FACTORS CONTRIBUTING TO TRANSMISSION OF SELECTED INFECTIONS: KLEBSIELLA SPECIES IN NEONATAL INTENSIVE CARE UNIT AT THELLE MOGOERANE REGIONAL HOSPITAL, GAUTENG PROVINCE, SOUTH AFRICA

By

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[redacted]

Dissertation

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DECLARATION

I, **Mmatsie Rahab Mothapo,** officially state that this dissertation **'Factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital, Gauteng Province, South Africa'** herewith put forward to the University of Limpopo, for the degree of Master of Nursing Science has not been formally submitted by me for a degree at this or any other university; that is my work in blueprint and execution, and that all reference materials contained herein have been accordingly acknowledged.

Mothapo Mmatsie Rahab …….

Full names Date

DEDICATION

I devote this dissertation to:

- My husband, Aron Tjale, my baby girl Moremadi and my son Michael for putting up with a studying mother. Your True love, comfort, and tranquillity, and encouraging me to endure until I complete this course, thank you, my beautiful family.
- My late father, Mr Michael Mikia Mothapo for what you taught me is the reason I resumed studying.
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ABSTRACT

Background: Neonatal Intensive Care Units (NICUs) are regarded as a specialized area in any hospital and are extremely risky wards which are more likely to spread transmissions. Moreover, neonates get easily infected as a result of their developing immune systems. This occurs because they are various types of infections which are likely to suppress their undeveloped immune system. The National Institute for Communicable Diseases (NICD) reported that eleven neonates were infected with Klebsiella infections at a university-affiliated hospital in Gauteng Province. Cross-transmission via the hands of healthcare workers was also the likely source of an outbreak of Klebsiella infections in the NICU.

Purpose: The purpose of this study was to determine the factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital, Gauteng Province, South Africa.

Research method: A quantitative cross-sectional, descriptive design was used, and data were collected using self-developed close- ended questionnaires. Fifty-five nurses working in the Neonatal Intensive Care Unit constituted the sample and completed and submitted the questionnaires. The researcher piloted the questionnaires at various hospitals in Gauteng province to ensure the validity and reliability of the data. Data were dissected by applying SPSS version 28.0 with the aid of a University biostatistician and presented in tables and graphs. Turfloop Research Ethics Committee gave ethical clearance and the Gauteng Department of Health was permitted to conduct the study at TMRH. Ethical standards were adhered to throughout the study.

Results. The study revealed that health workers still need experience in the execution of Infection Prevention Control (IPC) measures which could be associated with the cause of increased Klebsiella infection in NICU. Thus, a knowledge deficit in the management of infections could be attributed to a lack of education and training. The study also found that there are inconsistencies in the availability of material resources such as linen and that pose a risk in the delivery of standard infection prevention and control protocol.

Recommendations: The unit infection control team should ensure the proper management, evaluation, and regulation of the spread of Klebsiella infection. All healthcare workers in NICUs are ought to be workshopped or be in-service trained at regular intervals. Thus, this training should focus mainly on the prevention of Klebsiella infections. Therefore, to avoid human error the Department of Health is also advised to appoint and increase the number of newly qualified health workers. It is also recommended that the Department of Health appoint sufficient staff including retired nurses if the need arises.

Key concepts: Factors, transmission, Klebsiella infections, NICU

LIST OF ABBREVIATIONS

HAI	: Hospital-acquired infections
HH	: Hand Hygiene
IPC	: Infection Prevention and Control
KP	: Klebsiella Pneumonia
NDoH	: National Department of Health
NICD	: National Institute for Communicable Diseases
NICU	: Neonatal Intensive Care Unit
NHMRC	: National Health and Medical Research Council
SA	: South Africa
SANC	: South African Nursing Council
SPSS	: Statistical Package for Social Science
TMRH	: Thelle Mogoerane Regional Hospital
TREC	: Turfloop Research Ethical Committee
US	: United States
WHO	: World Health Organization

DEFINITION OF CONCEPTS

Hospital-Acquired Infection (HAI), also known as a nosocomial infection-is an infection acquired by a patient during their hospital stay. The infection was not present on admission or incubating at the time of admission. (Hand Hygiene Australia, 2015). In this study, this shall mean, infection resulting from a hospital stay.

Infections- "An infection due to Klebsiella species was characterized as any NICU patient who had infection symptoms or indications and from whom a Klebsiella was isolated from the blood, urine, cerebrospinal fluid, bronchoalveolar lavage, and/or aseptically obtained any other physiological body fluid" (Founou, Allam, Ishmail & Essack, 2019). In this study, infections will refer to the presence of Hospital Acquired Infections on or in the body, where the patient is exhibiting symptoms of being unwell.

Intensive Care Unit – Blackwell's Nursing Dictionary (2012) defines it as a special area in hospital settings where critically ill patients who need close observation and frequent ministrations can be cared for by highly qualified, specially trained staff. In this study, an Intensive Care Unit means an area that provides critical care and life support for acutely ill and injured patients.

Klebsiella species – are bacterial organisms constituting part of the normal human flora, inhabiting particularly the human gastrointestinal tract, and are classified as an opportunistic pathogen (Kurmar, Chakraborti, Joshi & Chacraborty, 2011). In this study, Klebsiella species mean any type of bacterial organism that can cause different types of hospital-acquired infections, including pneumonia, bloodstream infections, wound or surgical site infections, and meningitis.

The neonatal intensive care unit (NICU) - A ward in the hospital where infants who are sick or need extra care due to birth defects and sickness are cared for. This usually occurs when they need intensive care for longer. (Polacco, Shinkunas, Perencevich, Kaldjian, & Reisinger, 2015). In this study, NICU means a specialized closed unit where all babies are managed by the intensivist on duty together with the referring specialist and a dedicated team of nurses and doctors.

Transmission – It is the transfer of a disease from one person to another (Blackwell's Nursing Dictionary, 2012). In this study, the transmission will mean the action or process of carrying infections or the state of being transmitted.

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CHAPTER 1

OVERVIEW OF THE STUDY

1.1. INTRODUCTION AND BACKGROUND

Klebsiella organisms are long known to be the cause of infections in the Neonatal Intensive Care Unit (NICU). This study seeks to focus on the Klebsiella organism as it is responsible for a significant percentage of hospital-acquired infections (Ismael Fahim, Abdel-Aziz Abdel-Slam & Rady El Said, 2022). Sick new-borns admitted to neonatal units in low-resource settings are at an increased risk of developing hospital-acquired infections due to poor clinical care practices (Okomo, Senghore, Darboe, Bojang, Zaman, Hossain, Nwakanma, Le Doare, Holt, Hos & Lawn 2020). According to Dramowski, Aucamp, Bekker, and Mehtar (2017) hospitalized neonates are a vulnerable population owing to immature immunity and frequent infectious disease exposures through contact with healthcare staff, parents, other patients, equipment, and the hospital environment.

Klebsiella species possess a long history of being significant sources of infections in neonatal intensive care units (NICU). The isolation of Klebsiella species from a patient without clinical symptoms or evidence of infection is known as colonization. It can occur from blood, urine, cerebrospinal fluid, bronchoalveolar lavage, and/or aseptically acquired any other physiological body fluid. (McKay & Bamford 2015). The organisms may live in the environment as well as momentarily in the hands of medical professionals, which makes baby-to-baby transmission easier in the intensive care unit (Gasser, Zingg, Cassini & Kronenberg, 2019).

Moreover, Coffin and Zaoutis (2010), identify the three methods—contact (direct or indirect), droplet (from big respiratory droplets that fall out of the air at a maximum distance of 3 feet), and airborne (from droplet nuclei)—of transmitting HCAIs to newborns. It can travel farther since it can stay in the air for extended periods. Polin, Denson, and Brady (2012) and Coffin and Zaoutis (2010) allude that pathogens affecting the neonates dwell in the neonatal intensive care unit (NICU) and are affected, at least in part, by the NICU environment and the hands of medical personnel, such as when performing evasive procedures like intravenous insertion, parental nourishment, and urine cleaning, catheterization, Oro/nasogastric tubes. While

contact transmissions of pathogenic organisms by healthcare professionals' hands are probably a major contributor to infections, these transmissions can be avoided.

Globally, in 2018, around 2·5 million newborns died within the first 28 days of birth, and almost 80% of these deaths occurred in South Asia and sub-Saharan Africa. Infections (especially sepsis, meningitis, and pneumonia) were among the leading causes of these deaths. The risk of hospital-acquired infection is particularly high for newborns admitted to hospitals in low-resource settings and is associated with overcrowding and understaffing, as well as weak infection prevention and control protocols (Fink, 2019). Findings of Okomo, et al., (2020) at the Paediatric Hospital of Luanda indicated that between March 1 and Dec 31, 2016, 321 blood cultures were done, of which 178 (55%) were positive with a clinically significant isolate.

According to the study by Rauwers, Annet, Fluit, Wissink, Loeve, Vleggaar, Bruno, Vos, Bode, and Monkelbaan, (2019) Outbreaks are associated with a combination of factors, including duodenoscope design issues, repair issues, improper cleaning, and systemic monitoring of contamination. In their study findings in Italy, it was discovered that out of 81 patients who were admitted, discharged, and invited back for culture, 27 were found to have been infected.

Hospital-acquired Klebsiella pneumonia in neonatal intensive care units (NICUs) has increased recently with numerous reports of outbreaks in neonatal ICUs throughout South Africa (SA). Klebsiella pneumonia is a gram-negative bacillus that belongs to the Enterobacteriaceae family and is responsible to form severe hospital-acquired infections. Investigations into these outbreaks have identified an underlying context characterized by overcrowding, understaffing, and a breakdown in infection prevention and control measures. The incidence of HAI varies across ICUs and with different patient profiles (Casewell & Phillip 2016).

According to Statistics South Africa, on August 4, 2014, the National Institute for Communicable Diseases (NICD) received a report of eleven neonates infected with Klebsiella infections from a university-affiliated hospital in Gauteng Province. Cross-transmission via the hands of healthcare workers was also the likely source of an outbreak of Klebsiella infections in The ICU (Statistics SA, 2014).

Therefore, it shows that various factors are contributing to the transmission of Klebsiella infections within intensive care units; hence the current study sought to determine factors contributing to the transmission of selected infections: Klebsiella species in a neonatal intensive care unit at Thelle Mogoerane Regional Hospital.

1.2. RESEARCH PROBLEM

Neonates are susceptible to a variety of illnesses that may be brought on by their underdeveloped, weakened immune systems, making NICUs a high-risk location where infections may spread (Morioka, Yahata, Shibata, Miwa, Yokota, Jikimoto, Nakamura, Lee, Yoshida, Yamada, Arakawa & Lijima 2013). Patients admitted to the NICU urgently require careful nurturing to reduce the danger of infections. Hospital-acquired infections (HAIs) are regarded as a serious issue that affects the entire world and appears primary cause of the rise in mortality and morbidity (Polacco, Shinkunas, Perencevich, Kaldjian & Reisinger, 2015).

In South Africa, the Health Minister (May 27, 2010) was reported as having said, “We want to accept upfront that there is a lapse in implementation of infection prevention and control measures. The lapse in infection prevention and control measures is a very good lesson and we hope that other hospitals have learned this lesson from a distance” (Health E-news, 2010).

In August 2018, the National Institute for Communicable Diseases (NICD) was alerted through a media report of two deaths associated with Klebsiella species: Klebsiella pneumoniae bloodstream infection (BSI) in the neonatal unit of a regional hospital in Gauteng Province, South Africa (SA) (Health E-News, 2018). Following a preliminary assessment of culture-confirmed cases of BSI from the unit, the NICD initiated an investigation, in collaboration with the Gauteng Provincial Department of Health and the health facility (Essel, Tshabalala, Ntshoe, Mphaphuli, Feller, Shonhiwa, McCarthy, Ismail, Strasheim, Lowe, Perovic, Hlonipho & Govender, 2020).

Moreover, on 22 August 2018, the National Institute of Communicable Disease, a division of the National Health Laboratory Services was informed of a suspected outbreak of Klebsiella species infections in the NICU at Thelle Mogoerane Regional Hospital (Health E-News, 2018). The Health Minister (August 22, 2018) reported having said ‘five babies have now died from antibiotic-resistant Klebsiella’ (Health E-News, 2018).

These outbreaks signifies a gap in infection and prevention principles within the intensive care units that need careful and continuous surveillance to limit the risk of infections hence the current study sought to determine the factors influencing the spread of specific illnesses: Klebsiella species in a neonatal intensive care unit at Thelle Mogoerane Regional Hospital.

1.3. AIM OF THE STUDY

The aim of the study was:

- To determine the factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital.

1.4 OBJECTIVES OF THE STUDY

- To identify contributing factors to the transmission of selected infections: Klebsiella species in the NICU at Thelle Mogoerane Regional Hospital.
- To describe contributing factors to the transmission of selected infections: Klebsiella species in the NICU at Thelle Mogoerane Regional Hospital.

1.5 RESEARCH QUESTION

The below research question guided the researcher throughout the study:

- What are the factors contributing to the transmission of selected infections: Klebsiella species in NICU at Thelle Mogoerane Regional Hospital?

