NEONATAL HEALTHCARE-ASSOCIATED INFECTIONS AND RELATED FACTORS IN THREE SELECTED TEACHING HOSPITAL IN RWANDA.

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June, 2022

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A dissertation submitted in partial fulfilment of the requirement for the degree of

MASTERS IN NURSING

In the college of Medicine and Health Sciences

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May, 2022

DECLARATION

I UMUHOZA Aline, do hereby declare that this dissertation entitled “Neonatal Healthcare-Associated Infections and related factors in three selected teaching hospitals in Rwanda” submitted in partial fulfillment of the requirements for the Masters of Science in Nursing. The neonatology track degree at the UR/CMHS/School of Nursing and Midwifery is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of the information quoted or cited.

I declare that this dissertation is my own work except where specifically acknowledged.

UMUHOZA Aline

Ref number: **220015841**

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Date:12th April 2022

DEDICATION

This work is dedicated to the Almighty God for his guidance and protection, to my family, and to all who contributed to the success of this work.

ACKNOWLEDGEMENTS

This research paper could not have been achieved without professional and financial support from several people and the University of Rwanda, especially UR/CMHS/School of Nursing and Midwifery hence the need to acknowledge this effort.

I also send my gratitude to the School of Nursing and Midwifery administration and all Midwifery Department staff for their treasured knowledge and skills. I highly appreciate the guidance offered by my supervisor Dr. Pamela Meharry and my co-supervisor, Mr. Védaste BAGWENEZA. I also thank all my classmates for their excellent co-operation during the course in sharing experience and knowledge, and all our friends for their good ideas.

Finally, to all whose contribution was invaluable to this study, my sincere thanks and profound appreciation.

ABSTRACT

Background: Nosocomial infection (NI), also known as Healthcare acquired infection (HCAI), is an infection (s) acquired during the process of receiving health care. Nosocomial infections are a substantial source of morbidity and mortality, as well as the duration of hospital stay and financial burden on patients, families, and healthcare systems around the world. However, there is limited information about HCAI among neonates in Rwanda.

Objectives: The study aims to assess Neonatal Nosocomial Infections and related factors in selected three teaching hospitals in Rwanda.

Methodology: A retrospective cross-sectional design was used. A sample size of 273 neonatal files was selected using a stratified simple random sampling method within the three study sites (RMH, KFH, CHUK). The researcher used data abstraction sheet in data collection and used descriptive and inferential statistics in analysis.

Results: A total of 273 neonatal files were reviewed. Significant factors associated with neonatal HCAIs included maternal blood group AB (OR=2.365: 95%CI=1.097-5.098; p=0.028), and O group (OR=3.097: 95%CI=1.321-7.262; p=0.009). A neonate with a weight of 3.6kg and above was less likely to have an HCAI (OR=0.094 95%CI=0.016-0.541; p value=0.008) than an infant weighing less than 1.5kg. A neonate born at CHUK was four times more likely to have an HCAI (OR=4.072: 95%CI=1.054-15.724; p=0.042), than a neonate born at KFH. Neonatal death was three times more likely to be associated with HCAI (OR=3.337:95%CI=0.996-11.186; p value=0.051). The main neonatal HCAIs were Klebsiella pneumonia, Staphylococcus aureus, and Candida albicans while the most predominant neonatal HCAIs we klebsiella pneumonia bacteria affecting 142(52%) of participants, and 80 (29.3%) died due to HCAIs.

Conclusion: This study showed that preterm, low birth weight, neonatal death, and maternal blood type were associated with HCAIs at the three study sites and the most predominant HCAI was Klebsiella pneumonia. Hence, understanding the risk factors associated with HCAIs is crucial to help reduce neonatal morbidity and mortality, related cost of care, and a potential increase in antibiotic resistance in clinical settings.

Keywords: Neonates, HCAIs, Neonatal Intensive Care Units, Referral teaching hospitals, Rwanda.

LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

BSI: Blood Stream Infection

CHUK: Centre Hospitalier Universitaire de Kigali

CLABSI: Central Line Associated Blood Stream Infections

CVC: Central Venous Catheter

HCAI/HAI: Healthcare Acquired Infection

HCF: Healthcare facilities

HH: Hand Hygiene

HIV/AIDS: Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

KFH: King Faisal Hospital

LMIC: Low- and Middle-Income Countries

LOS: Latent Onset Sepsis

LRI: Low Respiratory Infections

NHSN: National Healthcare Safety Network

NI: Nosocomial Infections

NICU: Neonatal Intensive Care Unit

NMR: Neonatal Mortality Rate

RMH: Rwanda Military Hospital

SSA: Sub Saharan Africa

SSI: Surgical Site Infections

UNAIDS: The Joint United Nations Program on HIV and AIDS

USA: United States of America

UTI: Urinary Tract infections

VAP: Ventilator-Associated Pneumonia

WHO: World Health Organization

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CHAPTER I: INTRODUCTION AND BACKGROUND

1.1. Introduction

Health Care Acquired Infections (HCAI) are infections the develop in patient resulting from received medical care and or treatments while in a hospital stay , nursing home and were not present nor incubating when the patient was admitted ; WHO(world Health Organization) has identified HCAIs as an illnesses and their history may be traced back to the beginning of hospitals(1). HCAIs are becoming increasingly a health concern in 21st century, according to studies. And its widespread as medical care has become more complex as a result of the use of invasive devices and procedures exposing the patient to the risk of HCAIs (1,2). Every year, an estimated of 2.4 million neonates die around the world. Over 80% of these deaths occurs in Sub-Saharan Africa and Asia.(3). In Europe, the prevalence of the most frequent infections HCAIs ranges from 4.8 % in district hospital to 7.2% for referral hospitals, with pneumonia (19.4%) and other lower respiratory tract infections (4.1%), surgical sites infections (SSIs)19.4, Urinary tract infection(UTIs) 19.0% and (Blood Stream Associated Infections) BSAIs (10.7%) (2).

In developing countries, the HCAI incidence in inpatient newborn care units is estimated to be 15.2 to 62.0 per 1000 patient-days; nine times higher than observed in some developed countries (3). An estimation of 1.2 million babies die before they reach the age of 28 days in Sub-Saharan Africa, with nosocomial illnesses accounting for the majority of these deaths. (4). Despite the fact that there are publications on HAIs in Sub-Saharan Africa, there are just a few studies on HAIs in neonates(5). Infections rate are very high in developing countries as a result of poor infection control measures, Hospital congestion, inefficient use of inadequate resources , and a lack of oversight HCAIs remains to be a significant cause of unnecessary sickness and death (6). Mostly affected new-borns are those particularly hospitalised in NICU as they are frequently exposed to medical devices, antimicrobial drugs and a wide range of pathogenic organisms (4,6,7).

A considerable variety of bacterial and fungal taxa associated with nosocomial illness in new borns can be found on NICU surrounding surfaces (8). Therefore, this study aims to assess neonatal HCAIs and their related factors in selected three teaching hospitals in Rwanda.

1.2. Background

Healthcare-associated infections (HCAIs) are a global burden across the world, and this is particularly the case in neonates whose immune system is still immature. Health Care Acquired Infections (HCAIs) is defined as: "An infection developed in a patient while receiving treatment at a health care facility and is resulted from medical care and or treatments and which was not present nor incubation on admission.(9). The term "HCAIs" is being used interchangeably with the term "Nosocomial Infection"(10). Healthcare-associated infections or infections acquired in healthcare settings, are the most frequent adverse event in healthcare delivery worldwide(3,5). Hundreds of millions of patients are affected by HCAIs worldwide each year, leading to significant mortality and financial losses for health systems(12).

Globally, HCAI is a major health-care concern that contributes to patient morbidity and death, length of stay, and cost burden in all countries(15). Some factors were found to be associated with HCAI and its mortality, and those factors include ; prematurity, low birth weight, patient who are on ventilation machines, venepuncture, hypoxia and feeding intolerance posed a significantly higher HCAIs risk compared to neonates in different conditions(6). In high-income countries (HICs), such as the EU member States of Iceland, Norway, and Croatia, the prevalence rate of HCAI in NICUs is the highest (10·7%) followed by neonatology wards (3·5%) (16). Some factors were reported to be significantly associated with HCAIs in HICs, such as, the length of hospital stay and having one or more invasive medical devices (17). HCAIs account for 4-56% of all causes of neonatal mortality, and the majority (75%) occur in Southeast Asia and Sub-Saharan Africa (SSA); also, the reasons are linked to length of hospital stay, age (prematurity), chemotherapy, and practices of an individual caregiver (18–21).

In low-income countries, (LIC) especially in Africa, limited data exists despite the fact that numerous factors promote the high incidence rates of HCAIs in neonates which include prematurity, which was the most critical risk factor and birth weight of less than 1500g (VLBW).(22).The more prevalent rate are markedly in low and middle income countries(LMICs) averaging from 8% up to 15% or higher (2). Furthermore in LMICs, the situation is aggravated by some countries with ineffective infection, prevention and control(IPC) measures exacerbated poor laboratory support, ineffective use of antibiotic policies, limited resources (2). The spread of HCAIs pathogens can be through person to person, environmental or contaminated water ,food and infected individuals, contaminated

health care personnel's skin , surface or contact via shared items; though significant advances in neonatal treatment have led to increased survival of smaller and sicker infants however HCAIs still a threat to the healthcare system(23). HCAIs are a severe problem in neonates admitted in NICU and neonatology services(24). There are many risk factors of HCAIs in neonates, including a weakened immune system, function barriers of the skin and gastrointestinal tract, aggressive diagnostic and therapeutic procedures (25). HCAIs threaten neonatal health(26). Neonates, especially preterm are mostly affected because they are frequently subjected to invasive treatments and rely on central catheters for nourishment and ventilators for breathing assistance(22,27).

A study conducted in Rwanda's CHUB from June 1 to November 30, 2015, revealed that the prevalence of HCAIs was quite high (12.1%) and that the incidence of HCAIs in NICUs is roughly 30%, accounting for 40% of recorded neonatal mortality in developing countries.(28). Moreover, among all HCAIs cases around 55% were low Respiratory Infections(LRI), around 36.2% were Blood Stream Infections(BSI) and finally 17.24% were Urinary Tract infections(UTI)(28).In predominant types of HCAIs; Hospital Acquired pneumonia(5/15,33.3%) were the most predominant followed by BSI(3/15,20.0%)(29). Furthermore, the prevalence of HCAIs was 23.1% in NICU as reported in a survey conducted in Rwanda teaching hospitals(7).HCAIs have been attributed to gestational age, low birth weight(30). These results showed a disparity in the global picture of HCAIs as the burden of HCAI is several fold higher in low and middle income countries than in higher income countries
(31).

1.3. Problem statement

Globally, HCAIs are the greatest health threats and still rising despite the widespread of infection control measures, which is concerning as the Neonatal Mortality Rate (NMR) has not declined as other under-five populations (24,32). The high prevalence rate regarding patient with HCAIs are estimated by the World Health Organization(WHO) , with a much larger burden on LMIC than HIC (33). In SSA, studies indicated a neonatal prevalence rate of 21.2-35.6% among all hospital-reported HCAIs, higher than previously estimated(15,34). A study conducted in Rwanda on neonatal HCAIs indicated a prevalence rate of 23.1%(7). Because of their underdeveloped immune systems, frequent handling by caregivers, and greater exposure to infectious illnesses, neonates are at a significant risk of contracting HCAIs(29). Any microorganism has the potential to cause a HCAI. However, Staphylococci,

Escherichia coli, Pseudomonas aeruginosa, Enterococci, and fungi, account for most infections among neonates (35). In Rwanda little is known about HCAIs among neonates, despite the higher NMR, which is primarily due to poor hygiene during delivery and HCAI exposure (36–38). Therefore, this study aims to assess neonatal HCAIs and their related factors in selected three teaching hospitals in Rwanda.

