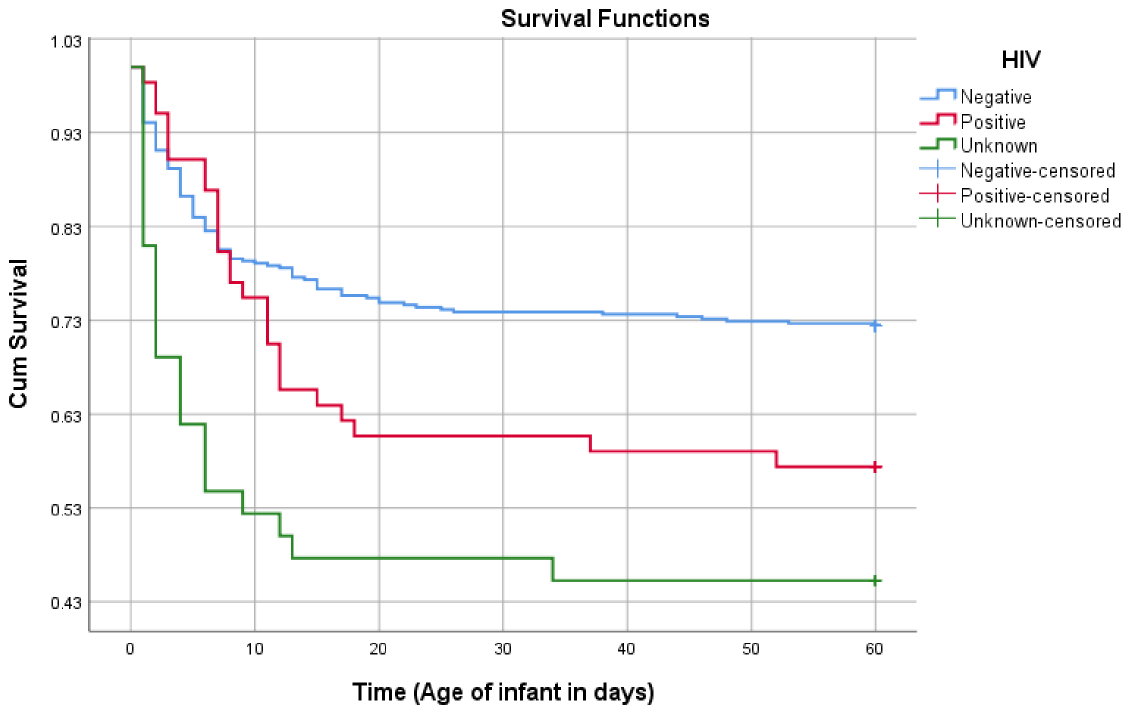


Figure 4.4.1.1 Kaplan Meier on HIV status of mothers on effect of survival

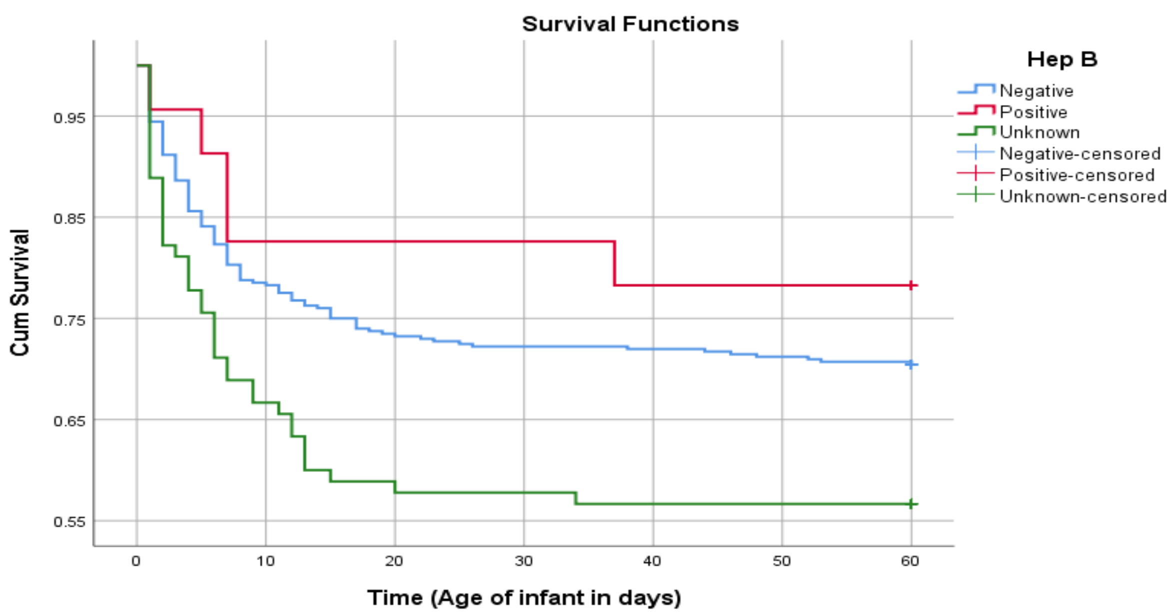


Figure 4.4.1.2 Kaplan Meier on Hepatitis B status of mothers on effect of survival

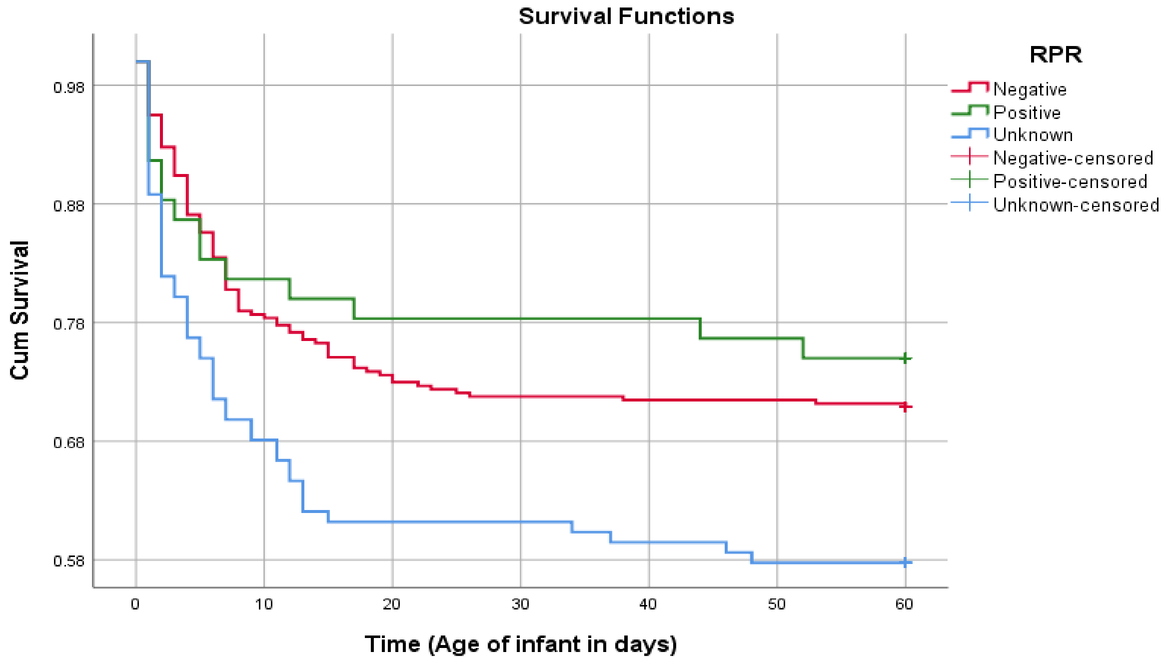


Figure 4.4.1.3 Kaplan Meier on RPR status of mothers on effect of survival

***b. Impact of Medical treatments received by mother on survival rate***

Table 4.4.1.5 *(Mothers who received antenatal* steroids), showed that there were small number of women who reportedly received antenatal steroids (9.43%) may be due to poor record-keeping, which could have affected the analysis because the alternative in the records is unknown.

Table 4.4.1.6 Mothers who received antenatal steroids

| | No (Dead) | | Yes (discharged) | | Total | |
|---|---|---|---|---|---|---|
| | count | % | Count | % | Count | % |
| Antenatal steroids given | 19 | 39.58 | 29 | 60.42 | 48 | 9.43 |
| Unknown | 252 | 54.66 | 209 | 45.34 | 461 | 90.57 |

As represented on Table 4.4.1.6, the audit results illustrated that from a total of 66 mothers who were vaccinated with all Tetanus Toxoid (TT5), 44 (66.7%) born infants survived. The percentages of survival infants whose mothers received TT1- TT2 and TT3-TT4 were 75.3 % (n=73) and 65% (n=20) respectively. We also observe that out of 350 mothers who received immunization, 236 (67.4%) born infants survived, however, the type or category of immunization is unknown or not recorded.

Table 4.4.1.7 Survival rates according to maternal immunizations

| | | No (Dead) | | Yes (discharged) | | Total | |
|---|---|---|---|---|---|---|---|
| Maternal immunization | No (dead) | Count | % | Count | % | Count | % |
| | TT 1 - TT 2 | 18 | 24.7% | 55 | 75.3% | 73 | 14.3% |
| | TT3 - TT4 | 7 | 35.0% | 13 | 65.0% | 20 | 3.9% |
| | TT5 | 22 | 33.3% | 44 | 66.7% | 66 | 13.0% |
| | Unknown/None | 114 | 32.6% | 236 | 67.4% | 350 | 68.8% |

### 4.4.2 The perinatal interventions

#### 4.4.2.1 Ventilator intervention, Surfactant and Oxygen treatment on the survival rates

*Mechanical ventilator:* neonatal mechanical ventilator has been considered an essential tool for managing premature and critically sick new-born babies with respiratory distress syndrome (RDS). From the *Table 4.4.2.1 below*, out of 177 premature and critically sick new-born babies put on ventilator, 113 (36.2%) survived. There is a significant correlation between the phototherapy administering on premature and critically sick new-born babies and the survival rate (sig<0.0001).