1.6 OVERVIEW OF RESEARCH METHODOLOGY

This research was conducted using a quantitative technique. The parameters influencing the propagation of specific pathogens were quantified using a quantitative research method: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital. A formal, methodical procedure known as a quantitative research study uses numerical data to learn more about the globe (Burns & Groove, 2011). The research was done in a 76 bedded NICU in TMRH.

A cross-sectional research design was applied to attain numerical data about the

factors contributing to the transmission of selected infections of klebsiella species in the NICU. A cross-sectional research design study was used as it was the most practical, economical, and successful method that health practitioners can employ (Brink, et al, 2012). Slovin's formula guided the simple random sampling which had

been applied in this study to select a sample size of 60 from a total population of 70. Since the objectives of the study were to identify and describe the contributing factors to the transmission of selected infections: of Klebsiella species in the NICU at TMRH, The researcher employed structured questionnaires to collect data on factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at TMRH. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 28.0 and the assistance of a statistician. In Chapter 3, the specific study approach is covered.

1.7 SIGNIFICANCE OF THE STUDY

Researching factors contributing to the transmission of selected infections: Klebsiella species in NICU at TMRH would be beneficial to the researcher, in such a way that the researcher will be able to lead the hospital in the management, containment and reduction of the Neonatal Klebsiella outbreak in the hospital. The employer, being the Thelle Mogoerane Regional Hospital and Gauteng Department of Health will be able to identify the risks brought in by the Klebsiella outbreak in the hospital and mitigate appropriately through quality improvement plans for infrastructure and availability of resources to prevent cross infections. The community of Gauteng Province (GP) will benefit from this research by getting informed on factors to be taken into account while ensuring that healthcare professionals follow routine infection control procedures to stop the spread of illnesses and organisms to other patients.

It is expected that the National Department of Health (NDoH) utilizes the findings of this research to update the existing policies on Neonatal Klebsiella infections and implement the policies to reduce the costs involved in the management of Klebsiella outbreaks. Thereby, ensuring that the allocation of finance and material resources which includes the provision of policies and guidelines for IPC, and the construction of IPC infrastructure within the hospital, is optimal for the achievement of the goals stipulated in the IPC program of the hospital.

1.8 ETHICAL CONSIDERATIONS

The research proposal was submitted to the Turfloop Research Ethics Committee (TREC) for ethical clearance and permission to conduct the study was granted by the Gauteng Department of Health Ethical Research Committee, the Chief Executive Officers, and the nursing management of the relevant hospitals. The study was carried out by the following ethical standards: informed consent, permission to conduct the study with ethical clearance, and voluntary participation. The study adheres to ethical standards such as the principle of autonomy, the principle of secrecy and anonymity, and the principle of beneficence and non-maleficence. The respondents given all information about aims, goals, and processes to follow. Lastly, the respondents were given written consent to sign after the deliberation of the information.

1.9 OUTLINE OF THE STUDY

Chapter 1: Introduction and background

Chapter 2: Literature review and theoretical framework

Chapter 3: Research methodology, design, study site, population and sampling, the data collection method, data analysis, validity and reliability, and ethical considerations.

Chapter 4: Presentation, Interpretation, and discussion of the findings.

Chapter 5: Summary, Limitations, Recommendations and Conclusions.

1.10 CONCLUSION

The chapter presented the factors contributing to the transmission of Klebsiella infection in Neonatal Intensive Care Units. An overview of the introduction and the background information on infections in NICUs was described in this chapter. This chapter presented the problem statement. The aim and objectives which were necessary to guide the study were outlined, and the research questions guiding they were presented. This study was conducted by the following ethical principles: informed consent, voluntary participation, and permission to conduct the study with ethical clearance. The study followed ethical guidelines, such as the concepts of autonomy, confidentiality, and anonymity, as well as the ideals of goodness and non-maleficent.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter two of this study describes literature review as an academic manner of presenting previous research discoveries and theories on specific topics (Brink, Van der Walt & Van Rensburg, 2012). The literature review emphasizes relevant factors contributing to the transmission of selected infections: Klebsiella species in the NICU at TMRH. It deepens, broadens, and clarifies the researcher's knowledge of what already exists on the topic, the findings of other researchers, gaps identified by other researchers, and areas that need further research. A review of the literature was done by the researcher using reports, books, papers, and downloads from Google Scholar, Science Direct, EBSCOhost, and ProQuest.

2.2 PURPOSE OF THE LITERATURE REVIEW

The tenacity of the literature review is to back up existing research with a new perspective. It helps researchers to absorb the topic by painting a vivid picture (Brink et al., 2011). The devotion of the literature review is to attain more knowledge and gain sustenance on the theoretical framework. It highlights what is known on the topic, what still needs to be researched and which angle still needs discovery. The purpose of the literature gains new data on the transmission of selected infections: Klebsiella species in the NICU at TMRH.

2.3 CLINICAL MANIFESTATIONS OF KLEBSIELLA PNEUMONIA

Klebsiella pneumoniae has been reported to cause community-acquired pneumonia and various hospital-acquired diseases, such as urinary tract infections, pneumonia, bacteremia, cholangitis, meningitis, endocarditis and bacterial endophthalmitis (Ziółkowski, Pawłowska, Stasiowski, Jachowicz, Wójkowska-Mach, & Bielecki, 2021; Bengoechea & Sa Pessoa, 2019). The likelihood of K. pneumoniae hospital-acquired infections is greatly increased by the 15 presence of invasive devices, such as catheters in hospitalised patients (Liu, Sai, Li, Zhu & Huang, 2020).

- **Pneumonia**

Patients infected with community-acquired pneumonia typically present with an acute onset of high fever, chills, flu-like symptoms and a productive cough with abundant, thick, tenacious, and blood-tinged sputum that is sometimes referred to as “currant jelly” sputum (Musa, 2021; Alfes, Fitzpatrick, & Hickman, 2018). Most of the pulmonary diseases caused by K. pneumoniae are in the form of bronchopneumonia or bronchitis (Franquet, 2018). Alcoholics and individuals with compromised pulmonary function are at an increased risk of developing pneumonia. This is due to the inability of these persons to clear aspirated oral secretions from the lower respiratory tract (Kosutova & Mikolka, 2021; Reka, 2018).

- **Urinary tract infections (UTIs)**

Klebsiella is a frequent cause of UTIs (Martin & Bachman 2018; Hyun, Lee, ah Kim, & Ryu, 2019). In hospital-acquired infections, catheterization is believed to be an important factor in the incidence and spread of Klebsiella strains; Anane, Apalata, Vasaikar, Okuthe & Songca, 2020). Furthermore, patients with diabetes, poor immune status or structural abnormalities are more prone to K. pneumoniae UTIs (Joseph, Merciecca, Forestier, Balestrino & Miquel, 2021). Clinical features of UTI include frequency, dysuria, low back pain and suprapubic discomfort (Chu & Lowder, 2018). Systemic symptoms, such as fever and chills are usually indicative of concomitant pyelonephritis (Romanò & Granata, 2018).

- **Bacteremia**

Bacteremia caused by ESBL-producing K. pneumoniae isolates is a major concern for clinicians due to the increased rate of treatment failure as well as the high mortalityrate (Mofolorunsho, Ocheni, Aminu, Omatola, & Olowonibi, 2021). The frequentunderlying conditions of K. pneumoniae bacteremia include alcoholism, cirrhosis, diabetes mellitus, malignancies as well as ageing (Rahim, Gupta, Maheshwari, & Singh, 2019). Patients with indwelling catheters, patients receiving antibiotic therapy and those undergoing invasive procedures are at the highest risk for K. pneumoniae bacteremia (Lou, Du, Zhang, Shi, Han, Lan, Yan, Hu, Wang, Wu & Jiang, 2022).

- **Liver abscess**

A pyogenic liver abscess (PLA) has been described as a potentially life-threatening disease with a reported mortality of up to 31% (Zimmermann, Wendt, Lübbert, & Karlas, 2021). Initially, Escherichia coli were regarded as the most common causative agent of PLA (Powlina, Gupta, Bhagat & Goel, 2022). However, Rossi, Gasperini, Leflon-Guibout, Gioanni, de Lastours, Rossi, Dokmak, Ronot, Roux, Nicolas-Chanoine, and Fantin (2018) reported that K. pneumoniae has now become the most frequent causative agent for PLA and Pyogenic liver abscesses caused by K. pneumoniae isolates are regarded as an emerging disease (Rossi, et. al. 2018). Most cases of K. pneumoniae liver abscesses have been reported in Taiwan (Jun 2018). According to Sánchez-López, García-Caballero, Navarro-San Francisco, Quereda, Ruiz-Garbajosa, Navas, Dronda, Morosini, Cantón, and Diez-Aguilar (2019) K. pneumoniae K1 serotype is the predominant serotype that causes a primary pyogenic liver abscess.

2.4 THE RISK OF TRANSMISSION OF HOSPITAL-ACQUIRED INFECTIONS

Most importantly, the following scholars Tellier, Li, Cowling, and Tang (2019) agree that there is more than one way in which microorganisms can be infectious and transmitted to patients in the hospital wards. They explain the various routes in which the klebsiella can infect patients through direct contact with other patients or equipment's, droplet, airborne, and vector-borne. Moreover, when they explain the transmission factors, contact transmission was the most vital and frequent one among other nosocomial infections. Furthermore, Tellier, et. al. (2019) explains why these transmissions spread as they can be direct or indirect. According to WHO (2015) Klebsiella indirect infection has to do with equipment's that is without proper sterilization, human error, and coming into contact with the host, such as coming into contact with contaminated objects, needles, dressings, and gloves.

Tellier, et. al. (2019) postulated that putting a patient to bed, bathing them, or performing other patient-care tasks that call for close contact with the patient are examples of when this happens.

2.5 FACTORS CONTRIBUTING TO THE SPREAD OF KLEBSIELLA INFECTION IN NEONATAL UNIT

There are several studies conducted on the factors that contribute to Klebsiella infection in a neonatal intensive care unit. These factors include a lack of staff empowerment, inadequate infrastructure, and hand hygiene. The following section discusses the different factors identified by other scholars.

2.5.1 Lack of staff empowerment

Mangochi, Tolhurst, Simpson, Kawaza, Chidziwisano, Feasey, Morse and MacPherson (2022) conducted a study about exploring health workers and patient caregivers' hand sterility habits in a neonatal unit in Blantyre, Malawi, implications for controlling outbreaks of drug-resistant infections. Thus, they detected that occurrences were a result of the lack of staff workshops. This is in terms of hand purity or cleanliness and HAIs reduction, apart from other factors. That means was important for healthcare professionals in NICU to frequently be re-educated about hand hygiene to reinforce amenability.

Salvi (2021) outlined that there were various reasons why recently, nosocomial transmission has skyrocketed at an alarming rate. Many medical treatments bypass the body's natural defences, medical staff move from patient to patient, hospitals house a significant number of sick people whose immune systems were frequently compromised, and increased use of outpatient therapy makes hospital patients sicker ~~and more often~~ than average. Inadequate sanitation protocols regarding clothes, equipment sterilization, washing and other preventive measures could be ignored by medical staff or too lax to effectively segregate patients from infectious agents, hence creating a route for pathogens to spread. Last but not least, the frequent use of anti-microbial drugs in healthcare facilities puts pressure on the evolution of resistant types of microbes. According to Lowman (2016), the South African public health sector.

2.5.2 Inadequate infrastructure

Stiller, Salm, Bischoff, and Gastmeier (2016), testified that the proximity of patients or sharing one single room is also a vital factor. Most importantly, if proximity is not considered for the patients, the riskiest it becomes. Lowman (2016) contributed that the more medical personnel present in a space, the greater for the spread of germs and breaches in infection control procedures, potentially resulting in an increased illnesses and Mehtar (2020) emphasized that lack of proper sterilization of nursing

equipment’s and futile transmission prevention practices and control can lead to outbreaks of lead to infections.

2.5.3 Hand hygiene

Alcan and Dolgun (2019) indicate that “hand hygiene is an important healthcare issue globally and the single most cost-effective and practical measure to reduce the incidence of healthcare-associated infection, as well as the spread of antimicrobial resistance across all settings from advanced healthcare systems to primary healthcare centres” and the health workers. Health Care Workers contaminate their hands by touching the environment and patients during routine care activities, thus, if hand hygiene practices were sub-optimal then microbial transmission could occur. Effective hand hygiene includes the application of adequate amounts of hand hygiene agents, be that soap or alcohol gel, adequate duration of hand hygiene with suitable mechanical action, coverage of all hand surfaces, and adequate drying (Zhang, Kadimisetty, Yin, Ruiz, Mauk & Liu 2019).

2.6 THEORETICAL FRAMEWORK

The theoretical framework is described as an ‘explanation which is based on formulated prepositions resulting from an existing theory which seeks to create a specific way of looking at a particular phenomenon. According to Nwozichi, Olorunfemi and Madu (2021) theories are part of the structure of the knowledge base of nursing and expressions of disciplinary roots for guiding practice and research. Furthermore, there are arguments around philosophical/paradigmatic, conceptual, and empirical and theory–practice gap issues that were previously seen as critical in developing core disciplinary knowledge for professional practice in nursing (Nwozichi, et al., 2021). However, perceptions were first influenced by philosophy than by knowledge. How nurses use science and theories to explain the empirical world depends on their philosophy (Chinn, Kramer, & Sitzman, 2021).