1.4. Study aim and objectives

1.4.1. Aim

The research aimed at the assessment of neonatal HCAIs and their related factors in selected three teaching hospitals in Rwanda.

1.4.2. Objectives

1. To identify the common types of HCAIs among neonates hospitalized in selected three teaching hospitals in Rwanda.
2. To describe factors related to HCAIs among neonates in selected three teaching hospitals in Rwanda.
3. To determine the association between the types and factors of HCAIs among neonates in selected three teaching hospitals in Rwanda.

1.5. Research questions

1. What are the common types of HCAIs among neonates hospitalized in selected three teaching hospitals in Rwanda?
2. What are the factors related to HCAIs among neonates in selected three teaching hospitals in Rwanda?
3. Is there an association between the types and factors of HCAIs among neonates in selected three teaching hospitals in Rwanda?

1.6. Significance of the study

The result from the above will contribute in:

Nursing practice:

Results from this study would inform national healthcare policymakers in both Referral and peripheral level facilities to recognize the common types, factors related to HCAIs and the relationship rising behind those types and related factors among neonates hospitalized in

Rwanda teaching hospitals. Hence, providing the rationale to develop appropriate approaches to handle the problem.

Nursing education:

The results of this study will provide additional literature as well as contribution to additional knowledge about neonatal HCAIs and their related factors among neonates hospitalized in our different healthcare facilities, hence contributing to future education. In addition, the study will be a reference to other scholars who would wish to venture into the same field.

Nursing research:

This study will describe neonatal HCAIs and their related factors among newborn infants in Rwanda; therefore, the study would provide a basis for further research.

Nursing administration (in hospitals)

The results from this study will help hospital administration establish news protocols regarding the prevention of HCAIs and their managements and monitor the progress gradually.

1.7. Definitions of concepts

Neonatal period:

The time elapsed between birth and 28 days of age (39).

Nosocomial infection:

Nosocomial infection, also known as hospital-
acquired infections are illnesses that emerge 48 hour or beyond to a hospital or 30 days later following inpatient care(19,40).

1.8. Structure of the study

Chapter one outlines the research's outline, as well as a brief history on the research and the rationale for choosing the research topic. Furthermore, the first chapter explains the research aim and objectives, as well as the organisation of the research.

Chapter two contains the review of the literature which analyses the theory behind the topic, followed by studies supporting or negating the findings that have been previously published. It contains also the definitions of main terms. This chapter logically presents the writers' perspectives on the study field in general and the research challenges in particular.

The methodology of the study is described in full in Chapter Three. The research process is explained in this chapter, which starts with the sort of study design and ends with spreading the findings. Moreover, the methodology chapter contains an explanation of research design, the choice and implementation of data collection methods. The sampling aspect of the study and discussions of ethical considerations are also included in this chapter.

Chapter four will provide all details regarding data presentation and interpretation of finding, displayed in tables and graphs.

Chapter five will discuss the findings, based on their similarities and differences to other studies, and a brief conclusion and recommendations based on study findings.

CHAPTER II: REVIEW OF THE LITERATURE

2.1. Introduction

This chapter is concerned with the study supporting literature. It is subdivided into the following parts: Introduction, the theoretical literature, Empirical Literature, Critical review and research gap identification, and the conceptual framework.

2.2. Theoretical literature

2.2.1. Common types of HCAI in NICU

Bloodstream infections (BSI), Central Venous Catheter (CVC), and Umbilical catheter-associated bloodstream infections are the most common types of neonatal HCAIs in developing countries (40). The commonly HAIs in the NICU are Bloodstream (BSIs) infections. With urinary tract infections (UTIs) and meningitis they can occur in isolation or in association. Endocarditis, osteomyelitis, pyogenic arthritis , ventilator associated pneumonia, peritonitis, conjunctivitis ,and skin abscess are important but less common HAIs (41)

However, the most common pathogen responsible for HCAIs in LMIC encompasses Staphylococcus aureus, Klebsiella species and Escherichia coli classified as early-onset sepsis (EOS) because it appears before 48 hours after neonatal admission and late-onset sepsis(LOS) as it appears later than 72 hours of admission includes mainly gram-negative bacteria such as E. coli, Klebsiella pneumoniae, Acinetobacter spp., Pseudomonas aeruginosa; as well as S. aureus (42). The newborn baby admitted in NICU is vulnerable to HCAIs due to a sudden transition from an intrauterine sterile environment to a different environment, and the exposure risk is increasing as the neonatal birth weight declines and as the need for invasive procedures inclines (43)(4).

2.3.2. Preventive measures of neonatal HCAIs

In HCAI prevention, understanding and implementing the "All or None" approach is crucial. HCAIs are frequently multifactorial, and therefore a preventive approach involves multiple interventions that operate in a synergetic way. Partially using this strategy could be ineffective. Proper line care, for example, could compromise a stringent aseptic central line insertion, leading in CLABSI. As a result, the concept of "bundles," which are a short, simple group of evidence-based practices (usually three to five) that, when adopted together, improve compliance reliability; as a result, patient outcomes are improving, including the reduction of unneeded antibiotic prescriptions that can lead to antibiotic resistance(44). This

"bundle" approach is particularly beneficial in reducing CLABSIs in NICUs. Among the various aspects of HCAI prevention, hand hygiene and breastfeeding seem to be quite simple but are surprisingly effective (22).In contrast, other interventions have not been yet introduced but still in their theoretical aspect (intravenous immunoglobulin) while others are still being evaluated (lactoferrin). Hand hygiene is the leading way to prevent infection. (22,28).

Hand hygiene

The most crucial and single strategy in reducing HCAIs by halting the transfer of germs remains hand hygiene. Humans shed live organisms on the squamous skin every day. If health care workers do not clean their hands before and after patient contact they are likely to contaminate patients, patients' clothing, the equipment in the room, bed linens and the furniture. Although a regular hand-washing protocol appears simple to follow, Even in the ICU, it is more difficult than predicted, with lower compliance rates. "Clean Care is Safer Care" is known as a global effort established by the WHO to improve the compliance rate of hand hygiene (22). People are more likely to confirm that in-service education, performance evaluation, reminders, the use of alcohol-based hand rubs, and the habit of using automatic sinks are all effective ways to promote hand hygiene compliance. The hand-rub devices are located in strategic places (at the entrance and exit of the patients' door), and since it is less time-consuming it has been shown to be effective in many settings and improves compliance (22).

Early feeding and human milk

Since discovered in 1984 that giving raw unpasteurized breastmilk to LBW newborns in India was related with decreased sepsis rates,Human breastfeeding is linked to a decreased rate of necrotizing enterocolitis (NEC) in preterm and VLBW newborns, according to various research conducted in HIC(22). Additionally, early enteral feeding, beginning 2 to 3 days after delivery, is linked to lower risks of HCAIs and NEC. Moreover, breastmilk is well tolerated than cow's formula milk since it is linked to the complete establishment of enteral feeding, which leads to early central line removal. However, this advantage is missing in human milk donor. Furthermore, human milk is known to be the neonates' best defence against infections, as it contains secretory antibodies, phagocytes, lactoferrin, and prebiotics, in addition to improving gastrointestinal function(22,37).

Central Line Care

Central lines are routinely utilized in ICUs to provide unwell and LBW infants with stable intravenous access for long term intravenous use, while umbilical arterial catheters are used for blood sample and continuous blood pressure monitoring. The majority of HCAI bloodstream infections are linked to a central line, and CLABSIs are linked to rising mortality and morbidity ,as well as longer hospital stays and costs. CLABSIs are higher in LMIC; therefore, implementation of central line insertion and maintenance bundles reduces the incidences of CLABSI in NICUs. In addition, evidence-based care of central lines has decreased CLABSI over the last decade(45).

2.3. Empirical literature

2.3.1. Epidemiology of healthcare associated infections in neonates

HCAIs have become more common as the medical field is advancing in technology and more population are accessing medical services, which is being accelerated by the use of more invasive procedures in healthcare settings(46). In HIC, surveys conducted in 1149 hospitals from 2011 to 2012 in the European Union member countries (Norway, Croatia and Iceland) showed the most prevalent HCAIs were bloodstream infections (65.4%) and urinary tract infections (22.5%). The mortality rate was 2.1%, with coagulase-negative staphylococci (361%) and Klebsiella pneumoniae being the most common infections (29.3 %).

(17,25).In Poland, HCAIs among neonates was 7.32%, and, in a study conducted at Talaghani hospital, Tehran, Iran, the infection prevalence was 14.3% among 285 neonates. In Darvishpour`s study in Gilan, there was a 16.3% infection rate among 270 infants in special care (17,25,35). In a similar study, the rate was 15.2% among 220 infants in Quazvin. It shows that the conditions of the NICUs in these hospitals are similar in terms of prevalence rate and the need for stronger infection control measures (35).

Furthermore, studies conducted in other countries are about the same or worse. The HCAI prevalence in South Korea it was 30.2% in 2006,in Brazil 50.7% in 2002 and 34% in 2003; in Taiwan 14.5% in 2007; and in Germany 14.8% in 2006 and in most cases, the primary reasons for admissions was BSI (80.7%) and pneumonia (6.7%)(47). In LMIC such as Botswana, a study showed that 13.54% patients (n=47) were associated with HCAIs among hospitalized neonates. In terms of infection locations, almost a quarter of HAIs were not specific and were usually seen in neonates. Surgical sites had the highest prevalence of HCAIs (23.4%), followed by ventilator-associated conditions/infections (17%), and decubitus ulcers (10.6%)(13).

2.3.2. Risk factors associated with neonatal HCAIs

The most significant HCAI risk factor is prematurity (22). Surveillance data from the national Institute of child Health and Human Development(NICHD) over nearly two decades revealed that 20–25 percent of VLBW infants who survived beyond three days had one or more episodes of blood culture-proven sepsis., mostly gram-positive organisms, and predominantly coagulase-negative staphylococcal(22). Multidrug-resistant Klebsiella species was the most common organism causing nosocomial septicaemia and pneumonia, and Pseudomonas aeruginosa was the second most common (39,48). The rate of nosocomial infection was 5.7 percent, with 7.1 infections per 1000 days spent in the hospital, while the most prevalent site was the bloodstream (45.6%), and most prevalent disease-causing organism was staph coagulase-negative (56.1%)(15).

Factors found to be related to HCAIs include lower gestational age, long-term mechanical ventilation, using parenteral nutrition, delay in initiation of oral feeding, and setting venous catheters(48). The factors which were significantly associated with neonatal HCAIs were a birth weight < 1500 g, and assisted ventilation >72 h(39).

A meta-analysis and systemic review study conducted by Wang and Zhao (2019) for infants in Neonatal intensive care units to assess Factors of HCAIs for 2270 infants with and 21 605 infants without HCAIs. The relative risk was calculated using categorical data supplied by the various studies (RR). Meta-analysis or RR in the incidence of HCAIs were undertaken to identify risk factors.

Chi-squared test and statistical indices I^2 were used to determine the meta analysis model and assess data heterogeneity. In order to assess publication bias, Egger's test or Begg's test were run after visualizing the funnel plot of an outcome measure. Meta-analyses were conducted using Stata software (version 10; Stata Corp., TX, USA).This study revealed that infant that weight less than 2500g (RR:3.44<95% CI:2.31-5.11), gestation age of less <37 weeks (RR:385,95% CI:1.87-7.92),mechanical ventilator use (RR:3.16,95% CI:2.21-4.50), venepuncture (RR:3.01,95% CI:1.20-7.57), the incidence of asphyxia (RR:168,95% CI:1.04-2.71) and feeding intorelence (RR:7.57), the incidence of asphyxia (RR:168,95%CI:1.04-2.71), and feeding intolerance (RR:2.12,95%CI:1.60-2.81) were identified as the risk factors for the incidence of HCAIs.