Table 4.4.2.1 Survival rate according to Ventilator intervention

| **Premature and critically sick new-born babies on ventilator** | **Total N** | **Died** | **Survived** | |
|---|---|---|---|---|
| | | | **N** | **Percent** |
| None | 332 | 48 | 284 | 85.5% |
| Yes | 177 | 113 | 64 | 36.2% |
| Overall | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 149.923 | 1 | 0.0001 | |

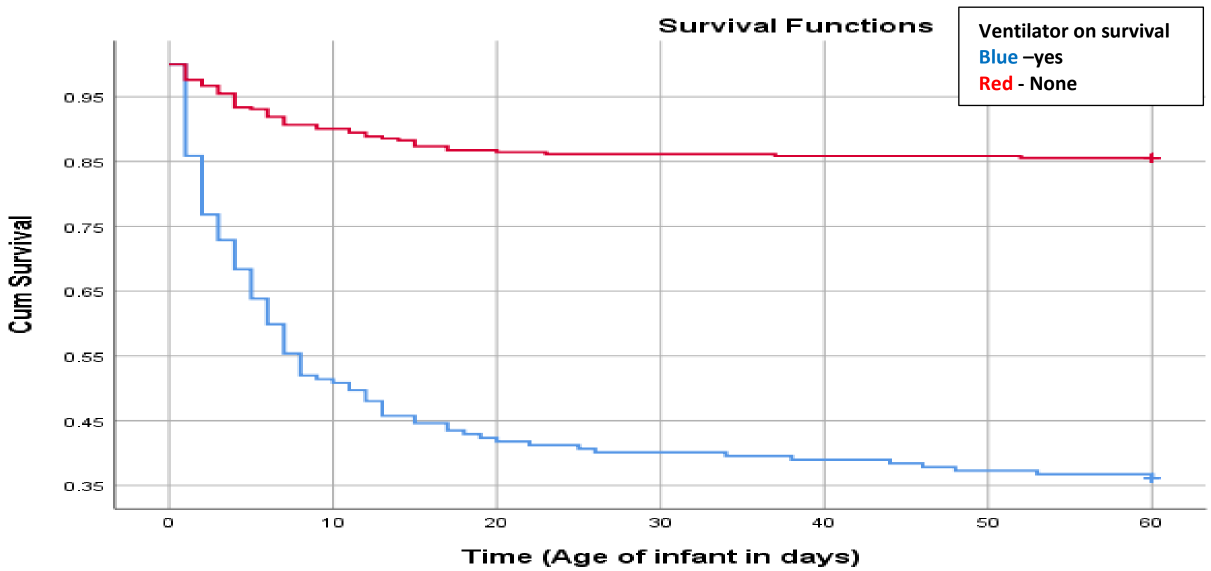


*Figure 4.4.2.1. Kaplan Meier graph of Ventilator intervention on survival rate*

It is apparent from the survival analysis estimator graph above (Figure 4.4.2.1) that the premature and critically sick new-born babies not on ventilator had a higher survival chance compare to those ones put on ventilator.

While infants given surfactant (presented on Table 4.4.2.2), only 48.5% (n=101) survived. The study revealed that there is a significant correlation between the administering of surfactant on premature and critically sick new-born babies and the survival rate (sig0.0001 < 0.05).

*Table 4.4.2.2 Survival rates according to Surfactant treatment*

| Surfactant | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| **None** | 408 | 109 | 299 | 73.3% |
| **Yes** | 101 | 52 | 49 | 48.5% |
| **Overall** | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| **Log Rank (Mantel-Cox)** | 23.376 | 1 | 0.0001 | |

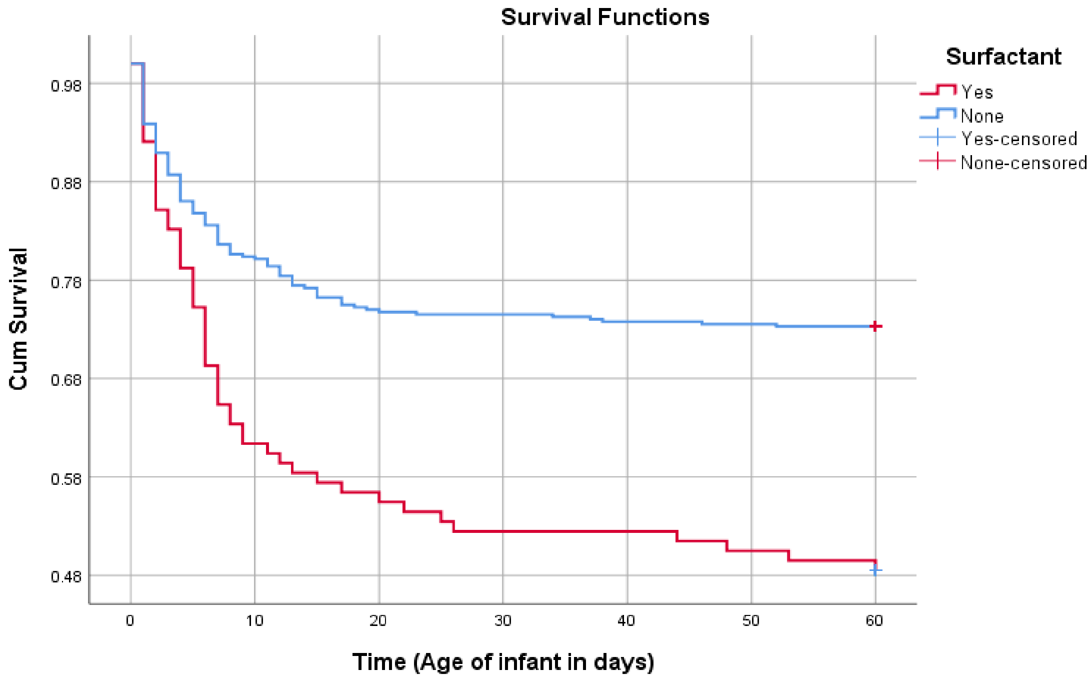


*Figure 4.4.2.2. Kaplan Meier graph of surfactant intervention on survival rate*

From day 3 on the survival analysis (Figure 4.4.2.2), the premature and critically sick new-born babies not given surfactant had a better chance of surviving compare to the one given surfactant.

As presented on Table 4.4.2.3, an incline on survival of premature and critically sick new-born babies given oxygen was noted, 60.1% of premature and critically sick new-born babies survived (n=278) while 39.9% did not survive. A significant correlation between the administering of oxygen on these new-born babies and the survival rate was observed (sig. 0.0001 < 0.05) The results in Table 4.4.2.3 show that administering of oxygen on premature and critically sick new-born babies reduce death risk (p<0.001).

Table 4.4.2.3 Survival rate according to Oxygen treatment

| | | | Survived | |
|---|---|---|---|---|
| **Oxygen days** | **Total N** | **Died** | **N** | **Percent** |
| **None** | 231 | 50 | 181 | 78.4% |
| **Yes** | 278 | 111 | 167 | 60.1% |
| **Overall** | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| **Log Rank (Mantel-Cox)** | 17.914 | 1 | 0.0001 | |

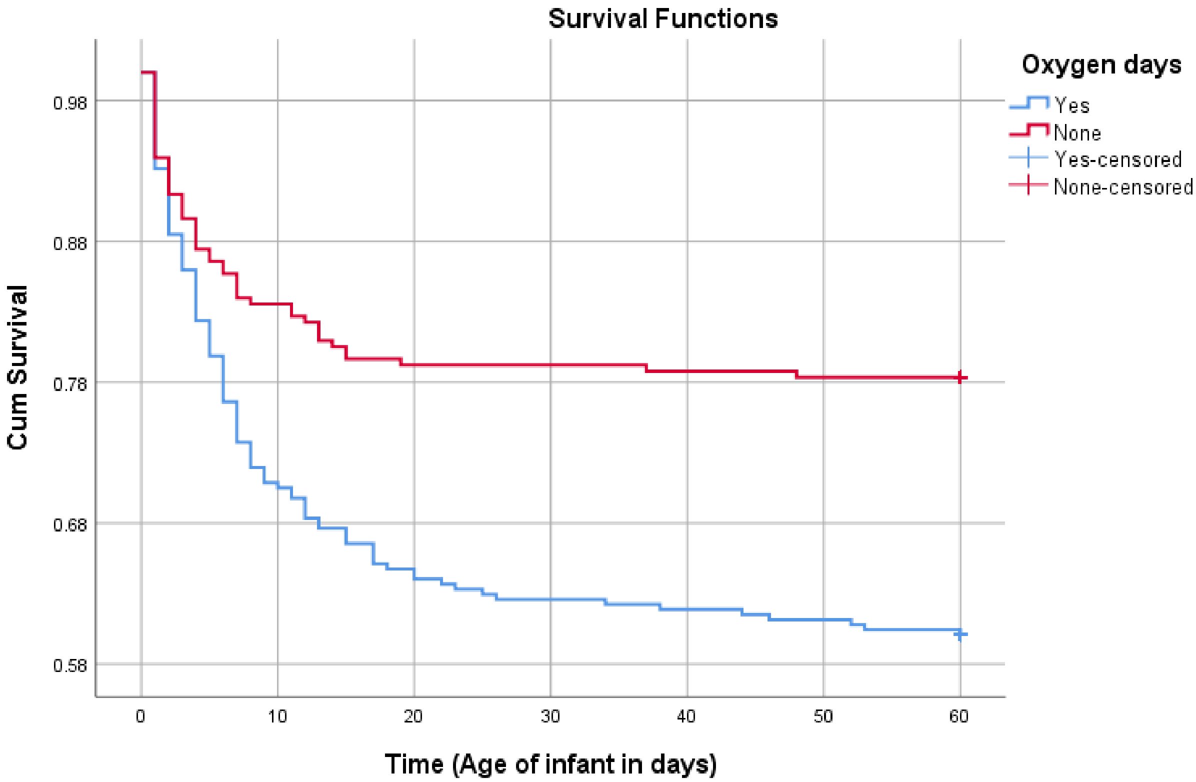


*Figure 4.4.2.3 Kaplan Meier graph of Oxygen treatment on survival rate*

Contrary (as presented on Figure *4.4.2.3)*, the survival analysis estimator indicated that since day 1, the new-born babies on oxygen had lower chances of survival compared to the new-born babies not given oxygen.