Nursing practices are guided by theoretical frameworks that provide a functional basis for nursing care. The application of Nightingale's theory of environment in nursing practices served as the foundation for this study. The theory identifies and clarifies 13

environmental cannons, including air circulation, cleanliness of the rooms' walls and floors, light, noise, individual hygiene, the bed, and bedding, and eating. The theory's implementation in nursing practices aids in understanding and reflecting the direct link between a patient's environment and health. The theory also discusses four crucial ideas: the environment, people, health, and nursing (Figure 1).

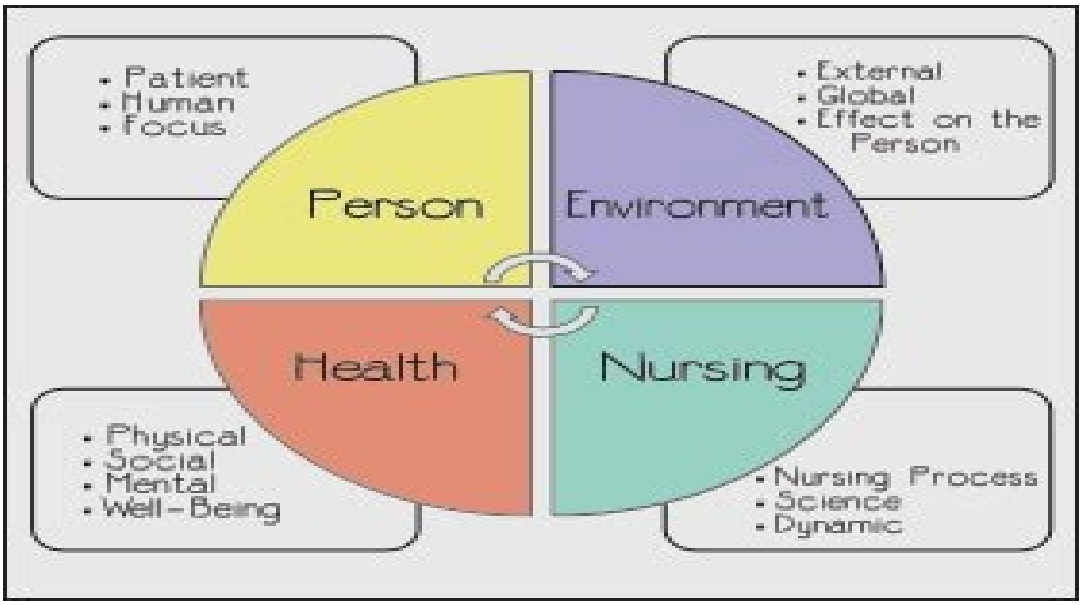

Figure 1: Illustration of the four key concepts in the nursing practice

2.6.1 Environment

The environment was the part of Nightingale's thesis that is most frequently discussed. Clean air and ventilation, warmth, noise, light, architecture, and cleanliness are among the environmental elements mentioned in Nightingale's hypothesis (Nightingale, 1860). A patient's health will be impacted and probably never improve without clean, pure, warm air, Nightingale emphasized almost more than anything else. Thus, the physical aspects of nurses' work environment significantly impact the nurse's ability to perform their nursing care and, as a result, impact negatively on patient care outcomes.

Nightingale's environmental theory has rapid increase in bringing change to the aspect of infection control in healthcare institutions. According to Nightingale's theory, simple tasks like hand hygiene have the potential to protect patients, visitors, and healthcare workers against the continued presence of hospital-based nosocomial infection (Khan, Fatima, Baig & Mehboob, R. 2017). Furthermore, present infection control is a

fundamental part of nursing and nursing practice in hospitals around the world. Therefore, it is an essential part of creating safe environments that help to promote good healing, good health and well-being and good patient outcomes (Khan et al., 2017).

In this study, the environment was attributed to the NICUs in healthcare organizations/institutions such as hospitals where neonatal patients are admitted. The hospital environment if not well-managed can in itself be a source of infection to patients, as well as the NICUs in this study. Institutional policies and the interests of different healthcare workers, including nurses and others, have an impact on the environment's characteristics. Social expectations and the public's perceptions of the values they ascribed to each profession, in turn, had an impact on institutional policies and the level of power other healthcare professionals possessed.

2.6.2 Person

Nightingale referred to a person as "multidimensional" and as having "components that are biological, psychological, social, and spiritual." 'You cannot make up the human body as you would draw up a prescription,' Nightingale responded to this (Nightingale, 1860). Nightingale continues by saying you shouldn't assume a patient will appreciate something, like sugary food, while they are unwell simply because they like it when they are healthy since they can despise it when they are sick (Nightingale, 1860).

Nightingale said that a person can maintain a sense of autonomy even while ill. According to Nightingale, if a patient has limited mobility, the nurse should give him a bedside table or an over-the-bed table so he can reach things on his own, otherwise, he will feel like he is "out of humanity's grasp" (Nightingale, 1860). Nightingale added that if the patient is capable of doing something on their own, let them do it because doing it oneself will reduce their worry (Nightingale, 1860). Nightingale claims that human beings are made up of social elements.

In this study, the person referred to as a nurse is Nightingale added that even while ill, a person retains a sense of autonomy. According to Nightingale, if a patient has limited mobility, the nurse should provide a bedside table or an over-the-bed table so the patient may reach things on his own, since otherwise he would feel," out of humanity's grasp" (Nightingale, 1860). Nightingale added that if the patient can care for

themselves, they should do so because doing so will reduce their worry (Nightingale, 1860). Nightingale claims that human beings are social creatures.

2.6.3 Health

Nightingale added that even while ill, a person retains a sense of autonomy. According to Nightingale, if a patient has limited mobility, the nurse should provide a bedside table or an over-the-bed table so the patient may reach things on his own, since otherwise, he would feel "out of humanity's grasp" (Nightingale, 1860). Nightingale added that if the patient can take care of themselves to do so because doing so will reduce their worry (Nightingale, 1860). Nightingale claims that human beings are social creatures (Nightingale, 1860).

Intelligent use of health care resources to improve patient health and wellbeing. It promotes efficiency, reduces employee turnover, and avoids wasteful spending dictated by a careful examination of how such an encompassing factor as the built environment could affect patient health outcomes. The healthcare resources are important contributors the o healthcare effectiveness of this study if not well utilized play a role in the transmission of selected infections: Klebsiella species in NICU. The presence of such an infection negatively impacts on the health of neonates admitted to the NICUs. Various aspects of the physical setting make a difference, however, health facility design decisions would continue to be made based on untested propositions. The healthcare environment was taken to include anything that could affect the patient.

Health in this study means the physical and emotional well-being of nurses working with neonatal patients admitted to the NICU where nurses have to promote health by ensuring that all hospital-acquired infections are prevented. Health is implied as a means of unity and integrity where the ultimate goal of nursing was to promote and maintain health.

2.6.4 Nursing

Nightingale's idea includes nursing since she said that nurses could "place the patient in the best condition for nature to act upon him" (Nightingale, 1860). According to Nightingale (1860), "nearly every woman is a nurse" since anyone who has been in charge of another person's personal health has held the role of a nurse. Nightingale

(1860) added, "It seemed quite immeasurable, the benefit that would undoubtedly come from such sound and attentive observation in that almost neglected field of nursing, or the support it would offer to the medical man," to her explanation of why the nurse was essential. The art of nursing, as it is currently practiced, "looks expressly constituted to unmake what God had made," according to Nightingale (1860).

Nightingale's theory still applies to nurses working in hospitals today where, for example, there is a need to always have a window in the room to let sunlight in. Natural sunlight might decrease the amount of stress, anxiety, and perception of pain felt by patients, it might even go as far as decreasing the amount of time in hospitals (Agency for Healthcare Research and Quality, 2014). In addition, the cleanliness of the hospital units was of the utmost importance. In hospitals today, every room is thoroughly cleaned and bedsheets are removed and replaced with clean ones before the next patient is brought in as an effort to try and control hospital-acquired infections. Without this thorough cleaning, patients may develop HAIs more frequently (Agency for Healthcare Research and Quality, 2014).

Additionally, proper ventilation was crucial for a patient's rehabilitation because it lessens the signs and symptoms of illnesses brought on by specific airborne disease-producing organisms (Agency for Healthcare Research and Quality, 2014). One way to provide adequate ventilation is to open a window unless contraindicated and make sure the maintenance of building was maintained and the filters were cleaned.

One problem that might arise from inadequate ventilation in a hospital or any building is a sick-building syndrome (Agency for Healthcare Research and Quality, 2014). Dizziness, headaches, a cough, difficulty concentrating, weariness, and other signs and symptoms are just a few of the ones that sick building syndrome can cause. Nightingale's concept of warmth is still used today, despite the fact that hospitals are typically frigid. Unless it is contraindicated, patients who are cold are typically given a heated blanket from a blanket warmer.

In this study, nursing was referred to as a healthcare profession with functions that include activities and tasks that promote the health of people, families, groups, and society as a whole could be described as the dimension that makes up the heart of the nursing universe. In this study, nursing roles include adherence to infection control measures aimed at the prevention of HAI to promote the well-being of neonates who

are admitted to the NICUs. This was accomplished using specialized nursing knowledge that was learned through formal schooling and then applied in nursing care facilities.

2.7 CONCLUSION

In this chapter, the relevant literature was reviewed and presented accordingly. The literature review chapter discussed factors contributing to Klebsiella infections in NICUs, sources of literature and search strategy and literature associated with factors that contribute to the transmission of selected infections: Klebsiella species in NICU at TMRH. The literature review included clinical manifestations of Klebsiella pneumonia, the risk of transmission of HAI, lack of staff empowerment, inadequate infrastructure, and hand hygiene. The chapter also discussed the theoretical framework of this study as grounded on the 1860 nursing methods that incorporated Nightingale's theory of environment. The research methods employed in this study, validity, reliability, and ethical issues are all covered in Chapter 3.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This study seeks to collect numerical data on the parameters influencing the transmission of particular infections, including Klebsiella species in the NICU at TMRH in Gauteng Province, South Africa, a quantitative research approach was adopted in this study. To accomplish its goal, the study employed a cross-sectional descriptive design and a quantitative research methodology. This chapter will discuss the research design, methods, population, sampling, data collecting, and analysis for the study, as well as the ethical issues. The study site was at Ekurhuleni Municipality, TMRH, Gauteng Province, South Africa.

3.2 RESEARCH METHODS

The research methodology employed in this study will be discussed in detail in the subheadings below:

3.2.1 Research approach

Quantitative research is a formal approach that uses numbers, land and logic to collect quantitative data on the parameters influencing the spread of specific infections, including Klebsiella species in the NICU at TMRH in Gauteng Province, South Africa. The researcher employed a quantitative research approach. To accomplish its goal, the study adopted a quantitative research strategy and a cross-sectional descriptive design. The demographic, sampling, data collection, data analysis, and ethical considerations for the study will all be covered in this chapter (Burns & Groove, 2011). This approach is utilized as a sample for a larger population (DeFranzo, 2011). Moreover, the researcher utilized quantitative research approach to sample results regarding factors contributing to the transmission of selected infections: Klebsiella species in NICU at TMRH, Gauteng Province, South Africa.

3.2.2 Research design

Grove and Burns (2010) a plan for carrying out a study with the most amount of control over variables that could undermine the validity of the results. The research design was concerned with what the researcher intended to explore as well as the methods that would be used for data collecting and analysis (Barbie, 2010). A cross-sectional

descriptive study design was selected for this investigation. A cross-sectional survey is a design in which a study is conducted at a specific point in time and information is collected from all respondents simultaneously (Brir , van der Walt & van Rensburg, 2018). There is no variable manipulation in a descriptive study, which seeks to learn more about the characteristics of a given topic of study (Burns, Grove & Gray, 2015).

3.2.3 Study site

The study was conducted at Ekurhuleni Municipality, Thelle Mogoerane Regional Hospital in Gauteng Province, South Africa. The study was conducted in a 76 -bedded NICU in TMRH.

