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FACTORS ASSOCIATED WITH NEONATAL EARLY ONSET SEPSIS AT KANYAMA LEVEL ONE HOSPITAL IN LUSAKA DISTRICT OF ZAMBIA

Mercy Njobvu[1i],
John Volk[2]
[1]Research Student Scholar, Zambia
[2]Dr., Research Supervisor, African Research University, Zambia

Abstract:
The study investigated the factors associated with neonatal early onset sepsis among this population at Kanyama Level One Hospital in Lusaka district, Zambia. This study was guided by an interpretive paradigm, in keeping with the research paradigm, a qualitative descriptive case study design was used. The sample for the study comprised 20 participants, who were 5 doctors, 5 midwives, and 10 mothers found admitted who were purposely selected. Data was collected using a semi-structured interview guide and focus group discussion guide, which was analysed thematically. It was found that the epidemiology of neonatal early-onset sepsis among this population at Kanyama Level One Hospital in Lusaka district is characterized by a higher incidence in preterm infants, with common causative pathogens including Group B Streptococcus and E. coli and is influenced by maternal health, delivery conditions, and limited access to adequate healthcare services. The study revealed that neonatal early-onset sepsis at Kanyama Level One Hospital is associated with premature birth, prolonged rupture of membranes, maternal infections, inadequate prenatal care, and poor hygiene during delivery. On the other hand, the study revealed that challenges in diagnosis and management persist, including limited access to diagnostic tools and antibiotics tailored to local microbial profiles. Based on these findings, the study recommends that the Ministry of Health establish a robust surveillance system for monitoring maternal infections during pregnancy and early signs of sepsis in newborns. Also, there is a need to strengthen the screening and management of maternal infections, particularly during the antenatal period and labour.

Keywords: neonatal, early-onset sepsis, management of neonatal infections, factors associated with sepsis

[i] Correspondence: email mercy.muleya@yahoo.com

1. Introduction

Neonatal sepsis refers to the presence of bacterial bloodstream infection in the setting of fever (Njagi, 2017). Neonatal septic infection occurs in infants younger than 90 days of age (Pek, *et al.*, 2020). The sepsis causes a systemic inflammatory response, leading to an increase in body temperature. This infection is divided into two categories: early-onset sepsis (EOS) and late-onset sepsis (LOS). Early-onset sepsis presents within seven days of life, while late-onset sepsis refers to the presentation of sepsis from 8 to 89 days of life (Tumuhamye, 2020). Usually, early-onset neonatal sepsis is associated with perinatal background and late-onset is mainly related to the medical and surgical invasive procedures required by neonates who already have the disease. Early onset sepsis (EOS), an invasive bacterial infection in infants in the first days after birth, is a rare but life-threatening condition with high mortality if treatment is not initiated very early after the start of the infection (Kuzniewicz *et al.,* 2017). Wale *et al.* (2021) revealed that worldwide 6.9 million neonates are spotted with potentially severe bacterial infections needing treatment, and 2.6 million of them occurred in sub-Saharan Africa (SSA). Neonatal sepsis is the eighth leading cause of under-five mortality globally, accounting for more than one million deaths globally (Fleischmann-Struzek *et al.,* 2018). Wale *et al.* (2021) reported that as many as 42% of deaths in the first week of life may occur as a result of sepsis.

The current neonatal mortality rate for Zambia in 2021 is 41.857 deaths per 1000 live births (Macrotrends, 2021). The incidence of neonatal sepsis is increasing from year to year despite the development in the medical field, where there is no accurate diagnostic test to help in detecting and diagnosing neonatal sepsis. Statistics collected from Kanyama Level One Hospital show that (120) 2.7 percent of all live births in 2018 developed neonatal sepsis and (145) 3.1 percent in 2019. Out of those, (17) 0.3 percent developed neonatal sepsis before discharge (MOH, 2021). Macrotrends (2021) noted that despite the high burden of neonatal sepsis, high-quality evidence in diagnosis and treatment is also lacking. It has been observed that in Zambia, there is a shortage of studies published on the subject of early-onset sepsis (Macrotrends, 2021). The objective of the present study was to determine the factors associated with neonatal early-onset sepsis at Kanyama Level One Hospital in the Lusaka district.

2. Statement of the Problem

The majority of children die from unsafe delivery in developing countries, accounting for over 99% of deaths in the world, and Zambia is no exception (Chomba *et al.,* 2009; Macrotrends, 2021). However, there has been a lack of research on this topic in Zambia and at Kanyama General Hospital in particular, as it has more incidences of neonatal sepsis relative to other health facilities in Lusaka. As of Kanyama General Hospital according to the HMIS report, the trends of the infections are as follows: 70% in 2019, 80% in 2020 and 71% in 2021 were reported by the fourth quarter. The above statistics for Kanyama General Hospital indicated that neonatal sepsis is a problem which

necessitated investigations. A few studies on factors contributing to neonatal early-onset sepsis have been reported in Zambia, particularly in the study setting (UNICEF, 2018; Mambwe, 2019); Belayneh, 2022). The type of pathogen-causing disease in newborns may vary from one country to another and also from one medical institution to the next. The establishment of factors associated with neonatal early-onset sepsis is an important step in the control and management of neonatal sepsis because an awareness of specific bacterial pathogens causing neonatal sepsis in a community, their sources, and drug interaction enables the medical personnel to correctly diagnose and manage the disease in early in order to reduce the rate of infection and also the rate of death in infants. Early identification of the risk factors for neonatal sepsis would enable early clinical diagnosis and treatment, aiming to reduce morbidity and mortality.

This study is, therefore, carried out to determine the factors contributing to neonatal sepsis among neonates at Kanyama Level One Hospital in the Lusaka district. The objectives of the study are as follows:

1) To examine the epidemiology of neonatal early-onset sepsis among this population at Kanyama Level One Hospital in the Lusaka district.
2) To explore factors associated with neonatal early onset sepsis among this population at Kanyama Level One Hospital in Lusaka district.
3) To establish the challenges faced in diagnosing and managing neonatal infections at Kanyama Level One Hospital in the Lusaka district.

3. Literature Review

Before birth, the foetus is optimally maintained in a sterile environment. Organisms causing early-onset sepsis to ascend from the birth canal either when the amniotic membranes rupture or leak before or during the course of labour, resulting in intra-amniotic infection (Braye *et al.*, 2019). New-born babies are at greater risk of infection as their immune system (which normally fights infection) is not fully developed. Most babies are born fit and healthy; however, some may develop an infection before, during, or shortly after birth. When a baby develops an infection in the first 72 hours of life, this is called early-onset neonatal sepsis (EONS).

