NURSES' ROLE IN MECHANICAL VENTILATION MANAGEMENT IN NEONATAL INTENSIVE CARE UNITS IN ACADEMIC TERTIARY CARE

Tsholofelo Petronella Matlhola

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DECLARATION

I, Tsholofelo Petronella Matlhola, declare this research report is my own work. It is being submitted for the degree of Master of Science (in Nursing) at the University of the Witwatersrand, Johannesburg. It has not previously been submitted for any degree or examination at this or any other university.

Signature: 

Signed at Johannesburg

On the …5th ……day of October…… 2020

Protocol Number: M180920

DEDICATION

I dedicate this research report to my God Almighty for making it all possible. To my late grandparents, Malenki and Rev. Ben Maseko, who were my constant voice of reason, humility and confidants during my studies. I wish they were here to witness the fruits of their prayers, encouragement and tireless fighting spirit for me throughout my studies, may their souls rest in peace.

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ABSTRACT

Background: Despite the key role nurses play in mechanical ventilation management process and coordinating care of their patients in intensive care units alongside doctors, little remains known about the role of NICU nurses in mechanical ventilation. The lack of literature in South African NICU settings, demonstrate evidence that the role of NICU nurses in mechanical ventilation management remains unclearly defined. Therefore, there is a need to gather current evidence to facilitate clarity on this role.

Purpose: The purpose of the study was to describe the role of neonatal nurses in the mechanical ventilation management process in neonatal intensive care units of two tertiary academic hospitals.

Methods: A quantitative, descriptive and cross sectional survey design was used to meet the objectives of the study to describe the NICU nurses role in ventilation management. The final sample comprised 90 (out of 108) respondents, which yielded a response rate of 83.3% for the study.

Results: Of the 108 surveys distributed, 90 were returned (response rate 83.3%). Ninety-seven percent stated that a 1:2 ratio was used for patients receiving mechanical ventilation. Only about 17% percent reported ventilation education for nurses was provided during ICU orientation, and indicated that NICUs had not provided opportunities for on-going ventilation education. Thirty-six percent stated that weaning protocols and protocols for weaning failure were present in ICUs, respectively. This study showed a small percentage of nursing autonomous input made in key ventilator decisions. The majority (66%) nurses in this study agreed that responsibility for ventilation decisions lies at the level of senior registrars and above, and in their absence, all NICU nurses (51%) were perceived to be responsible for key ventilator decisions.

Regarding independent titrations of ventilator settings, without medical consultation, findings showed that nurses in this study reported a frequency of >50% of the time for titration of fraction of inspired oxygen. Nurses with higher levels of autonomy, influence in decision making and years of experience scores, frequently (>50% of the time) made independent changes to ventilation settings ($p<0.05$), with contrast, nurses with fewer years of experience scores, infrequently (<50% of the time) made independent changes to ventilation settings without first checking with the doctor.

The study concludes that nurses should strengthen their input in collaboration of key ventilator decisions and the multidisciplinary team could help nurses to re-evaluate their role in ventilation management. Recommendations are made for clinical practice and education of nurses.

Key words: Neonatal Nurses, Roles, Mechanical ventilation management, Neonatal intensive care unit.

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LIST OF ABBREVIATIONS

AC	Assisted Control
BWAP	Burns Wean Assessment Program
FiO2	Fraction of inspired Oxygen
MAS	Meconium Aspiration Syndrome
NICU	Neonatal Intensive Care Unit
PaO2	Partial Pressure of Oxygen
PICU	Paediatric Intensive Care Unit
PPHN	Persistent Pulmonary Hypertension in Neonates
PEEP	Positive end expiratory pressure
SANC	South African Nursing Council
SBT	Spontaneous Breathing Trial
SIMV	Simultaneous Intermittent Mandatory Ventilation
TCPL	Time-Cycle Pressure limited

CHAPTER ONE

OVERVIEW OF THE STUDY

1.0 INTRODUCTION

In this chapter, an overview of the study will be presented. The chapter incorporates an introduction to the study, background information for the research problem, research purpose, research objectives and significance of the study, definition of key terms and theoretical assumptions. A brief overview of the research methods, ethical considerations and the validity and reliability of the study will be described.

Mechanical ventilation is the most commonly used lifesaving intervention in Neonatal Intensive Care Units (NICU). It is indicated to sustain life for neonates who suffer from inadequate spontaneous ventilation secondary to various medical conditions, such as acute respiratory failure, sepsis or neurological problems (Mustaf *et al*., 2019; Biban *et al*., 2013). In addition to treating respiratory insufficiency, mechanical ventilation is also necessary in managing other serious neonatal conditions, such as persistent pulmonary hypertension, meconium aspiration syndrome and apnoea of prematurity; it also offers cardiovascular system support post-operatively (Hockenberry and Wilson, 2015).

A European study on the roles of Intensive Care nurses revealed that nurses and physicians identified coordinating the diagnosis, treatment and care of their patients as a key role, with nurses having a critical role in managing mechanical ventilation and the weaning process. The findings showed that a large percentage (63% to 88%) of decisions were made by nurses in collaboration with physicians, and 40% to 68% ventilation adjustments were performed by nurses independent of physicians (Haugdahl *et al.,* 2013; Rose *et al*., 2011; Solberg, Hansen and Bjork, 2014). In addition, the findings highlighted that optimal patient outcomes were impacted by effective teamwork among the multidisciplinary team, particularly between the nurses and physicians. Full knowledge and understanding of each professional's role facilitated effective and efficient care of the patient on mechanical ventilation (Haugdahl, 2016).

1.1 BACKGROUND OF THE STUDY

Nurses practicing in the Neonatal Intensive Care Unit have a primary responsibility to provide optimal efficient care to their patients. This provision of care requires knowledge of one's role in the multidisciplinary team with regard to decision making during treatment procedures, such as mechanical ventilation management including weaning. Despite the key role nurses play in the mechanical ventilation management process and coordinating care of their patients in Intensive Care Units alongside doctors, little is known about the role of NICU nurses in mechanical ventilation. The lack of literature in South African NICU settings, demonstrates that the role of NICU nurses in mechanical ventilation management remains undefined. Therefore, there is a need to gather current evidence to facilitate clarity on this role.

Neonates are a special and vulnerable population, in that their first 28 days of life represent a crucial time for their survival. Previous statistics indicate that neonatal deaths accounted for 45% of deaths among children under the age of five (5) globally, as this is one of the indicators of a country's health status, such findings should raise concerns. Some of the causes of these deaths are believed to be preventable with optimal care (Oza *et al*., 2015). Therefore, it is important to seek various ways to improve quality of care rendered to this vulnerable population through efficient interventions, particularly in NICU settings where mechanically ventilated neonates are exposed to risks of nosocomial infections, amongst other complications (Miller and Carlo, 2008).

Although mechanical ventilation, a life-saving form of treatment, has over the years proven to reduce infant mortality, if misused it leads to increased morbidities. Over ventilation causes lung injury (barotrauma), which leads to prolonged NICU stay and increased risk for developing nosocomial infections, such as ventilator associated pneumonia (Miller and Carlo, 2008). Prolonged mechanical ventilation, "mechanical ventilation for more than 3 days" (McLean, 2006: 299), may result in haemodynamic impairment, volutrauma, analgosedative dependancy and morbidities such as bronchopulmonary dysplasia (BPD), atelectasis, retinopathy of prematurity (ROP) and pneumonia (Rivera and Tibballs, 1992 as cited in Njolomole, 2014, Nanou, *et al*., 2015). Therefore, the goal of treatment and the most important step to recovery is weaning the neonate off mechanical ventilation as soon as possible to avoid and minimise such risks (Tume, Scally and Carter, 2013). "Weaning is the

gradual reduction of respiratory support to the point when the patient no longer requires assistance or has reached maximum potential and further reduction of respiratory support is neither feasible nor realistic" (Crocker, 2009: 185).

Boles *et al.* (2007), describes weaning as an essential element universally applied when caring for critically ill patients receiving mechanical ventilation. This process needs to be timed correctly, as premature weaning may result in complications such as loss of airway, aspiration, impaired gaseous exchange and over exertion of respiratory muscles requiring re-intubation (McLean, 2006; Haugdahl, 2016). To minimise challenges pertaining to the right time to wean patients off mechanical ventilation, protocols were developed and implemented to standardise and ensure consistency in practice (Sweet, *et al*., 2010; Haugdahl, 2016). However, the findings from studies evaluating protocol implementation showed that protocols were being underutilised in neonatal care as nurses considered them to be medically oriented, limiting autonomous nursing practice and the application of clinical judgement in facilitating provision of individualised patient care (McLean *et al*., 2006; Sinyiza, 2015).

Historically, the responsibility of weaning a patient off mechanical ventilation was solely in the domain of the physician and nurses were only responsible for monitoring the patient without changing mechanical ventilator settings (Blackwood and Barnett-Wilson, 2007; Rose *et al*., 2007; Njolomole, 2014). However, the constant presence and continuity of care that nurses provide at the patients' bedside, gives the nurse the advantage of knowing their patient's pattern of response to treatment and noting the instant changes that take place during mechanical ventilation weaning process (Crocker, 2009; Haugdahl, 2016). Therefore, this often requires them to respond promptly, in the absence of the doctor, to deliver efficient care to the patient.

Nurses' roles are believed to be changing with time, and this is more evident in the sub-Saharan African countries where there is a crisis of shortage in healthcare workers. It has also been noted there is a greater population of nurses compared to doctors and often the nurses' roles appear to overlap with those of doctors (Msuya *et al*., 2017). It can be argued that nurses have a greater contribution to the country's healthcare status in their respective disciplines through optimal and efficient patient care. Therefore, nurses who are empowered and have knowledge of their roles and involvement in decision making during patient care,

have the ability to help alleviate the burden faced by fellow healthcare providers. Solberg, Hansen and Bjork (2014) mentioned how enhancing the involvement of nurses in mechanical ventilation management and decision making by ensuring flexibility of professional boundaries could result in increased work performance, improved patient care and decreased length of hospital stay.