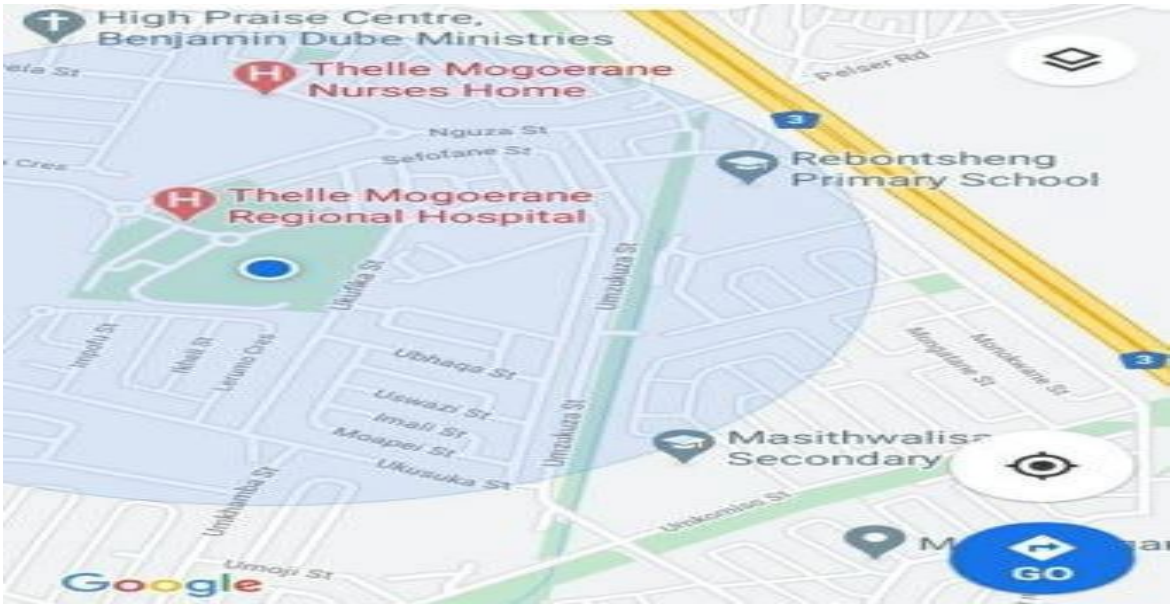

Figure 2: Thelle Mogoerane Reginal Hospital Map

3.2.4 Population and sampling

Burns and Grove (2011) defines population as part of respondents who meet the benchmark of the study. The number of respondents who showed attentiveness. Thus, the total population was 70 nursing personnel working in NICU. The population that was used includes all nurses who are employed full-time in NICU, the total population of nurses working at TMRH is 853 and the target population of the nurses working in NICU was 70 which include 1 operational manager, 28 professional nurses, 11 enrolled nurses, and 30 enrolled nursing assistants, therefore the total target number of a population was 70 respondents. Polit and Beck, (2012) postulates that sampling is a portion of a great population, who serve as representatives. A simple random

sampling method was used in this study to obtain information from the respondents. According to De Vos, Strydom, Fouche, and Delport (2011), simple random sampling was defined as a type of sampling method where each individual in the population theoretically has an equal opportunity to take part as a sample. Moreover, the process is fair to the respondents as they are given an equivalent opportunity to be part of the study.

- *Sample size and sampling technique*

A sample is a subsection of the population carefully chosen to participate in a research study through a sampling technique (Polit & Beck 2022). Slovin's formula was used to establish a sample size of 60 from the total population of 70 nurses in this study. The researcher used Slovin's formula to calculate the sample size as follows:

$$= \frac{\mathrm{N}}{1 + Ne^2}$$

$$n = \frac{70}{1 + 70 \times 0.05^2}$$

$$n = 60$$

- *Inclusion criteria*

All nursing staff personnel who are employed at TMRH and working in NICU, gave consent to participate in the study and were on duty during data collection.

- *Exclusion criteria*

Nurses who were on annual leave and maternity leave or those who were not available during the data collection were excluded. Nurses, who did not give written consent, as well as those employed on a contract or locum basis, were also excluded from participating in the study.

3.3 PRE-TEST OF THE QUESTIONNAIRE

"Pre-test participants comprised subject-matter specialists who are skilled in questionnaire design. The surveys' face validity and content-related validity were both assessed by the experts. Prior to the primary investigation, the researcher was able to improve the questionnaire thanks to the pilot/piloting of the study (Brink et al., 2011).

A pre-test study was done with 12 nurses at Bertha Gxowa Hospital's NICU to determine whether the solutions to the questions would be effective in achieving the objectives of the study and this hospital was not part of the main study".

The purpose of the pilot study was to:

- Measure feasibility of the academic study.
- To pinpoint mistakes if there is, in the questionnaire and make them to be accurate before data collection
- Acquire information to evaluate the validity and reliability of the main study.
- Make sure the queries are clear and practical.
- Check to see if the respondents comprehended the questions and were able to provide respond to each one.
- Before the primary investigation, make sure that the ambiguity and vagueness of the questions might be corrected.
- Allow the researcher to make any required changes to the questionnaires before beginning the real data collection process.
- Make sure the questions address the study's purpose and objectives.
- To create a suitable measurement tool for the variables.

The results of the Pilot Study

Twelve respondents made up a portion of the pilot study. They belonged to various groups of nurses who were qualified to participate in the study and who had signed consent forms.

Table 1: Summary of pilot results

Gender	
Female	9(75%)
Male	3(25%)
Job title	
Operational managers	1(8%)
Nurses with a speciality	2(17%)

General nurse without speciality	8(67%)
Enrolled nurses	0(0%)
Enrolled nursing Auxillary	1(8%)
Years of experience	
1-2 years	7(58%)
3-5years	4(33%)
6-10years	1(8%)

Modification of the data collection tool

Typing errors in section B were corrected effectively and nearly all of the questions were straightforward, thus the responders were able to answer every one of them completely.

The questionnaires were fairly completed in 20 to 30 minutes by respondents, thus the length was left alone. All of the questions were answered, and the readability was good.

3.4 DATA COLLECTION

Data collection is defined as the gathering of information to address a research problem (Polit & Beck, 2012). For the purpose of gathering quantitative data, elements that contribute to the transmission of specific infections were identified and described using a self-developed 4-point Likert scale questionnaire: Klebsiella species in NICU at The MRH. The questionnaire was self-administered to participants and is written in English as all participants were nurses. It comprised 54 closed-ended questions in the following sections: Section A: Demographic details consisting of 7 questions; Section B: Material resources consisting of 19 questions; Section C: Staffing and workload consisting of 10 questions; Section D: Education and training consisting of 6 questions and Section E: Equipment consisting of 7 questions.

At TMRH's NICU, the researcher distributed 60 questionnaires to participants. The questionnaires were individually completed by the respondents in a private consulting room with no outside interruptions. However, the researcher was on hand in case more

clarification was required. The questionnaires took between 35 and 45 minutes to complete.

3.4.1 Preparation for data collection

The researcher submitted a request to conduct the study at the Gauteng Department of Health. Also, permission was granted by TMRH Acting Chief Executive Officer before actual data collection. The researcher met the operational manager in NICU to discuss the objectives, the entire aspect of the study, and how their organisations might benefit from the study. Furthermore, the researcher was advised to ensure that the data collection does not interfere with the planned patient care and other essential activities in the unit. The NICU manager was then informed of the dates and times of the data gathering.

After introducing herself, the researcher gave a detailed explanation of the study's aim, aims, purpose, and advantages. The respondents were gathered in an empty consultation space that was free of external distractions like noise. Before the respondents began filling out the surveys, ethical concerns including informed permission, confidentiality, anonymity, and respect were emphasised. Before the respondents filled out the questionnaire, they gave their informed consent.

3.4.2 Data collection process

"The researcher brought the data collection equipment to the neonatal unit. After that, questionnaires were distributed to the respondents, who had 35 to 45 minutes to complete them. This was done at lunchtime so as not to interfere with the operation's flawless operation. For the pilot group, it took longer to complete the questionnaires. After completion, the surveys were promptly collected. Because the researcher's role in the process was more that of a researcher than a nurse, she attempted to reduce bias by keeping a safe distance from the respondents as they completed the surveys. The researcher remained nearby, though, in case she needed to clarify anything.

3.5 DATA ANALYSIS

According to Brink et al., (2018In order to describe and understand the phenomena that those observations reflect, quantitative analysis is the numerical portrayal and manipulation of those observations. The researcher captured data on Microsoft Office Excel 2010 and later analyzed descriptively using the Statistical Package in Social

Sciences (SPSS) program version 28.0 with the assistance of the biostatistician statistician. Descriptive statistics in the form of frequency distributions of study variables and tables were obtained to describe the characteristics. Frequency distribution tables and percentages were also produced to identify the causes and to determine factors associated with the transmission of infections in NICUs. A total of fifty-five questionnaires were distributed and five respondents did not answer the questions, however, they signed the consent forms.

3.6 RELIABILITY AND VALIDITY OF THE STUDY

Validity and dependability serve as indicators of a research instrument's quality. According to Brink et al. (2018), an instrument's validity is demonstrated by how well it replicates the notion under investigation. While the consistency of this instrument's measurement is related to reliability.

3.6.1 Reliability

According to Brink et al, (2012), reliability is the ability of an instrument to produce consistent results when used repeatedly over time on the same subject. By examining and testing the questionnaires during the pre-testing, this study increased reliability. The primary goal of the pilot study was to allow the researcher to modify or improve the research instrument tool before beginning the official data-gathering procedure.

3.6.2 Validity

Validity is the extent to which an instrument achieves its intended purpose or the degree to which the findings of a study are reliable and sound. Validity also considers whether the instrument accurately measured the variables it was designed to (Creswell, 2013). The suitability and accuracy of the questionnaires were confirmed by a group of subject-matter experts who were consulted in the process.

3.6.2.1 Face validity

According to Brink et al. (2012), face validity means that the instrument appears to measure what it is supposed to measure. Giving the questionnaire to the supervisor and co-supervisor to assess its validity before administration helped to ensure face validity.

3.6.2.2 Content validity

Content validity refers to an assessment of how well the instrument represents all the components of the variable to be measured Brink, et al (2012). The content validity of questionnaires was ensured by doing an extensive review of the literature regarding the factors contributing to the transmission of selected infections of Klebsiella species to check if the instrument's content was aimed at achieving the study's objective. Senior degree students, university committee members, and the Turfloop Research Ethics Committee (TREC) assessed the questionnaire to ensure that its content was valid, and that any revisions were made in accordance with their suggestions.

3.7 ETHICAL CONSIDERATIONS

3.7.1 Ethical clearance

The University of Limpopo granted the study an ethical clearance to conduct the study in Turfloop Research Ethics Committee (TREC/131/2021: PG).

3.7.2 Permission to conduct the study

Most importantly, the Gauteng department of health gave the researcher permission to collect data from TMRH and the management of the hospital facility under study. Therefore, permission was also obtained from participants before the study was undertaken.

3.7.3 Informed consent

The ethical ideal of voluntary engagement and safeguarding subjects from harm is formalized by informed consent (Brink, et al 2018). According to Polity & Beck (2010), obtaining informed permission is a crucial step in ensuring the safety of study participants. The topic, aims, and objectives of the study were explained to the respondents, who were also advised of their right to resign from the study at any time without suffering repercussions. They were also made aware of the study's dangers and advantages. All participants in the study were informed what to do if they experienced any emotional or psychological distress as a result of participating. A counsellor would be suggested to them. Before willingly signing a consent form, respondents were fully informed.

3.7.4 Anonymity and Confidentiality

The respondents' anonymity was ensured by not including the respondents' names on the questionnaires (Polity & Beck 2018). This was done to make sure that the responses could not be linked with the identity of the respondents. Given that participants in the study must do so voluntarily, the researcher did not coerce respondents to take part. Information obtained from respondents is handled confidentially, and promises are made that it won't be made public unless the researcher wants to (Moule & Goodman 2014). The respondents' confidentiality was protected by keeping study details private from those who were not directly involved in it. Respondents filled out the questionnaire in a private space, and consent forms were signed and kept in a secure location to be destroyed five years after the study's conclusion. The respondents also had the option to decline to respond to any inquiries and to have the privacy of their information safeguarded (Brink

3.7.5 Right to self-determination

The right to self-determination will be maintained by informing the respondents that they have the right to refuse to participate or withdraw from the study at any time without being penalised.

3.7.6 The principle of beneficence and non-maleficence

Beneficence is an obligation to do no harm and maximize possible benefits (LoBiondo-Wood & Haber 2014). Given that respondents are expected to participate voluntarily in the study, the researcher did not coerce them into doing so. Information gathered from respondents is handled confidentially, and assurances are made that it won't be shared with anybody but the researcher (Moule & Goodman 2014). To protect the privacy of the respondents, information regarding the study was kept private from those who were not directly involved in it. Those who participated in the study completed the questionnaire in a confidential setting, and their signed consent forms were stored securely for five years before being destroyed. Additionally, the respondents have the option to decline any question and to have the privacy of their information safeguarded (Brink, 2018).

3.8 BIAS

Because participation in the study is voluntary, the researcher did not coerce the respondents. Information obtained from respondents is treated with confidentiality,

and promises are made that it won't be made public unless the researcher wants to (Moule & Goodman 2014). By keeping study details private from those who were not directly involved in it, the confidentiality of the respondents was protected. In a secure location, completed consent forms were kept under lock and key until they were destroyed five years after the study's conclusion by the respondents. The questionnaire was administered in a private room. Additionally, respondents had the option to decline to respond to any questions and to have the privacy of their information preserved (Brink, 2018). Thus, to ensure that there was no systematic bias in either group, the participation of respondents was chosen randomly using the fishbowl sampling technique. The researcher made sure that all respondents completed the same questionnaire and that it was clear what each question asked.