A retrospective descriptive study conducted in NICU level three in Al Hasa,Saudi Arabia to determine the prevalence of BSI, and their association with the patient’s gestational age and their birth weight, the causative agents and antibiotic sensitivity. A sample size of 1209 neonates was obtained based on the inclusion and exclusion criteria, and comprises all

admissions criteria to NICU level III from January-2017 to December-2018, with a positive a blood culture beyond 48 hours. Descriptive statistics were used to interpret and summarise variables. Data were analysed using SPSS software version 25. Gram negative organism found to be the leading cause of BSI; the predominant organism found in the isolate was a coagulase negative Staphylococcus. Most of the affected neonates with BSI were device related and the survive rate among them found to be at 53.5%(49). With regard to assess the Risk factors for Neonatal HCAIs in NICU; A meta-analysis of eight observational studies conducted by Vanya Rangelova. Length of hospital stay (OR 23.45), reintubation (OR 9.18), enteral nutrition (OR 5.59), mechanical ventilator (OR 4.04), blood transfusion (OR 3.32), low birth weight (OR3.16), premature birth (OR 266), parenteral nutrition (OR 2.30), broncopulmonary dysplasia (OR 2.21) and tracheal intubation OR(112) were the identified risk factors according to the odds ratio. During a 12-month period, a cross section quantitative study was conducted in the NICU at Assiut University Children Hospital (from February 2018 to February 2019). Blood, pus, cerebrospinal fluid, and urine specimens were collected and analysed from a total of 150 non-infected infants at admission. The findings revealed that 107 (71.3%) of 150 newborns acquired NI.

Staphylococcus aureus (22.7 percent) and Klebsiella spp. caused the majority of the infections (16.0 percent). In neonates, bloodstream infection was the most common source of HCAIs (68.3%), followed by respiratory infection (20.8%). Low birth weight and preterm were states as associated factors for HCAIs, and death as the consequence of HCAIs in 52 % of neonates(50). Therefore, most strict guidelines should apply in the clinical settings to prevent HCAIs and death among this vulnerable age group (50).

2.4. Critical review and research gap identifications

Many studies were conducted globally concerning neonatal HCAIs and their related factors, with fewer done in SSA countries, especially in Rwanda(21,46). Most studies in SSA have focused on the prevalence, but few have mentioned the factors related to HCAIs among neonates, including Rwanda (15).

The current study was aimed at measuring the variables related to HCAIs and all associated risk factors among neonates in Rwanda, particularly in Rwanda teaching hospitals, which are located in Kigali. The researcher did adapt some of the variables to build up the conceptual framework and better guide this study.

2.5. Conceptual framework

Florence Nightingale's philosophy predominantly focused on the patient and the environment, with the nurse adapting the environment to improve patient recovery and outcome. According to Nightingale's theory, the patient wellbeing depends on the patient's responsibility to their health, but in collaboration with the nurse and the environmental factors. She believed that most patients' complaints are not directly related to her condition, but from the patients' environment (51).

Nightingale's four major concepts of nursing theory

1. Person:

In Florence Nightingale's theory, "A person is the recipient of nursing care". For this study, the person is the newborn and his demographic data; the gestational age, and lower Apgar scores at one and five minutes. The newborn needs to use their internal ability (innate immunity to fight against HCAIs), and the newborn's intrauterine life depends on maternal health and the role of the healthy placenta, which can act as a barrier to prevent infections reaching the newborn. However, following delivery, the newborn struggles in a non-sterile environment full of pathogenic agents and infections, and trying to survive with an immature immune system. Several neonatal factors, include the severity of illness, the underlying compromised immune status and the length of hospital stay, play a major role in susceptibility and outcome of a HCAI (15). Premature newborns were more than four times more susceptible to hospital-acquired illnesses than those with a normal gestational age, according to a study by Christina et al. (OR 4.45, 95 percent CI 2.04–9.72). Male gender is also associated with an increased risk for susceptibility to HCAIs(15,43).

2. Environment:

The environment is the patient's internal and external surroundings, and it plays a very crucial role in maintaining health, wellbeing and promoting the patient's recovery. The patient's environment is modifiable according to the patient's needs and status by the nurse's involvement. A healthy environment helps the patient restore their internal force or vital power toward natural healing. The most of HCAI agents are endogenous flora., as well as from many staff contacts and the hospital's surroundings, including nurse to patient ratio, open beds close together and invasive procedures (exogenous flora) (43).

3. Nursing

Nursing is a process of modifying the patient's environment to promote the natural laws of health. Florence Nightingale's theory defines nursing beyond the act of medicine administration and application of bandages, but the activity of promoting health, which

occurs in any caregiving situation. In this study, nursing means not only medication administration, but also altering the patient's environment (hand hygiene, central line care, etc.); feeding the baby the mother's breastmilk and letting nature act on the patient. According to the WHO, an estimated 38% of LMICs have inadequate water and sanitation facilities; thus, high prevalence of HCAIs could be linked to poor hand hygiene (HH) and resources.(52).

4. Health

Florence Nightingale's theory defines health not only as a state of wellbeing, but moreover, to be able to use our own powers in a natural environment to get well (51). In this study, health is defined as a term new-born with a possible low risk of HCAI. A term new-born has a stronger non-specific immune system and thus can fight common infections better than a preterm baby. According to a meta-analysis study, the incidence of HCAIs was higher in infants with asphyxia than in non-asphyxiated infants (RR: 1.68,95%CI: 1.04-2.71), and higher in infants with feeding intolerance than in those without feeding intolerance (RR:2.12,CI:1.60-2.81)(6).

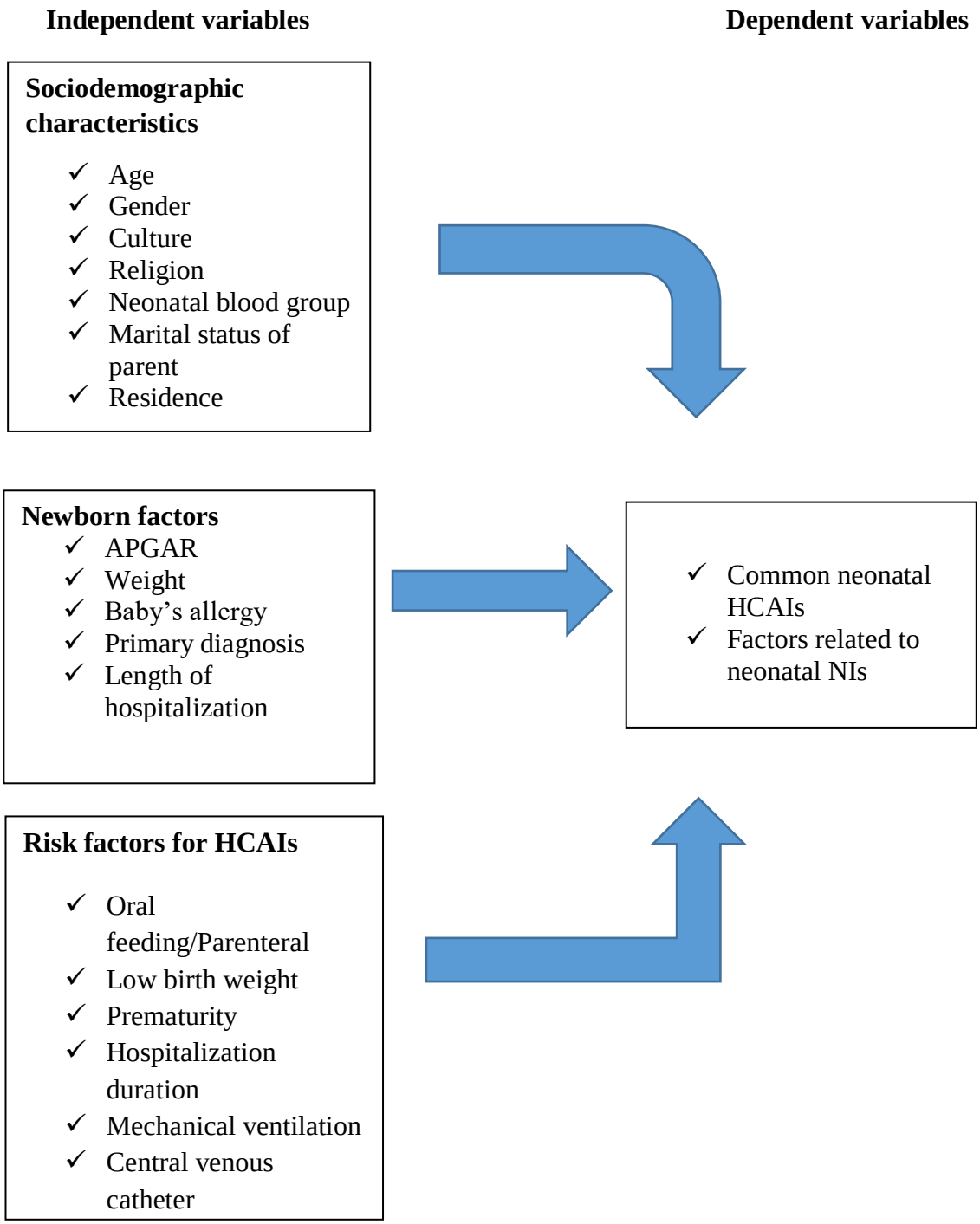


Figure 1: Conceptual framework(53,54).

CHAPTER III: RESEARCH METHODOLOGY

3.1. INTRODUCTION

The chapter explains the research process. Moreover, the methodology chapter covers an explanation of research design, the choice and implementation of data collection methods. The sampling aspect of the study and discussions of the ethical considerations are also included in this chapter.

This chapter entails the description of how the study was conducted. It specifies the research study area, study design, target population, sampling methods, data collection instrument and procedures and data analysis type.

3.2. STUDY DESIGN

A retrospective cross sectional design assessed the types and factors related to common neonatal nosocomial infections in three selected teaching hospitals in Rwanda(55).

3.3. RESEARCH APPROACH

A quantitative approach was used to quantify the types and factors associated with common neonatal nosocomial infections(56).

3.4. RESEARCH SETTING

The research was conducted in three different teaching hospitals in Kigali city, which include; Rwanda Military Hospital (RMH), King Faisal Hospital (KFH), and Kigali University Teaching Hospital (CHUK). These hospitals are legends in neonatal management, with NICUs fully prepared for critical conditions in Rwanda. Rwanda Military Hospital (RMH), King Faisal Hospital (KFH), and Kigali University Teaching Hospital (CHUK) are all referral hospitals located in different areas in Kigali City, which are Kicukiro, Gasabo and, Nyarugenge districts, respectively.

3.5. STUDY POPULATION

The study population consisted of 273 files of babies aged less than 28 days who were hospitalized in the NICU services of the study sites from April to September of 2021. The researcher retrieved the information from the files of these neonates because this is a retrospective study.

3.5.1. Inclusion criteria

Files of neonates (female and male) from birth up to the age of 28 days hospitalized in NICU of one of the following hospitals: KFH, RMH, and CHUK, for at least 7 days.

Having been hospitalized in the last six months prior to the time of data collection and having survived for at least seven days with a clear medical diagnosis.

3.5.2. Exclusion criteria

A neonate who was hospitalized in the NICU of the above study sites whose discharge is dated more than six months prior to the time of data collection

A neonate who died before final medical diagnosis and before seven days of hospitalization

3.6. SAMPLING

3.6.1. Sample size

In this study, the researcher considered the files of all neonates who were hospitalized in NICU within six months prior to the period of data collection of the three mentioned referral hospitals. The sample size was calculated using the following Cochran formula to compute the sample size for prevalence which was used(57).

$$n_0 = \frac{Z^2\,pq}{e^2} = \frac{(1.96)^2 \text{ x } 0.231 \text{ x}(1-0.231)}{(0.05)^2} = 273$$

The total sample size equal 273 neonatal babies

Where

- P: estimated population that is the expected prevalence in our study (in a proportion of one; if 23.1%, P = 0.231) of neonates who had previously had a HCAI as reported in a study conducted in Rwandan teaching hospitals among NICU patients(58)
- q: is 1-p
- n_0: stands for the sample size of the study
- e: is the desired level of precision (5%).
- Z: the desired level of confidence interval of 95% (1.96).