Locally, in the NICU setting, research suggests that the role of nurses in management of mechanical ventilation is not well defined. Findings from the nursing studies revealed controversies amongst participants with regard to mechanical ventilation management. Nurses identified a need for further training to enhance nurses' knowledge base in mechanical ventilation and weaning process for practice in the NICU. It is also apparent that very few nurses were formally trained in Intensive Care or Critical Care nursing, and this was believed to potentially increase the risk to the patient (De Beer, Brysiewicz and Bhengu [2011] as cited in Njolomole, 2014; Sinyiza, 2015). Staff training is important in ensuring that nurses practice competently and safely in the NICU. It has been stated in Babaei Pouya *et al*. (2019) that in order to prevent the occurrence of human errors in the workplace, the training of skills to personnel is vital in ensuring this.

The NICU nurses' role in fulfilling comprehensive management of mechanical ventilation requires adequate knowledge and skills of mechanical ventilation, knowing the patients and their response to the treatment, as well as actions to take in response to the patient's clinical changes (Crocker, 2009; Haugdahl, 2016). However, even with recent studies conducted in South African NICU settings, there are still discrepancies in nurses' roles in mechanical ventilation management in this setting. It is with this view that the researcher seeks to define the role of NICU nurses in the management of mechanical ventilation.

1.2 PROBLEM STATEMENT

The practice of nurses in the NICU is informed by their responsibility to acquire in-depth knowledge and skills of mechanical ventilation and to understand their role in the management of a mechanically ventilated neonate in order to meet the patients' needs for optimal clinical outcomes (Haugdahl, 2016). Previous research showed discrepancies in mechanical ventilation management with nurses highlighting the need for guidance in the treatment mode (Njolomole, 2014; Sinyiza, 2015); however little remains known about the

role of NICU nurses in mechanical ventilation. These discrepancies and the lack of literature in South African NICU settings, demonstrate that the role of NICU nurses in mechanical ventilation management remains undefined. NICU nurses need to have a clear understanding of what they are expected to do since the scope of practice does not clearly define the expanded functions of specialist nurses. A clear role of NICU nurses in mechanical ventilation management can lead to collaborative decision-making between doctors and specialist nurses thus improving quality patient care and outcomes. With this in mind, the gap in knowledge reveals the need for further studies to be conducted to define this role.

- What is the neonatal nurses' role in management of mechanical ventilation in the NICUs?

1.3 PURPOSE OF THE STUDY

The purpose of the study was to describe the role of neonatal nurses in the mechanical ventilation management in the NICU at two tertiary academic hospitals.

1.4 RESEARCH OBJECTIVES

The objectives of the study were:

- To describe NICU nurses' role in key mechanical ventilation management practices using a questionnaire adopted from Rose, Nelson, Johnston and Presneill (2008)
- To relate the association between NICU nurses' autonomy and influence on independent decision making to manage mechanical ventilation
- To relate the association between nursing contributions and influence on independent decision making to manage mechanical ventilation

1.5 SIGNIFICANCE OF THE STUDY

The study has gathered and provided current evidence regarding the role of nurses in mechanical ventilation management practices in NICUs. The findings will inform recommendations for clinical practice and in-service training on mechanical ventilation. Clarifying the nurses' role in this intervention will hopefully facilitate a better understanding of what is expected of them, potentially increasing their efficacy in providing quality

neonatal care. It is hoped that empowering nurses will provide an impetus for the development of nurse-oriented guidelines on neonatal mechanical ventilation management and weaning.

1.6 RESEARCHERS' ASSUMPTIONS

1.6.1 Meta-theoretical Assumptions

Meta-theoretical assumptions are statements regarded as obvious and not intended to be tested by the study and are accepted to be true for the researcher. The meta-theoretical assumptions in nursing comprise four concepts, namely the person, environment, health and nursing (Poggenpoel, 1996; Schmollgruber, 2015). These meta-theoretical assumptions reflect the researcher's view of a person, environment, nursing and health/illness. The researcher's meta-theoretical assumptions regarding these concepts were as follows:

- **The person**

The person is a holistic individual with complete body, mind and spirit, who should not solely be viewed as the sum of body organs (Fitzpatrick & Whall [1983], as cited in Schmollgruber, 2015). Nikfarid *et al*. (2018:4) defines a person as "a being whose wholeness is valuable and deserves respect, assistance and care." The person in this context is the critically ill neonatal patient who requires holistic and extensive specialised care provided by the NICU nurse along with the involvement of the multidisciplinary team.

- **Environment**

The environment refers to the internal as well as the external factors that affect the person. The external aspects are the surroundings or conditions within which a person functions or where a particular activity is carried out. The internal environment refers to the person's response to the particular surrounding (Geyer *et al*., 2013; Nikfarid, *et al*., 2018). In this context, the environment refers to the Neonatal Intensive Care Unit in which the critically ill neonate is receiving specialised care as well as their exposure to invasive procedures such as mechanical ventilation aimed at optimising the neonate's health outcomes.

- **Nursing**

Nursing encompasses autonomous and collaborative care of individuals of all ages, family, groups and communities, sick or well, and in all settings. It includes promotion of health, the prevention of illness and the care of ill, disabled and dying. It is also defined as all activities performed by nurses and concerned with restoration or maintenance of individual and community health, both physical and mental (WHO, 2019; Freshwater, 2005).

- **Health**

Health is the state of being physically and psychologically well, but it does not necessarily mean the absence of a disease; it is said to be a balance between the person and environment (WHO, 1946; Svalastog *et al*., 2017). In the context of this study, health refers to the neonatal patient's holistic wellbeing during mechanical ventilation in order for them to attain optimal developmental milestones regardless of their hospitalisation in the NICU.

1.6.2 Theoretical Assumptions

A theory is defined as "an integrated set of defined concepts and statements that present a view of a phenomenon and can be used to describe, explain, predict and control that phenomenon" (Burns and Grove, 2011:228). Creswell (2009) defines a theory as "an interrelated set of constructs formed into proposition or hypothesis that specify the relationship among variables." "A theory might appear in a research study as an argument, as discussion or rationale," and its purpose is to explain phenomena that occur in the world (Creswell, 2009:84). Assumptions are defined as "statements taken for granted or considered true, even though they have not been scientifically tested" (Burns and Grove, 2007:37).

Theoretical assumptions are inclusive of concepts and theories used as a point of departure in a study; it also includes the operational definitions used in a study.

1.6.2.1 Operational definitions

Operational definitions give a description of how variables are used in a study; knowledge gained from the described variable will create an understanding of the theoretical concept that the variable represents (Burns and Grove, 2007).

- **Roles**

Geyer *et al*. (2013:247) defines a role as "the function assumed or part played by a person in a particular situation," it is the expectations defined by society towards a person who holds a certain position or status in that society. In the nursing context, these come with obligations that are governed by the professional body itself (Geyer *et al*., 2013). This may include nurses' autonomous and collaborative practices during mechanical ventilation management in the NICU (Rose, *et al*., 2011). In the context of this study, roles refer to the responsibilities carried out by the professional nurses working in the NICU with regards to managing ventilated neonatal patients this includes and is not limited to the decision making, implementation of decisions as well as collaboration with the multidisciplinary team.

- **Mechanical ventilation management**

Is the treatment process where a patient receives manipulated pressure breaths to assist in exchange of gases and includes initiation of treatment (putting patient on ventilation), continuous monitoring and titration of oxygen (increase and decrease) (Rose *et al*., 2011). In this context refers to the manipulation of ventilator settings to suit each neonatal patients' needs in consultation and collaboration with the doctors involved in the care of the patient.

- **Weaning protocol and guideline**

A standard guide or official procedure with criterion on how to assess patient readiness to wean off mechanical ventilation, which includes the step-by-step statements on how to go about weaning the patient off mechanical ventilation (Crocker, 2009; Sweet *et al*., 2010; Haugdahl, 2016). In this study, weaning protocols and guideline refer to the standard guidelines followed by the nurses in the NICU in adjustment of ventilator settings as well as guidance regarding actions to take in reference to the neonatal patient's clinical presentation, or response to treatment.

- **Nurse**

Refers to the professional nurse registered by SANC as a person who is "qualified and competent to independently practice comprehensive nursing in the manner and to the level prescribed, and who is capable of assuming responsibility and accountability for such practice" (Nursing Act No. 33 of 2005, Section 31(1). In this study, nurse refers to professional nurses practicing in the NICU, where there are mechanically ventilated patients between birth and 28 days of life. They may or may not have undergone speciality training such as neonatal, paediatric or Intensive Care nursing, but are responsible for competently carrying out responsibilities in the unit.

1.6.3 Methodological Assumptions

Methodological assumptions do not only assist to give shape to the research context, but also influence a researcher's decision about the research design and method to be used, this choice is then linked to the desired outcome of the study (Crotty [2003:3], as cited in Golombek and Jordan, 2005; Creswell, 2009). A quantitative non-experimental descriptive design was chosen as the most appropriate approach to obtain information required in the study. The study was conducted to describe the role of NICU nurses in mechanical ventilation management to assist in clarifying the level of function expected of these nurses in clinical practice.

1.7 OVERVIEW RESEARCH METHODOLOGY

A quantitative descriptive design was utilised in this study using a 34-itemed self-administered questionnaire, adopted from Rose *et al*. (2008). This form of design enabled the researcher to describe characteristics or variables emerging from the respondents as well as draw conclusions from the sample data that represents the broader population (Brink, van der Walt and Rensburg, 2016). The study took place in the NICU of two tertiary academic hospitals in Gauteng, with a target population of 108 professional nurses working in the above-mentioned institutions. A census sampling method was utilised to select the sample size and data obtained was analysed using descriptive statistics with the assistance of a biomedical statistician.

Before commencement of the study, ethical clearance from the Human Research Ethics Committee of University of Witwatersrand and permission to conduct the study was

obtained from the Gauteng Department of Health and the hospital management. Permission was also obtained from the respective nurse unit managers to conduct the study in the units. Data was collected using a self-administered questionnaire developed by Rose *et al.* (2008) to describe the role of the NICU nurse in ventilation management.