A notable information (presented on table 4.4.2.4) was an increase on survival rate on premature and critically sick new-born babies with Total Serum Bilirubin (TSB) >400 umol/l with survival rate of 90.9% (n=11) (See Table 4.4.2.4 and Figure 4.4.2.4). Further survival percentage on different categories are as follow: 0 – 200 umol/l 83% (n=110) survived; 201 – 400 umol/l 60.6% (n=66) survived and 66.8% (n=322) of infants with bilirubin indicated as None (None = no bilirubin test done). There is significant correlation between the different level of bilirubin and the survival rate (sig. 0.0050 < 0.05). As represented on Figure 4.4.2.4 of the Kaplan Meier analysis estimator graph, infants with bilirubin of >400 umol/l had a greater chance of survival since day one (1).

Table 4.4.2.4 Survival rate according to Total bilirubin (umol/l)

| Total Bilirubin category | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| None | 322 | 107 | 215 | 66.8% |
| 0 – 200 | 110 | 27 | 83 | 75.5% |
| 201 – 400 | 66 | 26 | 40 | 60.6% |
| > 400 | 11 | 1 | 10 | 90.9% |
| Overall | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 7.825 | 3 | 0.050 | |

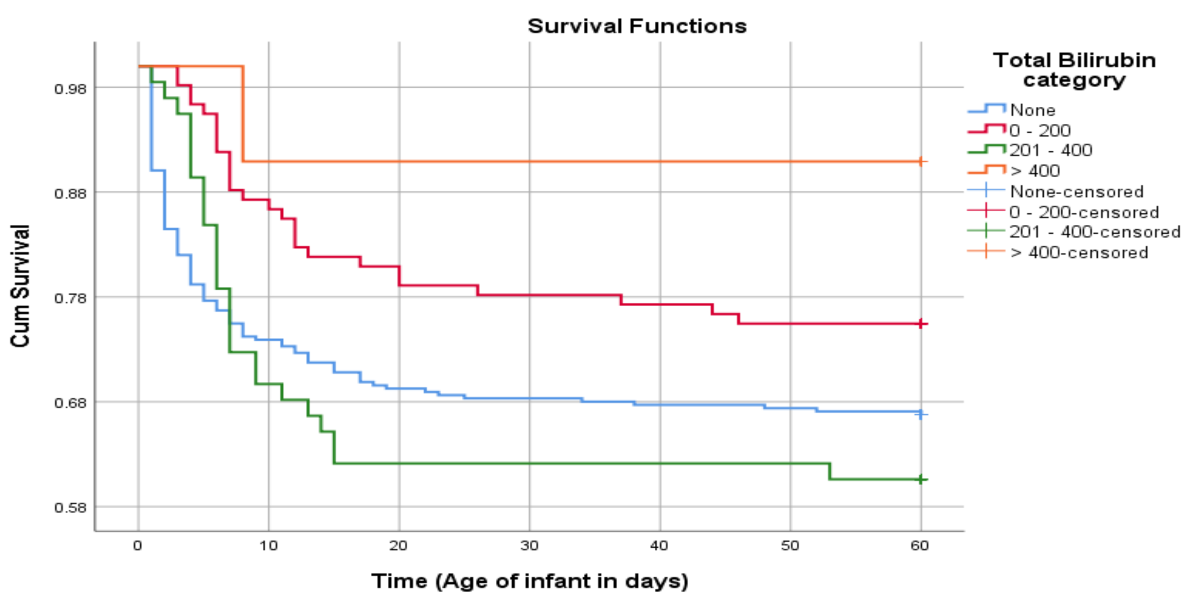


*Figure 4.4.2.4. Kaplan Meier graph of total bilirubin treatment on survival rate*

**APGAR score on the survival rates**

*APGAR score at 1-minute and 5-minutes:* The results also concluded that the lower the APGAR score the lower the chance of infant's survival, the higher the Apgar score the higher the chance of infant's survival. This was confirmed on Table 4.4.2.5 and Table 4.4.2.6 with 44.9% and 45.2% survival rate at 0-3 Apgar score at 3- minute and 5-minutes categories respectively. The study revealed that there is a significant correlation between both Apgar scores (at 1minute and 5 minutes) and the survival rate (sig. 0.0001< 0.05).

Table 4.4.2.5 Survival rate according to Apgar score at 1 minute

| APGAR Score 1M category | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| Low (0 - 3) | 69 | 38 | 31 | 44.9% |
| Medium (4 - 6) | 148 | 45 | 103 | 69.6% |
| Normal (7 - 10) | 270 | 65 | 205 | 75.9% |
| Overall | 487 | 148 | 339 | 69.6% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 29.278 | 2 | 0.0001 | |

Table 4.4.2.6 Survival rate according to Apgar score at 5 minutes

| APGAR Score 5M category | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| Low (0 - 3) | 42 | 23 | 19 | 45.2% |
| Medium (4 - 6) | 67 | 33 | 34 | 50.7% |
| Normal (7 - 10) | 378 | 92 | 286 | 75.7% |
| Overall | 487 | 148 | 339 | 69.6% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| Log Rank (Mantel-Cox) | 38.115 | 2 | 0.0001 | |

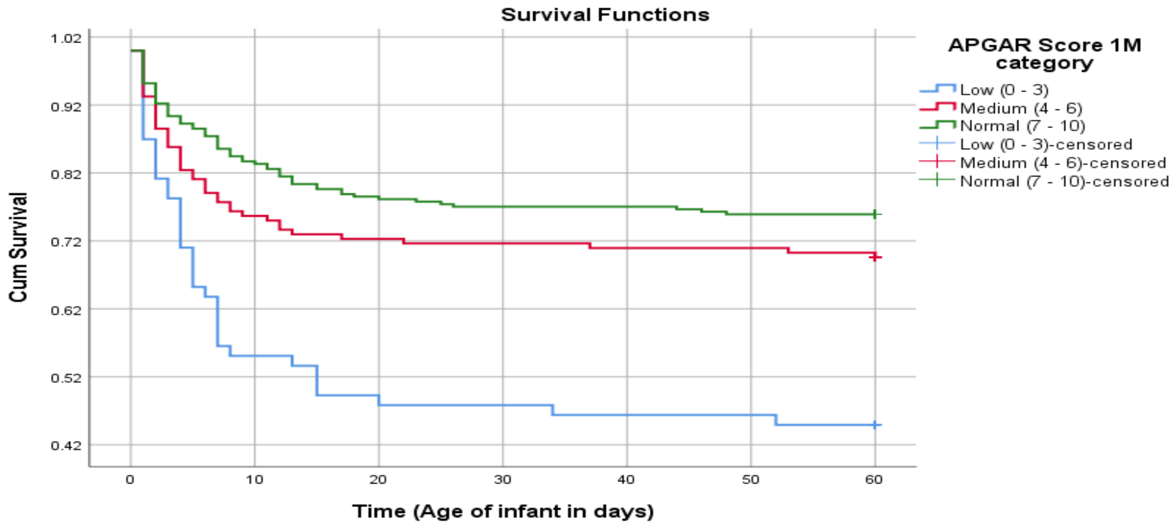


*Figure 4.4.2.5 Kaplan Meier graph of Apgar score on survival rate*

Figure 4.4.2.5 indicated that from day 2 the premature and critically sick new-born sick babies with normal Apgar score (7-10/10) had a better chance of surviving.

Table 4.4.2.7 Apgar score statistics

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **APGAR Score 1M category** | Low (0 - 3) | 38 | 55.1% | 31 | 44.9% | 69 | 14.2% |
| | Medium (4 - 6) | 45 | 30.4% | 103 | 69.6% | 148 | 30.4% |
| | Normal (7 - 10) | 65 | 24.1% | 205 | 75.9% | 270 | 55.4% |
| **APGAR Score 5M category** | Low (0 - 3) | 23 | 54.8% | 19 | 45.2% | 42 | 8.6% |
| | Medium (4 - 6) | 33 | 49.3% | 34 | 50.7% | 67 | 13.8% |
| | Normal (7 - 10) | 92 | 24.3% | 286 | 75.7% | 378 | 77.6% |

The mean Apgar score at 1 minute and 5 minutes were 5.37 (deceased), 6.75 (survivors) and 6.87 (deceased), 8.12 (survivors respectively (see Table 4.4.2.8)

Table 4.4.2.8 Apgar score mean

| | **Child is alive** | Mean | Minimum | Maximum | Standard Deviation | Mode |
|---|---|---|---|---|---|---|
| **APGAR Score 1M** | No (Dead) | 5.37 | 0.00 | 9.00 | 2.47 | 8.00 |
| | Yes (Discharged) | 6.75 | 0.00 | 10.00 | 2.09 | 8.00 |
| **APGAR Score 5M** | No (Dead) | 6.87 | 0.00 | 10.00 | 2.69 | 9[a] |
| | Yes (Discharged) | 8.12 | 0.00 | 10.00 | 2.31 | 9.00 |

**Phototherapy intervention on the survival rates**

From Table 4.4.2.9 and Figure *4.4.2.6,* one can observe that the phototherapy intervention yielded 71.7% success rate (132 out the 184) on infants who required the treatment. However, the intervention did not correlate with the survival rate (sig: 0.112> 0.05)

Table 4.4.2.9 Survival rate according to Phototherapy

| | | | **Survived** | |
|---|---|---|---|---|
| **Phototherapy** | **Total N** | **Died** | **N** | **Percent** |
| **None** | 325 | 109 | 216 | 66.5% |
| **Yes** | 184 | 52 | 132 | 71.7% |
| **Overall** | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| **Log Rank (Mantel-Cox)** | 2.520 | 1 | 0.112 | |