The stratified simple random sampling was computed as this study is made up of three different strata (RMH, KFH, CHUK), and after that in each stratum, to determine the files to be used in the study simple random sampling were used(59,60). To calculate the sample size

for each hospital, the researcher used the proportion of the admission capacity for each month by considering the capacity of admission for each one of the three hospitals as 100%.

Table 1: Sample size

The table below is displaying how sample size was calculated based on the estimated study population from each study site. The first column is for the study site, the second column for the estimated study population and the third column for the calculated proportion for each site. The fourth column is the calculation of the sample size of each study site based on the total sample size calculated based on the previous prevalence. Therefore, the estimated total study sample size was 273 files based on the prevalence of 23.1% (7).

Health Facility/ study site	Total number of neonates admitted to NICU per month	Proportion of the hospital (%)	Sample size for each hospital based on proportion
KFH	17	0.22	61
RMH	40	0.52	141
CHUK	20	0.26	71
Total	77	100%	273

3.7. INSTRUMENT

A data abstraction instrument was used for data collection. The instrument was developed based on the study objectives, an extensive literature review, and input from neonatal experts. The instrument is divided into three sections and contains 31 questions, which are divided as follows;

Section 1: Demographic characteristics; maternal age, obstetric history, mother's blood group, allergy, religion, occupation, Residence, Family history, communicable disease, current pregnancy history.

Section 2: Neonatal profile before admission; Age (in weeks), neonate's weight and sex, types of delivery, feeding, place of birth, Apgar, neonatal blood group, baby's allergies, neonatal chief complain on admission.

Section 3: Neonatal profile after admission**;** Admission diagnosis of the newborn in NICU and procedure done on or after admission, admission and discharge dates, procedure and treatment, Neonate's medical/surgical/treatment history, current medications, Admission

physical examination, investigations, Common neonatal nosocomial infections, a summary of illness, management/plan, reasons for neonatal death.

3.8. VALIDITY AND RELIABILITY OF RESEARCH INSTRUMENT

The items or questions on questionnaire had logical connection with the first objective since the questions were about risk factors of HCAI and were described in regard to the context of neonatal admission file and the continuity of the newborn progress sheet. All of these used tools justify the face validity of the used tool in this study. Concerning the content validity, the items used in data collection was enough and appropriate to measure the common types of neonatal HCAIs from the risk factors to the specific types of Neonatal HCAIs and the outcome of the neonates at the above mentioned teaching hospitals at discharge. The items or data abstraction sheet was more appropriate and adequate representation in each section to assess the common types of neonatal HCAIs and its related factors in all three teaching Hospitals(61,62). This instrument was also checked with deep analysis by various experts in research including the research supervisors for content validity.

The researcher used a pilot group of at least 10 files to test the instrument for validity feasibility purposes. The internal consistency of the pilot study was measured will using the Cronbach's coefficient; a reliability factor of 0.70 or higher indicated the reliability. Since a research assistant was trained to help with data collection, the pilot study was used to check for inter-rater reliability between data collectors. Files accessed for the pilot study were not included in the main study. The instrument was developed based on an exhaustive review of the related literature and according to the format or content in available files of three teaching hospitals as well as the input from neonatal experts to increase content validity. The instrument validity was based on the constructs of the conceptual framework and reflection of relevant current research on the topic of HCAIs. Identifying the types and factors associated with common neonatal nosocomial infections were added to criterion validity on the topic in Rwanda.

3.9. DATA COLLECTION

Data was collected using a data abstraction sheet; data was obtained from neonatal files. Data abstraction instrument was used to obtain information from patient files. Each hospital was sampled according to the sample size as calculated in sample size calculation. The researcher consulted each file for variables under investigation and tick on the sheet, the corresponding

variable. Each data abstraction sheet was given a code, and the researcher has established a list composed of neonates' identities to avoid using the same file twice.

3.10. DATA ANALYSIS

The researcher analysed the common neonatal nosocomial infection and their related factors using SPSS version 21. Sociodemographic characteristics was presented in frequencies and percentages, HCAI and related factors were presented in frequencies and percentages. Relationships between factors and HCAIs were presented in frequency, OR, and P-value. Data were presented using tables, and bivariate and multivariate analysis was performed to compare sociodemographic characteristics and other variables on HCAI. A multivariate binary logistic regression model was used to identify the independent predictors of HCAIs.

3.11. ETHICAL CONSIDERATIONS

Approval of the research was obtained from the university of Rwanda, college of Medicine and Health Science Institutional Review Board. This study is a retrospective design using files, so patient consent is not necessary(62). Authorization to access the files was obtained from the research committee of the three respective hospitals. There was no personal identifying information recorded on the questionnaire; instead, a code was used to respect the principle of anonymity. The collected data was kept by respecting the principles of confidentiality and locked in a cupboard. The study did not cause any harm to the participants and had no any impact on service delivery.

3.12. DATA MANAGEMENT

All data collection tools are kept in a locked cupboard to ensure the confidentiality of the participants. The data was entered in computer protected with a personal computer password.

3.13. DATA DISSEMINATION

After the research presentation, the feedback will be provided to the respective three referral hospital for further use. A copy of this research project will be availed in UR Library for library users consultation. Also, the researcher will use all effort possible to publish this study in an official research journal.

CHAPTER IV: RESULTS PRESENTATION

4.0. Introduction

This was a descriptive retrospective study of medical files of previously hospitalized neonates at the three study sites during the study period. The sample size of 273 files was accessed.

4.1. Sociodemographic characteristics

4.1.1. Study sites

Table 2 shows the frequency and proportion of files accessed at the three study sites. The sites included 61(22.3%) at King Faisal Hospital (KFH), 71(26.0%) at Centre Hospitaliere Universitaire de Kigali Hospital (CHUK), and 141(51.6%) at the Rwanda Military Hospital (RMH).

Table 2: The three Study Sites

Study Site	Frequency(n)	Proportion(%)
KFH	61	22.3
CHUK	71	26.0
RMH	141	51.6
Total	273	100.0

4.1.2. Maternal demographic variables

Table 3 shows the mother's demographic characteristics, the majority, 91(33.3%), were aged 21 to 25 years, 92(33.7%) were gravid 2, and 110(40.3%) were parity 2. More than half, 184(67.4%) had no obstetrical history, whereas 103(37.7%) had Gestational HTN & HTN D, which was the most frequent pregnancy condition. Regarding the blood group, the majority, 92(33.7%) were type O. The majority of participants, 90(33%) had Catholic affiliation, and 152(55.7%) lived in the urban area.

Table 3: Maternal demographic characteristics(n=273)

Mother's demographic variables	Frequency(n)	Proportion(%)
Age of the mother		
Below 21 years	34	12.5
21-25 years	91	33.3
26-30 years	77	28.2
26-30 years	32	11.7
26-30 years	24	8.8
26-30 years and above	15	5.5
Number of Pregnancy		
1 gravida	80	29.3
2 gravida	92	33.7
3-4 gravida	85	31.1
5 gravida and more	16	5.9
Number of Children		
1 parity	110	40.3
2 parity	99	36.3
3-4 parity	59	21.6
5 and more	5	1.8
Obstetrical history		
Yes	89	32.6
No	184	67.4
BG of the mother		
A	78	28.6
B	61	22.3
AB	42	15.4
O	92	33.7
Mother's Religion		
Catholic	90	33.0
Protestant	83	30.4
Muslims	31	11.4
Other and None	69	25.3
Mother's region		
Urban	152	55.7
Rural	118	43.2
Not mentioned	3	1.1
Pregnancy history		
Gestational HTN &HTN D	103	37.7
PPROM/PROM	86	31.5
UTI	30	11.0
P-Previa/abruption	20	7.3
Diabetes and others	34	12.5
Total	273	100

4.1.3. Neonatal demographic characteristics

Table 4 shows the neonates demographics identified in the files. The majority, 203(74.4%), were preterm, 101(37.0%) weighed less than 1.5kg, and 162(59.3) were boys, 179(65.6%) had a dystocic delivery. The majority, 169(61.9%) had an APGAR score of 8-10, 116(42.5%) had O type blood type, and 205(75.1%), received breastmilk. The most frequent NICU admission diagnosis, 200(73.3%) was for prematurity, LBW, or respiratory distress syndrome. The majority of neonates, 126(46.2%) were born at RMH, and 108(39.6%) were hospitalized 21 to 28 days.

Table 4: Neonatal demographic variables(n=273)

Neonatal demographic variables	Frequency(n)	Proportion(%)
Neonatal age		
Preterm	203	74.4
Term	70	25.6
Neonatal Sex		
Boys	162	59.3
Girls	111	40.7
Neonatal weight		
Below 1.5kg	101	37.0
1.5-2.5kg	100	36.6
2.6-3.5 kg	57	20.9
3.6 kg and above	15	5.5
Delivery types		
Eutocic delivery	94	34.4
Dystocic delivery	179	65.6
Feeding types		
Breastmilk	205	75.1
Formula milk	33	12.1
Fortified milk	31	11.4
Others	4	1.5
Place of birth		
KFH	30	11.0
CHUK	80	29.3
RMH	126	46.2
Other	37	13.6
Score of neonate		
0-7	104	38.1
8-10	169	61.9
Neonatal BG		
A	66	24.2
B	41	15.0
AB	50	18.3
O	116	42.5
Admission diagnosis		
Prematurity/LBW/R follr I/RDS	200	73.3
HIE/N Sepsis	44	16.1
Others(congenital anomalies)	29	10.6
Hospitalization period		
8 to 15 days	24	8.8
16 to 23 days	83	30.4
21 to 28 days	108	39.6
29 to 36 days	58	21.2
Total	273	100.0

4.2. Diagnosis and management of Healthcare Acquired Infections

Table 5 shows the frequency and proportion of neonates with a diagnosis and management of a HCAI. The majority of neonates, 200(73.3%) were diagnosed with Prematurity/LBW/R for I/RDS, and all 273(100%) received a physical exam. Almost all neonates, 272(99.6%) were given a treatment or procedure; the majority, 160(58.6%) received an IV line and/or oxygen therapy, and 260(95.2%) were given antibiotics.

Table 5: Diagnosis and management of HCAIs (n=273)

Diagnosis	Frequency(n)	Proportion(%)
Diagnosis at admission		
Prematurity/LBW/R for I/RDS	200	73.3
HIE/N Sepsis	44	16.1
Others(congenital anomalies)	29	10.6
Any treatment/procedure		
Yes	272	99.6
No	1	.4
Treatment/Procedure given		
Mechanical ventilation/central line/drain	71	26.0
IV line/Oxygen therapy	160	58.6
Blood transfusion	32	11.7
Surfactant	5	1.8
Others(surgical procedure)	5	1.8
Medication given		
Antibiotics	260	95.2
Non antibiotics	13	4.8
Physical exam performed		
Yes	273	100.0
No	0	0.0
Total	273	100.0

4.3. Common types of Healthcare Acquired Infections among hospitalized neonates

Table 6 shows the most commonly acquired healthcare pathogens at the three teaching facilities. Half of the neonates, 142(52.0%) had Klebsiella pneumonia, and more than a half quarter 68(24.9%) had Staphylococcus aureus. The majority, 193(70.3%) lived. Of those that lived, 141(51.6%) totally recovered, 50(18.3%) survived with disabilities, and 2(0.7%) were transferred. Over a quarter 80(29.3%) of neonates died, and the major cause of death 62(22.7%) was HCAIs.