1.7 VALIDITY AND RELIABILITY OF THE STUDY

To ensure that the study was valid, an accurate representation of all data obtained was ensured, no data was manipulated, and this was verified by the supervisor with additional assistance from a statistician. The same questionnaire was used in this study and administered by the primary researcher.

1.8 ETHICAL CONSIDERATIONS

Following ethical clearance to conduct the study, the following ethical considerations were upheld:

- All participants who completed the questionnaire were regarded as giving consent to take part in the study, as per the information letter issued to them, and they were reassured that their anonymity and confidentiality would be maintained throughout the study.
- Questionnaires were placed in a sealed box kept in the unit's duty room during data collection and further stored in a secured facility only accessible to the researcher and the supervisor.
- Data identifiable to participants was coded to avoid bridging their confidentiality and anonymity.
- Accurate and consistent representation of data findings was ensured for the reliability of the study.
- All data obtained will be retained for a period of 5 years as stipulated by University of Witwatersrand Research Policy.
- Correct referencing, as per university style requirement, has been used to avoid the threat of plagiarism.

1.10 OUTLINE OF THE STUDY

The study will be divided into the following chapters:

Chapter One: Overview of the study

Chapter Two: Literature review

Chapter Three: Research design and methods

Chapter Four: Data analysis and results

Chapter Five: Summary of main findings, limitations, recommendations and conclusions

1.11 SUMMARY

In this chapter, the outline of the study was described, which included the background, research objectives as well as purpose of the study and significance. The researcher's assumptions were described, operational definitions defined. The chapter briefly gave an overview of the research methodology, which will be further discussed in Chapter Three.

The following chapter will focus on the literature review of the study in question.

CHAPTER TWO
LITERATURE REVIEW

2.1 INTRODUCTION

The previous chapter provided a general overview of the study. This chapter presents the literature reviewed about the topic under study. The purpose of a literature review is to provide background information on the existing knowledge of the study topic. It gives direction as to what is known and unknown about the topic, therefore assisting in identifying the gap in knowledge to form a basis for the study being conducted in order to build on previous knowledge (Polit and Beck, 2012; Grove, Gray and Burns, 2015).

This chapter will present literature on the mechanical ventilation process, which includes but is not limited to the process of weaning through to extubation, as well as the types of mechanical ventilation modes utilised. It will highlight the involvement and responsibilities of the nurse with regard to mechanical ventilation management, decision-making and collaborative practices within the multidisciplinary team. The use of protocols and its influence in decision-making, and outcomes during mechanical ventilation management will also be discussed.

The search was conducted using electronic databases available in the University of Witwatersrand Health Sciences Library. The search engines used included CINAHL, EBSCO Host, MEDLINE and Science Direct.

2.2 OVERVIEW OF MECHANICAL VENTILATION

Mechanical ventilation is a lifesaving form of intervention, used on critically ill neonates who require assistance with provision of adequate oxygenation due to various reasons (Biban *et al.,* 2013). Blackwood *et al*. (2013:190) describes mechanical ventilation as "a complex intervention which involves a number of interrelated components that include clinical process (guidelines and protocols), context (organisations, resources and staffing) and characteristics of healthcare professionals (education, skill mix and inter-professional relationships)." A multidisciplinary team, which includes nurses, doctors and allied health

workers such as physiotherapists, are required in the management of ventilation as well as the process associated with it (Rose *et al*. 2008).

The goal of mechanical ventilation in neonates particularly is to maintain adequate gaseous exchange, to reduce work of breathing and to reduce ventilator-induced lung injury as well as prevent atelectasis (Mustafa *et al.*, 2019; Joseph, 2015). Mechanical ventilation in neonates is indicated in the management of various neonatal conditions, such as persistent pulmonary hypertension (PPHN), meconium aspiration syndrome (MAS) and apnoea of prematurity, as well as offering cardiovascular system support post-operatively (Hockenberry and Wilson, 2015).

The choice of mode of mechanical ventilation as well as settings vary depending on the severity of the neonates' condition, availability of resources and the healthcare team's experience. Understanding the mechanism of breathing is important when making this choice and has to match the needs of the patient and the pathophysiology of their disease (Joseph, 2015; Mallya and Gupta, 2013). There are different ventilation modes and strategies in place that optimise mechanical ventilation in neonates and assist in preventing ventilator-induced lung injury. Therefore, the goal of treatment and the most important step to recovery is weaning the neonate off mechanical ventilation as soon as possible to avoid and minimise such risks (Tume, Scally and Carter, 2013).

The selection criteria for mechanical ventilation modes utilised in neonatal patients, obtained from neonatal clinical practice guidelines developed by Minski *et al.* (2015) are displayed in **Table 2.1.**

Table 2.1: Clinical guidelines for selection of mechanical ventilation modes

Mechanical ventilation modes	**Selection criteria**
Assist Control with Volume guarantee (AC + Vg)	• Used in patients with moderate to severe lung disease
Pressure Support Ventilation with Volume guarantee (PSV+ Vg)	• Patients with an intact respiratory drive who are recovering, or • Have mild or no lung disease.

	• To assess readiness for extubation after AC + Vg
Nasal Continuous Positive Airway Pressure (NCPAP)	• Patients with intact respiratory drive who are recovering • Have mild or no lung disease. • Are weaning from mechanical ventilation
High Frequency Ventilation	For severe lung pathology: • Air leaks syndromes • Excessive secretions • Pulmonary haemorrhage • Diaphragmatic Hernia • Hypoplastic lung • Pulmonary interstitial emphysema • Oesophageal atresia with trachea-oesophageal fistula • Acute Respiratory Distress Syndrome • Severe prematurity • Persistent Pulmonary Hypertension of the Newborn

Source: Minski *et al.,* 2015

2.3 WEANING

2.3.1 Definition

Crocker (2009:185) defines weaning as "the gradual reduction of respiratory support to the point when the patient no longer requires assistance or has reached maximum potential." Weaning is an essential element during the care of a mechanically ventilated patient and covers the entire process of liberating patients from ventilation assistance to the removal of the endotracheal tube; this does not exclude aspects of end-of life care (Boles *et. al.,* 2007).

Weaning patients from mechanical ventilation is a complex and challenging process, which does not merely involve discontinuation of ventilation, but requires 'continuity of care, knowing the patient and the development of patient-centered, individualised weaning plan, which suggests the importance of nurse involvement in the process (Lavelle and Dowling, 2011).

To prevent complications such as ventilator-induced lung injury, weaning needs to take effect as soon as the patient's respiratory system functioning is stabilised. There are different approaches applied in weaning patients off ventilation, the choice of ventilation mode depends on the patient's condition and respiratory assistance needed. The commonly used ventilator modes in the neonatal complex is said to be the synchronised intermittent mandatory ventilation (SIMV) followed by Assist Control (A/C), which can be used in combination with other modes to achieve desired respiratory outcomes. Pressure support ventilation (PSV) is said to be the most preferred mechanical ventilation mode and is utilised during the weaning process (Boles *et al.,* 2007; Hummler and Schulze, 2009).

2.3.2 Categorisation of Patients

Patients are categorised into three groups (simple, difficult and prolonged) based on the complexity and duration of their weaning process. Simple weaning patients are those who pass the Spontaneous Breathing Trial (SBT) and get extubated successfully at the first attempt; literature has proven that their prognosis is good with a low ICU mortality rate of 5% (Boles *et al*., 2007:1036).

The difficult weaning group is for patients who fail their first attempt at weaning and may require repeated SBTs up to three attempts; it may take up to seven days to achieve successful weaning with this group of patients.

Patients who have failed three attempts of the SBT or those who have exceeded seven days of weaning trials from the initial SBT are categorised under the prolonged weaning group. these last two categories respectively were said to have an ICU mortality rate of 25% (Boles *et. al*., 2007: 1036).

2.3.3 Methods of Discontinuing Mechanical Ventilation

The approach to weaning varies and is dependent on how rapidly the underlying condition was resolved, and the patient's general condition. There are several weaning methods available, and these are synchronised intermittent mandatory ventilation (SIMV), pressure support (PS), continuous positive airway pressure (CPAP) and T-piece. Research has suggested that SBT is recommended, as it determines patient's ability to breathe independent of ventilation assistance.

Synchronised Intermittent Mandatory Ventilation (SIMV)

Is a patient in triggered mode, meaning that the ventilator detects the patient's attempt to inspire and therefore triggers inspiration. The ventilator delivers a fixed number of breaths programmed by the clinician and allows the patient to take spontaneous breaths between these predetermined breaths. The mode ensures that the patient has fully exhaled prior to delivering a set of breath in order to avoid or reduce asynchrony between the ventilator and the patient (Lewis *et al*., 2019).

- Advantages: improves infant's comfort, lessens complications such as air leaks, gas trapping, irregular arterial and cerebral blood flow rate
- May still lead to asynchrony if the patient's inspiratory time (Ti) is shorter than the ventilators pre-set Ti (Snow and Brandon, 2007:14)

Pressure Support Ventilation

Pressure support ventilation (PSV) is commonly thought of as a weaning mode, which provides additional pressure that is above the positive end expiratory pressure (PEEP) during an infant's spontaneous breath. This mode is used to reduce the patient's work of breathing and may be used in combination with other ventilator modes, such as SIMV (Snow and Brandon, 2007).

- Advantage: it reduces work of breathing due to resistance of the endotracheal tube (ET), can be used in conjunction with other modes, and may improve respiratory function in neonates

- Disadvantages: due to multiple settings to consider, weaning may be complex (Snow and Brandon, 2007).

Continuous Positive Airway Pressure

This mode appears to be commonly used as a post-extubation respiratory support mode. Warm humidified gas at a pre-set pressure is delivered continuously to the patient while maintaining a positive airway pressure throughout the respiratory cycle. The pressure delivered prevents the collapse of alveoli during expiration; the patient initiates breaths throughout (Grossbach, Chlan and Tracy, 2011; Daco, 2012; Al-Mandary *et al.*, 2015).