EONS is potentially serious and even life-threatening EOS is defined as a blood or cerebrospinal fluid (CSF) culture obtained within 72 hours after birth growing a pathogenic bacterial species (Tumuhamye, 2020). This microbiologic definition stands in contrast to the functional definitions of sepsis that are used in pediatric and adult patients, for whom the definition is used to specify a series of time-sensitive interventions. Before the first national guidelines were published in which researchers recommended intrapartum antibiotic prophylaxis (IAP) to prevent perinatal group B Streptococcus (GBS) disease, the overall incidence of EOS in the United States was 3 to 4 cases per 1000 live births. Sometimes, invasive procedures during childbirth become significant risk factors for early onset sepsis (EOS) in neonates (Braye *et al.*, 2019). These are formative data which need local verification by carrying out this research to

understand the epidemiology of neonatal early-onset sepsis at Kanyama Level One Hospital in the Lusaka district.

Wale *et al.* (2021) revealed that the occurrence of neonatal sepsis infections in developed countries is quite low (2/1000) when compared with developing countries, especially in Africa, where the incidence is 42/1000 live births (WHO, 1996). According to WHO (2000) estimates, globally, there are about 5 million neonatal deaths a year, 98% occurring in developing countries, where neonatal infection, premature births and delivery-related complications are the most contributory factors. Wale *et al.* (2021) reported that the most common risk factors associated with LOS include; maternal GBS colonization if untreated during labour, premature rupture of membranes (PROM), preterm rupture of membranes, the prolonged rupture of membranes, colonization of the mother's vaginal tract by other pathogenic microorganisms and intra amniotic infections which result to prolonged labour (Pek *et al.*, 2020; Tumuhamye, 2020). He went on to indicate that prematurity and low birth weight both contribute to a weakened neonatal immune system, as premature infants have underdeveloped immune responses and lower levels of protective antibodies. However, little is known about the epidemiology of neonatal early-onset sepsis among this population at Kanyama Level One Hospital in the Lusaka district.

Marks *et al.* (2020) revealed that Neonatal sepsis is still the major cause of morbidity and mortality in the NICU department, and there are many factors influencing the early onset neonatal sepsis related to the mother, such as prolonged rupture of membranes (PROM), prolonged ROM, Chorioamnionitis, and infection during pregnancy, and the neonate such as gender, age, birth weight and APGAR score less than seven at five minutes, early detection and treatment enhance and decrease the incidence of neonatal sepsis. Lekic *et al.* (2019) noted that infections are an important cause of morbidity and mortality in the neonatal period, particularly in preterm and very low birth weight infants. Maternal, environmental, and host factors determine which infant exposed to a potentially pathogenic organism will develop serious or other potentially invasive infections. The surfaces in the NICU, including incubators, cribs, and medical equipment, can harbour pathogens if not properly cleaned and disinfected (Lekic *et al.* (2019).

In the study of Aku *et al.* (2020), several risk factors have been identified to predispose neonates to sepsis and have been found to be linked to pregnancy, delivery practices, or other neonatal diseases. Some maternal factors include maternal fever, instrumental delivery, and foul-smelling liquor. Low birth weight and prematurity are among the predisposing neonatal factors reported. Other studies have also associated neonatal sepsis with low Apgar score in the fifth minute and place of delivery. Therefore, poor adherence to aseptic techniques during delivery or invasive procedures increases the risk of infection (Aku *et al.*, 2020). Macrotrends (2021) argued that the major risk factors for early-onset neonatal sepsis are preterm birth, maternal colonization with GBS, rupture of membranes >18 hours, and maternal signs or symptoms of intra-amniotic infection. Other variables include ethnicity (such as black women are at higher risk of

being colonised with GBS), low socioeconomic status, male sex, and low Apgar scores. Preterm birth/low birth weight is the risk factor most closely associated with early-onset sepsis. Infant birth weight is inversely related to the risk of early-onset sepsis. The increased risk of early-onset sepsis in preterm infants is also related to complications of labour and delivery and immaturity of innate and adaptive immunity. This called for this study to determine factors associated with neonatal early-onset sepsis at Kanyama Level One Hospital in the Lusaka district.

3.1 Challenges Faced in the Diagnosis and Management of Neonatal Infections

In developing countries, clinically diagnosed sepsis is present in 49–170 per 1000 live births, culture-proven sepsis in 16 per 1000 live births and neonatal meningitis in 0.8–6.1 per 1000 live births diagnosed with neonatal sepsis. Early-onset sepsis (EOS) is due to bacteria acquired before and within the course of delivery, while late-onset sepsis (LOS) is due to bacteria acquired a week after delivery (nosocomial or community sources). Bacteremia infection that occurs between one day and seven days after delivery is said to be early onset sepsis, while late-onset sepsis occurs from 8 days to 89 days. Neonates have immature physiological systems, leading to less obvious or atypical presentations of conditions. For example, infections may not present with a fever but rather with subtle changes in behavior or feeding (Njagi, 2017).

The study by Barbara *et al.* (2020) revealed that neonatal sepsis is a major cause of morbidity and mortality in newborns. It presents a diagnostic challenge to neonatologists due to a lack of objective evaluation. It may mimic non-infective conditions, such as inborn error of metabolism, birth asphyxia, and even respiratory distress syndrome in preterms. Nonetheless, over-diagnosis and initiating unwanted empirical antibiotics may pose the threat of drug resistance, increasing the hospital stay and cost of treatment. Barbara *et al.* (2020) further indicated that the microbiological testing in neonates, delays in diagnosing and initiating treatment for neonatal infections.

Gandhi and Kondekar (2019) indicated that the immune system of a neonate remains incompletely understood; however, with the robust development of molecular characterisation of this immature immune system, it has now been possible to identify an array of biomarkers that these ill infants produce in response to the offending organism aiding the prompt diagnosis of sepsis. The facilities lack specific diagnostic tools, neonates are fragile, and invasive diagnostic procedures pose risks (Gandhi & Kondekar, 2019). Kuzniewicz *et al.* (2017) argued that diagnostic tests for neonatal sepsis have poor positive predictive accuracy. As a result, clinicians often treat well-appearing infants for extended periods of time, even when bacterial cultures are negative. The study revealed that healthcare providers face additional challenges in effectively treating these vulnerable infants due to prematurity, low birth weight, and other underlying medical conditions, which significantly increase the risk of neonatal infections (Kuzniewicz *et al.*, 2017). However, EOS remains a serious and potentially fatal illness. Marks *et al. (*2020) argued that laboratory tests alone are neither sensitive nor specific enough to guide EOS management decisions.