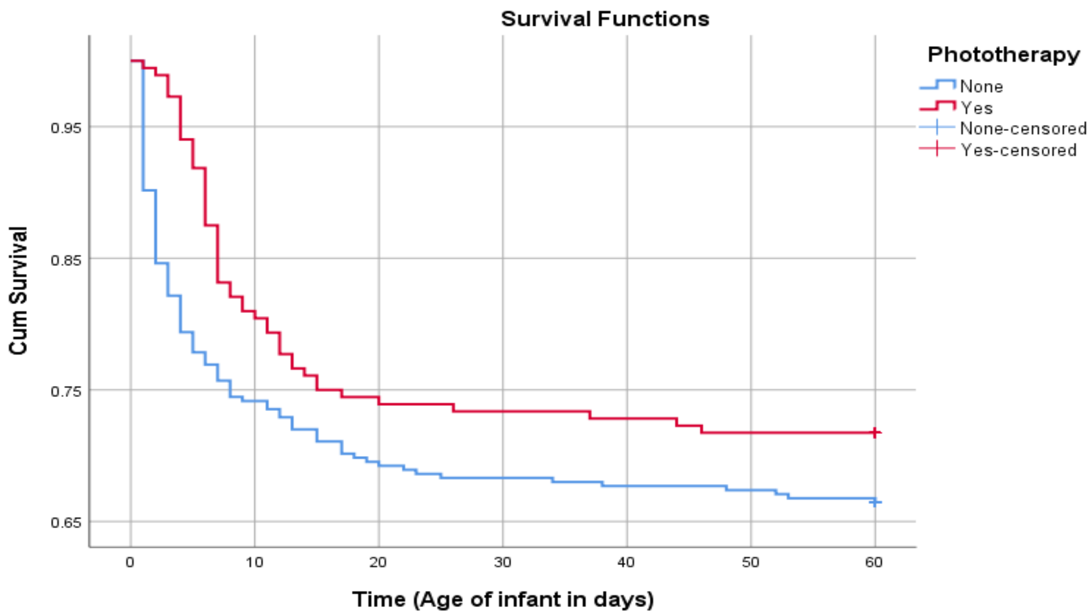


*Figure 4.4.2.6. Kaplan Meier graph of Phototherapy intervention on survival rate*

**CPAP intervention on the survival rate**

The CPAP intervention yielded 66.1% success rate (256 out the 387) on infants who required the treatment. However, the intervention did not correlate with the survival rate (sig: 0.0722> 0.05) (*see on Table 4.4.2.10 and Figure 4.4.2.7)*

Table *4.4.2.10* CPAP intervention

| CPAP | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| **None** | 122 | 30 | 92 | 75.4% |
| **Yes** | 387 | 131 | 256 | 66.1% |
| **Overall** | 509 | 161 | 348 | 68.4% |
| Overall Comparisons | | | | |
| | Chi-Square | df | Sig. | |
| **Log Rank (Mantel-Cox)** | 3.248 | 1 | 0.072 | |

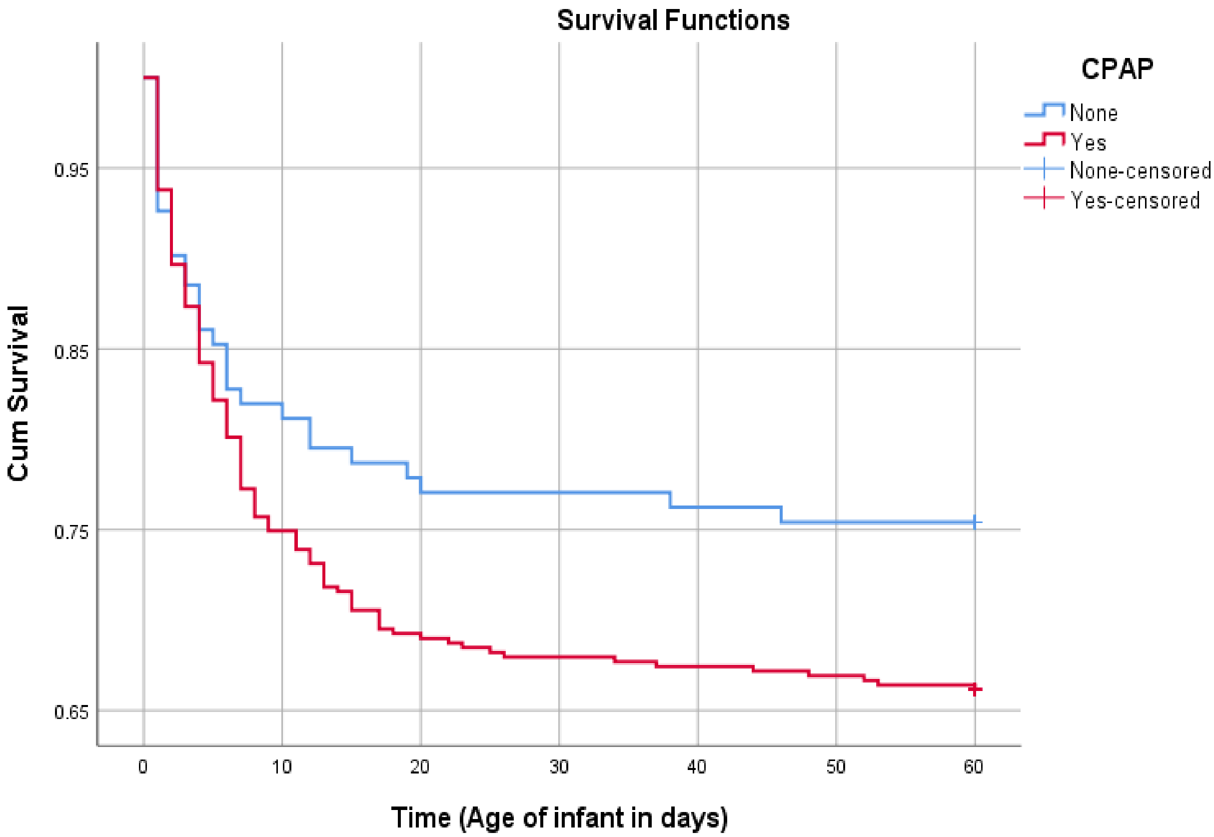


*Figure 4.4.2.7. Kaplan Meier graph of CPAP intervention on survival rate*

**Antibiotic as a perinatal intervention**

Out of 509, 37.3% of babies admitted in NICU were given the first line antibiotics categories (L1) (***see table 4.4.2.11 for Antibiotic categories and table 4.4.2.12 for antibiotic given***). The individual results for all categories were as follow: First line antibiotics 67.9% (n=190) survivors, second line antibiotics (L2) = 64.4% (n=45), third line antibiotics (L3) 50% (n=2), L1 + L2 = 63.5% (n=85), L2 + L3 = 71.4% (n=7). Combination of L1 + L3 categories and L1 + L2 + L3 categories had 33.3% (n=3) and 56.7% (n=30) respectively. The highest survival rate was observed on infants given L1 category of antibiotics with 67.9%.

Table 4.4.2.11 Antibiotic categories

| **Categories** | Antibiotic given |
|---|---|
| **First line Antibiotics (L1)** | Pen G & Gent |
| **Second line Antibiotics (L2)** | Amp & Amik |
| **Third line Antibiotics (L3)** | Mero & Vanco |
| **L1 + L2** | Pen G + Gent & Amp + Amik |
| **L2 + L3** | Amp + Amik & Mero + Vanco |
| **L1 + L3** | Pen G + Gent & Mero + Vanco |
| **L1 + L2 + L3** | Pen G+ Gent; Amp + Amik; Mero + Vanco |
| **Others** | Unknown, None, Gent, Amikacin, Pen G only |

Table 4.4.2.12 Survival rate according to antibiotic given

| Antibiotic given to infants | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| Others | 147 | 35 | 112 | 76.2% |
| First line Antibiotics (L1) | 190 | 61 | 129 | 67.9% |
| Second line Antibiotics (L2) | 45 | 16 | 29 | 64.4% |
| Third line Antibiotics (L3) | 2 | 1 | 1 | 50.0% |
| L1 + L2 | 85 | 31 | 54 | 63.5% |
| L2 + L3 | 7 | 2 | 5 | 71.4% |
| L1 + L3 | 3 | 2 | 1 | 33.3% |
| L1 + L2 + L3 | 30 | 13 | 17 | 56.7% |
| Overall | 509 | 161 | 348 | 68.4% |

Overall Comparisons

| | Chi-Square | df | Sig. |
|---|---|---|---|
| Log Rank (Mantel-Cox) | 7.948 | 7 | 0.337 |

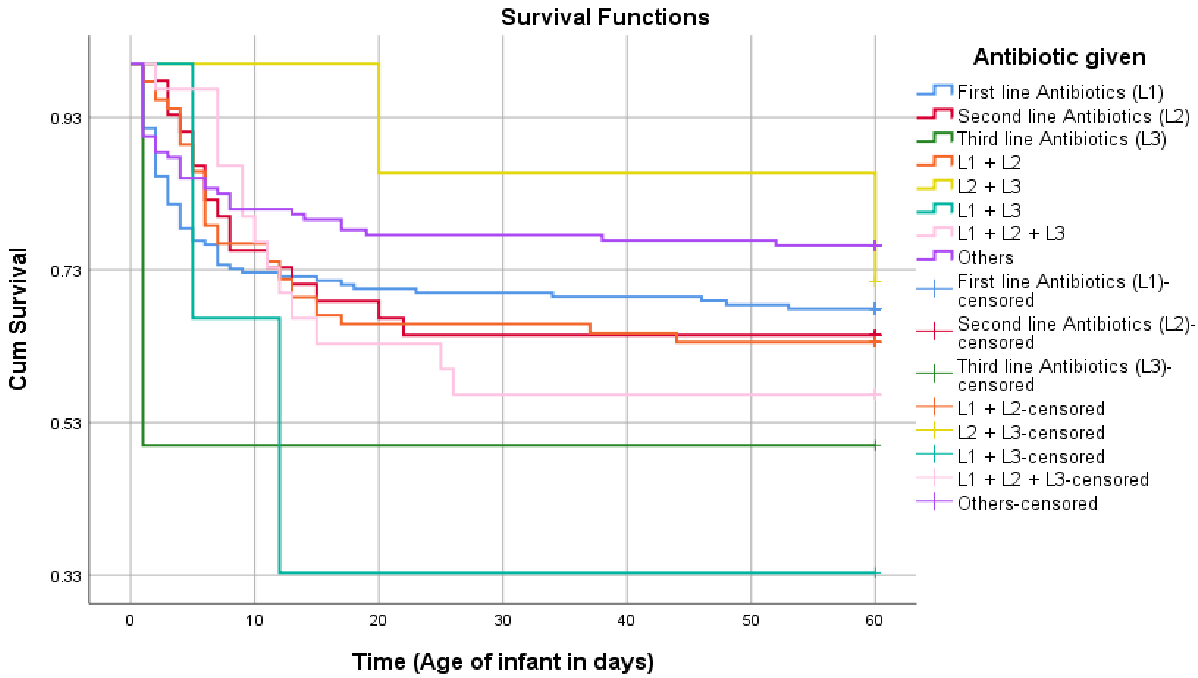


*Figure 4.4.2.8 Kaplan Meier on antibiotic given*

Figure *4.4.2.8* above of the Kaplan Meier illustrate that from 0 day up to 20 days, infants given a combination of L1 + L3 had a higher chance of surviving hence the intervention did not correlate with the survival rate (sig: 0.337> 0.05).