T-piece

Modes usually used in this approach include placing the patient on a T-piece for 30 to 120 minutes, or on low settings such as a PEEP setting of 5cmH2O via Constant Positive Airway Pressure (CPAP) or a low level Pressure Support (PS) of 5 to 8cmH2O. This process may take weeks to achieve spontaneous respiratory effort. The patient is considered to have passed the SBT when they are stable for 90 to 120 minutes and able to maintain spontaneous respiratory effort. A study by Biban *et al.* (2013) suggests that the implementation of short spontaneous breathing tests has demonstrated benefits such as early extubation in preterm neonatal patients.

2.3.4 Comparison of Weaning Modes

A systemic review by Rose *et al*. (2013), on trials conducted to compare automated and non-automated weaning modes, showed some benefits from utilising automated weaning modes over non-automated modes. Results obtained appeared to be in favour of the use of automated weaning modes; these were measured based on the modes' influence on certain outcomes. The primary outcome was total duration of ventilator weaning, that is the time from the study being conducted until successful extubation or discontinuation of mechanical ventilation between 24 and 72 hours, whilst secondary outcomes were based on the following:

- time from study being conducted to extubation

- total duration of mechanical ventilation
- time from intubation to study being conducted
- time from favourable extubation criteria to actual extubation
- mortality
- ICU and hospital length of stay
- number of adverse events

Randomised trials in the neonatal care settings, which compared different weaning modes to one another, demonstrated favour of SIMV + PS mode as opposed to SIMV alone, stating that patients reached minimal ventilator settings and were extubated much sooner on the combination mode compared to those on SIMV. Volume targeted ventilation modes were compared to pressure limited ventilation modes, and it appeared that the volume targeted mode resulted in a shorter duration of ventilation, reduced deaths and the likelihood of neonates developing pneumothorax (Biban *et al.,* 2013).

2.3.5 Criteria for Determining Weaning Readiness

There are parameters to consider prior to initiating the process of weaning. These parameters, obtained from clinical guidelines on mechanical ventilation by Goldsworthy and Graham (2013:56), are displayed in **Table 2.2**.

Table 2.2: Clinical guidelines for determining weaning readiness

Criteria	**Assessment**
Clinical assessment	• Adequate cough • Absence of excessive tracheobronchial secretions • Resolution of disease acute phase for which the patient was intubated
Haemodynamic stability	• Minimum support of inotropes,

	• Patient is afebrile, • Has an adequate cardiac output and a haematocrit greater than 25% • Stable metabolic factors; electrolytes within normal ranges and normalised arterial blood gases
Respiratory stability	• Improved chest X-ray findings • PaO2 > 60mmHg with an FiO2 < 0.5, PaO2 > 150-200 • PEEP < 5-8cmH2O, • Vital capacity of 10-15mL/kg, Spontaneous Tidal Volume 5mL/kg • Respiratory rate < 30breaths/minute, Rapid shallow breathing index >105 and a Minute ventilation 10-15L/minute
Pain management	• Adequate pain management is ensured, and the patient is well rested

Source: Goldsworthy and Graham (2013: 56).

The screening tools utilised in assessing patient's readiness to wean can be those developed by the institution, or validated tools such as the Burns Wean Assessment Programme (BWAP).

2.3.6 Weaning Failure

Boles *et al. (*2007; 1034) define weaning failure as "failure of the Spontaneous Breathing Trial or the need for reintubation within 48 hours post extubation." Some patients fail the SBT due to various factors, such as pain, excessive sedation, fluid imbalance, short resting periods in between weaning trials and possibly inconsistencies in evidence-based practices regarding weaning. Therefore, it is important to address and optimise these factors to avoid

weaning failure, although some patients may require prolonged ventilation before attempting to wean (Goldsworth and Graham, 2013).

2.3.7 Extubation

The discontinuation of mechanical ventilation treatment on a patient whose underlying respiratory failure has stabilised and no longer requires mechanical ventilation is called extubation; the term is often used interchangeably with liberation from ventilator (MacIntyre, 2006; Goldsworth and Graham, 2013). In a study conducted by Al-Mandry et al. (2015), to determine peri-extubation practices in extremely premature infants, it was found that the decision to extubate was based on ventilator settings, blood gases and the presence of clinical stability instead of evidence-based practices. Extubation failure prevalence in neonatal patients is said to vary from 10% to 80% depending on factors such as policies put in place regarding pre and post-intubation management, definition and timing of extubation failure as well as gestational age, as extremely preterm neonates are considered to be at a higher risk for reintubation (Biban *et.al*., 2013:5).

2.4 ROLE OF THE NURSE

A professional nurse registered with the South African Nursing Council (SANC) is defined as a person who is qualified and competent to practice comprehensive nursing independently in the manner and to the level prescribed, and who is capable of assuming responsibility and accountability for such practice (Nursing Act No. 33 of 2005, Section 31(1)). Some acts or procedures entailed in the context of this study, from the scope of practice of a registered nurse as stated in Chapter 2 of South African Nursing Council Regulation 2598 of 1984, are as follows:

- Section 31(1) (b) the execution of a programme of treatment or medication prescribed by a registered person for the patient;
- Section 31 (1) (h) the supervision over and maintenance of a supply of oxygen to a patient;
- Section 31 (1) (r) co-ordination of the healthcare regimens provided for the patient by other categories of health personnel.

- Section 31 (1) (s) provision of effective patient advocacy to enable the patient to obtain the healthcare he needs.

These obligations can be interpreted, as the role of a nurse is to carry out and manage the processes pertaining to mechanical ventilation, to co-ordinate this form of treatment and advocate for the patient through collaborating with the multidisciplinary team regarding decisions such as patient's readiness or failure to wean.

A study on the role and responsibilities of doctors and nurses in mechanical ventilation and weaning in Paediatric Intensive Care Units (PICU), by Blackwood, *et al.* (2013), revealed that more than 50% (Blackwood *et al.,* 2013:191) of the time nurses made independent adjustments to ventilator settings, however they were more likely to independently adjust the fraction of inspired oxygen (FiO_2) rather than change other settings, such as respiratory rate, inspiratory pressure and pressure support.

In Scandinavia, nurses are said to engage actively in mechanical ventilation weaning usually in the absence of specific protocols; they make ventilator changes in response to the patient's physiological factors (Rose *et al*., 2011). In the United States of America, the nurses' role in mechanical ventilation adjustments and weaning varies from one institution to the other, depending on availability of respiratory therapists, presence of protocols and policies, which assist in empowering the nurse in managing a ventilated patient (Rose *et al.,* 2011).

In a study conducted in Europe, on the roles of Intensive Care nurses, nurses were identified as having a critical role in managing a mechanically ventilated patient including their weaning process. Findings from the study revealed that 63%-88% of decisions were made by nurses in collaboration with physicians, which was a large percentage, whilst 40%-68% of ventilation adjustments were performed by nurses independent of physicians (Rose *et al*., 2011; Solberg, Hansen and Bjork,, 2014; Haugdahl, 2013).

Education was emphasised in one study as a basis for offering nurses credibility to perform their important roles in critical care nursing such as wean patients. Relating this to Rose *et al.,* 2007 findings where most nurses, 75%, held a critical care qualification and were noted to show high levels of autonomy in their practice. It may be is evident that Education enhances high performance (Rose *et al*., 2007; Lavelle and Dowling, 2011). Ongoing staff

training for nurses is important in ensuring that quality of neonatal nursing care improves and that the role of nurses is enhanced for safe practice in the NICU thus improving the health and wellbeing of neonates (Mustafa *et al*., 2019; Babaei Pouya *et al.*, 2019).

2.5 WEANING PROTOCOLS

Determining weaning readiness was historically based on the clinician's judgement and experience, which resulted in variations in practice. However, with the development and use of weaning protocols, this has proved to increase the quality of care, reduce variations in practice and cost of care (Rose *et al*., 2013). Several studies proved that mechanical ventilation weaning protocols had benefits, such as a reduction in the duration of mechanical ventilation, hospital length stay, and reduced complications associated with mechanical ventilation. It has been highlighted that it increases the nurses' involvement in decisions regarding the care of their patient and that they gain comprehensive and valuable knowledge of respiratory assessment and mechanics (Wongrastrai, *et al.,* 2014; Blackwood *et al*., 2013; Grap *et al.,* 2003).

2.5.1 Nurses Perceptions of the Use of Protocols

To minimise the potential risks, Sweet *et al*. (2010) employed evidence-based guidelines in the management of neonates with respiratory distress and the utilisation of different mechanical ventilators. The authors proved that guidelines facilitated the standardisation of care by ensuring consistency in delivery of care and minimised risk to haemodynamic impairment and volutrauma. Literature reveals that mechanical ventilation protocols have been implemented in Intensive Care Units, but it appears there is poor adherence to them.

A study conducted by McLean *et al.* (2006), on improving adherence to mechanical ventilation weaning protocol for critically ill adults, revealed that less than 1% of the Intensive Care Units adhered to the utilisation of protocols despite efforts to educate and involve the multidisciplinary team. Reasons for non-adherence to protocol use by healthcare professionals was reported to be due to them not being aware of the existence of a protocol in the unit and verbalising its complexity when applying it at the bedside (Goldsworth and Graham, 2013). Some healthcare professionals were reportedly frustrated by the protocols, as it seemed to remove their clinical judgement and individualised patient care. In aiming to

improve the guidelines in order to optimise adherence, healthcare professionals suggested that the protocol should ensure that physician's orders were not required to initiate mechanical ventilation (McLean *et al.,* 2006). In contrast, other studies demonstrated positive views on the utilisation of protocols, such as ensuring consistency in care when staff changed shifts. Protocols offer a basis of imparting knowledge on newly appointed staff and students as they could be used as a teaching tool (Sinyiza, 2015).

