UNIVERSTY OF RWANDA
COLLEGE OF MEDICINE AND HEALTH SCIENCES
SCHOOL OF NURSING AND MIDWIFERY

ADMISSION PATTERNS AND OUTCOMES IN THE NEONATAL INTENSIVE CARE UNIT (NICU) AT KING FAISAL HOSPITAL, KIGALI: A RETROSPECTIVE STUDY

A research dissertation in fulfilment of the requirements for the degree of

MASTER OF NURSING

NEONATOLOGY TRACK

By

NYIRIBAMBE Leonie

Registration Number: **220016370**

Supervisor: **PAMELA Meharry, PhD**

Co-Supervisor: **MUHAYIMANA Alice, MS**

September, 2022

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Declaration

I hereby declare that this work submitted in fulfillment of the requirement for the Master of Science in Nursing, Neonatology Track UR/CMHS, is my own new work and has not been previously submitted elsewhere.

Name: **NYIRIBAMBE Leonie** Date: 14/3/2022

Registration Number: **220016370**

Neonatal track

Dedication

This work is dedicated to my supervisor, to all my family and friends who encouraged me during my studies and to the colleagues who indirectly contributed to the completeness of this work.

Acknowledgement

I would like to express my gratitude to the supervisor, **Dr Pamela Meharry and Co-supervisor Mrs Muhayimana Alice** who accepted and committed to supervise this work.

My sincere gratitude also goes to **King Faisal Hospital management that partially** financially support my master of nursing, neonatology track, without their support, this masters and this work would not be accomplished.

Special thanks to my husband and children for accepting the opportunity cost of my absence from home to attend this master's program.

Abstract

Background

Less is known about the determinants of poor clinical outcomes of neonatal admissions in Rwandan tertiary hospitals. This study aims to determine neonatal admission patterns and the factors associated with poor clinical outcomes in the NICU at King Faisal Hospital

Methods

This was a retrospective study of neonatal patients admitted to the NICU between January 1, 2019 and December 31, 2020. The sample consisted of all records of newborns admitted with documented admission outcomes. The dependent variable was a neonatal admission's results, defined as alive or dead at discharge. Independent variable was general information related to admission, neonatal factors, and parental factors. For data analysis, SPSS version 21 was used, and frequencies and percentages were used to present descriptive data. Logistic regression model was performed for bivariate and multivariable analysis and a P value < 0.05 indicated a level of significance and the odd ratios (OR) and 95% CI were used to present these associations.

Results

Of 284 recorded newborn admissions during study period, about 70% had RDS and 58.5% were males and almost 52% were admitted ≥ 1 hour from birth. About, 88% of admitted newborn were discharged alive versus nearly 12% who were discharged dead. RDS was reported to be the most cause of death with 41.2% follows by neonatal infection with 26.5%. The poor discharge outcome was found to be associated with neonatal factors such as congenital anomaly and low neonatal admission weight. The number of preterm pregnancies, ranging from 2-4 to none was found as maternal factors associated with poor admission outcome of newborn admitted at KFH, K, NICU.

Conclusion

Our results revealed that RDS was the most frequent cause of neonatal admissions. Neonatal factors associated with this poor outcome were congenital anomaly and low neonatal weight on admission whereas the number of preterm pregnancies was the maternal factor associated with poor admission outcome of neonatal admissions. Timely respiratory support for all emergency cesarean sections and for babies born at less than 37.6 weeks' gestational age and availability of neonatologist all the time are needed.

Key terms: Admission Patterns-Neonates -King Faisal Hospital, Kigali

List of abbreviations

aOR: Adjusted odd ratios
AMA: Against medical advice
ANC: antenatal care
APGAR: **Appearance, Pulse, Grimace, Activity, and Respiration**
CMHS: College of Medicine and Health Sciences,
CPAP: Continuous positive airway pressure
CI: Confidence interval
GA: Gestational age
GTPAL: Gravida, term, preterm, abortion, living children
HMIS: Health Management Information System
IRB: Institutional Review Board
KG: Kilogram
KFH, K, K: King Faisal Hospital, Kigali
LBW: low Birth weight
N: number
NMR: Neonatal mortality rate
NICU: Neonatal Intensive care Unit
NNI: Neonatal infection
OR: Odd ratios
RDHS: Rwanda Demographic Health Survey
Ref: Reference
SDG: Sustainable Development Goal
RDS: respiratory disease syndrome

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CHAPTER ONE: INTRODUCTION

1.1. Background

Despite efforts to reduce neonatal mortality worldwide, the number of deaths remains high(1), mostly preventable or treatable causes (2). In 2017, the likelihood of death in the first 28 days has been estimated to be 18 per 1000 live births worldwide. (3). Of these, 60% occurred at birth or shortly after admission to the neonatology unit (4)(5). At the global level, it is difficult to achieve and maintain the Sustainable Development Goal (SDG) three that aim to reduce the neo-natal death rate (NDR) to 12 per 1000 live births by 2030 (6). However, to maintain this SDG's target, knowledge of neonatal disease patterns seems to be very crucial(3). Apart from newborns' physiological adaptation difficulties, prematurity and infection are the foremost reasons of these deaths in evolving countries (7).

In 2018, Sub-Saharan Africa had the largest neonatal death rate, with 28 deaths per 1,000 live births, with Central and South Asia following with 25 deaths per 1,000 live births (8). In Rwanda, the neonatal death rate has decreased from 41 per 1,000 live births in 2000 to 17 per 1,000 live births in 2016(9). Recent Rwanda Demographic Health Survey (RDHS) report of 2019-2020 indicated, the NMR to be at 19 deaths per 1000 live births(10).while the 2019-2020 RDHS does not specify on cause of NM, a study conducted at the tertiary hospital level, reported the most cause of neonatal mortality to be hypothermia (9). In this survey, the overall average length of stay for all causes admissions was five days (10)though, sick neonates with hypothermia spent much more time in neonatology units than those without hypothermia (22 versus 13 days)(11). However, despite the neonatal intensive care unit being considered well-equipped, data on patterns of neonatal admission are limited at King Faisal Hospital (KFH, K).

Rwanda Health Management Information System (HMIS) provides aggregated data on neonatal survival at the population level (13), including the number of admissions, age at admission, gender, and discharge status. Data on associated risk factors, the reason for admission, treatments given, quality of care, and neonatal outcomes other than deceased or discharged are missing. Although trends in neonatal admissions are unknown, data on neonatal mortality at KFH, K is also limited. Therefore, this study describes the causes and patterns of neonatal admissions and factors associated with poor clinical outcomes at KFH, K.

1.2. Problem statement

Despite the fact that globally, NMR has gradually declined, few studies have reported common factors related to this decline(15). Studies on NICU admission patterns have reported a variation of patterns by region and time(14).. In Rwanda, the RDHS reported the NMR to be 20 deaths per 1,000 live births in 2015(16) and 19 deaths per 1,000 live births in 2020 (10). However, this report did not focus on patterns of neonatal admissions, particularly at the tertiary level. The recent RDHS report indicates that of the deaths that occurred before the first birthday, about 42% occurred within the first month after birth (10), indicating the NMR is a serious health concern.

Much work remains to be done to achieve SDG's 3, which is to reduce the NMR rate to a maximum of 12 per 1,000 live births by 2030 (3). Though utmost neonatal deaths are due to avoidable diseases and circumstances(17) and remains high in rural hospitals (13.3%)(12). Neonates' patients, once admitted to a tertiary hospital level, are expected to receive comprehensive NICU services and KFH, K is the only hospital in the country that offers these services, less is known about the determinants of poor clinical outcomes of neonatal admissions in Rwandan tertiary hospitals. This knowledge gap indicates a need to gain insight into the causes of neonatal admissions, as only by targeting these problems and developing strategies to manage them effectively will the SDG-3 be achieved and sustained in Rwanda. This study aimed to identify neonatal admission patterns and factors associated with poor clinical outcomes in the NICU at King Faisal Hospital.

1.4. Aim

The aim of the study was to describe patterns of neonatal admissions and factors associated with clinical outcomes in the NICU at King Faisal Hospital in Kigali over a two-year period.

1.4.1. Specific objectives

1. To identify patterns of newborn admissions to the NICU between 01/01/2019 and 31/12/2020 at King Faisal Hospital records and files.

2. To determine factors associated with clinical outcomes of neonatal admissions discharged from the NICU from 1/1/2019 to 31/01/2020 from King Faisal Hospital records and files

1.4.2 Research questions

1. What are the patterns of neonatal admissions to the NICU between 01/01/2019 and 31/12/2020 documented in the records and files of the King Faisal Hospital?

2. What factors are associated with clinical outcomes of neonatal admissions to the NICU between 01/01/2019 and 31/12/2020 documented in the records and files of King Faisal Hospital?

1.5. Significance of the study

In public health practice, this work provided insight into the admission pattern of newborns to the KFH, K NICU. Identifying factors associated with clinical outcomes also provided insight into where the hospital can do the most to reduce poor clinical outcomes.

At the institutional level, the results of this study will contribute to the morbidity and mortality reduction of KFH, K when planning health interventions targeting a certain age group and most recorded cause of admissions.

At the scientific level, the results of this study provided insight into current knowledge gaps about poor clinical outcomes of new NICU admissions and ultimately guide future improvements in quality of care.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This section explores the actual knowledge of what causes of newborn admissions and the clinical outcomes of these admissions. In particular, it highlights the theoretical literature review that includes operational definition of the concept, a summary of the overview of neonatal physiology, description of neonatal admission patterns. In addition, it includes the description of clinical outcomes of newborn admissions. The empirical theory literature includes current knowledge about factors associated with poor clinical outcomes of newborn admissions, and highlights gaps in knowledge about clinical outcomes observed at newborn admissions and provided framework model for the study.

2.2. THEORETICAL LITERATURE REVIEW

The theoretical review talks about the theory of available concepts, it defines the most used concept for the context of the study, it talks about neonatal physiology, admission models and results of neonatal admissions.