Table 4.4.2.13 Survival rate according to CRP (mg/l)

| | **Child is alive** | Mean | Minimum | Maximum | Standard Deviation | Mode |
|---|---|---|---|---|---|---|
| **CRP in mg/l** | No (Dead) | 40.63 | 0.10 | 305.00 | 72.26 | 0.20 |
| | Yes (Discharged) | 24.86 | 0.10 | 288.40 | 49.21 | 0.20 |

It is evident from table 4.4.2.13 above that the majority of infants died had high CRP mean of 40.63 mg/l deceased and 24.86 mg/l mean for survivors, (ranges: 0.1 – 305 mg/l for deceased and 0.1 – 288 mg/l for survivors).

### 4.5 Confounding factors (distance) on survival rate of premature and critically sick new-born babies

Table 4.5.1 Survival rate according to Location of delivery.

| Location of delivery | Total N | Died | Survived | |
|---|---|---|---|---|
| | | | N | Percent |
| Erongo | 25 | 8 | 17 | 68.0% |
| Hardap Region | 16 | 4 | 12 | 75.0% |
| //Kharas Region | 10 | 3 | 7 | 70.0% |
| Kavango East Region | 4 | 2 | 2 | 50.0% |
| Kunene | 5 | 2 | 3 | 60.0% |
| Khomas | 397 | 119 | 278 | 70.0% |
| Omaheke | 10 | 5 | 5 | 50.0% |
| Oshana | 2 | 2 | 0 | 0.0% |
| Oshikoto | 1 | 1 | 0 | 0.0% |
| Otjozondjupa | 37 | 14 | 23 | 62.2% |
| Zambezi | 2 | 1 | 1 | 50.0% |
| Overall | 509 | 161 | 348 | 68.4% |

Overall Comparisons

| | Chi-Square | df | Sig. |
|---|---|---|---|
| Log Rank (Mantel-Cox) | 11.062 | 10 | 0.353 |

As indicated on table 4.5.1, the overall survival rate for all regions was 68.4%, Hardap region had the highest percentage survival 75% (n=16) followed by //Kharas and Khomas, 70% (n=10) and 70% (n=397) respectively. Individual percentage for each region are: Erongo 68% (n= 25), Hardap 75% (16), //Kharas 70% (n= 10), Kavango

East 50% (4), Kunene 60% (n= 5), Khomas 70% (n= 397), Omaheke 50% (n=10), Oshana 0.0% (n= 2), Oshikoto 0.0% (n=1), Otjozondjupa 62.2% (n=37) and Zambezi 50% (n=2). There was no significance comparison on test of equality of survival distributions for the different regions (sig = 0.337, >0.05).

Table 4.5.2 Distance and how long it takes from district hospitals to WCH NICU (courtesy of Google map)

| Regions | Location | Distance (KM) | Time (in hours, minutes) |
|---|---|---|---|
| Erongo | Omaruru | 207.6 | 2h9 min |
| | Swakopmund | 352.4 | 3h38 min |
| | Usakos | 215.8 | 2h16 min |
| | Walvis Bay | 395.5 | 4h6 min |
| Hardap | Mariental | 268 | 2h36 min |
| | Rehoboth | 93 | 1h3 min |
| //Kharas | Karasburg | 709.2 | 6h33 min |
| | Keetmanshoop | 498.1 | 4h35 min |
| | Luderitz | 684.1 | 7h36 min |
| Kavango | Rundu | 715 | 6h41 min |
| Kunene | Khorixas | 449.5 | 4h13 min |
| | Opuwo | 732.4 | 6h48 min |
| | Outjo | 316.7 | 2h58 min |
| Khomas | Groot Aub | 56.3 | 0h45 min |
| Omaheke | Gobabis | 212.1 | 2h25 min |
| Oshana | Oshakati | 711.8 | 6h59 min |
| Oshikoto | Tsumeb | 432.1 | 4h5 min |
| | Okaukuejo | 433.2 | 4h11 min |
| Otjozondjupa | Grootfontein | 458 | 4h18 min |
| | Okahandja | 72 | 0h45 min |
| | Okakarara | 293 | 2h45 min |
| | Otjiwarongo | 250.5 | 2h22 min |
| Zambezi | Katima Mulilo | 1225.5 | 11h36 min |

As indicated in the table 4.5.2, the farthest referring hospital is Katima Mulilo followed by Opuwo and Oshakati district hospitals.

### 4.6 Causes of death in premature and critically sick new-born babies

Table 4.3 indicated that most infants died due to blood disease e.g. hypoglycaemia (n=155) followed by congenital malformations and digestive system problems e.g Necrotizing enterocolitis (**NEC**) (n=137). It is worth observing that only 71 infants died due to prematurity and breathing problems.

Table 4.6.1 Survival rate according to Causes of death

| | | | No (Dead) | | Yes (Discharged) | | Total | |
|---|---|---|---|---|---|---|---|---|
| | | | Count | % | Count | % | Count | % |
| **Causes of death** | **Breathing and prematurity problems** | No | 71 | 16.9% | 348 | 83.1% | 419 | 82.3% |
| | | Yes | 90 | 100.0% | 0 | 0.0% | 90 | 17.7% |
| | **Infections (Viral and bacterial)** | No | 118 | 25.3% | 348 | 74.7% | 466 | 91.6% |
| | | Yes | 43 | 100.0% | 0 | 0.0% | 43 | 8.4% |
| | **Congenital malformations and digestive systems problems** | No | 137 | 28.2% | 348 | 71.8% | 485 | 95.3% |
| | | Yes | 24 | 100.0% | 0 | 0.0% | 24 | 4.7% |
| | **Cardiac disease, nervous system and other conditions** | No | 116 | 25.0% | 348 | 75.0% | 464 | 91.2% |
| | | Yes | 45 | 100.0% | 0 | 0.0% | 45 | 8.8% |
| | **Blood conditions** | No | 155 | 30.8% | 348 | 69.2% | 503 | 98.8% |
| | | Yes | 6 | 100.0% | 0 | 0.0% | 6 | 1.2% |

### 4.7 Conclusion

Data presentation and analysis were presented in this chapter. The results indicate that, there is an enormous reduction in survival rate in low GA (<31 weeks) and low birth weight (Birth weight of <1500g). This was also confirmed on the Kaplan Meier analysis estimator. The results concluded that location of delivery and mode of delivery can have a negative impact on the survival rate of premature and critically sick new-born babies. Other factors such as antibiotic given, and resuscitation given can also reduce the survival rate of premature and critically sick new-born babies.

# CHAPTER 5

## DISCUSSION

### 5.1 Introduction

The previous chapter focused on the analysis and presentation of the results, concerning the survival rate of premature and critically sick new-born infants admitted at WCH NICU.

In this chapter the research findings are discussed, conclusions are drawn based on these findings, from which recommendations for further practice and research are formulated. The study was meant to address the following objectives:

(a) To investigate the number of neonates admitted and treated in the Neonatal Intensive Care Unit according to life status at birth, gender, mode of delivery and survival rate from January 2018 to December 2018;

(b) To analyse the impact of gestational age and birth weight on survival rate of all neonates admitted to the Neonatal Intensive Care Unit;

(c) To analyse the effect of medical interventions given to infants on the survival rate of premature and critically sick new-born neonates admitted and treated at the Windhoek Central Hospital Neonatal Intensive Care Unit;

(d) To analyse the effect of medical risk factors, confounding factors and obstetrical factors on the survival rate of neonates.

### 5.2 Life status on birth, gender, mode of delivery and survival rate

The study's results indicated that the total number of infants admitted at WCH NICU from 1st January 2018 to 31st December 2018 were five hundred and nine (509). The high number of admission point out that premature and critically sick new-born birth is a huge concern in Namibia, the results concurred with the findings of WHO (2012) which reported that prematurity birth is a global problem and more than 60% of preterm births occur in Africa and South Asia, this is because these are lower-income countries. Out of 509, 68.4% of premature and critically sick new-born infants admitted at WCH-NICU survived, while 31.6% did not survive, the reason for 31.6% death can be attributed to lack of experienced paediatricians and neonatal staff in the NICU. The analysis results indicated that there are only 5 qualified paediatricians in the unit attending to a monthly admission of 30 – 45 infants. This is an indication that there is a shortage of experienced paediatricians and this might have a negative impact on the survival of these premature and critically sick new-born babies. A study by Mdala & Mash (2015) concluded that to improve the survival of under-five infants one needs experienced staff in maternity and neonate's units.

The total number of female infants were 231 (45.4%) to 278 (54.6%) males' infants admitted in the ward. There was no statistical association between the survival rate based on gender, 68.4% and 68.3% survival for female and male respectively. The analysis was conducted using chi-square analysis and there was no statistically significant difference between the two genders. Shim, Cho, Kongo, & Park (2017) had similar findings on their analysis that there is no significant difference on the mortality of infants based on their gender.