3.9 CONCLUSION

This chapter described the research approach, design, methods, and procedures followed in the study. A quantitative, cross-sectional design was used to investigate factors associated with the transmission of Klebsiella infections in the NICUs. The study population, sampling and sample size, inclusion and exclusion criteria, relevant data, collection methods, and process of data analysis were outlined. The principles of validity and reliability as well as the ethical principles that were taken into consideration during the research process were discussed and explained in detail. Chapter 4 discusses the presentation, interpretation, and discussion of findings.

CHAPTER 4

PRESENTATION, INTERPRETATION AND DISCUSSION OF FINDINGS

4.1 INTRODUCTION

In this chapter, data collected during the distribution and analysis of the structured questionnaires will be presented. Tables and graphs will be used to present the results. The university statistician assisted with data analysis using the computer programs SPSS version 28.0 and Microsoft Office Excel 2010. Study findings soughtto answer the objectives of the study which were:

- To identify contributing factors to the transmission of selected infections: Klebsiella species in the NICU at Thelle Mogoerane Regional Hospital.
- To describe contributing factors to the transmission of selected infections: Klebsiella species in the NICU at Thelle Mogoerane Regional Hospital.

The respondents signed the consent forms that were issued. The data collection for the study took place from the 15th of October 2021 to the 22nd of October 2021, where 60 structured questionnaires were issued to 60 NICU nurses and only 5 were returned unanswered.

4.2 PRESENTATION, INTERPRETATION AND DISCUSSION OF THE FINDINGS

The study questionnaire's sections A, B, C, D, and E results will be displayed in the form of graphs and tables. Section A of the questionnaire presents the demographic data which covered gender, age, marital status, race, educational qualification, job title and years of experience in NICU. Tables and graphs will be used to present the findings from research questionnaire parts A, B, C, D, and E.

SECTION A: DEMOGRAPHIC DATA

Section A presents the characteristics of respondents in the study to ascertain the sample inclusion criteria of Neonatal ICU Nurses in this study. Moreover, gender, age, marital status, race, qualification, educational qualification, and years of experience are presented. An overall depiction of the characteristics of respondents in the study

is provided. Thus, 55 nurses answered a structured open-ended questionnaire and met the inclusion criteria. The response rate was 88.7%.

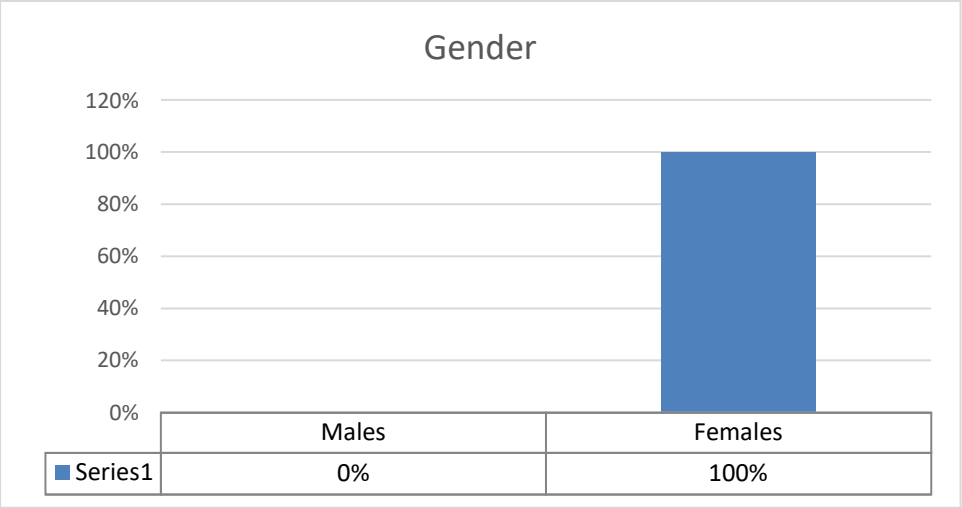

Figure 3: Gender of the respondents

The findings of the study showed that 55 (100%) of the respondents were females. This implies that the majority of NICU nurses are females because the nursing profession is predominantly female. The vast majority of them are mothers and have personal experience nurturing neonates. There were no male nurses in the NICU. It may be confirmed by this study that nursing remains a female-dominated confession and males may not have an interest in NICU. The study carried out in Korea by Koo and Lee supports the findings of this one (2021).

The educational needs for practicing neonatal intensive care nursing students whined out that males (20.7%) needed more neonatal nursing practice and active and direct involvement in neonatal nursing. The findings of a study conducted in North West province, South Africa, revealed the level of job satisfaction amongst nurses. There were 92.4% more female nurses than male nurses 7.6% (Sisinyana & Davhana-Maselesele, 2016). According to the study conducted by Staiger, Auerback and Buerhaus (2012) on the RN workforce. It was confirmed that men continue to be a minority in the nursing profession. Thus, it is also stated that through the efforts of Florence Nightingale in the mid-nineteenth century. Nursing was established as a women's profession (Hus, Chen & Lou, 2010). However, the study did not investigate

the role of gender in the determination of factors that contribute to Klebsiella infections in the NICU.

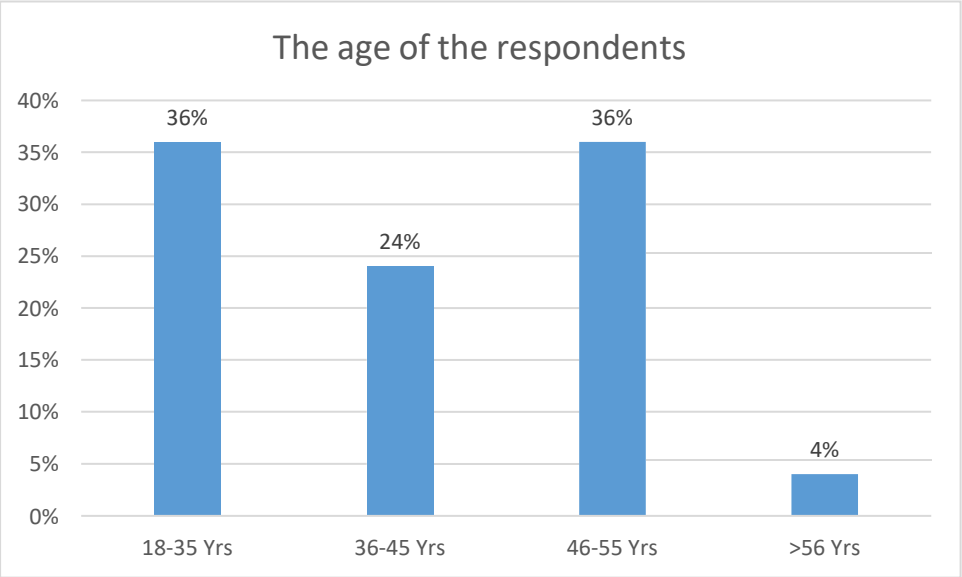

Figure 4: Age of the respondents

Figure 4.2.2 reflects that 20 (36%) of the NICU nurses were between the ages of 18-35 and 45-55 years respectively, 13 (24%) were aged 50-60 years and 2 (4%) were 56 years and above. This means that the majority of nurses are within the young age group and near retirement age with more middle age group than the old age group. Therefore, the age of the respondents requires that the hospital develops a succession plan in terms of the transferability of NICU skills and mentoring of the 36% age group between 18-36 years.

Figure 4.2.3: Marital status (n) =55

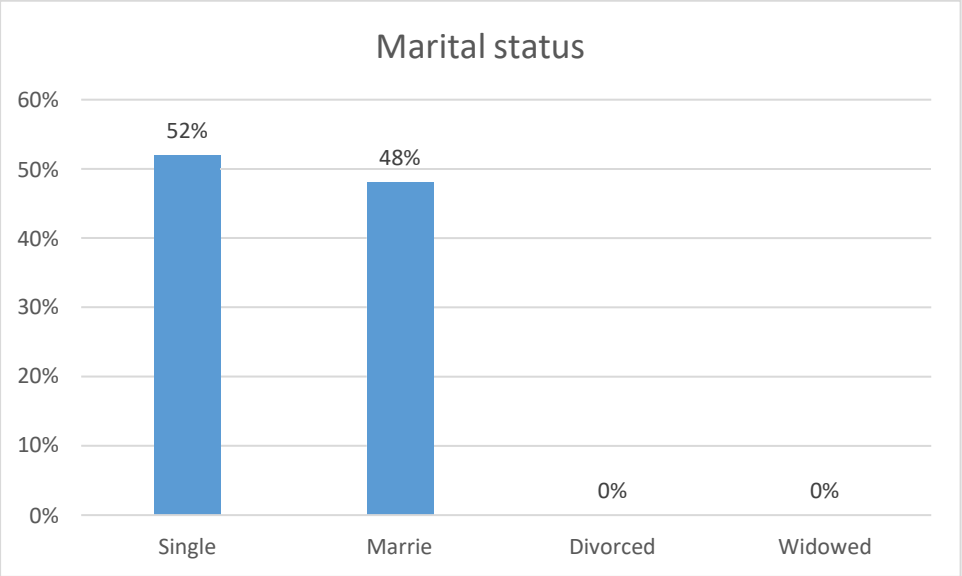

Figure 5: Marital status of the respondents

Marital status was studied to ensure that the sample represented all groups; for most nurses in NICU 29 (52%) were single and 26 (48%) were married, not divorced, and not widowed. However, the study did not focus on the impact of marital status on neonatal care. Furthermore, studies reviewed on marital status mainly discussed the impact of marital status on the maternal mental health of women having to take care of infants in the absence of their partners and the post-partum depression they have experienced. There was no study found on the impact of nurse marital status in the delivery of nursing actions in the units.

Figure 4.2.4: Race (n) =55

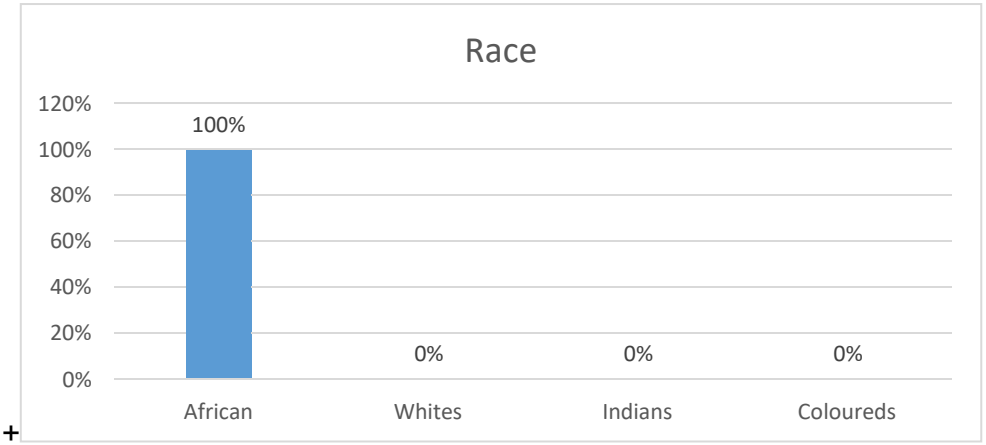

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Figure 6: Race of the respondents

This indicates that 55(100%) nurses in NICU were all black. This finding supports the demographic location of the hospitals and the large percentage of the population serviced by these hospitals. According to Miller, Serwint and Boss (2021), the racial element is important in enhancing clinicians-family relationships as a measure to support families and improve the success of patient and family-centered care in NICU. Miller, et al. (2021) confirmed that non-English families tend to experience strained relationships with staff based on race and the implicit biases it has on medicine.

Figure 4.2.5: Educational qualifications

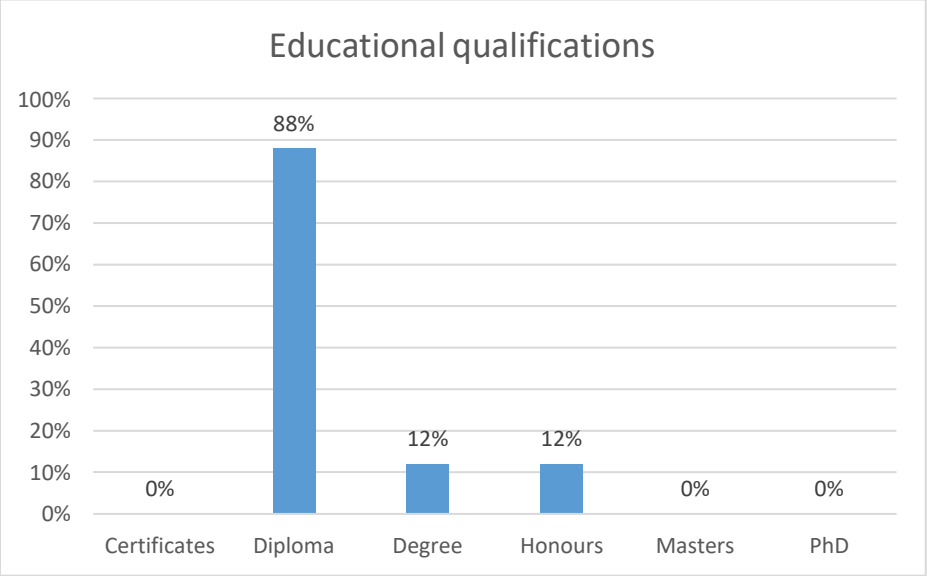

Figure 7: Educational qualification of the respondents

Figure 4.2.5 reflected that 48 (88%) of the respondents in this study had diplomas, and 7 (12%) had higher education qualifications, that is Honours and degrees in Nursing Science. This implies that respondents of this study had the required knowledge and skills to deliver quality nursing care to neonates in ICU. It is further deduced that most of the respondents were from nursing colleges and fewer graduates are from universities. This finding is probably because colleges have higher quotas than Universities in terms of student intake. However, the fact that professional nurseswith a Diploma in Nursing get a monthly stipend during their training and are exempt from paying tuition fees, as opposed to university nursing students, who must pay fortheir education and are therefore more likely to hold this credential. The stipend can be used to cover the costs of necessities like books and suitable uniforms. As a result,the post-graduate study is encouraged so that nurses may care for patients with professional knowledge.