2.5.2 Nurse-led Weaning Protocols

Blackwood *et al. 's* (2013) study revealed there is minimal involvement of nurses in adjusting other ventilator settings in the United Kingdom's PICUs, and it was assumed to be due to the low prevalence of nurse-led weaning protocols. Some studies have established that nurse-directed weaning protocols may lead to an increase in nurses' knowledge and sense of autonomy (Grap *et al.,* 2003). A local study found that nurses expressed the need for a nurse-led protocol and that its development should involve nursing experts and doctors within the line of speciality (Sinyiza, 2015).

Nurses have highlighted the need for nurse-led protocols in order to enhance autonomy when managing ventilated patients and to impart knowledge on fellow colleagues in the unit. The nurse's role is to have adequate knowledge of the treatment process, to display a level of autonomy when managing a mechanically ventilated patient, using evidence-based guideline to inform their decisions and to collaborate effectively with the multidisciplinary team during patient care.

2.5.3 Decision-making in Weaning

Literature has argued that the "duration of ventilation and weaning may be viewed as nurse-sensitive outcomes that are positively influenced by an increase in nursing input into decision-making processes" (Rose *et al*., 2008:1036). It also states that autonomous practice and the responsibility for clinical decision-making, as well as interdisciplinary collaboration, is influenced by the social setting in which they occur, as it appears doctors predominantly made decisions on weaning or extubating the patient (Rose *et al*., 2008). It has been noted that the dominance of the medical profession in the ICU may be a factor affecting the nurses' active involvement in decision-making. Although the presence of protocols in the units can

facilitate an increase in this involvement, the medically oriented protocols nature does not warrant a true definition of nurses' autonomy in clinical decision-making (Rose *et al.,* 2008; Wongrastrai *et al.,* 2014)

A survey conducted on nurses' contribution to key ventilation and weaning decisions revealed a high level of autonomy and decision making amongst nurses in mechanical ventilation management. Nurses were shown to frequently make decisions on ventilator adjustments, and this was said to be partially due to Australia not having respiratory specialist like in the North American ICUs. The decisions to extubate the patients however remained a predominately collaborative role of both nurses and doctors (Lavelle and Dowling, 2011). What was also highlighted was how junior nurses appeared more reluctant in practicing autonomously when weaning was concerned and would rather fulfil their other nursing roles and leave weaning patients as their last role (Lavelle and Dowling, 2011)

2.6 INTER-PROFESSIONAL COLLABORATION

Nurses' collaborative decision making plays an important role during mechanical ventilation, as they are constantly beside the patient, vigilantly looking for any changes in the patients' condition. Optimal patient outcome is also impacted by effective teamwork among the multidisciplinary team, predominantly so between the nurses and physicians. "Relational coordination has a strong effect on caregivers' process of preparation to provide and manage care, which promotes better outcomes for patients" (Solberg, 2014).

Findings from previous literature, demonstrated that collaboration meant sharing of roles and responsibilities, such as having discussions and making decisions as a team, having knowledge and respect towards one another, thus resulting in a proficient team. It was discovered that this inter-professional collaboration in decision making occurred mainly between senior nurses and senior doctors. However, decisions to extubate and the method of weaning were done predominantly by the doctors, independent of the nurses' input (Rose *et al.,* 2008, Blackwood *et al.,* 2013; Wongrostrai *et al.,* 2016).

Effective teamwork is influenced by team members having knowledge of what their role is in the team. A study done in Europe looking into the responsibilities or roles of Intensive Care nurses revealed that nurses and physicians are responsible for coordinating the diagnosis, treatment and care of their patients (Rose *et al.,* 2011; Haugdahl, 2016).

2.7 AUTOMATED WEANING

Automated weaning modes are designed to reduce level of ventilatory support in response to the patients' respiratory effort improvement. The process has the potential to reduce delays in weaning, as it is not reliant on the presence of the clinician and them recognising patient's readiness to wean (Rose *et al.,* 2013). These include PS and SIMV, as discussed under methods of discontinuation of ventilation, as well as assisting control and time cycled pressure limited modes.

Assist Control (A/C)

Assist control (AC) is also a patient-triggered type of ventilator mode, which assists the patients every spontaneous breath and has a backup rate. With a volume-controlled A/C, this parameter is fixed, and with every inspiration effort detected by the ventilator, an additional mandatory breath is delivered (Mallya and Gupta, 2013, Grossbach, Chlan and Tracy, 2011). The Pressure A/C is a pressure-controlled mode where with every breathing attempt detected at a PEEP level, a mandatory breath is triggered. If after completion of an expiration time, a mandatory breath is not triggered, then a mandatory breath will be delivered automatically; this is called a backup rate (Draeger, 2015; Goldsworthy and Graham, 2014).

Time-cycled pressure limited (TCPL)

Time cycle refers to air or gas being delivered over a pre-set period (Goldsworthy and Graham, 2014:26). This ventilation method is a machine triggered mode, which influences the inspiration to expiration (I:E) ratio, only the inspiratory time (Ti) determines the starting point of expiration and there is no influence on the duration of inspiratory phase by the patient (Draeger, 2015; Goldsworthy and Graham, 2014).

2.8 SUMMARY

This chapter presented a summary of literature on this topic. Previous research was examined, and the results and recommendations were highlighted. An overview of mechanical ventilation, the definition of and methods of weaning, the role of the nurses, use

of nurse-led protocols, inter-professional collaboration and automated weaning were discussed.

The next chapter will outline the research methods and design used in the study.

CHAPTER THREE

RESEARCH DESIGN AND METHODS

3.1 INTRODUCTION

This chapter will discuss the research design and methods used to achieve the study objectives. The research objectives, setting, population and sample will be discussed, including the data collection procedure, data analysis and ethical considerations considered during the study.

3.2 AIM AND OBJECTIVES OF THE STUDY

The purpose of the study was to describe the role of neonatal nurses in the mechanical ventilation management in the NICU at two tertiary academic hospitals.

The objectives of the study were:

- To describe NICU nurses' role in key mechanical ventilation management practices using a questionnaire adopted from Rose, Nelson, Johnston and Presneill *(*2008).
- To relate the association between NICU nurses' autonomy and influence on independent decision making to manage mechanical ventilation
- To relate the association between nursing contributions and influence on independent decision making to manage mechanical ventilation

3.3 RESEARCH DESIGN

A non-experimental descriptive quantitative design was employed for this study using a self-administered questionnaire adopted from Rose *et al.* (2007; 2008). According to Brink, van der Walt and van Rensburg (2016), this method enables the researcher to describe characteristics or variables that emerge from respondents allowing one to draw conclusions from the sample data to represent the broader population (Creswell, 2009). It also allows respondents to respond anonymously without feeling pressured to respond according to the group.

3.3.1 Quantitative

In this method, the investigator identifies a research problem based on trends in the field, or on the need to explain why something occurs (Creswell, 2012). It is used to test objective theories through determining the relationship between variables and provides a numeric representation of trends and opinions (Polit and Beck, 2012). This can be measured using instruments, in turn the numerical representation of data can be analysed statistically (Creswell, 2009).

3.3.2 Non-experimental

In this study, data was collected without any manipulation of independent variables or intervention being introduced, hence a non-experimental design was employed as the researcher only describes the phenomenon as it exists (Nieswiadomy, 2008; Polit and Beck, 2012).

3.3.3 Descriptive

Descriptive research seeks to describe characteristics of situations, groups or persons and occurrences within the context of the study; it also describes the relationship between variables within which the phenomena may have previously been studied (Nieswiadomy, 2008; Polit and Beck, 2012). Therefore, in this study it seeks to describe the NICU nurses' role regarding mechanical ventilation management.

3.3.4 Cross-sectional Survey

A cross-sectional survey research is designed to obtain information about prevalence, distribution and interrelations of variables within a population and this is done at one point in time (Creswell 2009; Polit and Beck, 2012). Survey data can be collected in various ways. In this study data was collected using self-administered questionnaires, whereby respondents were handed questions in written form and requested to complete the answers in writing.

3.5 RESEARCH SETTING

The study was conducted in two NICUs from two tertiary academic hospitals, including a Cardiothoracic Unit, which is an adult unit that also admits neonatal patients who require cardiothoracic related surgeries. One institution's NICU is a 14-bedded unit, admitting both paediatric and neonatal patients, while the other institution has a 12-bedded unit admitting neonates only. Patients admitted in these units are those in a critical condition, who require mechanical ventilation due to life threatening morbidities or for post-operative cardiovascular support purposes. The Cardiothoracic ICU also consists of neonatal population, with three to four beds dedicated to them. Paediatric and neonatal patients who undergo cardiology related surgeries are admitted in this unit as there is no designated ICU for them, and because the physicians and surgeons are based in the adult Cardiothoracic Unit.

The Intensive Care sector in South Africa is adversely affected by a nationwide shortage of neonatal and paediatric nursing staff; such shortages limit paediatric cardiac services as staff require skills different to those required for adult cardiac or general paediatric patients. According to the European guidelines, six to eight paediatric cardiac Intensive Care beds are considered appropriate for every 250 patients. However, in the South African context it was found that only 19.6% beds were dedicated to paediatric and neonatal patients; this accounts for 815 out of 4168 beds in both public and private sector.

3.6 RESEARCH METHODS

Research methods involve the form of data collection, analysis and interpretation that researchers propose for their studies (Creswell, 2009: 15).

3.6.1 Population

The target population for this study was professional nurses practicing in the NICU settings in the two tertiary academic hospitals in Gauteng. According to staffing registers from the respective institutions, 108 professional nurses, in total, work in the collective units who all care for mechanically ventilated neonates daily. The population included eighteen (18) professional nurses identified in the Cardiothoracic Unit who nursed ventilated neonates admitted to their unit, which is situated outside the NICU/PICU.

3.6.2 Sampling and Sample

A census sampling method was used to recruit participants for this study as only 108 (N=108) participants were available for recruitment in the setting. This allows an accurate representation of respondents, thus decreasing bias. The inclusion criteria were as follows:

- Professional nurses registered with the South African Nursing Council (SANC)
- Professional nurses who have been working in the NICU for six months and longer.
- Professional nurses who are nursing ventilated neonatal patients daily.