2.2.1. Operational definition of the concept

Neonate: A newborn is a baby who is four weeks of age or less.

Neonatal period: The neonatal period is a life period from birth to one month of extensive and continuous systemic transition from the uterine environment to the outside world(17)

Clinical Outcome: These are the outcome of care in terms of the patient's health over time and are quantifiable changes in health, activity, or quality of life that result from the provider's actions. (18)(17).

Frequency represents the number of cases of a disease or condition in the NICU population, and also the relationship of the case numbers to the population size over one year(19).

Pattern represents the occurrence of the disease or condition by time (one-year), place (King Faisal Hospital, Kigali City, NICU), and person (socio- demographic factors) (19).

2.2.2. Overview of neonatal physiology

The neonatal period is a time of dramatic physiological modifications that occur during the course of a human life. Distinct physiological changes are held during this period, particularly in the respiratory and cardiovascular systems. The capability to assist gas exchange, circulation and waste products for the fetus creates a need for physiological adaptation. There are several factors and organ systems that contribute to successful adaptation. Delayed cord clamping of 1-3 minutes provides superior hemodynamics and respiration at birth compared to immediate cord clamping of less than one minute (18). The endocrine system is responsible for lung maturation by releasing cortisol, whereas; a mature thyroid gland contributes to the cardiovascular system's development (19).

2.2.3. Description of neonatal admission patterns

Neonatal morbidity or mortality rates in health care facilities mirror the efficiency of health service delivery(7). On the one hand, it is an important indicator of hospital services, and on the other hand, it can serve as a useful indicator of a country's socioeconomic status (20)(7). It is used to plan better health service delivery in general and maternal and child health in particular. The first 28 days after birth is a most critical period (23)(22)(19)for neonates (19) (21))(22), as their body systems undergo rapid changes, and many critical events occur: "Feeding patterns are established, bonding between parents and infant begins, the risk for infections that may become more serious are higher, and many birth or congenital defects are first noted"(17).

Once admitted to the NICU, the newborns' outcome depends on their underlying conditions, severity, and subsequent management. Studies in Eritrea, Pakistan, and Bangladesh, indicated that prematurity and infections are leading causes of admission to the neonatal unit followed by birth asphyxia and neonatal jaundice respectively(24) (7). The same trends in 2014 were reported in a survey conducted in Rwanda in the NICU's of two district hospitals in Rwinkwavu and Kirehe(12). Among infections, researchers cited sepsis, followed by pneumonia and acute gastroenteritis(7). In addition to neonatal infection, the maternal socioeconomic characteristics (26), obstetrical history, antenatal clinic (ANC) visits, gestational age, presence of asphyxia, APGAR score < 7/8, delivery process (27), age group ≥ 35 years, primiparity, hemorrhage, high blood pressure and maternal syphilis (28), are the common patterns related to neonatal admissions. Reduction in

newborn deaths can be attained by identifying potential newborn health issues and suitable responses.

2.2.4. Description of clinical outcomes of neonatal admissions

Neonatal mortality remains a significant burden in low and middle-income countries(23)(29). A study conducted at the national referral hospital in Mauritania found that most of the reported neonatal deaths involved newborns born outside the health facility and then transferred to a referral hospital(29). Another study carried out in Asmara, Eritrea, in a specialized neonatal care unit, revealed that low birth weight, late admission, low Apgar scores, and congenital anomalies were the leading causes of poor neonatal admission outcome(24). Ongoing review of the results of clinical practice helps establish the norms relative to which all clinical practice aspects can be continuously improved. Clinical outcomes can be assessed by activity data like hospital admission rates or predetermined scales, and other dimension methods.

2.2.4.1. Clinical outcomes.

Internationally, neonatal care has been stratified in three layers as shown below (30): 1) basic life support and well-baby care, 2) care of preterm newborns over 32 weeks gestational age (GA) (subdivided into 2A and 2B based on brief ventilation of less than 24 hours and continuous positive airway pressure (CPAP)). 3) Finally, the care of extremely preterm newborns.

The tertiary level of NICU receives neonates who require higher intensive care. However, in all cases, the main result measure used in NICU is the survival rate of patients, when they are discharged from the hospital (survival/death rate)(31).

Evidence revealed that there are few data on the care and quality of treatment of high-risk newborns in health facilities; therefore, the factors predicting clinical success remain uncertain in most sub-Saharan African countries (12). However, neonatal admissions clinical outcomes have been reported to be associated with staff training, lack of a consistent standard of care backed by established protocols, and vary upon the subjacent medical condition, its seriousness and the further treatment. In general, neonatal admission outcomes are categorized into four categories (30): discharge home once the newborn is well, death, referred for further management and leaving against medical advice (AMA).

2.2.4.2. Measures of clinical outcomes.

Measuring change using clinical outcomes is one way to monitor the impact of the unit and hospital services. The outcome severity of admissions to the NICU varies according to the care pathway in which they were born (32). Newborns delivered in a primary care health facility have the highest rate of occurrence of morbidity compared to newborns delivered in a secondary care facility under the supervision of an obstetrician. However, NICU admissions should never be considered as a means of measuring newborn morbidity, especially when considering the comparison of various birth contexts. Each setting should be individualized to enable detect the gaps.

2.2.4.3. The benefits of measuring outcomes

A reliable results measurement system will have many advantages: greater transparency and greater accountability to the public, and healthcare providers have a better basis for judging and improving their practices(18). This situation will also provide patients, relatives, and guides with the basics necessary to make informed choices about their care and evidence of improved services and quality assurance of operations. It also serves a better data for health service managers when making funding decisions.

2.3. EMPIRICAL LITERATURE REVIEW

This unit explores existing studies and reports that are similar to our study and highlights the relationship between neonatal admission outcomes and the other concepts studied. It also provides the study framework that establishes a probable causal relationship between the factors.

2.3.1. Description of patterns of newborn admissions to the NICU

While a number of previous studies have attempted to identify factors associated with neonatal admission (33)(34), few have examined patterns of neonatal admission.

A study conducted in a second-level hospital in Pakistan reported that prematurity and infection were the main reasons for admission (27.9% and 20.33% respectively), followed by birth asphyxia (13%) and neonatal jaundice (11.3%). Of these admissions, 6.8% were discharged dead(7). Low birth weight is also the most frequently reported reason for neonatal admission in various studies (35).

2.3.2. Factors associated with poor clinical outcomes of neonatal admissions

Several factors influence poor clinical outcomes in neonates admitted to the NICU. These include factors related to the parents' socioeconomic status, maternal, delivery, and newborn factors.

2.3.2.1. Parental social, economic status

Despite the decrease of neonatal mortality across the world, significantly in developed countries, evidence has indicated that the social-economic status of the parent, specifically mothers, has an important impact on the neonate's life. Problems related to low socio-economic status, including nutritional inadequacies, anemia, maternal illnesses, other obstetric complications, inadequate antenatal care, and drug addiction, can affect an infant's futurity. A study by Dibben C. et al. demonstrated a statistically meaningful link of social class, household income, and living in disadvantaged areas to premature birth and death of infants (36).

Others have indicated that as the maternal educational level increases, prematurity birth rates decrease, a leading cause of NICU admissions(37)(38). This means that improving mums' information and consciousness of the danger for preterm births, especially among fresh mothers, and the significance of prenatal care in preventing preterm births can reduce neonatal admissions. The mother's education level also helps raise awareness of the importance of antenatal care, the ideal interval between births, choosing the factual time to get pregnant, and opting for a feeding plan during pregnancy. Maternal employment is also associated with prematurity, which is explained by the link between education and employment. Other results showed that prolonged hospitalization of newborns was linked to skilled, semi-skilled, and unskilled occupations of the father in a meaningful way (39).

2.3.2.2. Maternal factors

The poor knowledge of primigravida mothers about newborn care contributes to neonatal admission and their mortality. Studies have shown that these mothers may not be aware of the importance of prenatal and postnatal care(40). These studies indicate that all mothers should receive regular prenatal care monitoring and be aware of the importance of giving birth in health facilities.

Maternal body weight gain during pregnancy is related to low birth weight in a meaningful way (41). Others reported that the number of babies who were low birth weight in mothers who had

gained 6 kg during pregnancy was 3.3 times higher compared to those who had reached the normal weight(42). Others reported <4 ANC follow-ups, current unintended and unplanned pregnancies, gestational age ≥42 weeks to be associated with a neonatal "near miss" (39)(28).

Newborns of mothers who delivered prematurely experienced low birth weight 19.8 times more than those born at 37 weeks (41). Similarly, Bahrami et al. (44) reported that 57.2% of prematurely born and only 2.6% of full-term babies were underweight. In Ranjiran's study (41), 44.7% of preterm births and 3.1% of full-term births were low birth weight.

2.3.2.3. Related delivery factors

Mode of delivery is associated with neonatal admission. After operative delivery, newborns are considered to have more odds of being be admitted to the NICU than those born after an unassisted vaginal delivery at 40 weeks' gestation (42). This is due to a newborn's median gestational age and birth weight being lower if born via Caesarean than vaginal birth. This difference in weight persists five days after birth. This anticipated situation necessitates more intensive treatment for newborns delivered via Caesarean, such as the use of surfactant, nasal cannula oxygen, and more extended periods of antibiotics than newborns born by vaginal delivery. In the context of increasing Caesarean sections, this information is important for women considering elective procedures.

2.3.2.4. Neonatal factors

Neonatal admission in intensive care is often due to physiological immaturity. Physiological immaturity is also associated with young gestational age, placing these neonates at greater risk for respiratory distress and greater need for support(40). Neonatal characteristics at birth such as being male, low birth weight less than 2.5 kgs, and born in may also contribute to the number of observed admissions(46).