In addition to this, Melati, Utomo, Arif, Etika, Puspitasari and Aden (2022) indicated that a 1:1 nurse-to-infant ratio among neonatal intensive qualified nurses in NICU is required. It implies that the level of knowledge acquired through formal education is important in the management of neonates in NICUs. Hence, Mahomed and Abd-Elmawgood (2021) recommended that additional regular training and workshops on infection prevention and control guidelines have to be organised for nurses and health team members in NICU.

Figure 4.2.6: Years of experience in NICU

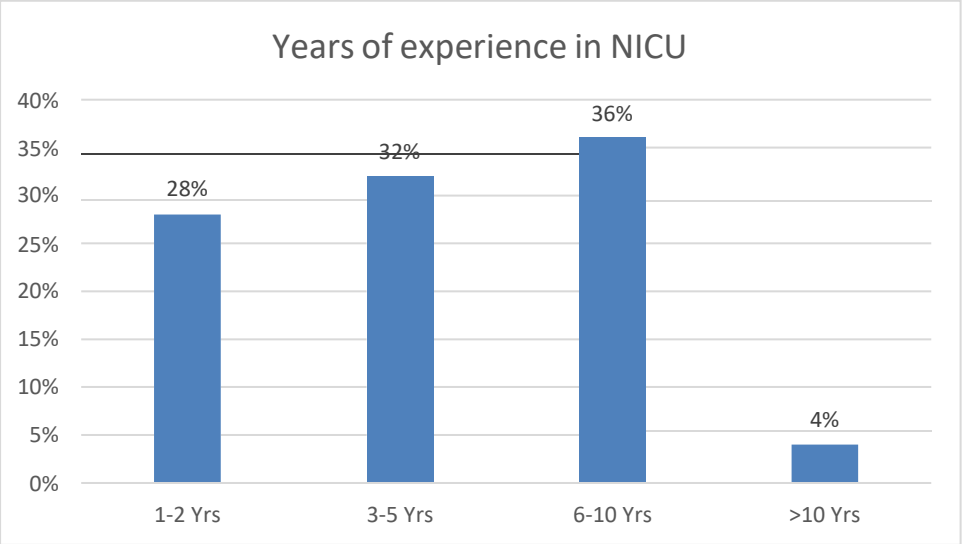

Figure 8: Years of experience in NICU

Figure 4.2.6 illustrated that 19 (36%) NICU nurses had 6 to 10 years of experience, followed by 17 (32%) with 3 to 5 work experience, 15 (28%) of the respondents were inexperienced with 1-2 years of work experience and mentors or experienced with more than ten years of service were the least at 4%. This implied that NICU experience is fairly spread across nurses in the NICU. A lesser percentage of the NICU nurses had vast experience in NICU, meaning that mentoring and skills sharing in NICU is possible because above half (68%) of these nurses are more experienced in NICU reasonable mentoring unlike the above a quarter (28%) which may need more effort to mentor and skills transfer. Furthermore, it indicates that the NICU had a balance of experience where the new nursing respondents had the support of the experienced staff to execute nursing activities within the unit.

This study's conclusions are reinforced by research was done by Fahim, et al. (2022) on klebsiella preventative strategies. Moreover, Fahim et al. (2022) found that knowledge, practice, and attitudes regarding the implementation of Klebsiella preventative strategies positively affected the rate of Klebsiella in neonates. This implies that experience in the management of Klebsiella is achieved through knowledge and continuous exposure to the NICU environment.

Furthermore, the study conducted by McHugh and Lake (2010) indicated that lower rates of prescription mistakes and patient falls were associated with higher proportions of nurses with more than 5 years of experience. It was also noted that factors like the knowledge and experience of individual nurses have an impact on the standard of care they deliver.

SECTION B: MATERIAL RESOURCES

Illustration of material resources required for infection containment and management in NICU.

Table 2: Material Resources

Hand hygiene				
	1	**2**	**3**	**4**
Is water service available:	**Never**	**Sometimes**	**Often**	**Always**
Always and in an enough quantity for all users	0	0	0	55 (100%)
Is there always, everywhere, and in all wards a trustworthy, safe drinking water station that staff, patients, and relatives can access?	0	0	0	55(100%)
For hand hygiene	0	0	0	55 (100%)
Personal hygiene	0	0	0	55 (100%)
Gloves	0	0	0	55(100%)
Paper towels	0	35(64%)	19(34%)	1(2%)
Soap	0	14(26%)	40(72%)	1(2%)
Hand hygiene station functioning well	0	0	0	55(100%)
Clean single-use hand are towels available	0	17(30%)	18(32%)	20(38%)
Alcohol-based hand rub solution or Hibi scrub soap is available	0	9(16%)	35(64%)	11(20%)
Cleaning				
Cleaning materials available such as detergent, soap and buckets	0	4(8%)	4(8%)	47(84%)

Cleaning purposes	0	0	0	55 (100%)
Decontamination	0	0	0	55 (100%)
Sterilization	0	0	0	55 (100%)
Laundry				
Laundry services	0	13(24%)	0	42(76%)
Bed linen	0	4(8%)	11(20%)	40(72%)
Invasive procedure items				
Suctioning catheters	0	0	14(26%)	41(74%)
Administrative sets	0	0	0	55(100%)

Table 4.1 illustrated material resources required for infection containment and management in NICU and outlined material resources such as hygiene, cleaning, laundry, and invasive procedure requirements. NICU should have sufficient material resources required in the management of any infection as a measure to combat and prevent the spread of infections such as Klebsiella. According to Okomo, et, al. (2020) in low-resource settings neonates is at risk of developing hospital-acquired infections due to poor clinical care practices. In this study, material resources required in the management of infections in NICU, especially, during the Klebsiella outbreak focus on hand, hygiene, cleanliness, procedures involved with cleaning, and invasive procedures carried out on neonates.

The results indicate that 55 (100%) of nurses in the NICU agreed that water is always available for hand hygiene, personal hygiene, sterilization, decontamination, and cleaning purposes. In addition, agreed that water is safe for drinking water station present and accessible for staff, patients, and families at all times and in all locations/wards and hand hygiene is functional. However, regarding other material resources' availability on hand hygiene, there were response inconsistencies. The inconsistencies identified in the study results may need further investigation, looking

into the facts surrounding the availability of resources to other respondents and not to other respondents.

The study found that out of 55 NICU nurses 9(16%) and 52(64%) argued that alcohol-based hand rub solution or Hibi scrub soap is not always available and only 10(20%) agreed that alcohol-based hand rub solution or Hibi scrub soap is always available. However, the results are such that a certain 44 (80%) of the respondents are not satisfied with the availability of the other required material for hand hygiene and cleaning, except for water which is always available. Only 1 (2%) agreed that there is always paper towel and soap in the unit, whilst a total of 54 (98%) reported that paper towel and soap is not always available. The inconsistent unavailability of paper towels implies that IPC requirements are not adhered to and complied with. Hence, infection spread will continue to be an uncontrolled element within the NICU. This is also in contravention of the IPC framework, policy, and Standard Operating Procedures.

According to a Zambian, Advancing Newborn Healthcare Systems document of 2019, it was indicated that hand hygiene is key in preventing infection and the document further stated that there should be adequate paper towels at all times. In support of the finding on the non-availability of paper towels, Gammon, and Hunt (2019) stated that several studies were conducted on the utilization of hand drying measures and acknowledged paper towels as the most effective hand drying means and most effective as the bacteria is physically removed from hands as compared to jet and hot dryers which were found to be dispersing microbes. In addition to ensuring that hand hygiene protocol is adhered to, Masroor, Doll, Stephens and Bearman (2017) discovered that utilization of paper towels and hand rub agents can be used as a measure to monitor hand hygiene compliance, which would be difficult to ensure that hand hygiene protocol is complied with if the paper towel is inconsistently unavailable in the unit.

According to Nightingale’s theory of the environment if nurses modify patients' environment and ensure that proper equipment, the availability of handwashing equipment, laundry equipment and the water supply are available in the ward environment, this can help to prevent hospital-acquired infections thus restoring the patient to their usual health or bring patient recovery Nightingale believed that

providing a suitable environment was something important to make the difference in the recovery of patients, and in this perception emphasizes on the Environment theory.

The study showed that 55 (100%) of nurses in the NICU agreed that there is cleaning procedure is adhered to as evidenced by the availability of cleaning purposes, decontamination and sterilization, and above half 46 (84%) indicated that cleaning material is always available. However, 9 (16%) of the respondents disagreed that cleaning materials (detergent, soap, and buckets) are always available. Around 16% of the respondents disagreed with the availability of detergent, soap and buckets raising concerns in terms of ensuring that proper cleaning of the NICU floors, high dusting, isolation rooms cleaning and decontamination procedure is adhered to and compliance with the IPC framework, policies, and SOPs.

The findings of this study are by Nightingale‘s theory which indicates and addresses the provision of factors for maintaining an environment that is conducive to the promotion of healing and healthy living processes such as ventilation, cleaning, lighting, heat, noise, odours and feeding so that the recovering process is well facilitated. Thus, the availability of adequate detergents, soap, and buckets to ensure proper isolation room cleaning and decontamination procedures are resources needed to improve patient care in the NICUs.

The results reflected that 13(24%) of the respondents indicated that are sufficient, whilst 41(76%) agreed that laundry services are always sufficient. It is further deduced that 15 (28%) of the respondents were not satisfied with the availability of bed linen whereas 40(72%) agreed to the availability of bed linen. This implies that some shifts are covered in terms of the availability of laundry services. The inconsistencies in the availability of material resources pose a risk to the delivery of standard infection prevention and control protocol.

A study conducted by Mangochi, Tolhurst, Simpson, Kawaza, Chidziwisano, Feasey, Morse, and MacPherson, (2022), concluded that the shortage of material resources such as soap needs to be addressed to create an enabling environment for healthcare workers. In support of the availability of resources. Another study conducted in Nepal discovered that the infection on mattresses and incubators in the NICU was imperative. As the implementation of the protocol for incubators disinfection and

monitoring stopped the infection of Klebsiella (Cadot, Bruguière, Jumas-Bilak, Didelot, Masnou, de Barry, Cambone, Parer & Romano-Bertrand, 2019).

Invasive procedures and equipment such as catheters also need monitoring in the prevention and determination of infections in the NICU. The changing and utilization of the invasive lines (suction catheters, intravenous lines) on neonates have to be monitored according to Infection control protocols. In this study, 55 (100%) of the respondents stated that administrative sets are always available and 13 (26%) indicated that suction catheters are often available whilst 37 (74%) agreed that suction catheters are always available. A study conducted by Mohamed and Abd-Elmawgood (2021), revealed that discarding suction catheters immediately after use or replacing suction tubing after 6 hours is needed. Although a higher percentage agrees that suction catheters are available, the percentage that did not agree with the availability of suction catheters is a concern. Hence, the inconsistent availability of suction catheters and administration sets poses a risk in Klebsiella management strategies in NICU.

SECTION C: STAFFING AND WORKLOAD

Table 3: Staffing and Workload

STAFFING AND WORKLOAD	1	2	3	4
	Never	**Sometimes**	**Often**	**Always**
Absenteeism is a big problem in the neonatal intensive care unit	0	0	0	55(100%)
Are appropriate staffing levels assessed in your facility according to the patient workload using national standards or standard staffing needs assessment tools such as the WHO Workload indicators of staffing need method	49(88%)	2(4%)	2(4%)	2(4%)
Is an agreed (that is, WHO or national) ratio of health care workers to patients maintained across your facility	51(92%)	2(4%)	1(2%)	1(2%)
Is a system in place in your facility to act on the results of the staffing needs assessments when staffing levels are deemed to be too low	0	35(64%)	9(16%)	11(20%)
Working conditions in the neonatal intensive care unit are pleasant	0	3(6%)	11(20%)	41(74%)
NNICU is understaffed	1(2%)	1(2%)	7(12%)	46(84%)
I cannot cope with the workload	11(20%)	18(32%)	13(24%)	13(24%)
The numbers of nursing staff on night duty are enough for sufficient total patient care	51(92%)	2(4%)	1(2%)	1(2%)

The workload in NNICU is manageable	11(20%)	15(28%)	14(26%)	14(26%)
Nursing staff on duty always manage to cover all the work during day duty	31(66%)	10(20%)	6(10%)	2(4%)

Table 4.2 reflects that 100% of respondents agreed that absenteeism is always a big problem in the unit, whilst 84% of the respondents indicate that NICU is always understaffed and 74% indicates that the working condition in NICU is unpleasant. Above half 49 (88%) indicated that staffing levels are never assessed according to a patient workload, 51 (92%) stated that the number of night nursing staff is never sufficient for patient care and 51 (92%) indicated that the health worker's ratio to patients is never maintained. In the study conducted by Melati et, al (2022), it was discovered that the nurse-infant ratio of 1:1 is required for neonatal intensive care qualified nurses and 2:1 for the high decency unit. This implies that the hospital is not compliant with set norms and standards of NICU staffing.