Table 6: Common types of HCAIs affecting hospitalised neonates(n=273)

Common HCAI	Frequency(n)	Proportion(%)
Common HCAI		
Escherichia/enterococcus	11	4.0
Pseudomonas aeruginosa	1	.4
Klebsiella pneumonia	142	52.0
staphylococcus aureus	68	24.9
Candida albicans and others	10	3.7
None	41	15.0
Outcome at discharge		
Totally recovered	141	51.7
With disabilities	50	18.3
Death	80	29.3
Other/transferred	2	.7
If Died or Not		
Yes	80	29.3
No	193	70.7
Reason for death		
Respiratory distress syndrome	1	.4
Prematurity	5	1.8
Neonatal infection	62	22.7
HIE	7	2.6
Other	5	1.8
Alive	193	70.7
Total	**273**	**100.0**

4.4. Factors related to HCAIs among neonates in the Rwanda teaching hospitals.

4.4.1. Bivariate logistic regression analysis

Table 7 shows the Bivariate logistic regression analysis of the factors related to HCAIs in the study population.

For assessing the association between common healthcare acquired infection and other variables, bivariate logistic regression analysis was computed. Hospital(CHUK) was associated with HCAIs with OR: 2.806 (C.I:1.511-5.210), P value:0.001; Maternal Blood group especially Group O with OR:2.235(C.I:1.062-4.705),P value:0.034; Neonatal weight at 1.5-2.5 kg OR: 0.059 (C.I:0.013-0.278),P value:0.000; gender male with OR: 1.689(1.030-2.772) ,P value:0.038, Place of Birth with OR:0.656(C.I:0.491-0.877), P value:0.004; Admission Discharge with O.R:0.629(C.I:0.475-0.831), P value:0.001; Neonatal Treatment/procedure with O.R:1.406(C.I:0.983-2.011), P value:0.062; Regarding neonatal outcome, total recovered was significant with a P value 0.000 ;place of birth OR: 1.200(CI:0.544-2.645),p Value:0.009; neonatal death OR: 0.218 (C.I:0.118-0.405), P value:0.001.

Table 7: Bivariate logistic regression analysis (n=273)

Variables	Common HCAI			
	OR	**95%CI of OR**		**P Value**
		Lower	**Upper**	
Hospital				
KFH	1			.005
CHUK	2.806	1.511	5.210	.001
RMH	1.493	0.835	2.670	.176
Mother Blood group				
Blood Group A	1			.046
Blood Group B	.888	.472	1.668	.711
Blood Group AB	1.976	1.022	3.818	.043
Blood Group O	2.235	1.062	4.705	.034
Neonatal weight				
Weight below 1.5 kg	1			.000
Weight 1.5-2.5 kg	.059	.013	.278	.000
Weight 2.6-3.5 kg	.154	.033	.717	.017
Weight 3.6 kg and above	.149	.031	.719	.018
A Neonatal gender				
Female	1			
Male	1.689	1.030	2.772	0.038
Place of Birth				
KFH	1			.004
CHUK	1.200	.544	2.645	.009
RMH	.843	.398	1.785	.656
Admission discharge				
Prematurity/LBW/R for I/ARDS	1			.001
HIE/N sepsis	1.864	0.721	4.818	.969
Other Congenital Sepsis	0.984	0.446	2.171	.199
Neonatal treatment/procedure				
No	1			.000
Yes	1.406	.983	2.011	.062
Neonatal outcome				
Total recovered	1			.000
With disabilities	1.238	0.076	20.190	.881
Death	0.923	0.055	15.592	.956
Other/Transferred	0.250	0.015	4.217	.336
Neonatal death				
Not died	1			.000
Died	0.218	0.118	0.405	.001

4.4.2 Multivariate logistic regression analysis of HCAIs among neonates

Table 8 shows that after computing multivariate logistic regression of the variables that were significant in bivariate analysis, four variables remain statistically significant. A neonate with the maternal blood group AB (OR=2.365: 95%CI=1.097-5.098; p=.028) is over two

times more likely to have an HCAI than a neonate with a mother with BG A. A neonate with the maternal BG O (OR=3.097: 95%CI=1.321-7.262; p=.009) is three times more likely to have an HCAI than neonates with a mother with blood group A. A neonate with a weight of 3.6kg and above (OR=0.094 95%CI=0.016-0.541; p value=0.008) is less likely to have an HCAI, than an infant weighting below 1.5kg. A neonate born at CHUK is four times more likely to have an HCAI (OR=4.072: 95%CI=1.054-15.724; p=0.042) than a neonate born at KFH. And finally, a borderline significance (p=0.051) showed neonatal death was three times more likely to be associated to HCAI with OR=3.37(95%CI=0.996-11.186).

Table 8: Multivariate logistic regression analysis of HCAIs among neonates

Variables	Common HCAIs			
	OR	95%C.I.for OR		P Value
		Lower	Upper	
Hospital				
	.774	.531	1.129	.183
Mother Blood group				
Blood Group A	1			**.037**
Blood Group B	1.128	0.551	2.307	.742
Blood Group AB	2.365	1.097	5.098	**.028**
Blood Group O	3.097	1.321	7.262	**.009**
Neonatal Weight				
Weight Below 1.5kg	1			**0.003**
Weight 1.5-2.5kg	0.033	0.005	0.215	**0.000**
Weight 2.6-3.5kg	0.069	0.011	0.419	**0.004**
Weight 3.6 kg and above	0.094	0.016	0.541	**0.008**
Place of Birth				
KFH	1			0.199
CHUK	4.072	1.054	15.724	**0.042**
RMH	1.997	0.673	5.925	0.212
Other place	1.745	0.604	5.041	0.303
Admission-Discharge date				
	0.932	0.626	1.387	0.727
Procedure treatment				
	0.000	0.000		1.000
Neonatal treatment/procedure				
	1.419	0.929	2.167	0.105
Neonatal outcome				
	0.923	0.513	1.660	0.789
Neonatal death				
No	1			0.282
Yes	3.337	0.996	11.186	**0.051**

CHAP V: DISCUSSION AND RECOMMENDATIONS

5.1. Introduction

This is a chapter five of this study and which describes the comparison between the current study findings and what other researchers found in other studies similar or quite similar to this study, and it has mainly three different sub-chapters; discussion, conclusion and recommendations.

5.2. Discussion

5.2.1. Socio demographic characteristics of the participants

The main aim of this study was to assess common neonatal healthcare acquired infections and their related factors in selected three teaching hospitals in Rwanda , and was conducted in three different teaching hospitals which includes King Faisal Hospital(KFH) which had around 61(22.3%) of the total participants, while Centre Hospitaliere Universitaire de Kigali (CHUK) had 71(26.0%) participants and finally Rwanda Military hospital(RMH) had the majority of around 141(51.6%) participants, similarly to this, many researches were conducted common neonatal healthcare acquired Infections and related factors in different teaching hospitals like University children hospital in Egypt(10,50).

Regarding maternal demographic characteristics, the majority 91(33.3%) were between the age of 21-25 and were having 2 gravida at 92 (33.7) and most of the mothers had 1parity with 110(40.3%), similar results found in a study conducted in Ethiopia where most of the participants were primipara and delivered at hospital(63,64). Regarding the blood group, the majority 92(33.7%) of the total participants had Blood Group O and most of them were catholic with 90(33%) of the total participants, and were living in urban with 152(55.7%) of the total participants and finally regarding pregnancy history the majority of 103(37.7%) were having Gestational HTN & HTN Disease with similar results were found in a study which was conducted in Ethiopia where the majority of the mothers were below 35 years of age, living in urban and the majority were Christian and were married(63).

Neonatal demographic characteristics showed that, the majority were preterm babies at the proportion of 203 (74.4%) of the participants and were male at 162(59.3%), compared to

The study conducted in referral Hospital in China, the majority of the participant were male with a proportion of 66.3%,as well as a study which was conducted in Tanzania(65,66).And considering the birth weight, below of 1.5kg at the proportion of 101(37.0%)of the total participants, while the majority among them were born dystocically at 179(65.6%), similar

results were found in a study conducted in Cameroon where the majority had birth weight below 2.5kg and contrary to this most of the participant were born eutocically(67). And were being fed breast milk at the proportion of 205(75.1%) and the majority were premature, similar results were found in a study conducted in Tanzania where the majority were premature at 200(72%)(66). And the majority with 126(46.1%) were born at RMH at around 116(42.5%) of the participants were having Blood Group O, and at admission 200(73.3%) were diagnosed with Prematurity/LBW/R for I/RDS, while 108(39,6%) were hospitalized around 21 to 28 days, same results was reported in Tanzania where the majority were diagnosed prematurity and low birth weight and were hospitalized more than two days at enrolment(66,67).

5.2.2. Diagnosis and management of HCAIs

Regarding diagnosis of the participants, the majority of 200(73.3%) were diagnosed with Prematurity/LBW/R for I/RDS similar results were found in a study conducted in Egypt where neonates with HCAIs were most of them diagnosed with prematurity and low birth weight(50). And 272(99.6%) among them were given medications/procedures, and the majority of 160(58.6%) were given oxygen therapy and/or IV medications among them 260(95.2%) were given antibiotics, while all the participants got physical examination, same results was found in Ethiopia where neonates with HCAIs were administered medications including antibiotics and oxygenotherapy (63,66).

5.2.3. Common types of HCAIs among neonates hospitalized in the Rwanda teaching hospitals.

Regarding the most common healthcare acquired germs, Klebsiella pneumonia were most predominant with about 142(52%) of the participants, and the majority of the participants were totally recovered at the proportion of 141(51.6%) and the minority of the participants died at 80(29.3%) similar results were found in a study conducted in Turkey where common HCAIs were caused by gram negative bacteria which includes Klebsiella pneumonia and mortality rate was at 10.8% of the total participants 352 (50,68). As well as in India where mortality rate was at 29%(32).And the reason among those participants died were neonatal HCAIs infection at 62(22.7%),similar results were found by WHO in a study conducted in developing countries where neonatal deaths related to HCAIs were ranging from 4 to 56 % of all neonatal deaths(41,69)

5.2.4. Factors related to HCAIs among neonates in the Rwanda teaching hospitals.

5.2.4.1. Bivariate logistic regression analysis

For assessing relationship between common healthcare acquired infection and other variables, bivariate logistic regression analysis was computed and hospital(CHUK) was associated with HCAIs with OR: 2.806 (C.I:1.511-5.210), P value:0.001; Maternal blood group especially Group O with OR:2.235(C.I:1.062-4.705), P value:0.034; in contrast to other studies, Maternal blood group was not considered when considering factors associated with HCAIs, the results from a study conducted in Ethiopia(63). Neonatal weight at 1.5-2.5 kg OR: 0.059 (C.I:0.013-0.278), P value:0.000; Place of Birth with OR:0.656(C.I:0.491-0.877), P value:0.004 similar results were found in a study conducted in Turkey where they found a strong association between preterm ,low birth weight and HCAIs, as well as results reported from a study conducted in Tanzania(68,70). Admission Discharge with O.R:0.629(C.I:0.475-0.831), Pvalue:0.001, Neonatal Treatment/procedure with O.R:1.406(C.I:0.983-2.011), Pvalue:0.062, and finally Neonatal Outcome with OR:0.493(C.I:0.367-0.663) P.value:0.000; place of birth OR: 1.200(CI:0.544-2.645), p Value:0.009 and neonatal death OR:4.578(C.I:2.471-8.480), P value:0.000,similar results was reported in Ethiopia where treatment provided and neonatal outcome were associated with HCAIs(71).