Meanwhile, a study by Ibrahimou, Kodali & Salihu, (2015) specified that caesarean sections intensified the risk of all types of infant deaths. The study pointed out that caesarean sections associated with high rate of mortality. On a contrary, the current analysis results indicated that 76.4% (n=233) of infants born via caesarean survived compared 62%, (n=274) born via normal vaginal delivery. There are several possible explanations for the higher number of survival on caesarean sections birth compared to normal vaginal delivery which can be: 1) Some of the premature and critically sick new-born babies born via normal vaginal delivery are self-induced delivery, this can be due to any gynaecological, medical, or other causes during pregnancy. This was confirmed from the paediatricians in the ward that the self-induced delivery can be an explanation to the lower survival rate in normal vaginal delivery. Even though these infants were born through NVD, in most cases they have a low birth weight due to self-induced birth (abortion) and the Low birth weight is the major leading cause of infant and child mortality. Our results indicated that 165 babies had a low birth weight (birth weight of < 1500 g, see Table 4.2.2 Weights at birth). 2) Some of these NVD born infants were born with life-threatening birth defects such as gastrointestinal, heart and lung conditions, as well as other complex diseases that can reduce their chances of surviving. As indicated in Table 4.6.1 (Survival rate according to Causes of death), 137 babies died due to birth defects conditions. 3)While some of the NVD infants were born at home (BBA-Born Before Arrive) with no proper resuscitation and by the time the infants reach the hospital it will be too late to resuscitate them. The medical personnel can try to save them but it will be too late. 4) Other factor can be, a non-survivors born via

NVD as a referral from district hospital (outside Khomas), analysis results (as presented on Table 4.5.1) show that around 50% of referred infants did not survive.

## 5.3 The impact of gestational age and birth weight on survival rate

### *5.3.1 Birth weight*

Low birth weight is the leading cause of infant mortality. According to the analysis results, a low survival rate was observed on infants with the birth weight < 900 g. The highest survival rate (85.2%) was observed in full term babies (birth weight of >2500 g). Our findings are consistent with the findings by Luthuli & McKerrow (2019) analysis that concluded that the highest survival rate (72.7%) was observed in babies with a birth weight of >900 g. The weight of an infant during childbirth is the most generally utilized result proportion of pregnancy, ordinarily explored in epidemiological investigations, and is broadly connected with mortality and morbidity risks of new born children (Amosu, 2014).

It is worth mentioning that the seventy-five percent survival rate obtained on extremely low birth weight is due to low sum of events (n = 4, 1 infant die and 3 survived), this does not necessary mean that the survival rate is high. Other factor that can affect the survival of infants in the perinatal care, is the lack of basic care for the infants. The researcher is of the opinion that the basic care of infants will be compromised due to overcrowded of the unit (31 beds, admit 30 – 45 infants monthly) which can result in infections risks e.g. nosocomial infections to infants (. Martines et al. (2015) concluded that the availability of skilled care during childbirth and family/community-based care through postnatal home visits to improve the survival rate of premature and critically sick new-born babies.

Furthermore, our study results concurred with the results for a study by Luthuli & McKerrow, (2019) indicated that the survival rate of Extremely Low Birth Weight (ELBW) babies tend to escalate with increase in gestational age and birthweight. The study also emphasized that the mode of delivery, 5-minute Apgar score and time to admission were not associated with an increased survival rate of ELBW neonates. As per Table 4.2.2 the babies with low birth weight had a lower chance of survival.

#### *5.3.2 Gestational age*

Gestational age is the best indicator of prematurity. Our analysis results indicated that the majority of extremely premature infants (GA- <25 weeks) died (25.7% survivors and 74.3% non-survivors. This concurs with the literature by Blencowe et al. (2013), that concluded that the lower the gestational age, the lower the chance of the baby to survive. By using gestational age, prematurity can be further sub-divided into extremely premature (<28 weeks), very premature (28 - 32 weeks) and moderate or late premature (32 - 37 completed weeks) (Quinn, et al. 2016). From the analysis results, one can see that the rate of survival increases as the gestational age increase, very premature, 42.5% (25 – 32 weeks); Moderate premature 22.2% (32 – 37 weeks); Premature 20.4% (37 – 39 weeks) and full term 14.8%. Our conclusion is consistent with Ibrahimou, Kodali, & Salihu (2015) conclusion that indicated that the death rate for premature babies increase proportionally with declining gestational age or birth weight and that makes gestational age and birth weight a good indicator of survival rate of premature babies.

The analysis results are also in line with the findings from a study by Patel et al. (2015), which concluded that approximately one in four extremely premature infants born at 22 to 28 weeks of gestation do not survive the birth hospitalization; mortality rate decrease with each additional week of completed gestation. The low survival rate in infants with low gestational age is instigated due to conditions such as congenital anomalies, asphyxia, or sepsis, (see Table 4.6.1) which could also cause death in full term infants. Due to their medical condition, very premature and critically sick new-born babies' stays longer in the hospitals and this will result on infants acquiring nosocomial infections in the ward. Nosocomial infections can be as a result of overcrowded, our analysis results confirmed that, only 31 beds in WCH-NICU which cater for 30 – 45 infants per month. The observed trend is similar to that of comparable study by Luthuli & McKerrow (2019) in which survival rates were also reported to improve with increasing gestational age and birth weight.

Furthermore, Resende et al. (2015) indicated that premature and critically sick new-born babies in developing countries are at high risk of acquiring infections due to overcrowded neonatal wards. Our results concurred with Resende et al. (2015) since majority infants (118 death) died due to infections as a third causes of death following congenital malformations and digestive system (137 death) and blood conditions (155 death). The results indicated that the infections were mostly acquired in the NICU due to overcrowd in the unit (31 beds accommodating 30-45 infants monthly). The fact that the majority of infants died had high CRP results shows that the infections were acquired in the Unit (Table 4.4.2.13).

## 5.4 Reason for admission

The majority of infants admitted were due to severe prematurity and breathing problems (see Table 4.3.1). This is a clear indication that most of the babies' organs were still under-develop, the most common problems in premature and critically sick new-born babies is a lung problem and this is because they are not fully developed resulting in respiratory distress syndrome (RDS). Premature babiesdevelop RDS when the lungs do not produce sufficient amounts of surfactant. This is a substance that keeps the tiny air sacs in the lung open. As a result, a premature often has difficulty expanding their lungs, taking in oxygen, and getting rid of carbon dioxide. Apnea is when a baby stops breathing for more than 15 seconds. Apnea may be accompanied by a slow heart rate called bradycardia. Hoque, Haaq, & Islam (2015) concluded that prematurity, low birthweight and neonatal infection are the leading cause of neonatal hospitalisation. Critically sick new-born babies' contribute to other factors such as digestive and congenital problems; blood problems (metabolic or electrolyte disturbances such as hypoglycaemia, thrombocytosis, hyperbilirubinaemia and hypoglyceamia etc.); cardiac, nervous system and infections (viral or bacterial infection) which were also observed as reasons for admission. Intrestingly, observation of atresia (duodenal or oesphagael atresia) abnormality was noted as main reason of admission in full term babies. Atresia is an absence of a normal opening, or failure of a structure to be tubular. Atresia can affect many structures in the body. For example, esophageal atresia is a birth defect in which part of the esophagus is not hollow, and with anal atresia, there is no hole at the bottom end of the intestine.

## 5.5 Maternal factors on survival rate

Gravidity (Gravida) is defined as the number of times that a woman has been pregnant. Parity (Para) is defined as the number of times that she has given birth to a fetus with a gestational age of 24 weeks or more, regardless of whether the child was born alive or was stillborn. Seventy-three percent of infants died are those ones from mothers who carried more than 2 pregnancies (gravida), the range was from 1 – 9 pregnancies. While for para it was discovered that most infants who died were from mothers who have 1 – 2 survived infants. The mean gravida on survivors was 2.47 while on non-survivors was 2.70 with a mode of 1 in both cases, this indicate that there is a significance between the number of pregnancies conceived and delivered to the survival of the unborn infant. The higher the number of pregnancies, the greater the risk for early birth which result in premature and critically sick new-born birth. A study by Luthuli & McKerrow (2019) indicated that babies born to prim gravida women had a 51.7% survival rate. Each additional baby a woman carries during her pregnancy increases the possibility of developing pregnancy complications.

The analysis indicated that there was higher survival rate of infants from HIV negative mother (72.4 %) compared to infants of HIV positive mothers (57.4%). While survival rate of infants from Hepatitis B (70.5%) and RPR (70.9%) negative mothers, were lower compared to infants of Hepatitis B (78.3%) and RPR (75.0 positive mothers. Fascinatingly, there are statistical association between the survival rate and HIV status of the mother (sig. = 0.0001< 0.05), Hepatitis B and RPR status to the survival rate (sig. = 0.013 and 0.009 < 0.05). This can be attributed to the fact that infants from the HIV positive mothers are being monitored closely for appropriate growth and neurodevelopment, as well as signs of perinatal exposure to HIV virus and other infectious diseases. The other reason for low survival rate in HIV positive mothers can be due to the fact that, these infants (infants from HIV positive mothers) are given prophylaxis at 24-48 hours to prevent them from HIV virus from their mothers, these prophylaxes can be harmful to the infants, can end up causing NEC and suppress their immune system and this will lead to infants attain nosocomial infection and eventually die.

The Hepatitis B virus (HBV) can cause acute and chronic liver infections. It is transmitted through infected blood products, unprotected sex, infected items such as needles, razor blades, dental or medical equipment, unscreened blood transfusions, or from mother to child at birth. The higher survival of infants from Hepatitis B positive can be due to the fact that there is a policy on Hepatitis B eradication by WHO (2016) which stated that all adults, adolescents and children with Hepatitis B and clinical evidence of compensated or decompensated cirrhosis (or cirrhosis based on APRI score >2 in adults) should be treated, regardless of ALT levels, Heptitis B surface Antigen (HBeAg) status or HBV DNA levels. Treatment is recommended for adults with CHB who do not have clinical evidence of cirrhosis (or based on APRI score ≤2 in adults), but are aged more than 30 years (in particular), and have persistently abnormal ALT levels and evidence of high level HBV replication (HBV DNA >20 000 IU/mL), regardless of HBeAg status.