2.4. Critical review of the study

This research will examine the patterns of newborn admission to a NICU in a tertiary hospital. It will highlight the association between factors in the onset and progression of neonatal admissions. Following a review of the literature, and using a tentative theory(47), researchers explicitly state their framework as follows: The result of a neonatal admission is a note from the physician indicating the point at which hospital care ends(21), it can be a transfer to another facility, a return

home when the patient is well, two means a positive result in our study. It can also be a notation that indicates or confirm a death. This will be considered a negative outcome in our study.

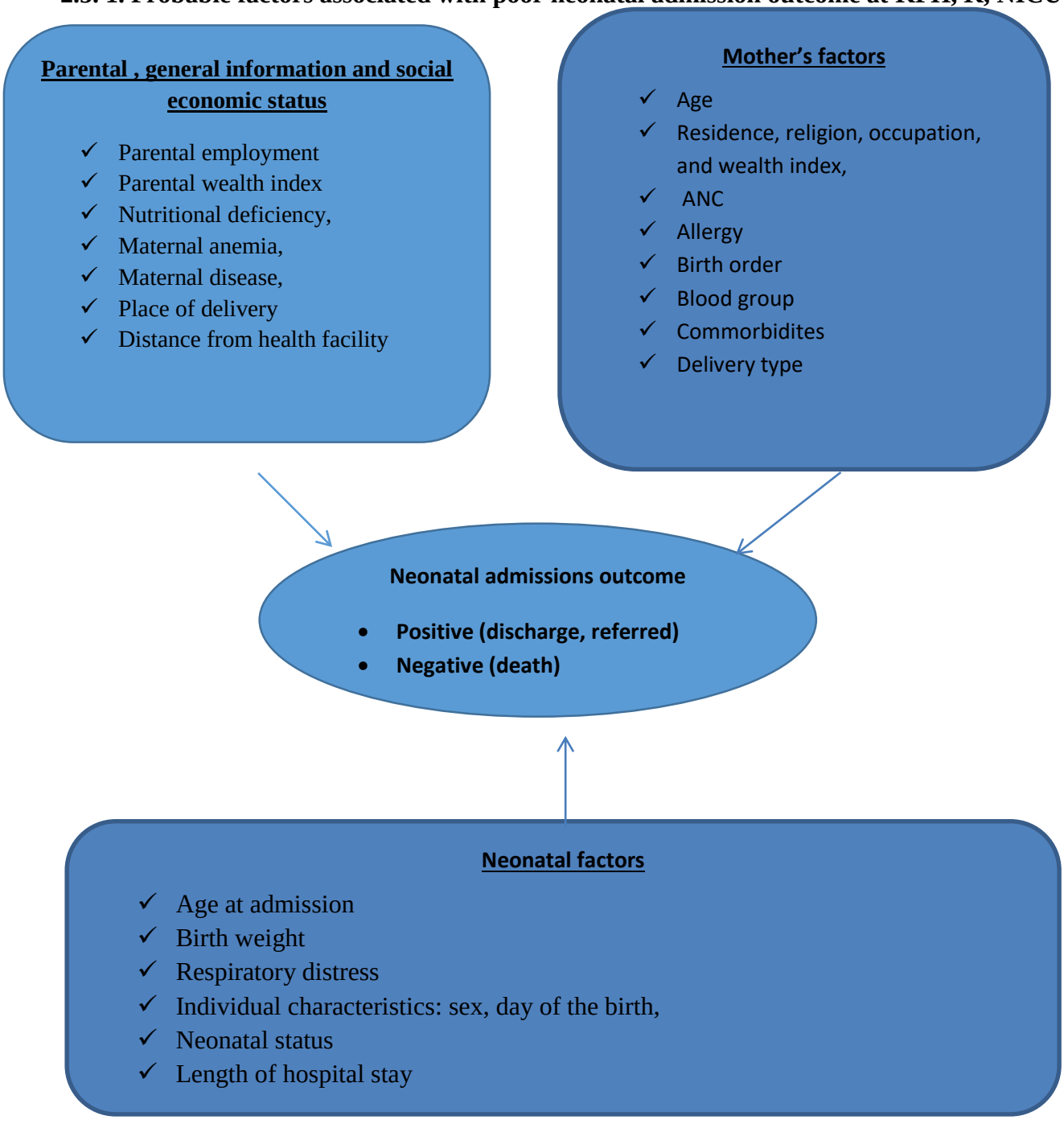
Maternal factors such as level of education were associated with first neonatal admission, particularly prematurity(37). Increasing the education level of mothers has a positive impact on the health behavior of mothers and profoundly shakes the reduction of premature infant mortality in different ways. For example, it raises awareness of the importance of prenatal care, ideal birth intervals, choosing the right age to become pregnant, among others. The level of education of parents as well as their professional skills have a significant impact on reducing neonatal mortality(39)(48). This can be clarified by the link between education and maternal employment, such that working mothers are likelier to have a higher education or income.

There are many other factors that affect NICU admission. Maternal smoking history is suspected to be linked to neonatal morbidity, and smoking not only increases the risk of infant mortality, but also increases upcoming disorders in later life(37). In addition, it has been shown that women from lower social and economic status groups have advanced baseline stress(49) which could clue to fetal lung maturity in early gestations, similar to the effect observed in growth-restricted babies(50). It is likely that the effect of maternal age on the increased risk of newborn hospitalization occurs secondarily. Advanced maternal age has been shown to be related to various complications of pregnancy, such as intrauterine growth retardation, preeclampsia, premature placental abruption, preterm birth and fetal death. Changes resulting from the mother's age may anticipate delivery, resulting in preterm births and very low birth weight, which require more hospitalization.

The insufficient number of prenatal consultations is a factor associated with neonatal admission, followed by an increase in mortality (51). It is with the ANC that women are most likely to obtain information on how to preserve their pregnancy, and thus plan for childbirth. Some neonatal factors also contribute to the admission of newborns, including prematurity and low birth weight. These factors are often due to complications of pregnancy, more often to physiological maladjustment after birth, as well as family factors(52).

2.5. Conceptual framework

2.5. 1. Probable factors associated with poor neonatal admission outcome at KFH, K, NICU



2.5. Figure 2: Adapted from a published articles conceptual Framework for a poor clinical outcome from neonatal admissions

CHAPTER THREE: METHODOLOGY

This section provides information on the study design, setting, population, instrument, data collection, data analysis, and ethical considerations.

3.1. STUDY DESIGN

The study was a retrospective cross-sectional design of neonatal patients admitted to the NICU between 01/01/2019 and 31/12/2020. The choice of this design was motivated by the fact that exposure and outcome was measured simultaneously, retrospectively. This study examined data about neonatal admission patterns defined as occurrence of the diseases by time and place and person's patterns, and outcomes of these admissions. The study included indications/causes for admissions, history of admitted sick neonates, treatment given, and results at the time of discharge.

3.2. STUDY SETTING

The study was carried out at NICU of KFH, K, a private referral hospital in Kigali. The NICU contains specialized units with human resources and equipment necessary to receive and take care of critically ill newborns directly admitted (inborn) or referred from other hospitals across the country (out born).

3.3. STUDY POPULATION

From admissions to KFH, K, newborns admitted to the hospital's NICU between Jan 1st, 2019 and December 31st, 2020 were potentially included in the study. This period of two years was chosen based on the ability of the researcher, both in terms of time and logistics, and to meet the academic requirements. In addition, it was a period when we expect the data to be readily available and accessible. The number of admissions to the NICU per year was estimated to be about 150 yearly, with 133 in 2019, and 188 in 2020.

3.4 SAMPLE

In this study, a total population sampling method was used to include a total of medical files and records based on their availability during the data collection period.

3.4.1. SAMPLING STRATEGY AND SAMPLE SIZE

The sample consisted of the total files from the targeted population, which consist of the neonates admitted to the NICU during 01 January 2019 to 31 December 2020. The sampling strategy was non-probability sampling with total population sampling of all neonates in the study population. Therefore, every neonate admitted to KFH, K NICU during the year 2019 and 2020 was included in the sample.

3.5. INSTRUMENT

As previously described by other findings for retrospective data collection(53)(54)(55), we conducted a literature review, found similar subjects to our study and requested permission to use their data abstraction form with contextual adaptation. Secondary, as demonstrated by other researchers(55), we reviewed the KFH, K NICU medical records to understand the variables that are typically captured, in order to better inform our list of variables to be studied. This review provided essential information on how medical records are constructed and opened a window to construct a data collection tool. We have identified about four similar studies across literature and sent email to request permission to adapt their data collection tools, but only one of them responded to us. This one was a recently published study by Andegiorgish et al., in Eritrea to assess Neonatal mortality and associated factors in the specialized NICU in Asmara (24). The authors recommended going through the article and generating the predictors and considering the local context, and making a final structure of the questionnaire. Refer to his email in Appendix 1 of Saturday at 1: 36 PM, 24 October 2020.

With this permission to examine the variable used, we selected variables that are available in the KFH, K NICU medical record to allow a data collection instrument to be parallel to the flow of information in the NICU medical record. This techniques has been shown elsewhere to be more effective in ensuring the validity and reproducibility of the instrument(55).The constructed data abstraction instrument consists of three sections, these include general admission information, neonatal factors and, maternal factors.

3.6. Inclusion and exclusion criteria

3.6.1. Inclusion criteria

In this study, newborns admitted to NICU of the KFH, K during the study period and whose results from admission to discharge were documented were included in the analysis.

3.6.2. Exclusion criteria

Neonates whose outcomes could not be found in the medical records were excluded from the analysis.

3.7. VARIABLES

The outcome variable for this study was a binary response to neonatal admission's status, being positive when the child is discharged alive and or referred and being negative when the child is discharged dead. Independent variable are described by sections;

Section of general information. In this section, we have reason for admission, time from birth to admission, delivery type and, place of birth.

For neonatal factors sections, we had gestation age, age on admission (days), birth weight, neonate status, APGAR Score, neonate blood group, gestational size, time starting feeding, and length of stay in NICU.

For maternal factors section, we had residence area, religion, socio economic status, mother and father' occupation, GTPAL [gravida, term, preterm, abortion, living children], ANC visits, birth order, comorbidities, and maternal blood groups.