Marks *et al.* (2020) revealed that newborn infants are more prone to environmental or community-related infections because of their naïve innate immune responses to infection and also due to the invasive procedures to which they are subjected during and after delivery. Marks *et al. (*2020) also acknowledged the need for adequate resources for hand hygiene, environmental cleaning, and personal protective equipment, but this shortage compromises infection control and safety measures. Puopolo *et al.* (2018) suggested that adequate and proper supportive care is crucial in a sick neonate with sepsis. He/she should be nursed in a thermo-neutral environment taking care to avoid hypo/hyperthermia.

4. Material and Methods

4.1 Study Design

The study employed an interpretive paradigm and adopted a qualitative descriptive case study design. The interpretive paradigm was well-suited for studying the factors associated with neonatal early-onset sepsis at Kanyama Level One Hospital, as it seeks to uncover and understand the nuanced experiences, beliefs, and practices within the hospital environment that contribute to this condition. A qualitative descriptive case study design was ideal for exploring the factors associated with neonatal early-onset sepsis at Kanyama Level One Hospital because it allows for an in-depth examination of this complex, context-specific health issue.

4.2 Population

The population of the study comprised 5 doctors, 5 midwives, and 10 mothers found admitted at the time of data collection at Kanyama Level One Hospital in Lusaka District. However, expert sampling was used to select five doctors who were knowledgeable about a topic and were willing to share their knowledge. The study utilized purposive critical case sampling to select five nurses, one from the facility, who are critical in providing care to the mothers admitted to the facility. Then, criterion sampling was used to select 10 mothers with shared experience but varied in characteristics and in their individual experiences. The sample composed of elements that contained most characteristics representative or typical attributes of the population with the information needed for the study.

4.3 Research Instruments and Analysis

The researcher conducted a face-to-face interview with doctors and midwives. One-on-one interviews were conducted and tape-recorded to collect data on factors associated with neonatal early onset sepsis among this population at Kanyama Level One Hospital in Lusaka district from all the key informants. Further, focus group discussions were conducted with mothers by the researcher on factors associated with neonatal early onset sepsis among this population at Kanyama Level One Hospital in Lusaka district, Zambia. Data from the participants were collected using a voice recorder and later transcribed

into questions and responses in Word documents. All the interviews were transcribed verbatim. The study manually used an Inductive thematic approach for data analysis using six major stages that included familiarization with the data, generation of initial codes, searching for themes among codes, reviewing themes, defining and naming themes and report writing, and, where possible, verbalisms were used to indicate actual voices of the participants. To establish trustworthiness, Lincoln and Guba's criteria were adopted such as credibility, dependability, confirmability and transferability.

5. Results

Data was collected from twenty participants to establish the epidemiology of neonatal early-onset sepsis among this population at Kanyama Level One Hospital in the Lusaka district. The study used interviews and FGDs to probe the participants. The findings indicated that maternal infection can increase the risk of early-onset neonatal sepsis (EONS) through various pathways. When a pregnant woman has an infection, particularly during labour and delivery, the pathogens causing the infection can be transmitted to the baby. As evidence of these findings, the doctor had this to say:

> "*Maternal infection can be associated with early-onset neonatal sepsis through vertical transmission of pathogens from the mother to the infant during pregnancy, labour, delivery, or the immediate postnatal period. This transmission can occur through various routes.*" (KGH-DOC5)

Similarly, the doctor during interviews narrated that:

> "*Infection of the placental membranes, including the amniotic sac and chorionic membranes, can lead to the direct transmission of pathogens to the fetus in utero. Bacterial pathogens, such as Group B Streptococcus (GBS), Escherichia coli (E. coli), and other gram-negative bacteria, can breach the placental barrier and infect the fetus, resulting in colonization and subsequent development of early-onset neonatal sepsis. Additionally, higher incidence of early-onset sepsis in infants we experience are born to mothers with clinical signs of intra-amniotic infection, such as fever, uterine tenderness, and foul-smelling amniotic fluid.*" (KGH-DOC2)

The findings indicated that prolonged rupture of membranes (PROM) is a well-established risk factor for early-onset neonatal sepsis (EONS). Doctor participants during the interview advanced that:

> "*Amniotic sac ruptures more than 18 hours before delivery, and it increases the risk of infection in both the mother and the newborn.*" (KGH-DOC1)

"*Prolonged rupture of membranes exposes the fetus to the vaginal microbiota for an extended period, increasing the risk of bacterial colonization and subsequent infection. This prolonged exposure enhances the likelihood of bacterial translocation to the fetus, contributing to the development of early-onset neonatal sepsis.*" (KGH-DOC3)

Additionally, one mother pointed out that:

"What you know is that the risk of neonatal infection increases with the length of time between the rupture of membranes and delivery. The longer the membranes are ruptured, the higher the likelihood of bacteria entering the uterine cavity and infecting the fetus." (KGH-M6)

The finding indicated that during vaginal delivery, the newborn passes through the birth canal, which harbours a diverse microbiota, including potentially pathogenic bacteria. As evidence of these findings, the doctors had this to say:

"*…the mother is colonized with pathogens, and the newborn can acquire these bacteria during delivery, increasing the risk of EONS.*" (KGH-DOC1)

"*Infants born vaginally are directly exposed to this microbiota, increasing the likelihood of colonization with maternal pathogens. If the mother is colonized with pathogenic bacteria, such as Group B Streptococcus (GBS) or Escherichia coli (E. coli), there is a higher risk of vertical transmission to the newborn during vaginal delivery, predisposing the infant to early-onset neonatal sepsis.*" (KGH-DOC2)

"Also, during prolonged labour and maternal fever during labour can be transmitted to the newborn during vaginal delivery, leading to sepsis." (KGH-MW2)

Contributing to common epidemiological patterns associated with early-onset neonatal sepsis, one midwife during the interview had this to say*:*

"Premature babies are often delivered by C-section, which makes them vulnerable to infections, as they have immature immune systems." (KGH-DOC1)

One mother participant in the study, during a focus group discussion with similar views, expressed that:

"Premature infants are at increased risk of early-onset sepsis due to their immature immune systems and underdeveloped protective barriers." (KGH-M8)

The findings indicated that bacteria introduced during invasive procedures can colonize the newborn's skin, mucous membranes, or respiratory tract, predisposing them

to early-onset neonatal sepsis. In support of this, one doctor participant in the study during interviews noted that:

> *"The use of forceps to assist with the delivery of the baby can cause minor trauma or lacerations to the baby's scalp, providing a potential entry point for bacteria and increasing the risk of infection."* (KGH-DOC3)

Adding to the same discussion, one midwife participant in the study expressed additional feelings by saying that:

> "*The use of invasive devices, such as fetal monitors, scalp electrodes, or catheters, increases the likelihood of neonatal infection following exposure to these pathogens during childbirth, contributing to the development of early-onset neonatal sepsis."* (KGH-MW4)

A midwife participant in the study, during the interviews, noted that:

> *"Premature babies are at higher risk for both respiratory distress and sepsis due to underdeveloped lungs and more vulnerable to infections because of their immature immune systems."* (KGH-DOC3)

A similar sentiment came from another midwife participant in the study who mentioned that:

> "*Mechanical ventilation (VAP) is a common complication of mechanical ventilation in neonates, and it led to bloodstream infections and sepsis, particularly in infants with respiratory distress.* (KGH-MW1)

From the findings, nurture factors, including maternal health, birth environment, delivery practices, breastfeeding, postnatal care, and broader socioeconomic and cultural influences, significantly impact the risk of early-onset neonatal sepsis. This was confirmed by one doctor participant in the study who supported these findings:

> "*Poor hygiene practices during childbirth, such as inadequate hand hygiene among healthcare providers or caregivers, can facilitate the vertical transmission of pathogenic bacteria from the mother to the newborn. Bacteria present in the hands of healthcare providers or caregivers can be transferred to the infant during delivery or routine care procedures, leading to colonization and subsequent infection. Without proper hygiene measures in place, there is an increased risk of neonatal exposure to maternal pathogens, predisposing the newborn to early-onset sepsis."* (KGH-DOC4)

> *"You should know that the cleanliness and infection control practices of the birthing environment are critical. Hospitals and birthing centers with poor sanitation or inadequate*

sterilization protocols can increase the risk of nosocomial (hospital-acquired) infections, with the dirty hospital setting and poor hygiene can lead to EONS." (KGH-MW5)

Supporting the findings above, one mother participant in the study during interviews lamented that:

"Also, poor hand hygiene can lead to the transmission of bacteria from caregivers to the infant, increasing the risk of sepsis." (KGH-M7)

Other questions were asked to find out the factors that are associated with neonatal early-onset sepsis here at Kanyama General Hospital. The sub-themes that emerged were focused on maternal risk factors, neonatal risk factors, and risk factors associated with intensive care units. The participants indicated that maternal risk factors associated with neonatal EOS can vary. In contributing to the same, doctor participant in the study had this to say:

"I think sometimes it is bacterium that colonize the gastrointestinal and genital tracts of women. Maternal colonization with GBS is a major risk factor for early-onset sepsis in newborns. Everyone needs to know, especially mothers, that GBS is a common bacterium that can colonize the genital tract of pregnant women." (KGH-DOC2)

In support of the above submission, a doctor-participant in the study had this to say:

"Urinary tract infections, especially if untreated or recurrent, increase the risk of early-onset sepsis in the newborn. I think even maternal fever during labour is often associated with an underlying infection, and it can increase the risk of neonatal sepsis." (KGH-DOC5)

In support of the notion of factors associated with neonatal early-onset sepsis, a doctor participant in the study reported that:

"If a woman has had a previous infant with early-onset sepsis, there may be an increased risk of recurrence in subsequent pregnancies." (KGH-DOC1)

Additionally, a mother participant in the study advanced that:

"These children, having their fellow children at a very young age, risk having early-*onset sepsis due to inadequate prenatal care or increased susceptibility to infections."* KGH-MW-4)

Another theme that emerged from the findings on the factors that are associated with neonatal early onset sepsis here at Kanyama General Hospital was neonatal risk factors. Neonatal early-onset sepsis (EOS) can be influenced by various factors related to the newborn. In support of the findings above, a doctor participant in the study had this to say:

> *"Premature infants are at a higher risk of early-onset sepsis due to their immature immune systems, which may not be fully equipped to fight off infections."* (KGH-DOC1)

In support of the above-recounted experiences, a doctor participant in the study had this to say:

> *"We should know that babies born before 37 weeks of gestation have an underdeveloped immune system and are more susceptible to infections, including EOS."* (KGH-DOC4)

In addition to the above experiences, a midwife participant in the study reported that:

> *"Invasive procedures during labour and delivery, such as fetal scalp monitoring or the use of invasive devices, can introduce bacteria and increase the risk of infection"* (KGH-MW5).

The following sentiments came from the mother participant in the study who mentioned:

> *"Those children born with low birthweight have immature immune systems and may lack the protective antibodies transferred from the mother, increasing their vulnerability to infections."* (KGH-M6)

Further, another theme that emerged from the findings was the Intensive Care Unit associated risk factors as the contributor to factors associated with neonatal early onset sepsis here at Kanyama General Hospital. A midwife participant in the study confirmed this during one-on-one interviews and focus group discussions:

> *"Preterm infants in the NICU are particularly vulnerable to infections, including early-onset sepsis, due to their underdeveloped immune systems and immature protective barriers"* (KGH-MW1)

In support of this, a doctor participant in the study had this to say:

"The NICU environment often involves numerous invasive procedures such as intubation, central line placement, and catheterizations. These devices provide a potential entry point for bacteria." (KGH-DOC5)

In contributing to the same, the mother participant in the study had this to say:

"Prior antibiotic use, especially broad-spectrum antibiotics, can alter the infant's microbiome and increase the risk of opportunistic infections. Also, for those mothers who take herbs to fasten the labour process and frequent vaginal examination, poor cleaning of the cord." (KGH-M7)

However, the following sub-themes emerged from the discussions in the interviews and focused groups on challenges faced in the diagnosis and management of neonatal infections at Kanyama General Hospital in the Lusaka district. Clinical Challenges were found to be one of the challenges faced in the diagnosis and management of neonatal infections. A doctor participant in the study indicated that:

"*Neonates often exhibit non-specific signs and symptoms of infection, such as lethargy, poor feeding, irritability, or temperature instability. These symptoms overlap with other common conditions, making it challenging to distinguish between infectious and non-infectious causes."* (KGH-DOC4)

In underwriting the above views, a midwife participant in the study had this to say:

"*Neonates have an immature immune system, making them more susceptible to infections. Their immune responses may be insufficient or dysregulated, leading to atypical clinical presentations and difficulty in distinguishing between infectious and non-infectious causes of illness."* (KGH-MW2)

Similarly, one male midwife participant in the study, during interviews, pointed out that:

"*Neonates may have various risk factors predisposing them to infections, such as prematurity, low birth weight, maternal chorioamnionitis, prolonged rupture of membranes, invasive procedures, and exposure to healthcare settings."* (KGH-MW3)

From the findings, it can be challenging to determine whether the source of infection is congenital, intrapartum, or postnatal. In conformity with the above findings, one doctor during interviews said that:

"*The increasing prevalence of antibiotic-resistant bacteria poses a challenge in choosing effective treatment. Overuse of broad-spectrum antibiotics in neonates may contribute to the development of antibiotic resistance."* (KGH-DOC4)

In conformity with the above findings, one doctor during interviews said that:

"*Neonates have limited blood volume, which may result in insufficient sample volumes for culture-based microbiological testing. This limitation can reduce the sensitivity of diagnostic tests and increase the likelihood of false-negative results"* (KGH-DOC5)

Further, the findings noted that adequately trained staff and equipment are crucial for the management of critically ill neonates with infections. In support of the view expressed above, a midwife participant in the study had this to say:

"*Not all healthcare facilities may have the resources or expertise to manage neonatal infections effectively, particularly in low-resource settings."* (KGH-MW3)

Contributing to challenges faced in the diagnosis and management of neonatal infections during interviews, one doctor said that:

"Healthcare infrastructure, including limited laboratory facilities, diagnostic equipment, and trained healthcare personnel, can impede timely diagnosis and management of neonatal infections. Lack of essential resources lead to delays in obtaining diagnostic test results or inaccurate interpretation of findings." (KGH-DOC2)

These results were supported by the views of a doctor participant in the study who expressed sentiments:

"*Limited availability of diagnostic tests, including blood cultures, cerebrospinal fluid analysis, and imaging studies, hamper the accurate diagnosis of neonatal infections. Healthcare facilities in resource-limited settings lack access to essential diagnostic tools, resulting in underdiagnosis or misdiagnosis of infections."* (KGH-DOC3)

From the findings, it was indicated that challenges in the treatment and management of neonatal infections lie in the early recognition of subtle symptoms, selecting appropriate antibiotics while considering emerging antibiotic resistance, and managing complications in vulnerable neonates with limited immune responses. This was also evident in what a mother participant in the study reported:

"*Lack of specialised doctors and antibiotics, also, inadequate knowledge by caregivers or mothers on seeking early medical care."* (KGH-M4)

These findings were supported by one doctor participant in the study during interviews who noted that:

> "*Neonates have unique pharmacokinetic characteristics that influence drug distribution, metabolism, and elimination. Achieving therapeutic drug levels while avoiding toxicity requires careful consideration of factors such as gestational age, postnatal age, renal function, and organ immaturity.*" (KGH-DOC3)

The findings further showed that maternal and perinatal factors can significantly impact the diagnosis and management of neonatal infections. Sentiments by a mother participant in the study were:

> "*Prematurity, low birth weight, and other underlying medical conditions increase the risk of neonatal infections and can complicate both diagnosis and management.*" (KGH-M5)

In contributing to the same, a doctor-participant in the study had this to say:

> "*Intrauterine infections, such as chorioamnionitis, can predispose neonates to infection even before birth. Maternal antibiotic use during labour can also affect the presentation and microbiology of neonatal infections.*" (KGH-DOC1)

Another doctor said that:

> *"Invasive procedures performed during labour and delivery, such as fetal scalp electrode placement, fetal monitoring, and caesarean section, can increase the risk of neonatal infections.*" (KGH-DOC2)

6. Discussion

The findings indicated that maternal infection can increase the risk of early-onset neonatal sepsis (EONS) through various pathways. When a pregnant woman has an infection, particularly during labour and delivery, the pathogens causing the infection can be transmitted to the baby. As evidence of these findings, the doctor indicated that maternal infection is associated with early-onset neonatal sepsis through vertical transmission of pathogens from the mother to the infant during pregnancy, labour, delivery, or the immediate postnatal period. For example, specific pathogens, such as Group B Streptococcus (GBS), Escherichia coli (E. coli), and other gram-negative bacteria, significantly increase the risk of EONS. These bacteria colonize the maternal genital tract and are known to be major causes of EONS when transmitted vertically to the newborn during childbirth.

These results were in line with (Braye *et al.*, 2019), who noted that maternal infections, particularly those occurring during labor or shortly before delivery, can

significantly increase the risk of early-onset neonatal sepsis as pathogens may be transmitted to the infant during birth. This vertical transmission of bacteria or viruses overwhelms the newborn's still-developing immune system, leading to serious and potentially life-threatening infections within the first 72 hours of life. Also, babies born to mothers who are colonized with pathogenic bacteria are more likely to develop signs and symptoms of sepsis shortly after birth. Bacteria residing in the maternal genital tract can be passed to the baby as it traverses the birth canal or during the rupture of the amniotic membranes. This direct transfer of bacteria from mother to infant increases the likelihood of neonatal colonization and subsequent infection, leading to early-onset sepsis. Similarly, Nyma *et al.* (2020) revealed that bacteria residing in the maternal genital tract, such as Group B Streptococcus or Escherichia coli, can be transmitted to the baby during childbirth, especially during vaginal delivery. This transfer of bacteria leads to neonatal infections, as the baby's immune system is not fully equipped to fight off these pathogens, increasing the risk of conditions like neonatal sepsis or meningitis. This suggests that maternal colonization plays a critical role in the transmission of pathogens to the newborn, leading to early-onset sepsis. Newborns are particularly susceptible to invasive bacterial infections due to their immature immune systems.

It was further indicated that sexually transmitted infections, such as syphilis, gonorrhoea, and chlamydia, can be vertically transmitted from mother to fetus during pregnancy, labour, or delivery. These pathogens breach the placental barrier, infecting the fetus directly, or can be acquired by the newborn during passage through the birth canal. Therefore, it was found that urinary tract infections and bacterial vaginosis during pregnancy are associated with an increased risk of preterm labour and EONS. These findings were in line with the study by (Oo, 2021), indicating that the presence significantly heightens the risk of vertical transmission, where the infection is passed from mother to baby during pregnancy, labour, or delivery. This was found to increase the risk of transmission that led to severe neonatal infections, including conjunctivitis, pneumonia, or systemic infection, potentially causing serious health complications and long-term effects for the newborn.

Further, factors such as prematurity, low birth weight, and prolonged rupture of membranes were reported to compromise the neonatal immune response, exacerbating the risk of developing sepsis following exposure to maternal pathogens, leading to the direct transmission of pathogens to the fetus in utero. It was further noted that maternal urinary tract infections have been implicated in the pathogenesis of premature. These findings were supported by Tumuhamye (2020), who noted that prematurity and low birth weight both contribute to a weakened neonatal immune system, as premature infants have underdeveloped immune responses and lower levels of protective antibodies.