A Rapid Plasma Reagin (RPR) test is a blood test used to screen for syphilis. Syphilis is a contagious infection caused by the bacterium *Treponema pallidum* that can result in fetal death, or multiple organ problems. It can also affect the ears, eyes, liver, bone marrow, skin, bones, and heart of the fetus. Syphilis is a leading cause of premature and critically sick new-born birth, low birth weight, congenital syphilis infection, or neonatal death. Factors that can cause the infants from Syphilis positive mothers to have a higher chance of surviving can be due to the factor that the study was not based on RPR positive group therefore the number of events were few. Smith, et al (2012) concluded that premature and critically sick new-born babies at 22 – 24 weeks are at high risk of acquiring retinopathy of prematurity, late-onset sepsis, severe intraventricular hemorrhage, periventricular leukomalacia, necrotizing enterocolitis, and bronchopulmonary dysplasia. The higher survival rate has attributed to the Millennium Development goal 4 which is to reduce infant mortality rate of 0-1 year old per 1000 live birth.

According to the MoHSS Strategic Plan-2017/2018 – 2021/2022, maternal health or safe motherhood, newborn care and prevention of Mother-to-Child transmission of HIV and syphilis. A total of 333 (94%) out of 355 health facilities are providing PMTCT country-wide, and 87% of all births occurred in the health facility while 88% of births are attended to by a skilled birth attendant. The mother to child transmission rate of HIV has decreased from 13% in 2012 to 3% in 2017. In line with WHO recommendations, lifelong ART for PMTCT (OPTION B+) for all HIV positive pregnant and breastfeeding women was introduced in 2014 and has rapidly scaled up. Child Health success covers improvement in areas such as stillbirths' rate, Neonatal Mortality rate (NMR), Infant mortality rate (IMR), Under Five Mortality rate and Expanded Programme on Immunization (EPI).

### 5.6 Impact of Medical treatments received by mother on survival rate

There were small number of women who reportedly received antenatal steroids (9.43%) may be due to poor record-keeping, which could have affected the analysis because the alternative in the records is unknown.

Our analysis results indicated that 66.7% (n=66) infants of mothers who were vaccinated all Tetanus Toxoid (up to TT5) survived. Obtaining complete Tetanus vaccination produce protective antibody levels in more than 80% of recipients after two doses. However, the researcher is of opinion that some maternal immunizations were not recorded, and this will have a negative impact on the conclusion of results.

### 5.7 The perinatal interventions

The act of resuscitation ensures that an infant will have all his necessary breathing functions performed for them when it is needed. The administration of oxygen therapy, suction to remove unwanted secretions, and ventilation to enable lung expansion is not uncommon during resuscitation, these are some of the resuscitation methods used to help the infants. The statistics results show that 36.2% (n = 177) ventilated babies survived compared to 63.8% non-ventilated babies died. This does not mean that the treatment is harmful to the babies, it purely means that the ventilated ones are more critically sick babies and are treated with these extreme measures and therefore will obviously have higher mortality rates than those that did not need the same level of treatment. The babies that are administered on ventilator are those that are in a very critical condition and/ or severely premature, most of their organs, including the lungs, are under-developed and not mature enough to survive life outside the womb. In that case, they are prone to acquire infection which will lead to their death. The other factor can be that, these are the infants in critical conditions (high death risks) that were referred from district hospitals, it could be that during transportation to WCH-NICU, there were no proper resuscitation and basic care and by the time the infants reach the NICU, they are already in a critical condition.

The need for intubation and positive pressure ventilation is associated with so-called ventilator-induced lung injury which can result in neonatal sepsis (infection). A study by Carvalho, Silveira, & Procianoy, (2013) indicated that the use of mechanical ventilator can cause bronchopulmonary dysplasia in premature and critically sick new-born babies therefore Non-invasive ventilation techniques (NIVT) concluded to be more safe compare to mechanical ventilator. Our analysis results did not indicate which ventilator was used therefore the above findings cannot be proven.

The analysis results demonstrate that 60.1% (n=278) infants given oxygen survived, while the 48.5 %( n=101) given surfactant did not survive. The high survival in infants given oxygen could be as a result of mild Respiratory distress syndrome, (breathing problems) and once given oxygen in most case they recover. A below 50% survival in infants given surfactant can be due injury caused during intubation. Thus the use of surfactant can also cause injury during intubation that can result on neonatal sepsis, hence the survival in that category decrease. WCH NICU has the accommodation capacity of 31 beds and admit 30 – 40 infants per month, due to overcrowding of the unit, neonatal sepsis will be difficult to control.

A sixty percent on survival of premature and critically sick new-born babies given oxygen can be explained as to that majority of infants had a mild Respiratory Distress Syndrome and after given oxygen, it was resolved hence a higher survival noted. A significant correlation between the administering of oxygen on premature and critically sick new-born babies and the survival rate was observed (sig. $0.0001 < 0.05$). The correlation noted indicate that oxygen administering can have a positive effect on survival rate of these critical babies.

Infant jaundice is yellow discoloration of a new-born baby's skin and eyes. Infant jaundice is a common condition, particularly in babies born before 38 weeks' gestation (preterm babies) and some breast-fed babies. Infant jaundice usually occurs because a baby's liver isn't mature enough to get rid of bilirubin in the bloodstream. Watchko & Maisels (2003) defined kernicterus as a macroscopic yellow staining of specific subcortical nuclei—for example, globus pallidus, subthalamic nuclei, and brainstem cranial nuclei and microscopic evidence of neuronal damage in those nuclei. An increase on survival rate on premature and critically sick new-born babies with Total Serum Bilirubin (TSB) in our study proves that there is no significant correlation between the different level of bilirubin and the survival rate (Table 4.4.2.4). Bilirubin-related neurotoxicity can result in neonatal death or multisystem acute manifestations and long-term impairments, including irreversible athetoid cerebral palsy (CP), and speech, visuomotor, auditory, and other sensori-processing disabilities (Bhutani & Wong, 2013).

The results concluded that the lower the APGAR score the lower the chance of infant's survival, the higher the Apgar score the higher the chance of infant's survival. This was confirmed by 44.9% and 45.2% survival rate at 0-3 Apgar score at 3- minute and 5-minutes categories respectively. The mean APGAR score at 1-minute and 5-minutes in survivors and non-survivors were as follow: at 1-minute mean was 6.75 survivors and 5.37 non-survivors; at 5 minutes was 8.12 for survivors and 6.87 for non-survivors, meaning for the infants survived they had a higher Apgar score (ranges at 1 minute 0.00 – 9.00 survivors and 0.00 – 10.00, at 5 minutes 0.00 – 10.00 for both survivor and non-survivors). The analysis result is comparable with Hatupopi, (2016) that sixteen percent of neonates who died at the hospital under study had an Apgar score of 3–6/10 at 1 minute and remained the same at 5 minutes.

Phototherapy is a safe, effective method for decreasing or preventing the rise of serum unconjugated bilirubin levels and reduces the need for exchange transfusion in neonates. Phototherapy administration is given by assessing the risk based on bilirubin level as per the guidelines for all weights and gestational age. This help clinicians assess the risks toward the development of hyperbilirubinemia or jaundice in newborns over 35 weeks gestational age. Phototherapy is given when the Total Serum Bilirubin (TSB) level is greater than the appropriate reference range for neonate's gestation/weight and presence of risk factors. Therefore, the analysis results indicated that phototherapy as a form of intervention yielded 71.7% success rate (132 out the 184) on infants who required the treatment. However, the intervention did not correlate with the survival rate (sig: 0.112> 0.05). Increase in survival rate is an indication that phototherapy reduced bilirubin level in the blood and this prevent kernicterus. Phototherapy reduces the need and/or use of exchange transfusion and that both phototherapy and exchange transfusion can individually prevent kernicterus (Bhutani & Wong, 2013).

Analysis on infants that were given CPAP as a medical intervention indicated that, 66.1% (n=387) survived, the rest succumb mostly due to prematurity and breathing problems such as Respiratory Distress Syndrome (RDS). According to Polin, Papile, Kumar, & Benitz, (2014) the use of early CPAP with selective surfactant administration in extremely preterm infant's results in lower rate of death compared to treatment with early surfactant therapy.

The finding indicated that, 37.3% of babies admitted in neonate ward were given the first line antibiotics categories (L1). The individual results for all categories were as follow: First line antibiotics (L1) 67.9% (n=190) survivors, second line antibiotics (L2) 64.4% (n=45) survivors, third line antibiotics (L3) 50% (n=2) survivor, L1 + L2 = 63.5% (n=85) survivors, L2 + L3 = 71.4% (n=7) survivors. Combination of L1 + L3 categories and L1 + L2 + L3 categories had 33.3% (n=3) and 56.7% (n=30) respectively. The highest survival rate was observed on infants given L1 category of antibiotics with 67.9%. First-line antibiotics are first administered for diseases, and are usually chosen due to less side effects and high clinical effectiveness. Second line antibiotics are used when first-line drugs show no effect for the disease or when it is difficult to continue the treatment owing to the side effect. The high survival in that category (L1) indicated that the infants in that group did not have higher disease severity, therefore the recovery is high or the antibiotic given was effective. The decline in survival can be explained that, the more the clinicians step up with antibiotic administration, (increase from L1 to L2 or give combination of antibiotics), the lower the chances of infant to survive. A study by Esaiassen, Fjalstad, Juvet, Anker, & Klingenberg, (2017) indicated that administering of antibiotic in infants may disturbs the microbial flora colonizing the neonate due to several reasons, including higher risk of NEC and increased risk of other later infections and/or immune-related diseases secondary to a certain degree of immune suppression. The study results are consistent with the literature above since 137 out of 509 infants died due to congenital malformations and digestive systems, NEC included.