3.8 DATA COLLECTION

Before to the actual data abstraction, to increase reliability of data two blind nurses from KFH, K not working in NICU were trained on the tool to ensure reliable data collection. This has been shown to be very effective elsewhere(55), rather than using nurses working in same unit. Also, training of data collectors prior to the start of data collection has proven to be an effective and reliable process for retrospective data collection(56). Additionally, the abstraction instrument was piloted and tested for feasibility to increase the internal validity of the tool in at least 10 cases from 2021 files and then adapted according to the pre-test results. This piloting process involved using NICU records but for a different time period than the current study so that the sample would not be affected. External validity was assessed by comparing the results to other studies evaluating the same type of activity at the same hospital level. Data were collected from the neonatal admission register, the patient's medical record, discharge and death records, and the NICU chart.

3.9. DATA ANALYSIS.

For data analysis, upon completion of data abstraction, we proceed with data entry in an excel sheet, cleaned and exported into IBM SPSS, version 21, a statistical software for analysis. Demographics and patterns of admissions were analyzed as categorical variables. Continuous variables such as age were categorized in days as follows (0-7, 8-14, 15-21, and 21-28 days). The choice of this age group was based to other studies assessing the same to enable the research findings comparable. Responses for variables of the clinical outcome were dichotomized as follows: "**Positive outcome or discharged alive** for responses, “discharged alive, transfer in the pediatric ward, transferred out (improved)”, and “**negative outcome** for a response, "death". We excluded missing values for outcomes variable.

Frequencies and percentages were generated from categorical variables and outcome variable was presented using a pie chart. Using logistic regression model for binary outcome, bivariate and multivariable analysis were performed to assess the statistical significance and associations between independent and outcome variables. The adjusted odd ratios and 95% confidence interval (CI) were used to present these associations. Significance level was considered for variables with a P-value < 0.05.

3.10. ETHICAL CONSIDERATIONS

Approval to conduct the study was obtained from the University of Rwanda, College of Medicine and Health Sciences, Institutional Review Board (Reference number CMHS/IRB/190/2021), and the KFH, K ethical committee. Since this was a retrospective study, there was no consent form but, the researcher signed confidentiality agreement with the KFH, K. In addition, no personal identifying information was collected, and instead, a chronological order number was assigned to each study participant data collected.

4. RESULTS

This was a retrospective study to identify the admission patterns and outcomes of 284 neonates admitted to the King Faisal Hospital from 1/1/2019 to 31/01/2020. The results are presented in tables.

4.1. Neonatal diagnosis at admission

Table 1 below shows the results of the 284 recorded newborn admissions during 2021. The reason cited in the files for the admission to the NICU showed that approximately 70% (173) were due to RDS, 13% (38) to prematurity, 10% (28) to NNI, and 9% (25) to birth asphyxia.

Table 1: Patterns of newborn admission at KFH, K NICU (n=284)

Variables	**n**	**(%)**
RDS	173	60.9
Birth asphyxia	25	8.8
Congenital abnormality	18	6.3
Macrocosmic	1	0.4
NNI	28	9.9
Prematurity	38	13.4
Shoulder dislocation	1	0.4

4.2. Description of newborns admitted to the KFH, K NICU during the study period.

Of these 284 neonates with available data 58.5% (166) were male, 70% (199) were born at less than 37.6 weeks, approximately 68% (193) were born from an emergency cesarean section, and nearly 80% (228) were born at KFH, K (Table 2). Of these neonates, nearly 53% (151) were preterm, and approximately 50% (121), 77% (190), and 90% (220) had a normal APGAR at 1, 5, and 10 minutes of birth, respectively.

Regarding admissions, almost 52% (149) were admitted ≥ 1 hour from birth, mainly between 0-7 days after birth 98% (279), about 70% (173) of them were admitted from RDS and the majority of them 34.5% (98) had a weight ranging between 1.5-2.49 kg and, almost 95% (270) were assisted by a resident. Regarding the feeding history of the neonates, about 85% (220) started breastfeeding within 24 hours and about 81% (218) used expressed breast milk as the type of enteral feeding. Of the neonates in the sample, about 38% (107) were the first child in the family and about 59.5% (169) had a small gestational age and about 46.5% (132) spent between 1 and 7 days on admission.

Table 2: Description of newborns admitted to the NICU (n=284)

Variables	n (%)	
Gender		
Female	118	41.5
Male	166	58.5
Gestation age (weeks)		
< 37.6	199	70.1
≥ 37.6	85	29.9
Type of delivery		
SVD	33	11.6
Elective Caesarian	56	19.7
Emergency Caesarian	193	68.0
Instrument delivery	2	0.7
Place of birth		
KFH, K	228	80.3
District Hospital	8	2.8
Private Clinic	34	12.0
Other Referral Hospital	14	4.9
Birth status		
Term	92	32.4
PMT	151	53.2

Late PMT	41	14.4
APGAR Score:		
APGAR at 1 minute		
Normal	121	49.6
Moderately abnormal	100	41.0
Abnormal	23	9.4
Missing	40	14.1
APGAR at 5 minutes		
Normal	190	77.6
Moderately abnormal	50	20.4
Abnormal	5	2.0
Missing	39	13.7
APGAR at 10 minutes		
Normal	220	90.2
Moderately abnormal	24	9.8
Missing	40	14.1

Additional description of newborns admitted at KFH, K NICU

Variables	n	(%)
Time from birth to admission (hours)		
< 1 hour	135	(47.5)
≥ 1 hour	149	(52.5)
Age on admission (days)		
0-7 days	279	(98.2)
8-14 days	2	(0.7)
15-21 days	2	(0.7)
22-28 days	1	(0.4)
Birth weight at admission (kg)		
<1.0	45	()15.8
1.0-1.49	40	(14.1)
1.5-2.49	98	(34.5)
2.5-3.99	90	(31.7)

≥ 4	11	(3.9)
Attending doctor		
Neonatologist	8	(2.8)
Pediatrician	5	(1.8)
Resident	270	(95.4)
Missing	1	(0.4)
Time feeding started (hours)		
Within 24 hours	220	(85.3)
24 to 48 hours	38	(14.7)
Missing	26	(8.4)
Type of enteral feeding		
Expressed breast milk	218	(81.0)
Formula	35	(13.0)
Mix (breast milk & formula)	16	(5.9)
Missing	15	(5.3)
Birth order		
1st child	107	(37.8)
2nd child	74	(26.1)
3rd child	57	(20.1)
4th child	24	(8.5)
≥ 5 child	21	(7.4)
Missing	1	(0.4)
Gestational size		
Appropriate for gestation age	93	(32.7)
Small for gestation age	169	(59.5)
IUGR	22	(7.7)
Length of stay (days)		
1-7	132	(46.5)
8-14	63	(22.2)
15-21	28	(9.9)
≥ 22	61	(21.5)

4.3. Description of the parents whose neonates were admitted to the NICU.

Among the newborns' parents, the majority, 95% (269) were Rwandan, 72% (204) were from the city of Kigali, 94% (267) had health insurance, and 56% (159) had no religious affiliation. Regarding the parents' occupation, about 14% (39) of mothers and 79% (203) of fathers were employed.

Table 3: Description of parents whose newborns were admitted to NICU (n=284)

Variables	n	(%)
Nationality		
Rwandese	269	94.7
Other	14	4.9
Missing	1	0.4
Residence		
Kigali City	204	71.8
Eastern province	35	12.3
Northern Province	5	1.8
Southern Province	19	6.7
Western Province	8	2.8
Out of Country	4	1.4
Missing	9	3.2
Affiliated Religion		
Protestant	40	14.1
Catholic	72	25.4
Muslim	7	2.5
None	159	56
Missing	6	2.1
Health insurance		
Insured	267	94.0
Not insured	17	6.0
Maternal employment		
Not working	23	8.1
Employed	39	13.7
Self employed	22	7.7
Missing	200	70.4
Fathers' employment		
Employed	203	71.5
Not employed	53	18.9
Missing	28	9.9

Health and obstetric information of mothers whose newborns were admitted at KFH, K, NICU

Variables		
Allergies		
	N	%
No Allergy	266	93.7
Allergy to medicine	11	3.9
Allergy to food (red meat)	1	0.4
Missing	6	2.1
Maternal comorbidity		
Hypertension **(chronic HTN)**	16	(5.6)
Preeclampsia	93	(32.8)
Diabetes	4	(1.4)
Cardiac disease	2	(0.7)
Other	6	(2.1)
None	160	(56.3)
Missing	3	(1.1)

Maternal condition post delivery		
Good	255	89.8
Critically ill	27	9.5
Maternal death	1	0.4
Missing	1	0.4
Gravida		
Primigravida	163	57.4
Multigravida	119	41.9
Missing	2	0.7
Maternal blood group		
A+	29	10.2
B+	32	11.3
AB+	10	3.5
O+	131	46.1
A-	3	1.1
B-	1	0.4
O-	10	3.5
Missing	68	23.9

Most of mothers had no allergy, 266 (94%) and the most common maternal comorbidity identified in the files was hypertension, including preeclampsia, 109 (38.4%), whereas the majority 160 (56.3%) had no comorbidities. The majority, 61% (131) had O positive blood type and 96% (266) had no history of allergies. At delivery, about 90% (255) had a good maternal condition, and 58% (163), had a single pregnancy.

4.4. Pregnancy history and living children

The maternal obstetric history showed the pregnancies and living children (Figure 1). The majority, 37% (106) had 2-4 full-term pregnancies, 42% (119) had one or more preterm pregnancies, 57% (160) had 2-4 live children, and 75% (213) had never had an abortion. Refer to figure 1.