The findings indicated that prolonged rupture of membranes (PROM) is a well-established risk factor for early-onset neonatal sepsis (EONS). Wale *et al.* (2021) also reported prolonged rupture of membranes to increase the risk of infection by exposing the fetus to potentially harmful bacteria from the maternal genital tract for an extended

period, further compromising the infant's ability to fend off infections and increasing susceptibility to sepsis and other complications. Doctor participants during the interview advanced that the amniotic sac ruptures more than 18 hours before delivery, and it increases the risk of infection in both the mother and the newborn. Therefore, prolonged rupture of membranes exposes the fetus to the vaginal microbiota for an extended period, increasing the risk of bacterial colonization and subsequent infection. This prolonged exposure enhances the likelihood of bacterial translocation to the fetus, contributing to the development of early-onset neonatal sepsis. Therefore, prolonged rupture of membranes increases the risk of early-onset neonatal sepsis by allowing bacteria to ascend from the vagina into the uterine cavity, where they can infect the fetus. These findings were also in line with the study by Pek *et al.* (2020), who indicated that prolonged rupture of membranes (PROM) exposes the fetus to the maternal vaginal microbiota and any present pathogens for an extended period, increasing the risk of infection. This prolonged exposure can facilitate the development of intra-amniotic infection, leading to a heightened risk of neonatal sepsis, as the newborn's immune system is not yet fully developed to combat these infections effectively. On the other side the longer the duration between membrane rupture and delivery, the higher the risk of the newborn being exposed to and acquiring an infection.

The finding indicated that during vaginal delivery, the newborn passes through the birth canal, which harbours a diverse microbiota, including potentially pathogenic bacteria. The findings, similar to the work of Macrotrends (2021), posit that mode of delivery is just one of several factors that can influence the epidemiology of early-onset sepsis, and preventive strategies can significantly reduce the associated risks. Infants born vaginally are directly exposed to this microbiota, increasing the likelihood of colonization with maternal pathogens. If the mother is colonized with pathogenic bacteria, such as Group B Streptococcus (GBS) or Escherichia coli (E. coli), there is a higher risk of vertical transmission to the newborn during vaginal delivery, predisposing the infant to early-onset neonatal sepsis Similarly, the study by Zambia Statistics Agency *et al.* (2019), reported that infants born via vaginal delivery, particularly in cases where the mother has been colonized with Group B Streptococcus (GBS) or other pathogenic bacteria, may have an increased risk of EOS. The bacteria can be transmitted to the neonate during passage through the birth canal. This can happen also during prolonged labour, and maternal fever during labour can be transmitted to the newborn during vaginal delivery, leading to sepsis.

Wynn and Polin (2018) indicate that premature babies are often delivered by C-section, makes them vulnerable to infections, as they have immature immune systems. The findings also revealed that premature infants often require prolonged hospitalization in neonatal intensive care units (NICUs) or special care nurseries, where they are exposed to healthcare-associated pathogens. This was in line with Nyma *et al.* (2020), who indicated preterm infants, regardless of the mode of delivery, are at a higher risk for EOS due to their immature immune systems and potential complications related to preterm labour. Further, the findings indicated that bacteria introduced during invasive

procedures can colonize the newborn's skin, mucous membranes, or respiratory tract, predisposing them to early-onset neonatal sepsis. The use of forceps, vacuum extraction to assist with the delivery of the baby can cause scalp trauma, the artificial rupture of membranes, instrumental delivery, and C-sections, frequent examinations to assess the progress of labour, bladder catheterization to keep the bladder empty and incision risk to enlarge the vaginal opening during childbirth increase the risk of early-onset neonatal sepsis by introducing bacteria into normally sterile environments. This was in agreement with (Braye *et al.*, 2019), who indicated that invasive procedures during childbirth become significant risk factors for early-onset sepsis (EOS) in neonates. These procedures introduce pathogens or disrupt the natural barriers that protect the infant from infection, leading to an increased risk of sepsis.

From the findings, nurture factors, including maternal health, birth environment, delivery practices, breastfeeding, postnatal care, and broader socioeconomic and cultural influences, significantly impact the risk of early-onset neonatal sepsis. These findings were in line with Macrotrends (2021), which reported that inadequate hygiene practices during childbirth, such as insufficient handwashing by healthcare providers or caregivers, can lead to the vertical transmission of harmful bacteria from the mother to the newborn. Further, inadequate hygiene practices in healthcare settings can result in the contamination of medical equipment, surfaces, and environments where newborn care is provided. Similarly, Zambia Statistics Agency *et al.* (2019) revealed that neglecting proper hand hygiene can cause bacteria to be transferred to newborns. This can increase the risk of infection in neonates.

6.1 Factors Associated with Neonatal Early Onset Sepsis among This Population at Kanyama Level One Hospital in Lusaka District

One of the questions asked was to find out the factors that are associated with neonatal early-onset sepsis here at Kanyama General Hospital. The sub-themes that emerged were focused on maternal risk factors, neonatal risk factors, and risk factors associated with intensive care units. The participants indicated that maternal risk factors associated with neonatal EOS can vary. Maternal colonization with certain bacteria in the gastrointestinal tract, such as Escherichia coli (E. coli), can contribute to the risk of early-onset neonatal sepsis. In support of the above submission, the doctor participant in the study indicated urinary tract infections, especially if untreated or recurrent, increase the risk of early-onset sepsis in the newborn. Even maternal fever during labour is often associated with an underlying infection, and it can increase the risk of neonatal sepsis.

Lekic *et al.* (2019) noted that infections are an important cause of morbidity and mortality in the neonatal period, particularly in preterm and very low birth weight infants. Maternal, environmental, and host factors determine which infant exposed to a potentially pathogenic organism will develop serious or other potentially invasive infections (Odabasi and Bulbul, 2020). Other factors include prolonged rupture of membranes, where the amniotic sac breaks before the onset of labour, providing a

potential pathway for bacterial entry. The longer the duration of ruptured membranes, the higher the risk of infection.

Further, premature infants are at a higher risk of early-onset sepsis due to their immature immune systems, which may not be fully equipped to fight off infections. In support of the above-recounted experiences, a doctor participant in the study indicated that babies born before 37 weeks of gestation have an underdeveloped immune system and are more susceptible to infections, including EOS. This was in line with Macrotrends (2021), who indicated that the increased risk of early-onset sepsis in preterm infants is also related to complications of labour and delivery and immaturity of innate and adaptive immunity. Also, babies with low birth weight, whether due to prematurity or other factors, may have underdeveloped immune systems and are more susceptible to infections. This finding agreed with Odabasi and Bulbul (2020), who revealed that low birth weight and prematurity are among the predisposing neonatal factors reported.