### 5.8 Confounding factors and obstetrical factors

Overall survival rate for all regions was 68.4% (Table 4.5.1, Hardap region had the highest percentage survival 75% (n=16) followed by //Kharas and Khomas, 70% (n=10) and 70% (n=397) respectively. Individual percentage for each region are: Erongo 68% (n= 25), Hardap 75% (16), //Kharas 70% (n= 10), Kavango East 50% (4), Kunene 60% (n= 5), Khomas 70% (n= 397), Omaheke 50% (n=10), Oshana 0.0% (n= 2), Oshikoto 0.0% (n=1), Otjozondjupa 62.2% (n=37) and Zambezi 50% (n=2). The researcher is of opinion that the high survival in Khomas region is due to high number of infants admitted are from Windhoek and mothers are nearby the hospital compare to other regions who are referring their babies to NICU. It's worth mentioning that the furthest referral points such as Oshana, Oshikoto, Kavango, Omaheke and Zambezi had lowest survival rates compare to the infants from Windhoek. However, infants' condition can deteriorate spontaneously (for example, pneumothorax), or equipment (for example, endotracheal tubes and intravenous lines) can be dislodged and this might have a undesirable results on the survival of the infant. By looking at the causes of death (Table 4.6.1), it is clear that most of the referred infants had blood problems (metabolic or electrolyte disturbances such as hypoglycaemia or thrombocytosis) and these are critically ill conditions therefore the chances for these babies to survive was very slim. Fluid and electrolyte balance is a key concept to understand for maintaining homeostasis, and for a successful treatment of many metabolic disorders. An electrolyte disorder occurs when the levels of electrolytes in your body are either too high or too low. Electrolytes need to be maintained in an even balance for your body to function properly.

### 5.9 Conclusion

The study revealed that the death rate for premature and critically sick new-born babies increase proportionally with declining gestational age or birth weight. Other factors such location of delivery, proper resuscitation, antibiotics and vaccine given and mother's maternal vaccination can increase the survival of infants if done properly. Perinatal factors such as administering of ventilator and surfactant reduced the survival rate of premature and critically sick new-born infants.

# CHAPTER 6

## CONCLUSION AND RECOMMENDATION

### 6.1 Introduction

The previous chapter focused on the discussion of the results. This chapter will look at the conclusion and recommendations where appropriate.

### 6.2 conclusion

The study revealed that the survival rate at Windhoek Central Hospital – Neonatal Intensive unit was 68.4% similar to the findings from comparable studies in other resource-limited settings.

The conclusion was drawn as per the study's objectives, from which recommendations for further practice and research are formulated.

a) A total of 509 infants were admitted in the ward from 1st January -31st December 2019. Male infants (54.6%) outnumbered female infants (45.4%) and the higher survival was observed with infants delivered through C-section (76.4%).
b) The analysis concluded that the lower the gestational age the lower the chance of infants to survive. It also concluded that infants with birth weight of < 1500 g has a lower chance of surviving.
c) This study also found that the gravida and para (multiple births) have a negative impact on the survival rate of premature and critically sick new-born infants. There were statistical association between the survival rate and the obstetrical factors such a HIV, Hepatitis B and RPR, meaning the infants from positive HIV, Hepatitis B or RPR (Syphilis) cannot have any negative impact on the survival of their infants because of the medial intervention to reduce these congenital infections and the effectiveness of policies in place to alleviate these mother to child infections. This study has revealed that maternal immunizations such as Tetanus Toxoid (TT) can have a positive impact on the survival of premature, infants from mothers administered withTT5 had a better survival chance. The study also concluded that some medical interventions such as ventilator and surfactant improved the survival of premature and critically sick new-born infants. The need for intubation and positive pressure ventilation is associated with lung injury which can result in neonatal sepsis and eventually can cause death. Therefore, required

skilled medical personals. The use of oxygen, phototherapy and CPAP yielded successful survival rates because majority of infants who received these medical interventions survived. The study concluded that the first line antibiotics were effective since more than 60% of infants administered first line antibiotics had survived.

d) The overall survival rate for infants from the furthest referral points was around 50%, compared to the local infants.

### 6.3 Recommendations

Based on this study, the following recommendations appear to be appropriate for the improvement of the survival rate in WCH NICU:

- There is a need for extending the WCH NICU to be able to accommodate more infants to avoid overcrowding in the ward, in this way it will reduce neonatal sepsis to provide quality health care.
- Ministry of Health and Social Services need to ensure that other health facilities that refer their critical premature and critically sick new-born infants to Windhoek central hospital has qualified paediatricians in their neonatal care ward. They must strengthen healthcare systems within the country, collecting workforce data to determine staffing ratios, neonatal outcomes, and supply and demand in order to have a well-educated workforce in the most needed areas.
- Ministry of Health and Social Services should develop a Nursery integrated set of technologies designed to combat the most common causes of newborn death and look out for effective health interventions for low-resource settings.
- To roll out a country wide awareness campaign on the prematurity and babies born with birth defect's survival
- There need to educate community about the consequences of birth at home
- There is a need to equip and build skilful human capacity capable of effectively running other referral centres. The study recommends that the Ministry of Health and Social Services should upgrade neonatal ward from district referring hospitals from far area such as Katima Mulilo, Oshakati and Keetmanshop in order to be able to attend to critical premature and extremely low birth weight infants,

- The study concluded that the first line antibiotics were effective since more than 60% of infants administered first line antibiotics had survival. However, this show that there is need to improve.

### 6.4 Limitations

A small number of women who reportedly received antenatal steroids (9.43%) may be due to poor record-keeping, can be a limiting factor since under reporting will not give you a true picture of what is happening, which could have affected the analysis because the alternative in the records is unknown.

There is no existing research on survival of premature and critically sick new-born babies in the WCH NICU in Namibia. The research problem was formulated based on the researcher's observations and a literature review consisting of studies done in other parts of the world. More research on survival of premature and critically sick new-born babies in NICU need to be done in Namibia to provide more local knowledge.

The information for the study was collected from public NICU in Windhoek. Although most women in Windhoek deliver in public hospital there is still a need to conduct a study that will capture participants from both public and private hospitals in Windhoek because there is a possibility that the survival rate of premature and critically sick new-born infants at private hospitals might be different from those who deliver in public hospitals. The other limitation is that it was difficult for the researcher to find the files because most of the files were stored in boxes in a very small room with no ventilation. Only one staff member working there, and this make it difficult or impossible to get the files if she is not around.

**Annexure A: Research approval letter from MoHSS**

**REPUBLIC OF NAMIBIA**

*Ministry of Health and Social Services*

Private Bag 13198
Windhoek
Namibia

Ministerial Building
Harvey Street
Windhoek

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**OFFICE OF THE PERMANENT SECRETARY**

**Ref:** 17/3/3 **SK**
**Enquiries:** Mr. J. Nghipangelwa

**Date:** 19 October 2017

**Ms. Selma N. Kashele**
**University of Science and Technology**
**Windhoek**

Dear Ms. Kashele

***Re: Analysis of survival rate of premature babies in Windhoek's state hospitals, Namibia.***

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**

3.1 The data to be collected must only be used for academic purposes;
3.2 No other data should be collected other than the data stated in the proposal;
3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects' should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
3.4 A quarterly report to be submitted to the Ministry's Research Unit;
3.5 Preliminary findings to be submitted upon completion of the study;
3.6 Final report to be submitted upon completion of the study;

3.7 Separate permission should be sought from the Ministry of Health and Social Services for the publication of the findings.

Yours sincerely,

**Andreas Mwoombola (Dr.)**
**Permanent Secretary**

PERMANENT SECRETARY MINISTRY OF HEALTH & SOCIAL SERVICES

*"Your Health Our Concern"*

# Annexure B: Data collection tool

**Antenatal risks**

| Last menstrual date | antenatal steroids given | Mode of delivery | | | Gravida | Para | Miscarriages/ stillbirths | smoker | non-smoker |
|---|---|---|---|---|---|---|---|---|---|
| | | Natural | Vacuum | C-section | | | | | |
| | | | | | | | | | |

**Booking blood and gestational aider (mother)**

| Mother's medical conditions | RPR | HIV | Hep B | | Maternal immunizations | Sonar abnormalities | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |

**Birth and admission**

| Date of birth | Admission date | Reason for admission in Neonatal unit (*please tick*) | | | | | | | | Location of delivery | Sex | | Discharge date | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Prematurity (ELBW/VLBW | Congenital malformatio | Jaundice (NNJ | Congenital | Hypoglycaem | Meconium aspiration | respiratory distress | Birth asphyxia | | Male | Female | survive | deceased |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |

| | | | | |
|---|---|---|---|---|
| (Length of the baby) | APGAR score 1m | APGAR score 5m | APGAR score 10m | |
| | | | | |

**Weight at Birth (*please tick*)**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| <600 grams | 600-700 grams | 700-800 grams | 800-900 grams | 900-1000 grams | 1000-1200 grams | 1200-1500 grams | 1500-2000 grams | 2000-2500 grams | 2500-3000 grams | 3000 – 4000 grams | >4000 grams |
| | | | | | | | | | | | |

**Gestational age (*please tick*)**
**Dates / Sonar / Ballard**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| <25 weeks | 25-25+6d weeks | 26-26+6d weeks | 27-27 +6d weeks | 28-29 + 6d weeks | 30-31 + 6d weeks | 32-34 + 6d weeks | 35-36+ 6d weeks | 37-40+ 6d weeks | >41 weeks |
| | | | | | | | | | |

| | | |
|---|---|---|
| *Gestational age (date): | *Gestational age (Sonar): | Gestation age (Ballard): |

**Interventions**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Highest CRP (which day) | Antibiotic given | Ventilator days | Surfactant | Oxygen days | Continuous positive airway pressure (CPAP) | Total serum bilirubin | Phototherapy (days) |

| | Penicciline G + Gentamycin | Ampicilline + Amikacin | Meronem + Vancomycine | Other | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

**causes of death** (*Please tick*)

| Prematurity | Hypoglycaemia | Neonatal sepsis | Pneumoniae | Necrotizing enterocolitis | Multiple organ failure secondary to birth asphyxia | Haemorrhage | Pulmonary haemorrhage | Congenital heart defect | Syndromic or congenital dysplasia/hypoplasia |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

**Discharge diagnoses** (*Please tick*)

| Prematurity | Neonatal respiratory | Bronchopulmona | Neonatal sepsis | Pneumoniae | Neonatal jaundice | Necrotizing enterocolitis | Birth asphyxia (HIE) | Haemorrhage | Hypoglycaemia | Congenital heart defect | Syndromic or congenital dysplasia/hypoplasia |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

*Estimated gestational ages noted according to the available information. If Ballard score, preference given to Ballard score over Sonar or dates. If Sonar was done preference was given over gestational age based on date of last menstrual period.

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