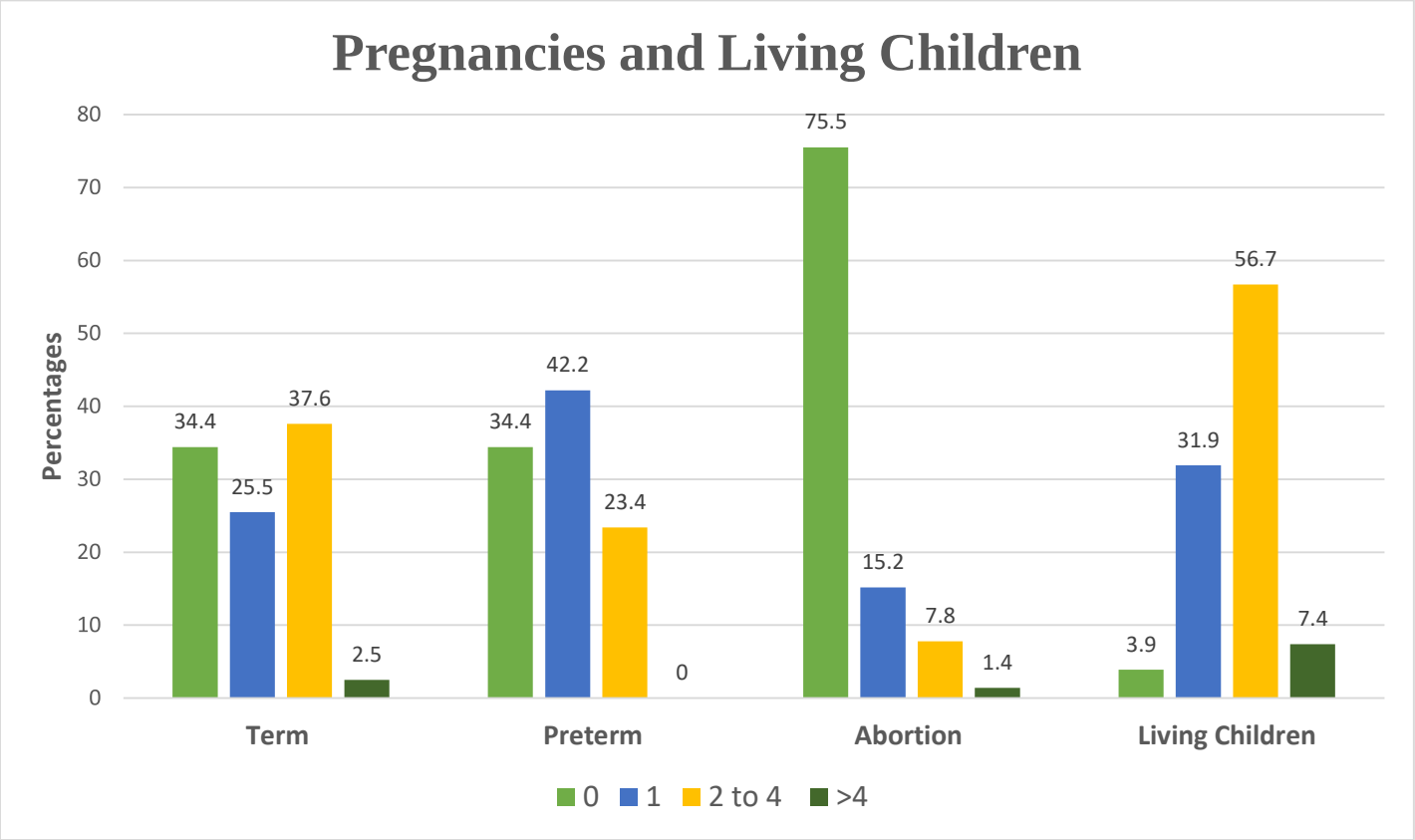


Figure 1: Pregnancy history and living children

Figure 1: Maternal history indicating percentage of term and preterm pregnancies, abortions, and living children. Note: all four categories had two missing values.

4.4. Result of the admission of the newborn

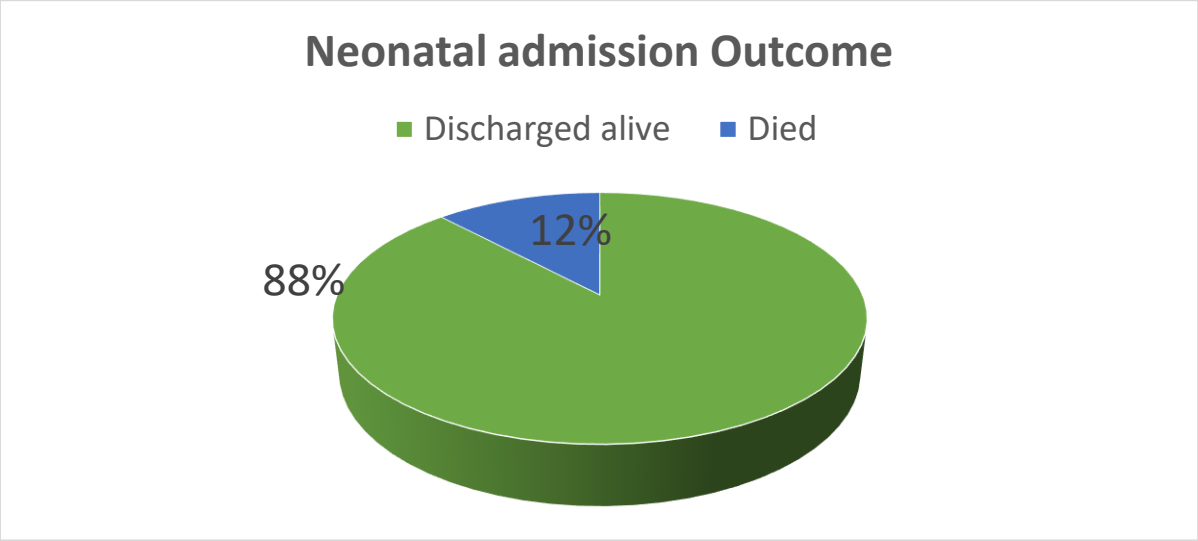


Figure 2: Neonatal outcome from NICU

The pie chart above shows that approximately 88% (250) of patients were discharged alive versus nearly 12% (34) who were discharged dead.

4.5. Cause of neonatal death at NICU of the KFH, K

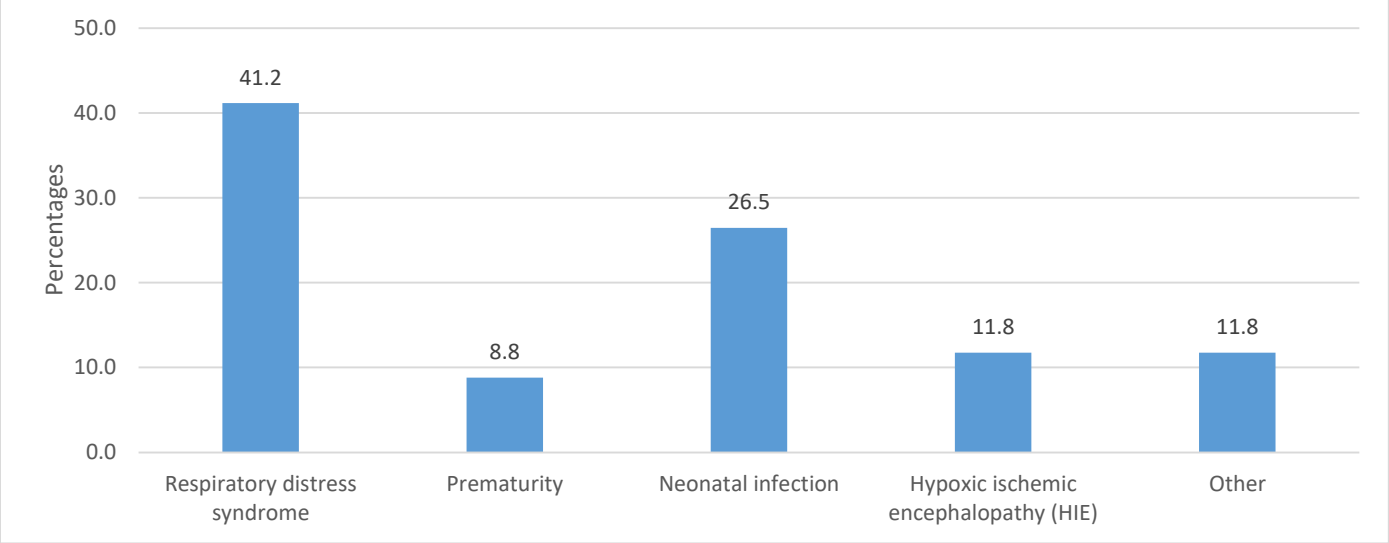


Figure 3: Reasons for neonatal admissions

The bar chart above presents the main reasons of neonatal deaths recorded in the files (Figure 3). About 41% of neonatal deaths were from RDS, and 26.5% from neonatal infections.

4.6. Neonatal factors associated with clinical outcome of neonatal admissions

The results of the bivariate analysis described in Table 4 indicate that the following factors were found to be positively associated with the clinical outcome of admission of newborns to the KFH, K NICU. These factors are neonatal gestation week ≥ 37.6 weeks (OR: 2.332, 95% CI: 1.126-4.830), place of birth such as district hospital (OR: 17.333, 95% CI: 3.856-77.924), or other referring hospital (OR: 4.160, 95% CI: 1.195-14.477). In addition, an abnormal APGAR recorded at one minute (OR: 12.321, 95% CI: 3.814-39.801), a moderately abnormal and abnormal APGAR recorded at five minutes (OR: 7.821, 95% CI: 3.8146-19.441) and (OR: 30.167, 95% CI: 4.466-203. 780) and moderately abnormal APGAR recorded at ten minutes (OR: 11.564, 95% CI: 4.433-30.170) were found to be statistically significant to be more likely to be associated with clinical outcome of neonatal admissions. Also, reasons for neonatal admission such as birth asphyxia (OR: 3.887, 95% CI: 1.323-11.421) and congenital abnormality (OR: 7.832, 95% CI: 2.598- 23.609) were found to be statistically significant to be more likely to be associated with clinical outcome of neonatal admissions. However, neonatal admission weights such as 1.0-1.49 kg (OR: 0.051, 95% CI: 0.006- 0.410), 1.5-2.49 kg (OR: 0.063, 95% CI: 0.017- 0.233), and 2.5-3.99 kg (OR: 0.308, 95% CI: 0.129 - 0. 733) compared with neonatal weight of <1.0 kg at admission were found to be statistically significantly less likely to be associated with the clinical outcome of neonatal admissions in the bivariate analysis.