Another theme that emerged from the findings was the Intensive Care Unit associated risk factors as the contributor to factors that are associated with neonatal early onset sepsis here at Kanyama General Hospital. Further, the doctor added that infants in the NICU receive parenteral nutrition through intravenous lines, which can increase the risk of bloodstream infections if proper aseptic techniques are not followed. Midwives confirmed that preterm infants in the NICU are particularly vulnerable to infections, including early-onset sepsis, due to their underdeveloped immune systems and immature protective barriers. This was consistent with Aku *et al.* (2020), who pointed out that poor adherence to aseptic techniques during delivery or invasive procedures increases the risk of infection. Similar findings were reported by Puopolo *et al.* (2018), who revealed that complications or comorbidities that prolong the NICU stay also increase the likelihood of developing sepsis. The longer an infant stay in the NICU, the greater the likelihood of exposure to pathogens from other patients or their caregivers. Consequently, prolonged stays in the NICU increase the duration of potential exposure to hospital-acquired pathogens, increasing the risk of sepsis. Puopolo *et al.* (2018), indicated that extended stays in the ICU can increase the exposure to nosocomial infections. Also, in the crowded and intense care setting of the NICU, there is an increased risk of cross-contamination between infants, healthcare providers, and equipment, leading to potential infection spread. These findings were in conformity with the study by Odabasi and Bulbul, 2020), which revealed that overcrowding and suboptimal infection control practices in the NICU contribute to the spread of pathogens. Babies become vulnerable to infections, which may lead to early-onset sepsis, as they have underdeveloped immune systems and immature protective barriers. These findings agree with Lekic *et al.* (2019), who stated that surfaces in the NICU, including incubators, cribs, and medical equipment, can harbor pathogens if not properly cleaned and disinfected.

It was further found that prior antibiotic use, especially broad-spectrum antibiotics, can alter the infant's microbiome and increase the risk of opportunistic infections. These findings agreed with Pek *et al.* (2020), who revealed that previous

antibiotic use increases the risk of sepsis, particularly in neonatal or other hospital settings, through several mechanisms related to the impact of antibiotics on the body's normal flora, immune response, and the development of antibiotic-resistant bacteria. The use of antibiotics creates a selective environment where only bacteria resistant to the drug survive and multiply. Also, for those mothers who take herbs to fasten the labour process and frequent vaginal examinations, poor cleaning of the cord. These findings were in line with the study by (Oo, 2021), who indicated that many herbs used to accelerate labour may contain unregulated or unknown ingredients that can have unpredictable effects on both the mother and baby.

Also, evidence findings showed that contaminated surfaces and equipment in the ICU can harbour pathogens and serve as reservoirs for nosocomial infections. These findings were in line with the study by Procianoy and Silveira (2020), who indicated that frequently touched surfaces such as door handles, bed rails, and monitoring equipment can serve as reservoirs for bacteria if hygiene protocols are not rigorously followed. If proper hand hygiene and infection control practices are not followed in the ICU, that is with inadequate infection control measures it becomes the breeding space for bacteria causing early-onset sepsis. The findings are in line with Macrotrends (2021), who indicated inadequate hand hygiene practices among healthcare workers can lead to the transfer of pathogens from contaminated surfaces or other patients to neonates. Visitors, including parents, may inadvertently introduce pathogens if proper hand hygiene is not enforced. Poor environmental hygiene contributes to the spread of pathogens, which lead to infections in vulnerable neonates. It was noted that regular cleaning and disinfection of the environment are essential to prevent the spread of infection.

Nevertheless, the following sub-themes emerged from the discussions in the interviews and focused groups on challenges faced in the diagnosis and management of neonatal infections at Kanyama General Hospital in the Lusaka district. Clinical Challenges were found to be one of the challenges faced in the diagnosis and management of neonatal infections. This was evidenced in the following verbal account, where a doctor participant in the study indicated that neonates often exhibit non-specific signs and symptoms of infection, such as lethargy, poor feeding, irritability, or temperature instability. The results align with Procianoy and Silveira (2020), who asserted that the management of neonatal sepsis is always a challenge. Neonatal sepsis is a frequent cause of neonatal morbidity and mortality, especially in developing countries. Its diagnosis is difficult since clinical signs are nonspecific and complementary exams have low accuracy.

Similarly, it was found that diagnosis relies heavily on clinical observations, laboratory tests, and imaging studies. Neonates often present with non-specific symptoms such as fever, lethargy, poor feeding, and respiratory distress, which can make it difficult to differentiate between various causes of infection. Also, conditions like preterm birth, low birth weight, and maternal factors like chorioamnionitis usually complicate the clinical presentation and recognition of neonatal infections. Kimpton *et al*. (2021) indicated that neonates often present with non-specific symptoms, which makes it

difficult to differentiate between serious infections and other non-infectious causes, leading to delayed or missed diagnoses.

In underwriting the above views, a midwife-participant in the study had this to say:

> "*Neonates have an immature immune system, making them more susceptible to infections. Their immune responses may be insufficient or dysregulated, leading to atypical clinical presentations and difficulty in distinguishing between infectious and non-infectious causes of illness*."

These findings resonate with the study by Njagi (2017), who indicated that newborns, especially preterm infants, have an underdeveloped immune system that responds differently to infections which results in atypical presentations of infections, which can complicate clinical diagnosis. This was in line with the study by Procianoy and Silveira (2020), who indicated that assessing the condition of neonates (newborns) accurately can be challenging for healthcare providers as neonates cannot express symptoms verbally, so providers must rely on subtle signs, which can be easily missed or misinterpreted.

From the findings, it was indicated that neonates can acquire infections from their mothers during pregnancy, delivery, or through breastfeeding. The increasing prevalence of antibiotic-resistant bacteria poses a challenge in choosing effective treatment. Therefore, neonatal units face challenges related to multidrug-resistant organisms, such as limiting treatment options and necessitating careful antibiotic stewardship. Similarly, Gandhi and Kondekar (2019) indicated a lack of specific diagnostic tools. Neonates are fragile, and invasive diagnostic procedures pose risks. This limits the use of some diagnostic tools, making it harder to get definitive diagnoses.

The findings noted that adequately trained staff and equipment are crucial for the management of critically ill neonates with infections. Contributing to challenges faced in the diagnosis and management of neonatal infections include healthcare infrastructure, including limited laboratory facilities, diagnostic equipment, and trained healthcare personnel, which can impede the timely diagnosis and management of neonatal infections. Lack of essential resources leads to delays in obtaining diagnostic test results or inaccurate interpretation of findings.

Puopolo *et al.* (2018) indicated that the specialized knowledge required to assess neonates requires specialized training and experience. Less experienced healthcare providers might struggle with recognizing and interpreting the subtle signs of neonatal distress or illness. This is in line with the study by Van der Hoeven *et al.* (2021), who noted that the absence of specialized doctors and essential antibiotics poses a significant challenge in providing adequate healthcare. This gap often leaves newborns vulnerable to untreated or poorly managed conditions. Additionally, caregivers and mothers may lack the necessary knowledge about the importance of seeking early medical care for their

infants. This combination of factors can lead to delayed treatment and worsened health outcomes for the most vulnerable patients.