According to Mudaly (2015), nursing absenteeism is a problem since it disrupts the daily schedule, overburdens the staff who are there, and continually reduces the standard of patient care. This nurse shortage will increase the nurse workload, which will lead to care being delayed or omitted and will result in increased infant mortality. Heavy workloads including a high-patient ratio, a subjective workload and an unmanageable workload are related to absenteeism. Respondents had a highly positive correlation. High-patient-ratio and unmanageable workloads have an impact on nurses' mental workload and affect their emotional and psychological well-being.

The study revealed that 46 (84%) of respondents agreed that there is understaffing in the unit. However, 9 (16%) felt that understaffing does occur not in a constant manner. Understaffing in a critical care area leads to unintended patient care outcomes. This is supported by the study conducted by Melati et, al. (2022) on the outbreak of Klebsiella, who found that understaffing is also a risk factor for increased infection rates and the occurrence of outbreaks in NICU. Furthermore, Melati, et, al. (2022) pointed out that the lack of an ideal nurse-infant ratio remains a challenge. A subjective workload measures the idea that only the nurse exactly knows how much work is necessary to meet the requirements (Mbombi, Mothiba, Malema & Malatji 2018).

Nightingale's theory, the human being is a member of nature and an individual whose natural defences are influenced by a healthy or unhealthy environment. Intelligent use of health care resources to increase efficiency, promote patient well-being, and lower employee turnover. Thus, to avoid wastage, opt for a thorough investigation of how a factor as broad as the built environment might have an impact on patient health

outcomes. Healthcare resources, including manpower, are important contributors to healthcare effectiveness. Thus, if the environment is not good to work in due to poor staffing this impact negatively on the care provided by nurses in the NICUs.

Table 4: Education and Training

EDUCATION AND TRAINING	1	2	3	4
	Never	Sometimes	Often	Always
Are there anyone qualified to lead IPC training (in IPC and/or infectious diseases)?	0	41(74%)	13(24%)	1(2%)
Are there additional or any extra non-IPC employees with the necessary skills to act as mentors and trainers (for instance, champions who are doctors or nurses on links)?	0	22(40%)	33(60%)	0
How frequently in your unit, do healthcare personnel undergo IPC training?	0	24(44%)	30(54%)	1(2%)
How frequently does your unit, do medical professionals undergo IPC training?	0	17(30%)	23(42%)	15(28%)
Are there periodic assessments of the efficiency of training initiatives (for instance, knowledge audits and checks on hand hygiene)?	0	19(34%)	14(26%)	22(40%)
Are there evaluations of training programs' success that are conducted regularly(such as knowledge audits and checks onhand hygiene, for instance)?	0	49(88%)	5(8%)	1(24%)

Table 4.3 illustrate that 60% of respondents indicate that there are IPC staff members receive continual training or education (for instance, by regularly attending conferences or courses). Therefore, 54% indicate that they often receive training regarding IPC in NICU. While 88% of respondents indicate that they are sometimes

offered on-going education for IPC. Although, IPC is crucial to all facets of providing clinical services, nurses must be acknowledged as the program's leaders and important members of the multidisciplinary team (Royal College of Nursing, 2014). In this study, the majority of respondents do not agree that training regarding IPC is always offered. This suggests that a lack of expertise in the application of IPC measures may be the root of the rising Klebsiella infection rate in NICUs. Thus, a knowledge deficit in the management of infections could be attributed to a lack of education and training. This suggests that there is a knowledge gap in the application of IPC procedures, which may be related to the reason for a surge in Klebsiella infection in the NICU. This shows a knowledge gap in the use of IPC protocols, which may be connected to the cause of an increase in Klebsiella infection in the NICU. This shows a knowledge gap in the use of IPC protocols, which may be connected to the cause of an increase in Klebsiella infection in the NICU. Triantafillou, Kopsidas, Kyriakousi, Zaoutis and Szymczak (2020) which revealed that a knowledge deficit is among the barriers to HAI prevention in NICU.

Healthcare workers possess the potential to contribute significantly to the implementation of AMS programs, but they still require further training (the National Healthcare System, 2014). This illustrates that are capable of contributing significantly to the implementation of AMS programs, but they require additional training. Hence, it is capable of contributing significantly to the implementation of AMS programs, but they require additional training (National Healthcare System, 2014). A total of 49 (88%) respondents indicated that ongoing development/training on IPC is sometimes offered. This implies that there is inconsistency in the will to improve IPC in the NICU at Thelle Mogoerane Regional Hospital. Training and development are key in the implementation of IPC programmes as research is conducted across the world with new strategies being discovered. In a study conducted on audit feedback and training sessions on IPC programmes, it was discovered that regular infection control training combined with feedback in the curriculum of healthcare professionals can improve the sustainability of infection control programs (Alrumi, Aghaakurdi, Habib, Abed and Böttcher, 2020).

Yu and Mann (2020) suggested that NICU training requires experiential learning, where a Virtual Reality simulation program supports the practical education of

nurses and nursing students having limited NICU experience. This implies that continuous education and training equip all categories involved in the NICU setup. Thus, ensuring that healthcare individuals are capable of implementing IPC policies and programs to achieve a positive outcome and prevent outbreaks of Klebsiella inclusive of other infections.

The Provincial Infectious Diseases Advisory Committee (2014) postulates that to reduce disease transmission, nurses must play a crucial part in implementing and adhering to an IPC program. This study showed that a nursing unit's pathogen prevalence can change depending on how well IPC principles are followed. A nurse's responsibility for an IPC program includes enhanced surveillance, hand hygiene compliance, standard and transmission-based measures, and environmental cleaning (CDC, 2014).

Nightingale's theory referred to a person as "multidimensional" and "a holistic being made up of biological, psychological, social, and spiritual elements". Thus nurses play an essential role in implementing IPC policies and programmes to achieve patient outcomes and prevent the outbreak of Klebsiella infections. The theory further stated that not everyone could become a nurse since there are unknown characteristics of a nurse, but the fact that nursing is a calling means that a nurse must be devoted to caring for patients in the NIC. Thus, not everyone could become a nurse since there are unknown characteristics of a nurse, but the fact that nursing is a calling means that a nurse must be devoted to caring for patients in the NIC. Indicating that a nursemust be determined in attending to patients in the NICUs to prevent infections at all costs to preserve life.

SECTION E: EQUIPMENT

Table 5: Equipment

EQUIPMENT	**1**	**2**	**3**	**4**
availability of equipment in good working condition	Never	Sometimes	Often	Always
Blood pressure apparatus	0	0	0	55 (100%)
Stethoscopes	0	0	0	55 (100%)

Suctioning apparatus	0	0	0	55 (100%)
Oxygen cylinders	0	2(4%)	5(8%)	49(88%)
Neonatal cribs	0	0	0	55 (100%)
Neonatal warmer	0	0	0	55 (100%)
Feeding catheters	0	2(4%)	7(12%)	46(84%)

Table 4.4 illustrated responses on the availability and functionality of the equipment. About 55 (100%) of the respondents agreed that blood pressure apparatus, stethoscopes, neonatal cribs and neonatal warmers and suctioning apparatus are available and functional. Although the majority 49 (88%) of the respondents agreed that there are always oxygen cylinders and feeding catheters, 7 (12%) and 9 (16%) showed inconsistencies in the responses about the availability and functionality of oxygen cylinders and feeding catheters respectively.

There is a need to focus on the inconsistencies in the availability and functionality of oxygen cylinders and feeding catheters. Monitoring and effective healthcare delivery are dependent on the availability and functionality of different equipment in the NICU. Utomo et. al. (2022) concluded that addressing human resources challenges cannot be sufficient to solve the problems of inappropriate care in the NICU. Furthermore, indicated that there is a need to also ensure that medical equipment maintenance, better technology and a better work environment are taken care of to increase the work productivity of NICU nurses (Utomo, et. al. 2022). In addition, to this finding, a great concern on the sharing of equipment such as oxygen cylinders become a risk incase of oxygen cylinder shortage in this regard, thereby increasing opportunities for infection spread in the NICU.

The inconsistencies in the availability of oxygen cylinders pose a risk to the emergency response of a neonate who needs oxygen. During a non-availability of equipment, it is possible that in response to emergency equipment is sharing between patients, whereby, for example, an oxygen cylinder that was utilized by an improving patient will be taken to respond to the emergency site non-availability of oxygen cylinders in hospitals is further confirmed by a study conducted by Demtse, Sebsibie, Godie,

Birhan, Nesru, Assefa, Teketel, Aragie, Anteneh, Mekuriya, Wari, Endale, Berihu, Habtamu, Alemayehu, Hirpha, Tessema, Dejen, Ketemaw and Molla (2020) on the clinical audit of NICU found that in some hospitals oxygen cylinders are not available in other NICU rooms. This poses a serious risk for the emerging need during resuscitation.

Nightingale's environmental theory focuses primarily on the environment, interpreted as all external conditions and influences that affect the life and development of an organism, that are content, suppress or contribute to disease and death (Medeiros, Enders & Lira, 2015). Thus, the lack of environmental resources utilized to improve patient ventilation like the oxygen cylinders will affect the normal health improvement of the patient's condition.

4.3 CONCLUSION

This chapter presented the data analysis, results, and interpretation of the findings of this study. The data, which was collected through a questionnaire from IPC guiding documents from the National Department of Health, IPC Committee and the available literature on Klebsiella management in NICU was used. A clear distinction was made between the responses from the questionnaire, and what the literature has revealed led to the explanations and reflections of the researcher. The data analysis on the structured questionnaire to answer the research, needed to determine the factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital. The overall conclusion from the data analysis is that the NICU nurses were knowledgeable regarding the NICU processes.

However, in terms of sections B to E of the questionnaire responses, there were challenges in terms of material resources requires to implement IPC protocol, staffing and workload, education and training on IPC and equipment. These challenges are associated with the factors contributing to the transmission of selected infections, especially, the Klebsiella species. It is, therefore, recommended that the Thelle Mogoerane Regional Hospital management ensure that material resources are available at all times, staffing and workload are allocated according to delegation

norms, standards capacitation of staff are achieved through continuous Continuing Professional Development through in-service training, workshops and hand hygiene campaigns and the availability of consumables and functional equipment as a measure to combat the transmission of infections in the NICU of TMRH.

CHAPTER 5

SUMMARY, LIMITATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

This section of the study presents the results summary, limitations, recommendations, and conclusions. This study aimed to determine the factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital.

Objectives of the study were:

- To identify contributing factors to the transmission of selected infections: Klebsiella species in the NICU at Thelle Mogoerane Regional Hospital.
- To describe contributing factors to the transmission of selected infections: Klebsiella species in the NICU at Thelle Mogoerane Regional Hospital.

5.2 SUMMARY

The descriptive cross-sectional quantitative approach was used to determine the factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital, Gauteng Province, South Africa. The study population included nursing personnel working in NICU employed at TMHR. Simple random sampling was used. Structured self-administered questionnaires were used to collect data. Questions were written in English. The researcher collected data and ensured privacy, confidentiality and bias were adhered to. Tables and graphs were used to display the data analysis and interpretation.

5.3 LIMITATIONS

The COVID-19 pandemic's global outbreak and dissemination changed timetables and the way this study was conducted. In this study, the researcher identified some limitations, whereby the study was conducted in one setting and one healthcare organization. The study was conducted at Thelle Mogoerane Regional Hospital in the Neonatal Intensive Care Unit and the results cannot be generalized to other hospitals and other units/wards. Some information could not be found and there could be other factors contributing to klebsiella infections in neonatal intensive care units other than

the ones identified in this study. Further, other hospitals should conduct a similar study to understand the factors contributing to the klebsiella infection outbreak.

5.4 RECOMMENDATIONS

The following recommendations are made for practice, education, and research:

5.4.1 Recommendations for practice

In partnership with the hospital hygiene department, an infection control program should be created that is in charge of overseeing and coordinating all infection control actions.

The unit infection control team should monitor and assess the application of the infection control program as well as professional nurses' use of infection control procedures every month, especially in NICUs.

The hospital infection control committee, which is in charge of overseeing the execution and compliance with the infection control program, shall also undertake monitoring and evaluation at least twice a year. The hospital infection control committee, which is in charge of overseeing the execution and compliance with the infection control program, shall also undertake monitoring and evaluation at least twice a year.

The most recent research should be incorporated into evidence-based infection prevention and control guidelines and policies once a year.