On multivariable analysis, the logistic regression model indicated that congenital anomaly as a reason for neonatal admission, compared with RDS, was a neonatal factor positively associated with the clinical outcome of neonatal admissions (aOR: 52.948, 95% CI: 3.972 -705.844). Similarly, neonatal admission weight of 1.0-1.49 kg (aOR: 0.29, 95% CI: 0.001-0.788), 1.5-2.49 kg (aOR: 0.018, 95% CI: 0.001-0.273) and 2.5-3.99 kg (OR: 0.004, 95% CI: 0.0001 to 0.349), compared with a neonatal admission weight of less than 1 kg, were neonatal factors negatively associated with the clinical outcome of neonatal admissions.

Table 4: Neonatal factors associated with clinical outcome of admission to NICU

			Bivariate analysis				Multivariable analysis			
Variables	**Discharged alive (n,%)**	**Died (n,%)**	**P-value**	**OR**	**95% CI**		**P-value**	**aOR**	**95% CI**	
					Low	Upper			**Low**	Upper
Gender										
Female	102 (86.4)	16 (13.6)	**Ref**							
Male	148 (89.2)	34 (10.8)	.488	.775	.378	1.591				
Gestation age (wks)										
< 37.6	181 (91)	18 (9)	**Ref**				**Ref**			
≥ 37.6	69 (81.2)	16 (18.8)	**.023**	**2.332**	**1.126**	**4.830**	.437	4.339	.107	175.659
Type of delivery										
SVD	29 (87.9)	4 (12.1)	**Ref**							
Elective Caesarian	46 (82.1)	10 (17.9)	.475	1.576	.452	5.497				
Emergency Caesarian	173 (89.6)	20 (10.4)	.762	.838	.267	2.629				
Instrument delivery	2 (100)	0 (0)	.999	.000	0.000					

Place of birth											
KFH, K	208 (91.2)	20 (8.8)	**Ref**				**Ref**				
District Hospital	3 (37.5)	5 (62.5)	**.000**	**17.333**	**3.856**	**77.924**	.333	4.046	.239	68.508	
Private Clinic	29 (85.3)	5 (14.7)	.278	1.793	.625	5.146	.137	3.795	.655	21.980	
Other Referral Hospital	10 (71.4)	4 (28.6)	**.025**	**4.160**	**1.195**	**14.477**	.147	6.029	.532	68.303	
Birth status											
Term	76 (82.6)	16 (17.4)	**Ref**								
PMT	133 (88.1)	18 (11.9%)	.236	.643	.310	1.334					
Late PMT	41 (100)	0 (0)	.998	.000	0.000						
APGAR Score at 1 minute											
Normal	115 (95)	6 (5)	**Ref**				**Ref**				
Moderately abnormal	89 (89)	11 (11)	.102	2.369	.844	6.652	.950	.954	.217	4.194	
Abnormal	14 (60.9)	9 (39.1)	**.000**	**12.321**	**3.814**	**39.801**	.510	2.033	.246	16.802	
APGAR Score at 5 minutes											
Normal	181 (95.3)	9 (4.7)	**Ref**				**Ref**				
Moderately abnormal	36 (72)	14 (28)	**.000**	**7.821**	**3.146**	**19.441**	.076	4.260	.861	21.088	
Abnormal	2 (40)	3 (60)	**.000**	**30.167**	**4.466**	**203.780**	.118	8.804	.574	135.055	

APGAR Score at 10 minutes										
Normal	205 (93.2)	15 (6.8)	**Ref**				**Ref**			
Moderately abnormal	13 (54.2)	11 (45.8)	**.000**	**11.564**	**4.433**	**30.170**	.280	2.615	.458	14.937
Time-birth to admission (hours)										
< 1 hour	122 (90.4)	13 (9.6)	**Ref**							
≥ 1 hour	128 (85.9)	21 (14.1)	.250	1.540	.738	3.210				
Admission reason										
RDS	160 (92.5)	13 (7.5)	**Ref**				**Ref**			
Birth asphyxia	19 (76)	6 (24)	**.014**	**3.887**	**1.323**	**11.421**	.294	4.918	.251	96.284
Congenital abnormality	11 (61.1)	7 (38.9)	**.000**	**7.832**	**2.598**	**23.609**	**.003**	**52.948**	**3.972**	**705.844**
Macrocosmic	1 (100)	0 (0)	1.000	.000	0.000		1.000	.000	0.000	
NNI	24 (85.7)	4 (14.3)	.241	2.051	.618	6.810	.115	9.453	.579	154.406
Prematurity	34 (89.5)	4 (10.5)	.539	1.448	.445	4.713	.622	1.535	.280	8.425
Shoulder dislocation	1 (100)	0 (0)	1.000	.000	0.000		1.000	.000	0.000	
Admission age (days)										
0-7	245 (87.8)	34 (12.2)								
8-14	2 (100)	0 (0)								
15-21	2 (100)	0 (0)								
22-28	1 (100)	0 (0)								

Admission birth weight (kg)										
<1.0	30 (66.7)	15 (33.3)	**Ref**				**Ref**			
1.0-1.49	39 (97.5)	1 (2.5)	**.005**	**.051**	**.006**	**.410**	**.036**	**.029**	**.001**	**.788**
1.5-2.49	95 (96.9)	3 (3.1)	**.000**	**.063**	**.017**	**.233**	**.004**	**.018**	**.001**	**.273**
2.5-3.99	78 (86.7)	12 (13.2)	**.008**	**.308**	**.129**	**.733**	**.015**	**.004**	**.000**	**.349**
≥ 4	8 (72.7)	3 (27.3)	.700	.750	.173	3.244	.089	.011	.000	2.014
Attending doctor										
Neonatologist	6 (75)	2 (25)	.279	2.479	.480	12.810				
Pediatrician	5 (100)	0 (0)	.999	.000	0.000					
Resident	238 (88.1)	32 (11.9)	**Ref**							
Time feeding started (hours)										
<24 hours	206 (93.6)	14 (6.4)	**Ref**							
≥24 to 48 hours	32 (84.2)	6 (15.8)	.053	2.759	.989	7.700				

Type of enteral feeding						
Expressed breast milk	197 (90)	21 (9.6)	**Ref**			
Formula	33 (94.3)	2 (5.7)	.460	.569	.127	2.539
Mix (breast milk & formula)	16 (100)	0 (0)	.998	.000	0.000	
Birth order						
1st	96 (89.7)	11 (10.3)	**Ref**			
2nd	65 (87.8)	9 (12.2)	.692	1.208	.474	3.080
3rd	48 (84.2)	9 (15.8)	.308	1.636	.635	4.217
4th	21 (87.5)	3 (12.5)	.751	1.247	.320	4.863
≥ 5	19 (90.5)	2 (9.5)	.916	.919	.188	4.482
Gestational size						
AGA	80 (86)	13 (14)	**Ref**			
SGA	151 (89.3)	18 (10.7)	.426	.734	.342	1.573
IUGR	19 (86.4)	3 (13.6)	.967	.972	.252	3.753
Length of stay (days)						
1-7	114 (86.4)	18 (13.6)	**Ref**			
8-14	58 (92.1)	5 (7.9)	.254	.546	.193	1.545
15-21	24 (85.7)	4 (14.3)	.928	1.056	.328	3.399
≥22	54 (88.5)	7 (11.5)	.678	.821	.324	2.083

OR: Odd ratios, CI: Confidence interval, aOR: adjusted odd ratios, %: percentages, Ref: reference, highlighted values are statistically significant

4.7. Parental factors associated with the clinical outcome of neonatal admissions

Regarding parental factors associated with clinical outcome of newborns admissions, bivariate analysis (**table 5**) indicated that the number of maternal pregnancies (multigravida versus primigravida) (OR: 2.331, 95% CI: 1.109- 4.900), the number of abortions (> 4 abortions versus none) (OR: 8.682, 95% CI: 1.164- 64.732) were statistically significantly more likely to be associated with clinical outcome of neonatal admissions. In contrast, the number of preterm pregnancies, such as 2-4 versus none (OR: 0.241, 95% CI: 0.067-0.864) was found to be statistically significantly less likely to be associated with the clinical outcome of neonatal admissions.

On multivariable analysis, the logistic regression model indicated that none of the parental factors studied was positively associated with the poor clinical outcome of neonatal admissions. However, the number of preterm pregnancies, ranging from 2-4 to none (aOR: 0.228, 95% CI: 0.062- 0.841), was found to be negatively associated with poor clinical outcome of neonatal admissions.