3.7 DATA COLLECTION

3.7.1 Instrument

The data collection instrument used was a survey adopted from Rose *et al*. (2008) titled "*Survey of Mechanical Ventilation and Weaning Roles and Responsibilities"* (**Appendix A**). Permission to use the tool was obtained from the developer.

The questionnaire consists of 34 close-ended, multiple-choice questions. It is divided into three sections, namely Sections A, B and C. Section A consists of five items, and requires the respondents' demographic data, nursing qualifications and position in the NICU, as well as duration working in the unit.

Section B consists of multiple-choice questions related to key ventilation decisions, staffing ratios and includes two items scored on a Likert scale of 1 to 10 to determine nurses' level of autonomy and influence in mechanical ventilation management. The key ventilation decisions refers to decisions on initial ventilation settings, evaluation of patient response and adjustment of settings. It also includes identification of patient readiness to wean, the decision on weaning method to be used, determining patient readiness to be extubated, as well as weaning failure.

Section C looks to determine which ventilation settings are independently implemented by nurses, the presence of protocols/guidelines/policies pertaining to mechanical ventilation, the use of automated weaning modes, as well as nursing education regarding mechanical ventilation management. The section consists of seven items; the first item is represented in a table form with nine types of ventilation settings listed, each setting has six columns with

ratings from 0% = Never to 75% and above= Routinely, the option "uncertain" being the final column on the table. The following three items contain questions on the presence of protocols/policies/guidelines on mechanical ventilation. Item five is a table representation of identified automated weaning modes, which requires the respondents to rate the usage of these modes if applicable on a scale of 0%=Never to 75% or above = routinely, with additional rows provided for other applicable weaning modes that may be used in the units. The final two items in the section are on nurse education opportunities in the NICU.

3.7.2 Validity and reliability of the instrument

The questionnaire, developed by Rose *et al*. (2007; 2008), was assessed for face and content validity by senior nursing staff who were experienced in mechanical ventilation management; a pilot study was conducted to further refine the tool. It has been used and modified in other studies, but there is no mention of its reliability results (Rose *et al*., 2011; Blackwood *et al*., 2011; Haugdahl *et al*., 2013). Although the tool has not been used in the NICU setting locally, it was used to collect data from nurses working in the adult ICU.

In order to verify that the instrument was applicable and easily understood in a neonatal or paediatric setting, at least three experts were consulted to assess the instrument. These experts were neonatal or paediatric trained professionals with experience in NICU practice and currently working as clinical facilitators, nursing educators or operational managers. They were in a good position to determine whether the questionnaire was a good representation of what the study sought to describe and whether all items in the instrument were relevant to the context. The questionnaires were issued to the three experts who were asked to comment, based on their professional expertise, as to whether all questions were understood and applicable to the NICU.

A few modifications were made to the questionnaire based on feedback received from the experts as follows:

- Section B of the questionnaire, under each option that contained the word "intern" it was suggested that it be changed to "medical officers" as there are no interns allocated in the particular unit and medical officers were regarded as the most junior category of doctors in the unit.

- Section C under question 1, the word “titration” was changed to “adjustment” as that was said to be the word commonly utilised when referring to the increase or decrease of settings.

3.7.3 Procedure

Professional nurses in the NICUs were recruited by the researcher, through a brief presentation about the study at the beginning of each different shift, with the permission of the operational managers. All the professional nurses who met the inclusion criteria were then given an information letter, inviting them to respond to the questionnaire, along with the questionnaire. By completing and posting the questionnaire into the sealed box provided, the respondents were considered to have consented to participating in the study; this was highlighted to the respondents on the information sheet issued to them. Collection boxes for the return of the completed questionnaires were placed at a neutral area in the staff tearoom. The collection boxes were emptied twice a week, provided there were questionnaires posted in the box. Each team within the units was visited twice during the duration of data collection and with each visit, they were encouraged to participate in the study and reminded to post their filled-out questionnaires in the sealed box. Data collection ran over a four-month period, which was from May to August 2019, due to a smaller than expected turnout of participants in the two NICUs, then extended to September into October as the Cardiothoracic Unit group was added.

3.8 DATA ANALYSIS

Data management was carried out in Excel. Data was checked for missing values, errors in coding and duplicates. Values were recorded to match response options on the questionnaire.

Data analysis was carried out in STATA version 15.0. Demographic variables and roles in mechanical ventilation were described as proportions and percentages. For continuous variables, the Shapiro Wilk test or normality was computed to determine the distribution of the variable, for a p-value of <0.05, data were concluded to be skewed and presented as medians and interquartile ranges (IQR). To determine the association between NICU nurses’ autonomy and influence on independent decision making to manage mechanical ventilation, logistic regression models were fitted. Odds ratio (OR) and confidence intervals (CI) were

presented at a 5% level of significance. The outcome for the logistic regression model was "influence on independent decision making to manage mechanical ventilation," which was created by running a factor analysis to reduce items (1 to 9) (see Figure 4.6), into one scale for influence on independent decision making to manage mechanical ventilation. A reliability coefficient test was computed to determine how well each item on the scale measured influence on independent decision making to manage mechanical ventilation. The outcome was the recoded into a binary outcome with two responses: "never/seldom" and "infrequently."

A biomedical statistician was consulted to assist with analysis of data.

3.9 PRE-TESTING THE INSTRUMENT

A pre-test of the modified instrument was conducted to verify its applicability in the NICU context using professional nurse students completing their paediatric specialist training. Five paediatric nurse specialist students who met the inclusion criteria were approached and following their responses and feedback, Question 3 of Section A was modified. The wording, "*State the year that you qualified as an Intensive Care nurse*" was changed to "*State the year you started working in the NICU,*" as the pre-test group raised a point that only a few of the nurses in the unit held an Intensive Care speciality qualification. The results from the pre-test were included in the main study.

3.10 ETHICAL CONSIDERATIONS

3.10.1 Informed Consent

Informed Consent was discussed during the briefing of the respondents about the study, prior to issuing of information letters, which also clarified that completing the questionnaire and posting it in the sealed box provided in the unit would be regarded as them giving consent to take part in the study.

3.10.2 Permission to Conduct Research

Permission to conduct the study was obtained from the University of Witwatersrand's Human Research Ethics Committee (**Appendix B**) following approval from the Gauteng Department of Health (**Appendix C**). Thereafter permission was obtained from the Charlotte Maxeke Johannesburg Academic Hospital management (**Appendix D**), the Chris Hani Baragwanath Hospital Ethics Department (**Appendix E**), as well as its institution's management to conduct the study in the institutions. This was followed by permission from the unit Head of Department, as well as Operational Managers to conduct the study in their NICUs. Permission was obtained from the developer of the instrument adopted from Rose *et al.* (2008) (**Appendix A**).

3.10.3 Anonymity

Anonymity was ensured throughout the study, as the questionnaires did not require the respondents to include their names and information; that which was identifiable to the respondents has been represented in coded form.

3.10.4 Confidentiality

A sealed box was provided for posting completed questionnaires. To ensure confidentiality, this was placed in the staff duty room, which was identified as a neutral place instead of collecting the questionnaires from them individually. The questionnaires were only removed from the box by the researcher.

3.6 VALIDITY AND RELIABILITY OF THE STUDY

Validity refers to "the degree to which all of evidence points to the intended interpretation of test score for the proposed purpose" (Creswell, 2012: 159). Content validity was achieved through having the NICU experts review the questionnaire. A valid questionnaire which was published by the developer, Rose *et al.* (2008) and previously used in another local study by Ladipo (2017) was used in collecting data for this study. The questionnaire was administered by the primary researcher. To avoid threats to internal validity the data collected was analysed without any manipulation of variables. In order to guarantee reliability, an accurate and consistent representation of all data obtained was ensured.

3.7 SUMMARY

This chapter has discussed the research design and methods employed by the researcher to achieve the study objectives. The research objectives, setting, population and sample were discussed, including the data collection procedure, data analysis and ethical considerations taken into account during the study.

The next chapter presents the results of the study.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

This chapter describes nurses' roles in ventilation management in paediatric and neonatal units, with the intention of making recommendations for clinical practice and education of such nurses. It was achieved by a quantitative, descriptive and cross-sectional survey design. The population included all nurses practicing in Paediatric ICUs at two university-affiliated public hospitals in Johannesburg. A sample size of 90 (n = 90) respondents, was obtained using convenience sampling Data was collected using a data collection tool (see **Appendix A**). Data were analysed using descriptive and comparative statistics, as described in Chapter Three. Statistical tests included independent sample t-tests and Chi-square analysis. Testing was done at the 5% level of significance ($p<0.05$). In this chapter, the findings will be discussed on the scale, construct and study group and item analysis.

4.2 RESULTS AND FINDINGS

4.2.1 Descriptive Results

4.2.1.1 Response Rate

By the end of the data collection period of six months, 90 surveys were returned, which is a response rate of 83.3% (N=108). This is a good response rate (Fincham, 2008) for a census sampling method.

4.2.1.2 Biographical and workplace data

This section of the questionnaire (see **Appendix A**) related to nurses biographical and workplace data, which comprised of five items.

Results of this process are summarised in **Table 4.1** for the total sample (n = 90).

Table 4.1 Biographical and workplace data for nurse respondents for the sample (n = 90)

Item	Category	Frequency	Percentage
Q1	Age		
	20 to 29 years	13	14.4%
	30 to 39 years	32	35.6%
	40 to 49 years	19	21.1%
	50 to 59 years	26	28.9%
	>60 years	-	-
Q2	Academic qualifications		
	Diploma, RN, PN	39	43.3%
	Degree	14	15.6%
	Child nursing	9	10.0%
	Critical care nursing	23	25.6%
	General plus additional	5	5.6%
Q3	Years of ICU experience		
	25 to 30 years	5	5.6%
	20 to 24 years	3	3.3%
	15 to 19 years	6	6.7%
	10 to 14 years	14	15.6%
	5 to 9 years	26	28.9%
	<1 to 4 years	36	40.0%
Q4	Position in ICU		
	No response	2	2.2%
	ICU nurse	37	41.1%
	Shift leader	38	42.2%
	Unit Manager	4	4.4%
	ICU nurses & Shift leader	9	10.0%
Q5	Speciality workplace area		
	Neonatal ICU	49	54.4%
	Paediatric ICU	2	2.2%
	Cardiothoracic ICU	18	20.0%
	Neonatal & Paediatric ICU	21	23.3%

Of the total sample (n = 90), the largest (35.6%; n = 32) group of nurse respondents was between the ages of 30 to 39 years, and 28.9% (n = 26) were in the 50 to 59 age categories. **Figure 4.1** presents these results.