Similarly, a doctor participant in the study indicated that the availability of diagnostic tests, including blood cultures, cerebrospinal fluid analysis, and imaging studies, hamper the accurate diagnosis of neonatal infections. The facility has limited availability of essential medications that include antibiotics and antiviral agents, compromising the ability to provide timely and appropriate treatment for neonatal infections. This finding is supported by Achten (2021), who stated that essential medications are not available in formulations suitable for neonates, such as liquid forms or dosages that are appropriate for their small size and immature organs. Similarly, the study by Kuzniewicz *et al.* (2017) revealed that the limited availability of essential medications for neonates with sepsis presents significant challenges, and the limited availability of essential antibiotics and supportive medications leads to delays in treatment, increasing the risk of severe complications or death. Therefore, healthcare facilities in resource-limited settings lack access to essential diagnostic tools, resulting in underdiagnosis or misdiagnosis of infections. The finding is in line with the study by Kuzniewicz *et al.* (2017), who revealed that in some settings, critical diagnostic tools are not readily available, and this lack of access hinders accurate and timely diagnosis of infection among neonates. The findings correlate with the findings of Marks *et al.* (2020), who found inadequate resources for hand hygiene, environmental cleaning, and personal protective equipment this shortage compromises infection control and safety measures.

It should further be noted that premature birth and low birth weight increase the risk of neonatal infections due to immaturity of the immune system, impaired skin barrier function, and susceptibility to nosocomial infections in the neonatal intensive care unit (NICU). The findings resonate with the study by Aku *et al.* (2020), who indicated that premature birth and low birth weight elevate the risk of diseases in neonates. These factors make newborns more vulnerable to health complications. Further invasive procedures performed during labour and delivery, such as fetal scalp electrode placement, fetal monitoring, and caesarean section, were indicated to increase the risk of neonatal infections. The findings of this study contradict a study by Van der Hoeven *et al.* (2021), who indicated that among the actions taken by health providers that increase the risk of neonatal infections were invasive procedures during labour and delivery, such as fetal scalp electrode placement, fetal monitoring, and caesarean section. Therefore, the diagnosis and management of neonatal infections present significant challenges due to the subtle and non-specific symptoms in newborns, which can lead to delayed or missed diagnoses. Additionally, limited diagnostic tools and the risk of antibiotic resistance complicate treatment, making it difficult to provide timely and effective care for these vulnerable patients.

7. Conclusion

The research on the factors associated with neonatal early onset sepsis at Kanyama Level One Hospital has provided valuable insights into the complex interplay of maternal, environmental, and healthcare-related factors contributing to this serious neonatal condition. The epidemiology of neonatal early-onset sepsis at Kanyama Level One Hospital in Lusaka district indicates a notable incidence rate, with a significant proportion of cases occurring in premature and low-birth-weight neonates. Neonatal early-onset sepsis is associated with maternal risk factors such as prolonged rupture of membranes, maternal chorioamnionitis, and colonization with Group B Streptococcus. Additionally, prematurity, low birth weight, invasive procedures, and perinatal exposure to infectious pathogens contribute to the increased susceptibility of neonates to early-onset sepsis. The study highlighted the critical role of maternal infections, delivery practices, and hospital hygiene standards in the development of sepsis among neonates. It also underscored the challenges faced in the timely diagnosis and effective management of the condition due to limitations in resources and diagnostic capabilities. Challenges in diagnosis and management persist, including limited access to diagnostic tools and antibiotics tailored to local microbial profiles.

Despite these challenges, the research emphasizes the importance of targeted interventions, such as improving infection prevention and control measures, enhancing maternal care, and strengthening neonatal surveillance protocols. Strategies to address challenges in the diagnosis and management of neonatal infections include implementing standardized protocols for early recognition, optimizing antimicrobial stewardship practices to combat rising resistance, improving access to advanced diagnostic tools, and fostering multidisciplinary collaboration among healthcare professionals to ensure comprehensive care. Additionally, enhancing parental education and supporting community-based surveillance efforts is essential for continually improving outcomes in neonatal infection management. These findings have the potential to inform future healthcare strategies aimed at reducing the incidence of neonatal early-onset sepsis, ultimately improving neonatal outcomes in similar healthcare settings. The next chapter presents a discussion of the findings.

7.1 Recommendations

The Ministry of Health needs to strengthen infection prevention and control measures and improve maternal and neonatal health surveillance. This includes regular hand hygiene training for healthcare workers, proper sterilization of medical equipment, and strict adherence to aseptic techniques during labour and delivery.

The hospital needs to enhance maternal infection screening and management, particularly during the antenatal period and labour. Ensure that women identified with infections receive timely and appropriate antibiotic therapy.

There is a need to establish a multidisciplinary neonatal care team composed of paediatricians, neonatologists, nurses, laboratory technicians, and pharmacists to

collaborate on the diagnosis and management of neonatal infections. This team should meet regularly to review cases, ensure adherence to clinical guidelines, and coordinate care across departments.

7.2 Limitations of the Study

Due to the usually small sample size in qualitative research, it is not easy to generalise the findings to a similar population (Creswell, 2014). The findings are specific to the population and context of Kanyama Level One Hospital. This limits the ability to generalize the results to other hospitals or regions, particularly those with different healthcare systems or population demographics. As a qualitative descriptive case study, the research may not provide longitudinal data that tracks changes over time. The researcher used in-depth interviews and FGD guides to collect data, providing participants with less anonymity. Thus, key participants who provided needed information for the study were unwilling to participate. To address this limitation, participants were assured of anonymity and confidentiality to enable them to participate in the study willingly.

Ethical Approval Statement

The study was conducted as part of a master project after getting approval from the National Health Research Authority.

Declaration of Participants' Consent

The authors certify that they have obtained all appropriate patient consent.

Conflict of Interest Statement

The authors declare no conflict of interest.

About the Author(s)

Mercy Njobvu is a unique research scholar in Master of Philosophy degree in Development Studies (with a specialization in Health Services Management) research at Africa Research University, Zambia. I obtained a bachelor's degree in nursing and midwifery sciences from Cavendish University and am pursuing a master's degree in Developmental Studies, majoring in Health Services Management. A clinical nurse working as a night superintendent supervising the juniors. I am very interested in health services management.

Dr. John Volk is currently a Professor of Research at Africa Research University, Zambia. He is a globally renowned researcher with an ability to look at things from different perspectives.

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