Table 5: Parental factors associated with the clinical outcome of neonatal admissions

			Bivariate analysis				Multivariable analysis			
Variables	**Discharged alive (n,%)**	**Died (n,%)**	**P-value**	**OR**	**95% CI**		**P-value**	**aOR**	**95% CI**	
					Low	Upper			**Low**	Upper
Nationality										
Rwandese	238 (88.5)	31 (11.5)	**Ref**							
Other	11 (78.6)	3 (21.4)	.276	2.094	.554	7.919				
Mother's residence										
Kigali City	180 (88.2)	24 (11.8)	**Ref**							
Eastern province	29 (82.9)	6 (17.1)	.378	1.552	.584	4.121				
Northern Province	5 (100)	0 (0)	.999	.000	0.000					
Southern Province	15 (78.9)	4 (21.1)	.251	2.000	.613	6.524				
Western Province	8 (100)	0 (0)	.999	.000	0.000					
Out of Country	4 (100)	0 ()	.999	.000	0.000					
Affiliated Religion										
Protestant	37 (92.5)	3 (7.5)	.485	.635	.178	2.272				
Catholic	59 (81.9)	13 (18.1)	.168	1.726	.795	3.748				
Muslim	7 (100)	0 (0)	.999	.000	0.000					
None	141 (88.7)	18 (11.3)	**Ref**							

Health insurance							
Insured	237 (88.8)	30 (11.2)	**Ref**				
Not insured	13 (76.5)	34 (12)		.141	2.431	.744	7.937
Maternal employment							
Not working	21 (91.3)	2 (8.7)	**Ref**				
Employed	34 (87.2)	5 (12.8)		.622	1.544	.274	8.690
Self employed	19 (86.4)	3 (13.6)		.601	1.658	.250	11.016
Father employment							
Employed	172 (84.7)	31 (15.3)	**Ref**				
Not employed	50 (94.3)	3 (5.7)		.079	.333	.098	1.135
Maternal allergy							
None	235 (88.3)	31 (11.7)	**Ref**				
Medicine	10 (90)	1 (9.1)		.795	.758	.094	6.126
Food (red meat)	0 (0)	1 (100)		1		0.000	
Maternal comorbidity							
Hypertension	13 (81.3)	3 (18.8)	**Ref**				
Preeclampsia	82 (88.2)	11 (11.8)		.449	.581	.143	2.367
Diabetes	4 (100)	0 (0)		.999	.000	0.000	
Cardiac disease	2 (100)	0 (0)		.999	.000	0.000	
Other	4 (66.7)	2 (33.3)		.473	2.167	.262	17.892

None	142 (88.8)	18 (11.3)	.384	.549	.143	2.114					
Maternal condition post birth											
Good	226 (88.6)	29 (11.4)	**Ref**								
Critically ill	23 (85.2)	4 (14.8)	.598	1.355	.438	4.196					
Maternal death	1 (100)	0 (0)	1.000	.000	0.000						
Gravida											
Primigravida	150 (92)	13 (8%)	**Ref**				**Ref**				
Multigravida	99 (83.2)	20 (16.8%)	**.026**	**2.331**	**1.109**	**4.900**	.127	1.907	.832	4.371	
Term											
None	87 (89.7)	10 (10.3)	**Ref**								
Singleton	67 (93.1)	5 (6.9)	.450	.649	.212	1.989					
2-4 term	89 (84)	17 (16)	.233	1.662	.721	3.831					
> 4	6 (85.7)	1 (14.3)	.742	1.450	.158	13.295					
Preterm											
0	81 (83.5)	16 (16.5)	**Ref**				**Ref**				
1	105 (88.2)	14 (11.8)	.319	.675	.311	1.463	.230	.613	.275	1.363	
2-4 preterm pregnancies	63 (95.5)	3 (4.5)	**.029**	**.241**	**.067**	**.864**	**.026**	**.228**	**.062**	**.841**	
Abortion											
None	191 (89.7)	22 (10.3)	**Ref**				**Ref**				
1	39 (90.7)	4 (9.3)	.839	.890	.291	2.728	.518	.682	.213	2.179	

2-4	17 (77.3)	5 (22.7)	.092	2.553	.858	7.598	.214	2.145	.644	7.142
> 4	2 (50)	2 (50)	**.035**	**8.682**	**1.164**	**64.732**	.112	5.418	.672	43.661
Living children										
0	0 (0)	11 (100)	.998		0.000					
1	82 (91.1)	8 (8.9)	.540	1.951	.231	16.511				
2-4	147 (91.9)	13 (8.1)	.592	1.769	.219	14.256				
> 4	20 (95.2)	1 (4.8)	**Ref**							
Maternal blood group										
A+	28 (96.6)	1 (3.4)	**Ref**							
B+	27 (84.4)	5 (15.6)	.145	5.185	.568	47.321				
AB+	9 (90)	1 (10)	.439	3.111	.176	54.967				
O+	117 (89.3)	14 (10.7)	.252	3.350	.423	26.558				
A-	2 (66.7)	1 (33.3)	.097	14.000	.618	317.377				
B-	1 (100)	0 (0)	1.000	.000	0.000					
O-	9 (90)	1 (10)	.439	3.111	.176	54.967				

OR: Odd ratios, CI: Confidence interval, aOR: adjusted odd ratios, %: percentages, Ref: reference, highlighted values are statistically significant.

5. Discussion

This study evaluated the trends of neonatal admissions in the NICU of King Faisal Hospital between 01/01/2019 and 31/12/2020. The results of the study indicated that among the recorded admissions, a large percentage of newborns suffered from RDS (70%), followed by prematurity (13%). This finding could be due to the lack of a lubricating substance in the lungs, surfactant, which helps the lungs fill with air and prevents the air sacs from deflating(57). Scientifically, it has been reported that RDS frequently occurs in those whose lungs are not yet fully developed(58) and physiological immaturity also, places neonates at greater risk for respiratory distress(40), hence more admissions. Similar results were also reported by Merab et al.(12) wherein two district hospitals supported by health partners in Rwanda, prematurity was also among the top three causes of neonatal admission, accounting for 20%, which is similar to other results (3)(24)(59). In addition, a study conducted at King Abdullah University Hospital in Jordan reported almost the same results as ours: RDS accounted for 41% and prematurity for 33% of the hospital's neonatal intensive care admissions(60).

On description and clinical characteristics of neonates admitted, more males accounted for admissions compared to females (58.5% versus 41.5%), and many were < 37.6 weeks at birth (70%). Researchers in a study conducted in Belgium reported that surfactant markers, such as lecithin, phosphatidylglycerol, and phosphatidylinositol appear much early in females than males(61), and x chromosome-linked diseases are more predominant in males than females(62), these may explain the observed differences. Other studies have reported similar results, with males appearing to be admitted to the NICU more often than females (3)(7)(63). These findings indicate that further research into the underlying causes of the predominance of male newborns in admissions is warranted as there may be interventions to address these persistent problems. At the time of admission, almost all (98%) were admitted within seven days of birth, similar to other studies that assess admission times at the national level (7)(12). Our results show that nearly 70% of recorded admissions were neonates <37.6 weeks gestation, indicating consistency with others that prematurity is the leading cause of neonatal morbidity and mortality in developed countries(64).

The results of our study indicated that of the admissions to the NICU, the majority of newborns weighed approximately 1.5-2.49 kg (34.5%). A study in southeast Queensland reported that babies

born with a birth weight <2499 g may require admission to the NICU(65), which explains why the majority in our sample were LBW neonates, similar to other studies in low-income countries (3)(7)(35).

Regarding the length of stay in the NICU, the majority of newborns stayed between one to seven days (46.5%), similar to a study conducted in two district hospitals in Rwanda (Rwankwavu and Kirehe) where the average length of stay was five days(12). With regard to birth status, the majority of recorded neonatal admissions (53%) were PMTs, which is consistent with another study where the percentage was 58%(60). In contrast, a study conducted in Abu Dhabi, United Arab Emirates (UAE), reported only 6% of the admitted neonates were PMTs. This difference could be explained by the variation in country settings, with Rwanda being a low-income country and the UAE being a developed country(66).

Regarding demographics and parental characteristics, maternal comorbidities such as preeclampsia were predominant among admitted neonates (33%). Although hypertension was not more frequent in the mothers of the admitted newborns (5%), it is known that pregnancy-induced hypertension (PIH) is associated with the admission of newborns in other studies, and hypertension often leads to eclampsia(67). Our results also indicate that the majority of newborns admitted were from mothers with at least one previous preterm pregnancy (42%), which is similar to another study reporting preterm labor triples the risk of NICU admission(67).

This analysis indicated that of the newborns admitted during the study period, nearly 88% were discharged alive compared with 22% who died. Similarly in a low-income country, a study conducted at a tertiary care hospital in Dhaka, Bangladesh, reported that 78.6% of newborns admitted to the NICU were discharged alive(3). Of these deaths, the leading cause cited was RDS (41%), followed by neonatal infections (26%). Since RDS was the most frequently recorded diagnosis at admission, it can be assumed that this predominance in the number of admissions would also have influenced the number of deaths. These results are quite similar to those reported in Bangladesh, where, among non- survived newborns, neonatal infections accounted for 10% and were the third leading cause of death(3).

Regarding neonatal factors associated with admission outcomes, congenital anomalies was positively associated with poor clinical outcomes to the NICU at KFH, K. This could be explained

by the fact that if the anomaly is severe, there is less likelihood of being discharged. Furthermore, 10 of the 18 admissions were born outside of the KFH, K, and this also indicates that the referral was late and not promising. The same findings were reported in a systematic review of causes of neonatal death in LMICs (68) as well as in a study conducted at King Abdullah University Hospital in Jordan(60).

Neonatal admission weights of 1.0-1.49, 1.5-2.49 and 2.5-3.99 kgs, compared with a neonatal admission weight of less than 1 kg, were found to be negatively associated with the poor clinical outcome of neonatal admissions. This finding indicates that as neonatal weight increases, the likelihood of survival increases. Low birth weight has been consistently reported as the leading cause of neonatal admission, which may also contribute to a large number of poor clinical neonatal admissions outcomes(59) (46). Similarly, studies conducted in low-income countries have reported that as the neonatal weight decreases while admitted, the likelihood of poor outcomes increases(69)(70).

The results of our study indicate that neonates whose mothers had two to four preterm pregnancies are negatively associated with poor clinical outcomes on neonatal admissions compared with neonates of mothers without preterm pregnancies. Although our study did not further explore the potential cause of this phenomenon, other studies have reported that newborns of mothers with preterm births suffer from LBW (41)(44)(41). Therefore, prematurity by itself could not be the cause of admissions and poor clinical outcomes, but LBW could play an important part in the observed outcomes.