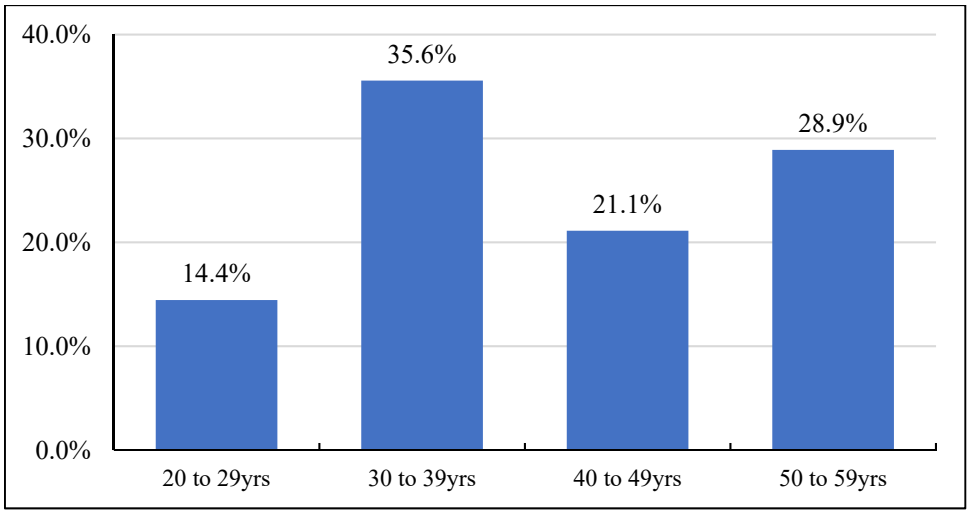


Figure 4.1 Age distribution of the respondents

The largest (42.4%; n = 38) group of the nurse respondents were shift leaders, 41.1% (n = 37) were ICU bedside nurses and 10.0% (n = 21) were both, ICU bedside nurses and shift leaders. In this study, the largest (43.3%; n = 39) group of the nurse respondents had a diploma level nursing qualification, 25.6% (n = 23) and 10.0% (n = 9) held an additional post basic level qualification in critical care nursing and child nursing science, respectively. Most (40.0%; n = 36) of the respondents had less than four years of ICU experience. **Figure 4.2** displays these results.

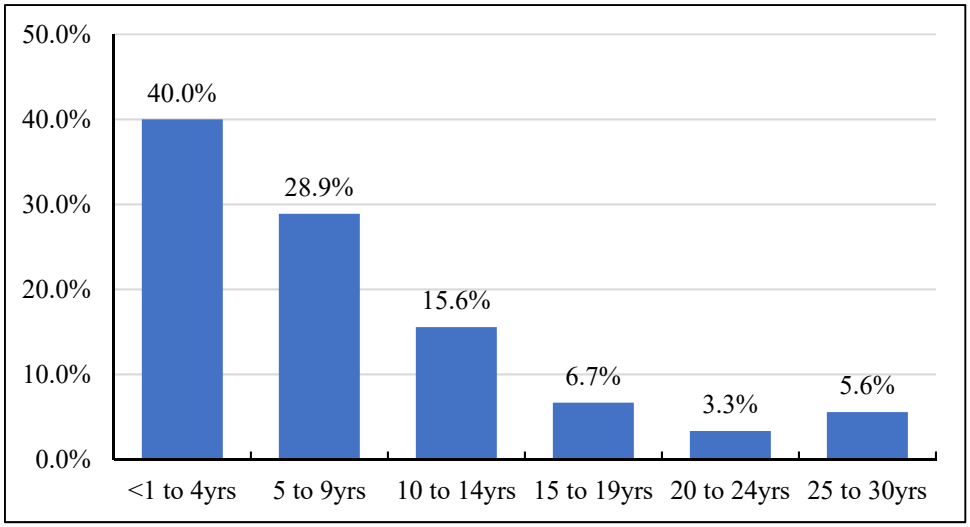


Figure 4.2 Distribution of years of experience of the respondents

In this study, the largest (54.4%; n = 49) group of the nurse respondents worked in a Neonatal ICU, the next largest group was in Neonatal and Paediatric ICU (23.3%; n = 21), followed

by 20.0% (n = 18) and 2.2% (n = 2) in Cardiothoracic ICU and Paediatric ICU respectively. **Figure 4.3** displays these results.

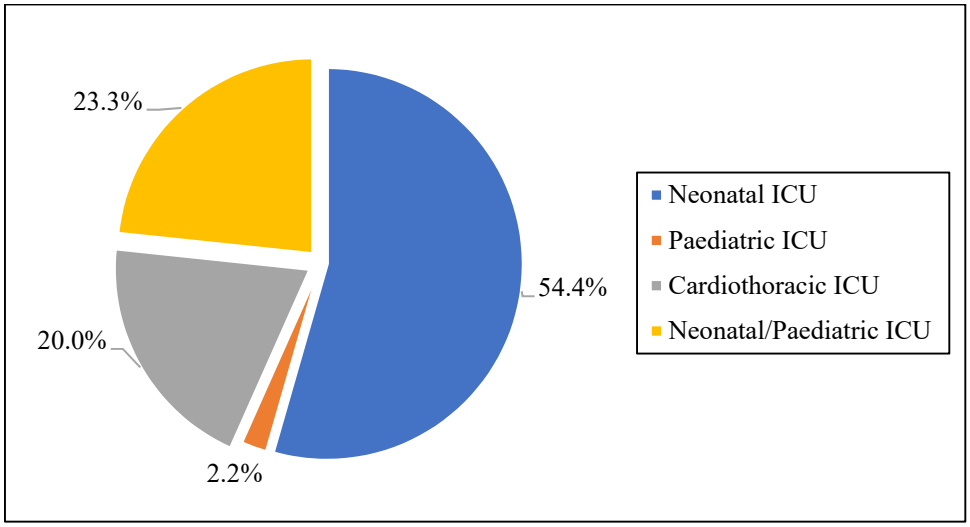


Figure 4.3 Distribution of respondents ICU workplace

4.2.1.3 Key ventilation decisions

This section of the data collection instrument (see **Appendix A**) related to key ventilation decisions. Six items (including 18 sub-items) were included in this section.

Results of this process are summarised in **Tables 4.2 to 4.4** for the total sample (n = 90).

Table 4.2 Inter-professional responsibilities for key ventilation decisions

Item	Statement	Doctors only		Nurses only		Doctors and nurses in collaboration		Other	
		n	%	n	%	n	%	n	%
Q1	Who determines the initial ventilation settings?	31	34.4%	2	2.2%	56	62.2%	1	1.1%
Q2	Who evaluates the patient's response to ventilation and titrates settings if required?	9	10.0%	-	-	81	**90.0%**	-	-
Q3	Who decides when the patient is ready to wean?	13	14.4%	-	-	77	**85.6%**	-	-
Q4	Who decides on the method of weaning from mechanical ventilation?	35	38.9%	-	-	55	61.1%	-	-
Q5	Who decides when the patient is ready to extubate?	45	**54.4%**	-	-	41	45.6%	-	-
Q6	Who decides when a patient is failing a weaning trial?"	14	15.6%	2	2.2%	72	**80.0%**	2	2.2%

Items Q1 to Q6 on the data collection instrument enquired about collaboration between nurses and doctors for ventilation related decisions. Most (90.0%; n = 81) of the respondents reported collaboration between nurses and doctors for decisions related to "*patient evaluation and titration of ventilation settings*" (item Q2), followed closely by 85.6% (n = 77) and 80.0% (n = 72) for "*readiness for weaning*" (item Q3) and "*determining weaning failure*" (item Q6), respectively.

More than half (n = 56; 62.2%) of the nurses reported collaboration between nurses and doctors for decisions "*related to ventilation settings*" (item Q1), and 55 (61.1%) reported collaboration between nurses and doctors for "*decisions related to method of weaning.*" It can be extrapolated from the findings that nurses appear not to be involved in decisions "*related to extubation,*" as these decisions are more likely to be made by the doctors.

Table 4.3 Seniority of doctors responsible for ventilation decisions

		Consultants only		Registrars and above		Residents and above		Other	
		n	%	n	%	n	%	n	%
Q1a	Identify the seniority of doctors responsible for initial ventilation settings.	9	10.0%	60	**66.7%**	19	21.1%	2	2.2%
Q2a	Identify the seniority of doctors responsible for titration of ventilation settings.	11	12.2%	58	**64.4%**	21	23.3%	-	-
Q3a	Identify the seniority of doctors responsible for determining weaning readiness.	12	13.3%	57	63.3%	21	23.3%	-	-
Q4a	Identify the seniority of doctors responsible for determining the method of weaning.	14	15.6%	57	63.3%	19	21.1%	-	-
Q5a	Identify the seniority of doctors responsible for determining readiness for extubation.	18	20.0%	57	63.3%	15	16.7%	-	-
Q6a	Identify the seniority of doctors responsible for determining weaning failure.	9	10.0%	57	63.3%	24	26.7%	-	-

Items Q1a to Q6a on the data collection instrument enquired about the seniority of doctors responsible for ventilator-related decisions. Most (66.7%; n = 19) of the respondents reported the category of registrars and above as the seniority of doctors responsible for ventilation decisions related to determining "*initial ventilator settings*" (item Q1a) and 64.4% (n = 58) for "*titration of ventilation settings*" (item Q2a).