5.4.2 Recommendations for education

During their onboarding, all newly hired NICU staff members must be introduced to evidence-based infection prevention and control guidelines and regulations.

Through conversations, brainstorming sessions, demonstrations, formal lectures, or PowerPoint presentations, nurses in NICUs should receive monthly or quarterly ongoing in-service training and updates on current trends in practice related to the prevention of transmission of klebsiella infections.

Opportunities should be provided to professional nurses employed in the units to obtain specialised education in critical nursing science as the majority of participants have not specialized in critical nursing science.

The study recommends that hospital managements integrate IPC training into normal hospital programmes to ensure that all healthcare workers access it frequently. There is a need for regular training among healthcare workers about IPC to reduce the spread of transmission of infections.

The Department of Health should increase the intake of newly qualified professional nurses (community service nurses) in the unit to reduce the shortage of professional nurses. The Department of Health should recruit retired nurses to assist and reduce the shortage of nurses.

5.4.3 Recommendations for further research

The pre-post-test survey and educational intervention should be improved and tested by utilizing a variety of additional implementation techniques that were not feasible for the study.

A similar study regarding factors contributing to the transmission of the klebsiella infection outbreak should be carried out with a bigger sample size, considering other hospital services (such as female and surgical units, the burns unit, the theatre, and maternity units).

An epidemiological study on factors contributing to the transmission of klebsiella infection outbreak in ICUs in all hospitals of Gauteng is recommended. The research report is concluded in this chapter. There was a conclusion, a list of the study's restrictions, and suggestions for improvement.

5.5 CONCLUSION

The research report is concluded in this chapter. This conclusion has a list of the study's restrictions and suggestions for improvement. There were suggestions for future research, instruction, and practice. These can aid in the provision of high-quality care and improve patient outcomes, hence reducing the occurrence of infection outbreaks in the NICU. There were suggestions for future research, instruction, and practice. These can support the delivery of high-quality treatment and enhance patient outcomes, hence lowering the spread of infection outbreaks in the NICU.

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LIST OF ANNEXURES

ANNEXURE A: QUESTIONNAIRES FOR NURSES

SECTION A: DEMOGRAPHIC DETAILS

Please complete all the sections of the questionnaires by marking them with an 'X' in the appropriate block. Use a black pen to indicate your response in the block corresponding to your response in the requested information.

1. What is your gender?

Female	
Male	

2. What is your age group?

18-35	
36-45	
46-55	
56 and above	

3. What is your marital status?

Single	
Married	
Divorced	
Widowed	

4. What is your race group?

African	
Whites	
Indians /Asian	
Coloured	

5. What is your highest qualification?

Certificate	

Diploma	
Degree	
Honours	
Masters	
PhD	

6. What is your job title?

Operational Manager	
Professional Nurse with a Speciality	
Professional Nurse without Speciality	
Enrolled Nurse	
Enrolled Nursing Assistant	

7. Years of experience in NICU?

1 year -2 years	
3years -5years	
6years -10years	
> 10 years	

SECTION B: MATERIAL RESOURCES

Please indicate the availability of the following using the key below by marking with an 'X' in the appropriate block:

1-Never 2-Sometimes 3-Often 4-Always

	Is water service available:	N	S	O	A
1.	At all times and of sufficient quantity for all users	1	2	3	4
2.	For hand hygiene	1	2	3	4
3.	For personal hygiene	1	2	3	4
4.	Sterilization	1	2	3	4

5.	Decontamination	1	2	3	4
6.	Cleaning purposes	1	2	3	4
7.	Laundry services	1	2	3	4
8.	Is a reliable, safe drinking water station present and accessible for staff, patients, and families at all times and in all locations/ wards	1	2	3	4
9.	The hand hygiene station function well	1	2	3	4
10.	Clean single-use hand towels are available	1	2	3	4
11.	Alcohol-based hand rub solution or Hibi scrub soap is available	1	2	3	4
12.	Is cleaning materials available such as detergent, soap and buckets	1	2	3	4
13.	Is clean bed linen available	1	2	3	4
14.	Are sterile and unsterile gloves available	1	2	3	4
15.	Are paper towels available	1	2	3	4
16.	Is suctioning catheters available	1	2	3	4
17.	Are administrative sets available	1	2	3	4
18.	Are all sizes of endotracheal tubes available	1	2	3	4

SECTION C: STAFFING AND WORKLOAD

Please indicate your opinion on the following statements, using the key below by marking with an ‘X’ in the appropriate block:

1-Never 2-Sometimes 3-Often 4-Always

1.	Absenteeism is a big problem in the neonatal intensive care unit	1	2	3	4

2.	Are appropriate staffing levels assessed in your facility according to patient workload using national standards or standard staffing needs assessment tools such as the WHO Workload indicators of staffing need method	1	2	3	4
3.	Is an agreed (that is, WHO or national) ratio of health care workers to patients maintained across your facility	1	2	3	4
4.	Is a system in place in your facility to act on the results of the staffing needs assessments when staffing levels are deemed to be too low	1	2	3	4
5.	Working conditions in the neonatal intensive care unit are pleasant	1	2	3	4
6.	NICU is understaffed	1	2	3	4
7.	I cannot cope with the workload	1	2	3	4
8.	The number of nursing staff on night duty is enough for sufficient total patient care	1	2	3	4
9.	The workload in NNICU is manageable	1	2	3	4
10.	Nursing staff on duty always manage to cover all the work during day duty	1	2	3	4

SECTION D: EDUCATION AND TRAINING

Please indicate your opinion on the following statements, using the key below by marking with an 'X' in the appropriate block:

1-Never 2-Sometimes 3-Often 4-Always

1.	Are there personnel with IPC expertise (in IPC and/or infectious diseases) to lead IPC training?	1	2	3	4

2.	Are there additional non-IPC personnel with adequate skills to serve as trainers and mentors (for example, link nurses or doctors, champions)?	1	2	3	4
3.	How frequently do healthcare workers receive training regarding IPC in your unit?	1	2	3	4
4.	How frequently do cleaners and other personnel directly involved in total patient care receive IPC training in your facility?	1	2	3	4
5.	Are there periodic evaluations of the effectiveness of training programmes (for example, hand hygiene audits, and other checks on knowledge)?	1	2	3	4
6.	Is ongoing development/education offered for IPC staff (for example, by regularly attending conferences, and courses)?	1	2	3	4

SECTION E: EQUIPMENT

Please indicate the availability of the following equipment in good working condition using the key below by marking with an ‘X’ in the appropriate block:

1-Never 2- Sometimes 3- Often 4- Always

1.	Blood pressure apparatus	1	2	3	4
2.	Stethoscopes	1	2	3	4
3.	Suctioning apparatus	1	2	3	4
4.	Oxygen cylinders	1	2	3	4
5.	Neonatal cribs	1	2	3	4
6.	Neonatal warmers	1	2	3	4
7.	Feeding catheters	1	2	3	4

ANNEXURE B: LETTER REQUESTING PERMISSION TO CONDUCT THE STUDY

UNIVERSITY OF LIMPOPO

DEPARTMENT OF NURSING

PRIVATE BAG X 1106

SOVENGA

0727

GAUTENG DEPARTMENT OF HEALTH

PRIVATE BAG X 085

MARSHALL TOWN

2107

Dear Sir/Madam

Request for Permission to Conduct Research Study on **FACTORS CONTRIBUTING TO TRANSMISSION OF SELECTED INFECTIONS: KLEBSIELLA SPECIES IN A NEONATAL INTENSIVE CARE UNIT AT THELLE MOGOERANE REGIONAL HOSPITAL.**

I, **Mothapo Mmatsie Rahab** request permission to conduct the study at Thelle Mogoerane Regional Hospital, Gauteng Province. I am currently studying research for a Master of Nursing Science at the University of Limpopo and my performance task is to conduct the study on 'factors contributing to the transmission of selected infections: Klebsiella species in a Neonatal Intensive Care Unit at Thelle Mogoerane Regional Hospital, Gauteng Province, South Africa.

The study has been ethically approved by the University of Limpopo Turfloop Research Ethics Committee. The target group of the study is nurses in NICU. Participation in the study will be voluntary. If the approval is granted, the study will not take longer than 2 years. The data/ results of the study will remain confidential and be used for educational purposes.

Your approval to conduct this study will be appreciated.

The researcher: Ms M R Mothapo

Contact details:

Cell phone no. 078 5638 375

Email address: mmatsierahabmothapo1@gmail.com

Approved by…….

Date ……

ANNEXURE C: ETHICAL CLEARANCE CERTIFICATE

University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING: 26 September 2022

PROJECT NUMBER: TREC/131/2021:PG-Amended

PROJECT:

Title: Factors contributing to transmission of Klebsiella infections outbreak in neonatal intensive care unit at Thelle Mogoerane regional hospital Gauteng province.
Researcher: MR Mothapo
Supervisor: Mr TA Phukubye
Co-Supervisor/s: Dr TE Mutshatshi
School: Health Care Sciences
Degree: Master of Nursing Sciences

PROF D MAPOSA
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.
ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.
iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

Finding solutions for Africa

ANNEXURE D: PERMISSION LETTER FROM BERTHA GXOWA HOSPITAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

ENQUIRIES
Office of the CEO
M | 083 293 1084
T | 011 278 7669
E| Zodwa.Mofokeng@gauteng.gov.za

Date: 07th October 2021

Dear Ms. MR Mothapo

Study Title: Factors Contributing to Transmission of Klebsiella Infections Outbreak in a Neonatal Intensive Care Unit at Bertha Gxowa Hospital, Gauteng Province.

Permission is granted for you to conduct the above-mentioned study as described in your request provided:

- Bertha Gxowa Hospital will not anyway incur or inherit costs as result of the said study.
- Your study shall not disrupt services at the study sites.
- Strict confidentiality shall be observed at all times.
- Informed consent shall be solicited from patients participating in your study.

Please liase with the HOD and Unit Manager in charge of the Department on the agreed dates and time that would suits all parties.

Kindly forward this office with the results of your study on completion of the research.

Approved/ not Approved

Mrs. ZPN. Mofokeng.
Acting CEO, Bertha Gxowa Hospital
Date: 2021/10/07

BERTHA GXOWA HOSPITAL
Chief Executive Officer
2021 -10- 07
GERMISTON 1400
BERTHA GXOWA HOSPITAL

BERTHA GXOWA HOSPITAL
Angus Street, Germiston, 1401
T | 011 278 7600

ANNEXURE E: PERMISSION LETTER FROM THELLE MOGOERANE HOSPITAL

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries: P/N Mabizela/P/N L. Mogoai
Directorate: Staff Development
Telephone number: (011) 8917109
Email: Thandiwe. Mabizela @gauteng.gov.za

18 February 2022

Ms Mmatsie Rahab Mothapo

Thelle Mogoerane Regional Hospital Management Team is pleased to grant you permission to conduct your research on **Factors Contributing to Transmission of Kleibsiella Infection Outbreak in a Neonatal Intensive Care unit at Thelle Mogoerane Regional Hospital . Your** data will be conducted through obtaining information through **"Prospective data collection'** 'in your protocol for which you will obtain the ethics clearance certificate from Witwatersrand University

The following condition must be adhered to:

- Once the research is finalized the results and recommendations of the research should be submitted to Staff development Department.

Dr M.M.Malaka
Chief Executive Officer
Thelle Mogoerane Regional Hospital
Date: 21.02.2022

"To be the best provider of quality health care services to the people of Gauteng"

ANNEXURE F: EDITING CERTIFICATE

Mothapo Matsie Rahab
University of Limpopo
Sovenga
O727

Unit C Mankweng 0727
081 5666 755
rightmovemultimedia@gmail.com
Researcheditors882@gmail.com
karabokonyani@gmail.com

28 November 2022

TO WHOM IT MAY CONCERN

This editing certificate verifies that this research proposal was professionally edited for Ms Mothapo M.R (200800753)

Thus, it is meant to acknowledge that I, Mrs K.L Malatji a professional Editor under a registered company Right Move Multimedia, have meticulously edited the proposal from the University of Limpopo. Title: " FACTORS CONTRIBUTING TO TRANSMISSION OF SELECTED INFECTIONS: KLEBSIELLA SPECIES IN NEONATAL INTENSIVE CARE UNIT AT THELLE MOGOERANE REGIONAL HOSPITAL, GAUTENG PROVINCE, SOUTH AFRICA".

Sincerely,
Mrs K. L Malatji

ANNEXTURE G: DIGITAL RECEIPT

turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

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FACTORS CONTRIBUTING TO TRANSMISSION OF SELECTED INFECTIONS: KLEBSIELLA SPECIES IN NEONATAL INTENSIVE CARE UNIT AT THELLE MOGOERANE REGIONAL HOSPITAL, GAUTENG PROVINCE, SOUTH AFRICA

By

MOTHAPO MMATSIE RAHAB

DISSERTATION

Submitted in fulfilment of the requirements for the degree of

MASTER OF NURSING

In the

FACULTY OF HEALTH SCIENCES

(School of Health Care Sciences)

At the

UNIVERSITY OF LIMPOPO

SUPERVISOR: Dr T A Phaladze

CO-SUPERVISOR: Dr T C Mamabolo