5.2.4.2. Multivariate logistic regression analysis

By computing multivariate logistic regression of those variables which were significant in bivariate analysis, maternal blood group especially AB and O were statistically significant with a P value 0.028 and 0.009 and OR:2.365(CI:1.097-5.098) and O.R:3.097(CI:1.321-7.262) respectively. And neonatal weight with OR:1.981(CI:1.310-2.996), P value:0.001; place of birth OR:0.682(CI:0.474-0.981), P value:0.039 and similar results was found in the studies conducted in Egypt and WHO where neonatal HCAIs were associated with preterm and low birth weight as well as place of birth(10,50).

LIMITATIONS

Since the researcher collected the data using only the clients' files, some factors related to healthcare providers that may affect neonatal HCAIs and its related mortality rate were not gathered. Due to the nature of this study, it was not applicable to get informed consent from the study participants. Moreover, this study was conducted in three in three selected teaching hospitals, and therefore the study findings may not be generalized to the whole country.

CONCLUSION

This study was aimed at the assessment of common HCAIs among neonates and related factors in selected teaching hospitals in Rwanda, and results showed that preterm, low birth weight, neonatal death, and maternal blood type were associated with HCAIs at the three study sites and the most predominant HCAI was klebsiella pneumonia. Hence, understanding the risk factors associated with HCAIs is crucial to help reduce neonatal morbidity and mortality related cost of care, and potential increase in antibiotic resistance in clinical settings.

RECOMMENDATIONS

The researcher recommends the teaching hospitals that the infection control measures such as hand hygiene complience, limitation of excessive use of umbilical catheter, mechanical ventilation, central venous line, and prevention of improper use of antibiotics would be emphasized in order to decrease the incidence of HCAIs. The academicians should teacher medical/nursing students about the impact of HCAIs to the economic status of the patient and that of the nation as whole without forgetting their impact on public health of the community for them to be aware hence contribute effectively in their prevention and management. The ministry of health should participate actively in prevention and management of HCAIs by organizing training and conducting evaluation sessions for ensuring that HCAIs are decreasing as they are main life threatening conditions for neonatal health especially those with low immunity. Additional to this more implementation studies need to be conducted in this area to help in the reduction and prevention of neonatal health care acquired infection(HCAIs).

REFERENCES

1. Mbim EN, Mboto CI, Agbo BE. A Review of Nosocomial Infections in Sub-Saharan Africa A Review of Nosocomial Infections in Sub-Saharan Africa. Br Microbiol Res J. 2016;15(1): 1-1(May).
2. Mpinda-joseph P, Paramadhas BDA, Reyes G, Maruatona MB, Chise M, Monokwane-BB, et al. Healthcare-associated infections including neonatal bloodstream infections in a leading tertiary hospital in Botswana. Hosp Pract [Internet]. 2019;47(4):203–10. Available from: https://doi.org/10.1080/21548331.2019.1650608
3. García AM, Cross JH, Fitchett EJA, Kawaza K, Okomo U, Spotswood NE, et al. Review Infection prevention and care bundles addressing health care-associated infections in neonatal care in low-middle income countries : a scoping review. eClinicalMedicine [Internet]. 2022;44:101259. Available from: https://doi.org/10.1016/j.eclinm.2021.101259
4. Rameshwarnath S, Naidoo S. Risk factors associated with nosocomial infections in the Neonatal Intensive Care Unit at Mahatma Gandhi Memorial hospital between 2014 and 2015. South African J Infect Dis [Internet]. 2018;33(4):93–100. Available from: http://doi.org/10.1080/23120053.2018.1453641
5. Kamgaing EK, Djoba JF, Ebori FJ, Ebori FJ, Santé LN De. Profiles of microorganisms isolated from neonates ' blood cultures , incubators , cradles , ventilators , washbasins , and health-workers of Libreville University Hospital Neonatal Service : focus on infection prevention and control measures. 2021;12.
6. Wang L, Zhao Y. Risk Factors of Nosocomial Infection for Infants in Neonatal Intensive Care Units : A Systematic Review and Meta-Analysis META-ANALYSIS. 2019;8213–20.
7. Lukas S, Hogan U, Muhirwa V, Davis C, Wong R. Establishment of a hospital-acquired infection surveillance system in a teaching hospital in Rwanda. 2016;1–9.
8. Boskabadi H, Maamouri G, Akhondian J, Zakerihamidi M, Seyedi SJ, Ghazvini K, et al. Neonatal infections: A 5-year analysis in a neonatal care unit in North East of Iran. Int J Pediatr. 2016;4(12):3989–98.
9. WHO. Improving the prevention, diagnosis and clinical management of sepsis- Report by the Secretariat. WHO Publ. 2017;executive(January):1–6.
10. WHO. Report on the Burden of Endemic Health Care-Associated Infection Worldwide

Clean Care is Safer Care. 2015;

11. Musa O, Aboderin AO, Salami T, Taiwo S. Nosocomial infections and the challenge of control in developing countries Nosocomial Infections and the Challenges of Control in. African J Clin Exp Microbiol · April 2010. 2010;(April 2015).
12. WHO. All reasonable precautions have been taken by the World Health Organization to verify the information contained in this document. However, the published material is being distributed without warranty of any kind, either expressed or implied. The responsib. 2015;
13. Mpinda-Joseph P, Anand Paramadhas BD, Reyes G, Maruatona MB, Chise M, Monokwane-Thupiso BB, et al. Healthcare-associated infections including neonatal bloodstream infections in a leading tertiary hospital in Botswana. Hosp Pract (1995) [Internet]. 2019;47(4):203–10. Available from: https://doi.org/10.1080/21548331.2019.1650608
14. Musa O, Aboderin AO, Salami T, Taiwo S. Nosocomial infections and the challenge of control in developing countries. African J Clin Exp Microbiol · April 2010. 2010;(April 2015).
15. Rameshwarnath S, Naidoo S, Group F. Risk factors associated with nosocomial infections in the Neonatal Intensive Care Unit at Mahatma Gandhi Memorial hospital between 2014 and 2015. South African J Infect Dis. 2018;0053:1–8.
16. Moffa M, Guo W, Li T, Cronk R, Abebe LS, Bartram J. A systematic review of nosocomial waterborne infections in neonates and mothers. Int J Hyg Environ Health. 2017;220(8):1199–206.
17. Zingg W, Hopkins S, Gayet-ageron A, Holmes A, Sharland M, Suetens C, et al. Health-care-associated infections in neonates , children , and adolescents : an analysis of paediatric data from the European Centre for Disease Prevention and Control point-prevalence survey. Lancet Infect Dis. 2017;3099(16):1–9.
18. Elizabeth M, Mboto C, Agbo BE. Nosocomial Infections in Sub-Saharan Africa Nosocomial Infections in Sub-Saharan Africa. 2019;(July).
19. Khan HA, Ahmad A, Mehboob R. Nosocomial infections and their control strategies Asian Pacific Journal of Tropical Biomedicine. J Trop Biomed. 2015;5(7)(June):505–9.
20. WHO. Prevention of Hospital-Acquired Infections. Surg Infect (Larchmt). 2016;17(4):422–6.
21. Nyirantibibaza M. Knowledge And Practice On Preventive Measures Of Nosocomial

Infections Among Nurses Working In Intensive Care Unit Of Referral Hospitals. Infect Control Hosp Epidemiol [Internet]. 2017;33(9):917–923. Available from: http://dr.ur.ac.rw/bitstream/handle/123456789/391/NYIRANTIBIBAZA Marianne.pdf?sequence=1&isAllowed=y

22. Ramasethu J. Prevention and treatment of neonatal nosocomial infections. Matern Heal Neonatol Perinatol. 2017;3(1):1–11.
23. Sharrow D, Hug L, You D, Alkema L, Black R, Cousens S, et al. Global, regional, and national trends in under-5 mortality between 1990 and 2019 with scenario-based projections until 2030: a systematic analysis by the UN Inter-agency Group for Child Mortality Estimation. Lancet Glob Heal. 2022;10(2):e195–206.
24. Zingg W, Hopkins S, Gayet-Ageron A, Holmes A, Sharland M, Suetens C, et al. Health-care-associated infections in neonates, children, and adolescents: an analysis of paediatric data from the European Centre for Disease Prevention and Control point-prevalence survey. Lancet Infect Dis. 2017;17(4):381–9.
25. Sadowska-Krawczenko I, Jankowska A, Kurylak A. Healthcare-associated infections in a neonatal intensive care unit. Arch Med Sci. 2012;8(5):854–8.
26. Helyaich A, El N, Slitine I, Bennaoui F, Soraa N. Bacterial Nosocomial Infection : Experience of the Neonatal Intensive Care Unit at the University Hospital of Marrakech Abstract : 2019;17–21.
27. Wójkowska-Mach, Chmielarczyk, Strus, Lauterbach, Heczko. Neonate Bloodstream Infections in Organization for Economic Cooperation and Development Countries: An Update on Epidemiology and Prevention. J Clin Med. 2019;8(10):1750.
28. Bayingana C, Gahutu JB, Sendegeya A, Habarugira F, Mukumpunga C, Lyumugabe F, et al. Prevalence of Bacterial Species Involved in Nosocomial Infections in Pediatrics Unit at Butare University Teaching Hospital (Chub). Int J Curr Microbiol Appl Sci. 2017;6(6):3227–32.
29. Olivier C, Kunneke H, Chb MB, Sa FCP, Paed M, Connell NO, et al. Healthcare-associated infections in paediatric and neonatal wards : A point prevalence survey at four South African hospitals. S Afr Med J 2018;108(5)418-422. 2018;108(5):418–22.
30. Brito DVD, Brito CS De, Resende DS, Ó JM, Olivetti V, Abdallah S, et al. Nosocomial infections in a Brazilian neonatal intensive care unit : a 4-year surveillance study Infecções hospitalares em uma unidade de terapia intensiva neonatal brasileira : vigilância de quatro anos. Rev Soc Bras Med Trop 43(6)633-637, nov-dez, 2010. 2010;43(6):633–7.

31. Nkachukwu US, Obu HA. Obu HA Nosocomial infections in neonatal intensive care units : cost-effective control strategies in resource-limited. Niger J Paed 2013; 40 125 – 132. 2015;(January).
32. Kumar S, Shankar B, Arya S, Deb M, Chellani H. Healthcare associated infections in neonatal intensive care unit and its correlation with environmental surveillance. J Infect Public Health. 2018;11(2):275–9.
33. WHO. Infection prevention and control The burden of health care-associated infection worldwide. Lancet [Internet]. 2017;(December 2010):2010–2. Available from: https://www.who.int/infection-prevention/publications/burden_hcai/en/
34. Mbim EN, Mboto CI, Agbo BE. A Review of Nosocomial Infections in Sub-Saharan Africa A Review of Nosocomial Infections in Sub-Saharan Africa. 2016;(May).
35. Ghotbi N, Nikofar M, Abedini M, Afkhamzadeh A, Mortaz-Hejri G. Prevalence of nosocomial infections in newborns and its related factors in neonatal intensive care unit unit of Besat Hospital in Sanandaj in 2011. Life Sci J. 2014;11(SPEC.ISS.2):35–9.
36. Kayinamura a M, Serubibi Y, Kakoma JB. Article Benefits of a Neonatology Service in a Rural District Hospital : Case Study of Rwamagana District Hospital / Eastern Province of. 2010;68(4):38–40.
37. Manzoni P, Luca D De, Stronati M, Jacqz-aigrain E. Prevention of Nosocomial Infections in Neonatal Intensive Care Units Prevention of Nosocomial Infections in Neonatal Intensive Care Units. Am J Perinatol · January 2013. 2013;(January 2014).
38. Kelley E. WHO work on sepsis. 2017;
39. Pawa AK, Ramji S, Prakash K, Thirupuram S. Neonatal nosocomial infection: profile and risk factors. INDIAN Pediatr Vol 34-APRIL 1997. 2017;34:297–302.
40. UNICEF. Infection Prevention and Control at Neonatal Intensive Care Units Adapting this presentation. 2012;
41. Gary LS and MK. Healthcare-Associated Infections in the Neonate. Pap Knowl Towar a Media Hist Doc. 2014;(January):200.
42. Tumuhamye J, Sommerfelt H, Bwanga F, Ndeezi G, Mukunya D, Napyo A, et al. Neonatal sepsis at Mulago national referral hospital in Uganda: Etiology, antimicrobial resistance, associated factors and case fatality risk. PLoS One [Internet]. 2020;15(8 August):1–14. Available from: http://dx.doi.org/10.1371/journal.pone.0237085
43. Sn U, Ha O. Nosocomial infections in neonatal intensive care units: Cost-effective control strategies in resource-limited countries. Niger J Paediatr. 2013;40(2):125-132–132.