5.1. Limitation

As a retrospective study, we did found errors in writing in patient medical files, missing data from incomplete patient records, unclear handwriting, and unfamiliar abbreviations, which could lead to a lower level of evidence and information bias. However due to enough sample, we do expect to have reduced the probability of having any hidden bias. The results of our study should be interpreted with caution; they cannot be generalized to all newborns in Rwanda admitted to NICUs.

They reflect only the admission outcomes of newborns admitted to KFH, K during the study period, and will only be compared with other results from a similar study in a hospital of the same level.

5.2. Future research

A future study could compare the patterns of neonatal admissions and the clinical outcomes of these admissions to a public referral health facility. Also, a further study could investigate the neonatal admissions and outcomes at all five referral health facilities, or district hospital neonatal units throughout Rwanda.

6. Conclusion

This study aimed to explore patterns of neonatal admissions to the NICU of the KFH, K and determine factors associated with clinical outcomes of neonatal admissions. The results revealed that RDS and PMT were the most common causes of neonatal admissions. Although many of the recorded neonatal admissions were discharged alive from the hospital, a significant percentage were discharged dead from the NICU. Neonatal factors associated with this poor clinical outcome of neonatal admissions were congenital anomaly and low neonatal weight on admission. At the parental level, the number of preterm pregnancies was found to be the maternal factor associated with poor clinical outcomes of neonatal admissions. Although a large number of recorded neonatal admissions had RDS, the majority were emergency cesarean sections and received by residents, and so many of these poor clinical outcomes of recorded neonatal admissions are likely preventable. Therefore, it is very important to have timely respiratory support for all emergency cesarean sections involving preterm infants, and the presence of a neonatologist ready at all times for new neonatal admissions at KFH, K

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ANNEXES

APPENDIX 1.

DATA ABSTRACTION INSTRUMENT

Code: _____ Date ____/___/2021 Data collector initials _____

I. General admission information

1. Admission diagnosis/reason for admission: ……..

2. Time from birth to admission:

a) < 1 hour	b) >1 hour

3. Delivery type:

a) SVD	b) Instrument delivery	c) Elective Caesarian	d) Emergency CS

4. Place of birth

a) KFH	b) Health center	c) District hospital	d) Private clinic	e) Other Referral hospital

II. Neonatal factors

5. **Gestation age:**

a) < 37.6 weeks	b) ≥ 38 weeks

6. **Age on admission (days):**

a) 0-7 days	b) 8-14 days	c) 15-21 days	d) 22-28 days

7. **Birth weight (kg)**:

a) <1.0 kg	b) 1.0-1.49 kg	c) 1.5-2.49 kg	d) 2.5-3.99 kg	e) ≥ 4 kg

8.

a)Neronatologist	**b) Pediatrician**	**c)pediatrician resident**	**d)Specialized nurse**	**e) Experienced nurse**

9. Neonate status:

a) Singleton	b) Twin	c) Triplet	d) Quadruplet

9. APGAR Score (min):

a) At 1 min	b) At 5 min	c) At 10 min

10. Neonate blood group:

a) A+	b) B+	c) AB+	d) O+	e) A-	f) B-	g) AB -	h) O-

11. Gestational size:

a) Appropriate for Gestation age	b) Small for gestation age	c). IUGR

12. Time starting feeding

a) Within 24 hours	b) Within 48 hours	c) After 48 hours

13. Type of enteral feeding

a) Expressed breast milk	b) Formula	c) Mix (breast milk & formula)

14.

DIAGNOSIS	
1. PREMATURITY	
2. NEONATAL INFECTION	
2.1 Sepsis	
2.2 Pneumonia	
2.3 Meningitis	
2.4 Necrotizing enterocolitis	
3. Hypoxic Ischemic Encephalopathy (HIE)	
4. Respiratory distress	
4.1 Respiratory distress Syndrom (RDS)	
4.2 Transient tachypnea (TTN)	
4.3 Meconium aspiration Syndrom	
5. Neonatal jaundice	
6. Congenital abnormality	
7. Others:	

15. Length of stay…….. in days

16. Discharge from NICU results:

a) Neonate discharged	b) Referred	c) Neonatal died

17. Reasons for neonatal death

a) Respiratory distress syndrome	b) Prematurity	c) Neonatal infection	d) Hypoxic ischemic encephalopathy (HIE)	e) Other

III. Maternal factors

18. Residence:

a) Province	b) District	c) Sector

19. Nationality:

a) Rwandan	b) Other

20. Religion:

a) Protestant	b) Catholic	c) Muslim	d) None	e) Other

21. Socioeconomic status: ……

Poorest

Poorer

Middle

Richer

Richest

22. Maternal occupation:

Not working

Professional/technical work

Clerical

Sales

Agricultural self employed

Agricultural employee

Household and domestic

Services

Skilled manual

Unskilled manual

23. Paternal employment/occupation……...

Not working

Professional/technical work

Clerical

Sales

Agricultural self employed

Agricultural employee

Household and domestic

Services

Skilled manual

Unskilled manual

24. Number of ANC visits:

a) None	b) 1-3 visits	c) ≥ 4 visits

25. Maternal allergy:

a) No	b) Yes	c) If yes, what

26. Birth order:

a) 1st	b) 2nd	c) 3rd	d) 4	e) ≥ 5

27. Maternal condition after delivery:

a) Good	b) Critically ill	c) Maternal death

28. Maternal GTPAL:

a) Gravida	b) Term	c) Preterm	d) Abortion	e) Living children

29. Maternal comorbidities

a) Hypertension	b) Diabetes	c) Cardiac disease	d) Bleeding d/o	e) Other
Type:	Type:			

30. Maternal blood group:

a) A+	b) B+	c) AB+	d) O+	e) A-	f) B-	g) AB -	h) O-

ANNEX 2: PERMISSION TO USE THE TOOL

Amanuel Kidane <akidane2016@gmail.com>

Sat, Oct 24, 2020, 4:36 AM

To me

Dear Leonie, I hope you are doing well and staying healthy. I have received your email forwarded from Prof. Zeng. I really appreciate for your interest on our publication. I regret to say that, I am away from Eritrea now and I could not find the data collection tool in my data storage.

I would like to recommend you to go through the article and generate the predictors besides considering your local context would be helpful for your final questionnaire structures.

I wish all the bests,

Best regards,

Amanuel Kidane Andegiorgish

ANNEX 3: REQUEST LETTER TO CARRY DATA COLLECTION

Leonie NYIRIBAMBE RN, BScN June 23rd, 2021

leonienyiri@gmail.com
PHONE: +250788569172

UNIVERSTY OF RWANDA

COLLEGE OF MEDECINE AND HEALTH SCIENCES

SCHOOL OF NURSING AND MIDWIFERY

NEONATAL TRACK

To the Chief Executive officer

King Faisal Hospital, Kigali

Dear Sir,

RE: Request for permission to conduct a research study

By this letter, I hereby request for a permission to conduct a research study at King Faisal Hospital, Kigali.

In fact, I am a student at University of Rwanda, College of Medicine and health sciences/ School of nursing and midwifery, I am doing masters in nursing (neonatology specialty).

I would like to conduct a research project at King Faisal hospital, NICU department for fulfillment of the requirements for degree of masters in nursing sciences at UR/CMHS. The study entitled" Admission patterns and outcome in the neonatal intensive care unit (NICU) at King Faisal hospital, Kigali: A retrospective study.

Kindly receive an attached ethical clearance approval from CMHS/Institutional Review Board for my research project.

Thank you for your consideration.

Yours Sincerely,

Leonie NYIRIBAMBE, RN, BScN

ANNEX 4: UR ETHICAL CLEARANCE LETTER

UNIVERSITY of RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES
DIRECTORATE OF RESEARCH & INNOVATION

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 9th /6/2021

Ref: CMHS/IRB/190/2021

Leonie NYIRIBAMBE
School of Nursing and midwifery, CMHS, UR

Dear Leonie NYIRIBAMBE

RE: ETHICAL CLEARANCE

Reference is made to your application for ethical clearance for the study entitled ***"Admission Patterns and Outcomes in the Neonatal Intensive Care Unit (NICU) At King Faisal Hospital, Kigali: A Retrospective Study".***

Having reviewed your application and been satisfied with your protocol, your study is hereby granted ethical clearance. The ethical clearance is valid for one year starting from the date it is issued and shall be renewed on request. You will be required to submit the progress report and any major changes made in the proposal during the implementation stage. In addition, at the end, the IRB shall need to be given the final report of your study.

We wish you success in this important study.

Dr Stefan JANSEN
Ag Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR

Cc:

- Principal, College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate studies, UR

Email: researchcenter@ur.ac.rw P.O Box 3286 Kigali, Rwanda www.ur.ac.rw

ANNEX 5: KING FAISAL HOSPITAL APPROVAL LETTER

KING FAISAL HOSPITAL KIGALI

KING FAISAL HOSPITAL, RWANDA
ETHICS RESEARCH COMMITTEE

Patient Centered Care

12th July, 2021

ETHICAL APPROVAL

Dear Leonie NYIRIBAMBE

We acknowledge receipt of your study protocol: **"Admission patterns and outcome In neonatal intensive care unit(NICU) at King Faisal Hospital, Rwanda: A retrospective study"**

After a thorough review, the reviewers of KFH Ethics Research Committee consider this study relevant. The investigator is allowed to start data collection.

N.B.

- The investigator is ***requested to submit one hard copy of his final research results*** in the office of the Directorate of Education, Training and Research at King Faisal Hospital, Kigali

Best Regards

KING FAISAL HOSPITAL - KIGALI

Dr. Dushimiyimana Jean Marie Vianney
Consultant ENT surgeon
Chair, Ethics Research Committee
King Faisal Hospital, Rwanda.

Dear Medical / re Coordinator Supervisor
Please facilitate the above mentioned for his/her activity in research.
23/07/21

CC:

1. Chief Executive Officer_ KFH-Rwanda
2. Director of Education, Training & Research_KFH- Rwanda
3. Members of the Ethics Research Committee, KFH- Rwanda

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