44. Rosenthal VD, Kanj SS. Bundle of the International Nosocomial Infection Control Consortium (INICC) to Prevent Central and Peripheral Line-Related Bloodstream Infections. 2016;(February 2017).
45. Sean Wasserman, MD Angeliki Messina Bp. Guide to Infection Control in The Healthcare Setting Bundles in Infection Prevention and Safety. 2018;
46. Mbim E, Mboto C, Agbo B. A Review of Nosocomial Infections in Sub-Saharan Africa. Br Microbiol Res J. 2016;15(1):1–11.
47. Karla Dal-Bo, Rosemeri Maurici da Silva TMS. Nosocomial infections in a neonatal intensive care unit in South Brazil. Rev bras ter intensiva vol24 no4 São Paulo Oct/Dec 2012. 2012;24(4):381–5.
48. Hamadan H, Basiri B, Sabzehei MK, Shokouhi M, Moradi A. Evaluating the Incidence and Risk Factors of Nosocomial Infection in Neonates Hospitalized in the Neonatal Intensive Care Unit of Fatemieh Evaluating the Incidence and Risk Factors of Nosocomial Infection in Neonates Hospitalized in the Neonatal Intensive. 2015;(August):2012–3.
49. Alhamad1 FAA, *, Mohammed Al-duhilan2 , Fadi Nabih Busaleh3 , Rahma Aldhahi3 AK, Al-Bahrani4 ZAA, Reem Mohammad Alkhalifa6 and Wardah Ibrahim Al-Saleh7 1. EC PAEDIATRICS Research Article Blood Stream Infection in a Neonatal Intensive Care Unit (NICU) Level III, in AlHasa, Saudi Arabia. 2018;9(2020):1–6.
50. El GS, Mahmoud D, Shoriet AH, Safwat M, Aziz A. Incidence and risk factors of health - care - associated infection in the neonatal intensive care unit of Assiut University Children ’ s Hospital. 2021;48–53.
51. Naz A, Sher A, Akhtar A. Clinical Application of Nightingale ’ s Theory. 2018;9(4):9–11.
52. Olivier C, Kunneke H, O’Connell N, von Delft E, Wates M, Dramowski A. Healthcare-associated infections in paediatric and neonatal wards: A point prevalence survey at four South African hospitals. South African Med J. 2018;108(5):418–22.
53. McElroy LM, Woods DM, Yanes AF, Skaro AI, Daud A, Curtis T, et al. Applying the WHO conceptual framework for the International Classification for Patient Safety to a surgical populatio. Int J Qual Heal Care. 2016;28(2):166–74.
54. AliSher AN, Atta S, Yasin I, Sohail MA. Clinical application of nightingale’s theory. Int J Nurs Care. 2019;7(1):13.
55. Ranganathan P, Aggarwal R. Study designs : Part 1 – An overview and classification. 2018;184–6.

56. Science N. Quantitative Research in Nursing Science. 2017;21(1):1–2.
57. Uakarn C. Sample size estimation using Yamane and Cochran and Krejcie and Morgan and Green formulas and Cohen statistical power analysis by G*power and comparisons. Apheit Int J. 2021;10(2):76–88.
58. Lukas S, Hogan U, Muhirwa V, Davis C, Nyiligira J, Ogbuagu O, et al. Establishment of a hospital-acquired infection surveillance system in a teaching hospital in Rwanda. Int J Infect Control. 2016;12(3):1–9.
59. Taherdoost H. Sampling Methods in Research Methodology ; How to Choose a Sampling Technique for Research Hamed Taherdoost To cite this version : HAL Id : hal-02546796 Sampling Methods in Research Methodology ; How to Choose a Sampling Technique for. Int J Acad Res Manag. 2020;5(2):18–27.
60. Cherie R. Rebar, Carolyn J. Gersch, Carol L. Macnee SM. Understanding nursing research,third edition. Paper Knowledge . Toward a Media History of Documents. 2018.
61. Middleton F. The 4 Types of Validity | Explained with Easy Examples. 2022;
62. Manandhar N, Joshi SK. Importance of consent in the research. 2020;(December).
63. Yismaw AE, Abebil TY, Biweta MA, Araya BM. Proportion of neonatal sepsis and determinant factors among neonates admitted in University of Gondar comprehensive specialized hospital neonatal Intensive care unit Northwest Ethiopia 2017. BMC Res Notes [Internet]. 2019;3–7. Available from: https://doi.org/10.1186/s13104-019-4587-3
64. Pemula PD. Knowledge, Attitude and Practices of Nurses on Prevention and Control of Hospital Acquired Infections In Soroti Regional Referral Hospital. 2017;110265(November):110493.
65. Wang L, Zhou K, Chen W, Yu Y. Epidemiology and risk factors for nosocomial infections in the respiratory intensive care unit of a teaching hospital in China : A prospective surveillance during 2013 and 2015. 2019;1–9.
66. Silago V, Kovacs D, Msanga DR, Seni J, Matthews L, Oravcová K, et al. Bacteremia in critical care units at Bugando Medical Centre , Mwanza , Tanzania : the role of colonization and contaminated cots and mothers ' hands in cross-transmission of multidrug resistant Gram-negative bacteria. 2020;1–14.
67. Penda CI, Betoko RM, Koum DK, Henri E, Eboumbou PE, Edimo CM, et al. Etiologies of Neonatal Mortality in a Tertiary Care Hospital in a Resource-Limited Setting. 2021;268–80.

68. Kilic A, Okulu E, Kocabas BA, Alan S, Cakir U, Yildiz D. Original Article Health care-associated infection surveillance : A prospective study of a tertiary neonatal intensive care unit.
69. WHO. The Burden of Health CareAssociated Infection Worldwide A Summary. 2014;
70. Mekitrida L. Kiwone 1, S. N, Chotta, 1, 2 Daniel Byamungu 1, and, Mghanga3 FP. Prevalence and factors associated with neonatal sepsis among hospitalized newborns at Ruvuma, southern Tanzania. South Sudan Med J. 2020;13(3):86.
71. Desalew A, Sintayehu Y, Teferi N, Amare F, Geda B, Worku T, et al. Cause and predictors of neonatal mortality among neonates admitted to neonatal intensive care units of public hospitals in eastern Ethiopia: A facility-based prospective follow-up study. BMC Pediatr. 2020;20(1):1–20.

APPENDICES

APPENDIX 1: Approval for data collection

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/198/2021

Aline UMUHOZA
School of Nursing and midwifery, CMHS, UR

Dear Aline UMUHOZA

RE: ETHICAL CLEARANCE

Reference is made to your application for ethical clearance for the study entitled ***"Neonatal Healthcare Associated Infections and Related Factors in Rwanda Teaching Hospitals".***

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.

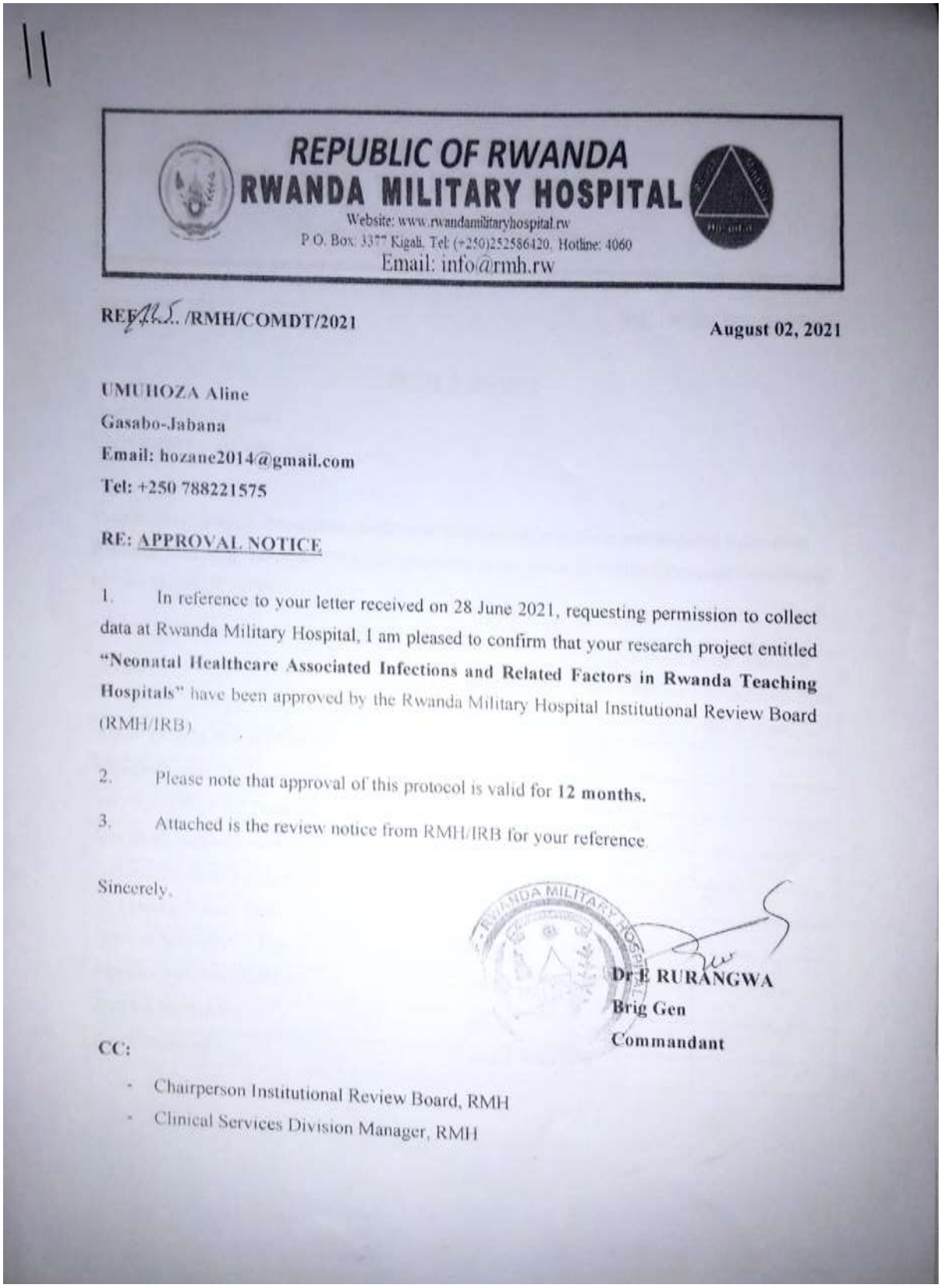
Dr Stefan JANSEN
Ag Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR

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

APPENDIX 2.APPROVAL FOR DATA COLLECTION FROM RMH



REPUBLIC OF RWANDA
RWANDA MILITARY HOSPITAL
Website: www.rwandamilitaryhospital.rw
P.O. Box: 3377 Kigali. Tel: (+250)252586420. Hotline: 4060
Email: info@rmh.rw

REF 415 /RMH/COMDT/2021

August 02, 2021

UMUHOZA Aline
Gasabo-Jabana
Email: hozane2014@gmail.com
Tel: +250 788221575

RE: APPROVAL NOTICE

1. In reference to your letter received on 28 June 2021, requesting permission to collect data at Rwanda Military Hospital, I am pleased to confirm that your research project entitled **"Neonatal Healthcare Associated Infections and Related Factors in Rwanda Teaching Hospitals"** have been approved by the Rwanda Military Hospital Institutional Review Board (RMH/IRB).

2. Please note that approval of this protocol is valid for **12 months.**

3. Attached is the review notice from RMH/IRB for your reference.

Sincerely,

RWANDA MILITARY HOSPITAL

Dr F. RURANGWA
Brig Gen
Commandant

CC:

- Chairperson Institutional Review Board, RMH
- Clinical Services Division Manager, RMH

APPENDIX 3. APPROVAL FOR DATA COLLECTION CHUK

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Quality Health Care Training & Research

Ethics Committee / Comité d'éthique

Ref.:EC/CHUK/105/2021

3rd Sep,2021

Review Approval Notice

Dear Aline UMUHOZA,

Your research project: ***"NEONATAL HEALTHCARE ASSOCIATED INFECTIONS AND RELATED FACTORS IN RWANDA TEACHING HOSPITALS "***

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 3rd Sep.2021 to evaluate your request for ethical approval of the above mentioned research project, we are pleased to inform you that the Ethics Committee/CHUK has approved your research project.

You are required to present the results of your study to CHUK Ethics Committee before publication by using this link:www.chuk.rw/research/fullreport/?appid=414&&chuk.

PS: Please note that the present approval is valid for 12 months.

Yours sincerely,

Dr Emmanuel Rusingiza Kamanzi
The Chairperson, Ethics Committee,
University Teaching Hospital of Kigali

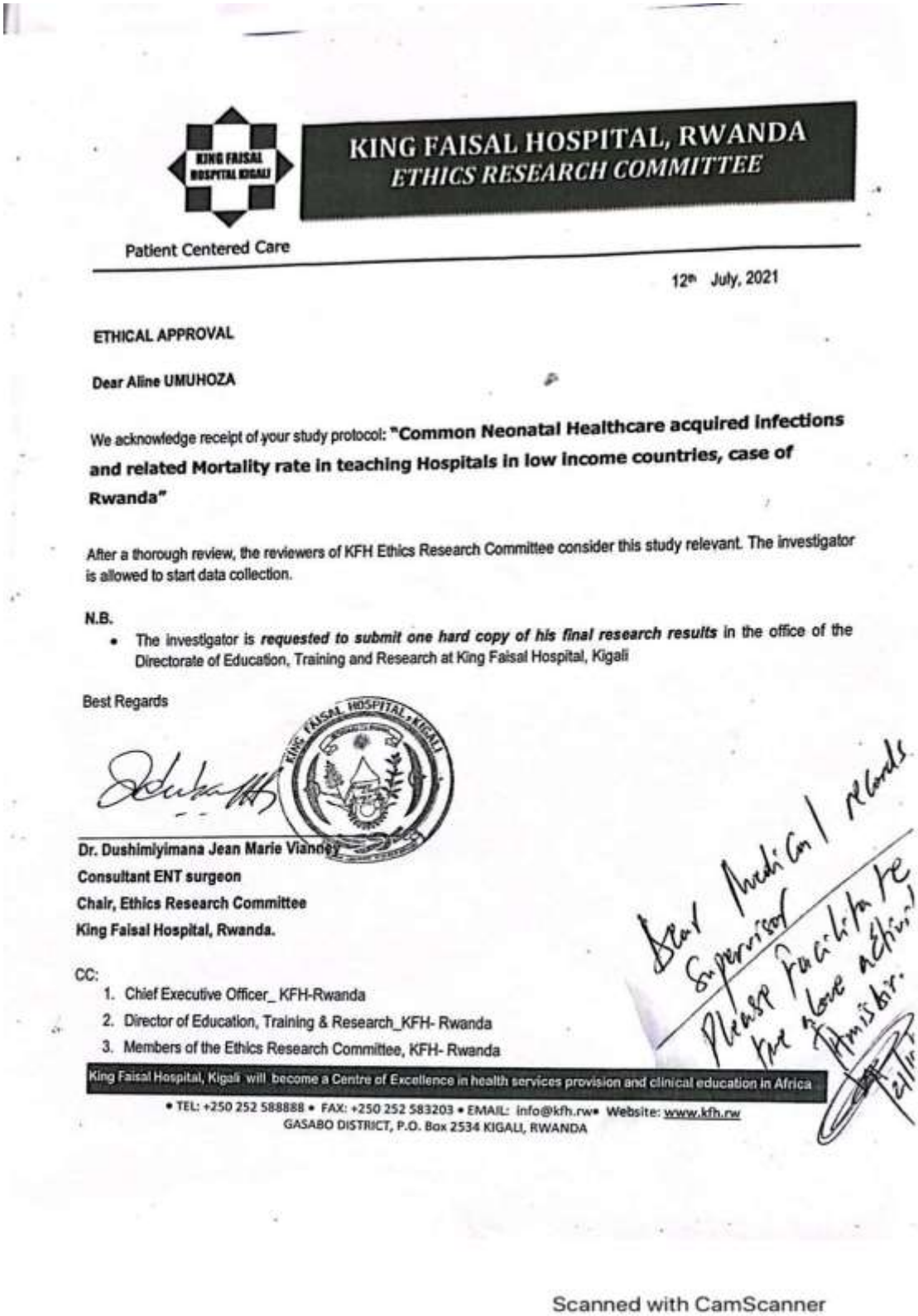
ETHICS COMMITTEE
CHUK

Scan code to verify

" University teaching hospital of Kigali Ethics committee operates according to standard operating procedures (Sops) which are updated on an annual basis and in compliance with GCP and Ethics guidelines and regulations "

Web Site : www.chuk.rw ; B.P. 655 Kigali- RWANDA Tel : 00 (250) 252575462 E-Mail: chuk.hospital@chuk.rw

APPENDIX 4. ETHICAL APPROVAL FOR DATA COLLECTION FROM KFH



KING FAISAL HOSPITAL, RWANDA
ETHICS RESEARCH COMMITTEE

Patient Centered Care

12th July, 2021

ETHICAL APPROVAL

Dear Aline UMUHOZA

We acknowledge receipt of your study protocol: **"Common Neonatal Healthcare acquired infections and related Mortality rate in teaching Hospitals in low income countries, case of Rwanda"**

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.

CC:

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

Dear Medical Supervisor Please facilitate the above activity. Amishir.

King Faisal Hospital, Kigali will become a Centre of Excellence in health services provision and clinical education in Africa

• TEL: +250 252 588888 • FAX: +250 252 583203 • EMAIL: info@kfh.rw• Website: www.kfh.rw
GASABO DISTRICT, P.O. Box 2534 KIGALI, RWANDA

Scanned with CamScanner

APPENDIX 5: Data Abstraction Instrument

Code number _____ Date and initials of collector:

____ / ____/2020	A

1. Hospital (where file is located):

KFH	KUTH	RMH

I.DEMOGRAPHICS

Maternal:

1. Age: _____ (years)

2. Obstetric history: Gravida _____ Parity _____ Miscarriage _____

3. Mother's blood group: _____

4. Mother's allergy: _____

5. Religion: _____

6. Occupation: _____

7. Residence: District _____ Urban/ rural

8. Family history:

HTN	Heart Ds	Diabetes	Cancer	Hepatitis	Other

9. Communicable diseases (for the mother):

Hep B	Hep C	HIV	TB	Meningitis	Other

10. Current pregnancy history:

HTN	Heart Ds	Diabetes	Cancer	Hepatitis	Other

II. Neonatal profile before admission in NICU:

11. Age (weeks)

12. Neonate's weight: (grams) and sex

Birthweight	**Current weight**	**Sex**	
		M	**F**

13. Type of delivery:

SVD	**Instrument delivery**	**Caesarean**

14. Feeding:

Breastmilk	**Formula**	**Br/Formula combo**	**Other (Please specify)**

15. Place of birth:

KFH	**CHUK**	**RMH**	**Other (Please specify)**

16. Apgar

1 min	**5 min**	**10 min**

17. Neonates blood group: _____

18. **Baby's allergies**: _____

19. Neonate's chief problem on admission in NICU_____

_____

III. Neonatal profile after admission

20. Admission diagnosis of newborn in NICU and procedure done on or after admission.

Prematurity	Mec. Aspiration	HIE	Neonatal sepsis(i.e. neonatal jaundice, meningitis etc…)	RDS	low birth weight
SGA(small for gestation age)	hypothermia	AGA(appropriate for gestation age)	LGA(large for gestation age)	Congenital malformations	Others …….

21. Admission and discharge dates: (2021)

Admission:	Discharge:	Other/missing

2**2. Procedures and treatments:**

ETT(endo tracheal tube)	CL(central lines: umbilical, jugular vein etc…)	IV lines	use of total parenteral nutrition,	Blood transfusion	surfactant administration
Immediate use of oxygen(nasal cannula ;CPAP circuit)	intravenous fluid	Insertion of drain	others	……..	**……**

23. Neonate's medical/surgical/treatment history:

_____

_____

_____

_____

24. Current medications:

Drug name	Dose (mg)	Frequency		

25. Admission physical examination:

Neurological:

_____

_____

Cardiovascular:

_____

_____

Respiratory*******:

_____

_____

Renal: _____

_____

Gastrointestinal: _____

_____

Musculoskeletal & Integument: _____

_____

26. Investigations: ***

Type	Date	Result
Blood culture* **		
Sputum culture		
Urine culture		
Wound swab culture		
FBC		
CRP		

27. Common neonatal nosocomial infections: *** Identify the main infections

Causative agents	**Most common infection that is causing**
1.Eschelichia coli(E.coli)	• **Bacteraemia** • **Urinal tract infection** • **Neonatal meningitis** • **Pneumonia**
2.Pseudomonas aeruginosa	• **Ventilator associated pneumonia** • **Urinary tract infection** • **Corneal ulceration** • **Acute bacteria endocarditis** • **bacteraemia**
3.Klebsiella pneumonia	• **septicaemia** • **endophtalmitis,** • **neonatal endocarditis** • **meningitis,** • **pneumonia** • **urinal tract infection** • **pneumonia** • **soft tissue infections**

28. Summary of illness:

_____

_____

_____

29. Management/plan:

_____

_____

_____

_____

_____

30. Neonatal Outcome at Discharge from NICU:

				Other

31. Reasons for neonatal death

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

APPENDIX 6: Study Budget

N^{o}	Description of items	Units	Quantity	Unit price	Total price
1	paper	ram	6	4000	24000
2	pens	bics	50	150	7500
3	Typing	page	400	500	200000
4	printing	page	400	20	8000
5	Binding	books	12	500	6000
Sub total					**245,000**
6	Lunch	Time	50	2000	100000
7	Drinks	Water	100	300	30000
8	Transport	Time	50	5000	250000
9	Airtime	Cards	40	500	20000
10	Internet	Hours	200	400	80000
Sub total					**480,000**
Data analysis expert					

Data coding	50000
Data analysis	300000
Data discussion	150000
Sub total	**500,000**
TOTAL	**1,225,000**

3. Study timeline

Months/ Activities	January 2021	Feb 2021	March 2021	April 2021	May 2021	June 2021	July
Preparation of research proposal	X	X	X				
Defense of research proposal			X	x			
Ethical clearance				X			
Correction of defended research proposal				X			
Field work					X		
Data coding					X		
Data Analysis					X	X	
Presentation of findings						X	
Correction of findings						X	
Final report						X	X
Dissemination of findings							X