Similarly, some (63.3%; n = 57) of the respondents reported the category of registrars and above as the level of seniority of doctors responsible for "*determining weaning readiness*" (item Q3a), "*method of weaning*" (item Q4a), "*readiness for extubation*" (item Q5a) and "*weaning failure*" (item Q6a), respectively. It can be extrapolated from these findings that senior registrars and above are responsible for key ventilation decisions. However, as nurses

carry sole responsibility for patient monitoring in ICU they are likely to carry more responsibility for decisions related to "*titration of ventilation settings*".

Table 4.4 Seniority of nurses responsible for ventilation decisions

		Senior nurses only		All nurses		Other	
		n	%	n	%	n	%
Q1b	Identify the seniority of nurses responsible for initial ventilation settings.	28	31.1%	49	54.4%	13	14.4%
Q2b	Identify the seniority of nurses responsible for titration of ventilation settings.	35	38.9%	46	51.1%	9	10.0%
Q3b	Identify the seniority of nurses responsible for determining weaning readiness.	28	31.1%	53	**58.9%**	9	10.0%
Q4b	Identify the seniority of nurses responsible for determining the method of weaning.	28	31.1%	52	57.8%	10	11.1%
Q5b	Identify the seniority of nurses responsible for determining readiness for extubation.	39	**43.3%**	41	45.6%	10	11.1%
Q6b	Identify the seniority of nurses responsible for determining weaning failure.	27	30.0%	59	**65.6%**	4	4.4%

Items Q1b to Q6b on the data collection instrument enquired about the seniority of nurses responsible for ventilation-decisions. Most (65.6%; n = 59) of the nurse respondents reported the category of **all nurses** responsible for ventilator-related decisions for determining "*weaning failure*" (item Q6b), followed closely by 58.9% (n = 53), 57.8% (n = 52) and 54.4% (n = 49) for "*weaning readiness*" (item Q3b), "*method of weaning*" (item Q4b) and "*initial ventilation settings*" (item Q1b), respectively.

Less than half (43.5%; n = 39) of the nurse respondents reported the category of senior nurses responsible for ventilator-related decisions for determining "*readiness for weaning*" (item Q3b), and 38.9% (n = 35) of responses determining "*titration of ventilation settings*" (item

Q2b). It can be extrapolated from the findings that all nurses are responsible for ventilation-related decisions.

4.2.1.4 Staffing ratios

This section of the data collection instrument (see **Appendix A**) related to staffing ratios. Two (items Q7 and Q8) items were included in this section. Results of this process are summarised in **Table 4.5** for the total sample.

Table 4.5 Staffing ratios for patients receiving invasive and non-invasive mechanical ventilation

Item	Statement	Frequency	Percentage
Q7	What is the nurse-to-patient ratio for patients receiving mechanical ventilation in your ICU?		
	-1:1 ratio	25	27.8%
	-1:2 ratio	51	**56.7%**
	-1:3 ratio	3	3.3%
	-Other	11	12.2%
Q8	What is the nurse-to-patient ratio for patients receiving non-invasive ventilation in your ICU?		
	-1:1 ratio	22	24.4%
	-1:2 ratio	32	**35.6%**
	-1:3 ratio	11	12.2%
	-Other	25	27.8%

Items Q7 and Q8 on the data collection instrument enquired about the nurse-to-patient ratio. Most (56.7%; n = 51) of the respondents reported a 1:2 nurse-to-patient ratio for patients receiving invasive ventilation, whilst only 27.8% (n = 25) of nurses reported a 1:1 ratio.

Similarly, the largest (35.6%; n = 32) group of the nurse respondents reported a 1:2 nurse-to-patient ratio for patients receiving non-invasive ventilation, whilst only 24.4% (n = 22) responses were reported for a 1:1 ratio. It can be extrapolated from these findings that the nurse-to-patient ratio is exclusively 1:2 for both, invasive and non-invasively ventilated patients.

4.3.1.5 Nursing autonomy and influence

This section of the data collection instrument (see **Appendix A**) was related to nurses autonomy and influence in ventilation decisions. Two (items Q9 and Q10) items were included in this section.

Nurse respondent's perception of the level of nursing autonomy in mechanical ventilation was established "by using a visual analogue scale (VAS) that ranged from 1 (low level) to 10 (high level)." In this study, responses ranged from 1 to 10 with a **Median (IQR) of 6 (range 5-8)** points. **Figure 4.4** presents these results.

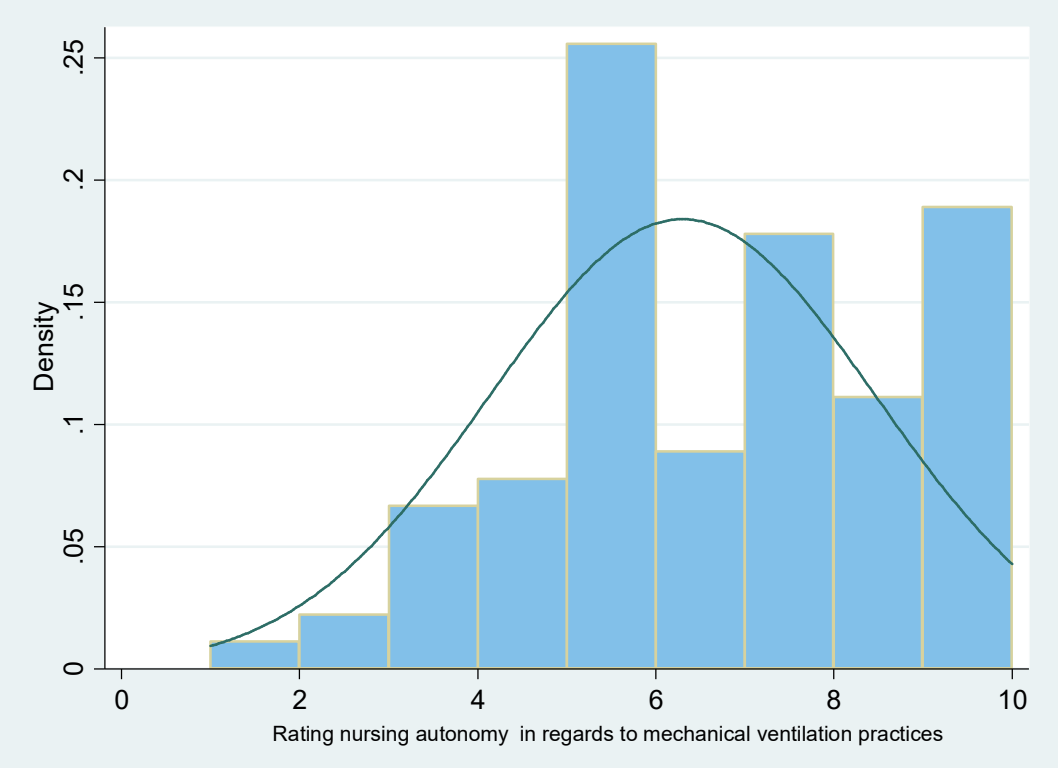


Figure 4.4 Perceptions of nursing autonomy

Similarly, nurse respondent's perception of the level of influence in decisions regarding mechanical ventilation was established by "using a visual analogue scale that ranged from 1 (low influence) to 10 (high influence)." Responses ranged from 1 to 10 with a **Median (IQR) of 6 (range 5 - 8)** points. **Figure 4.5** presents these results.

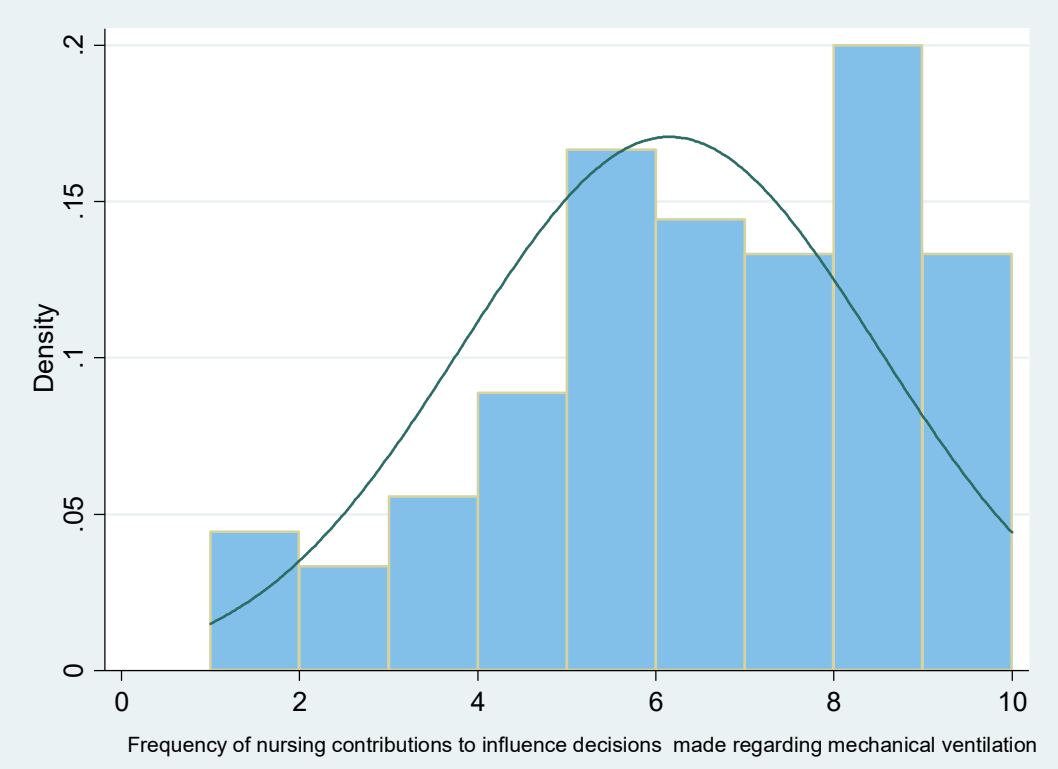
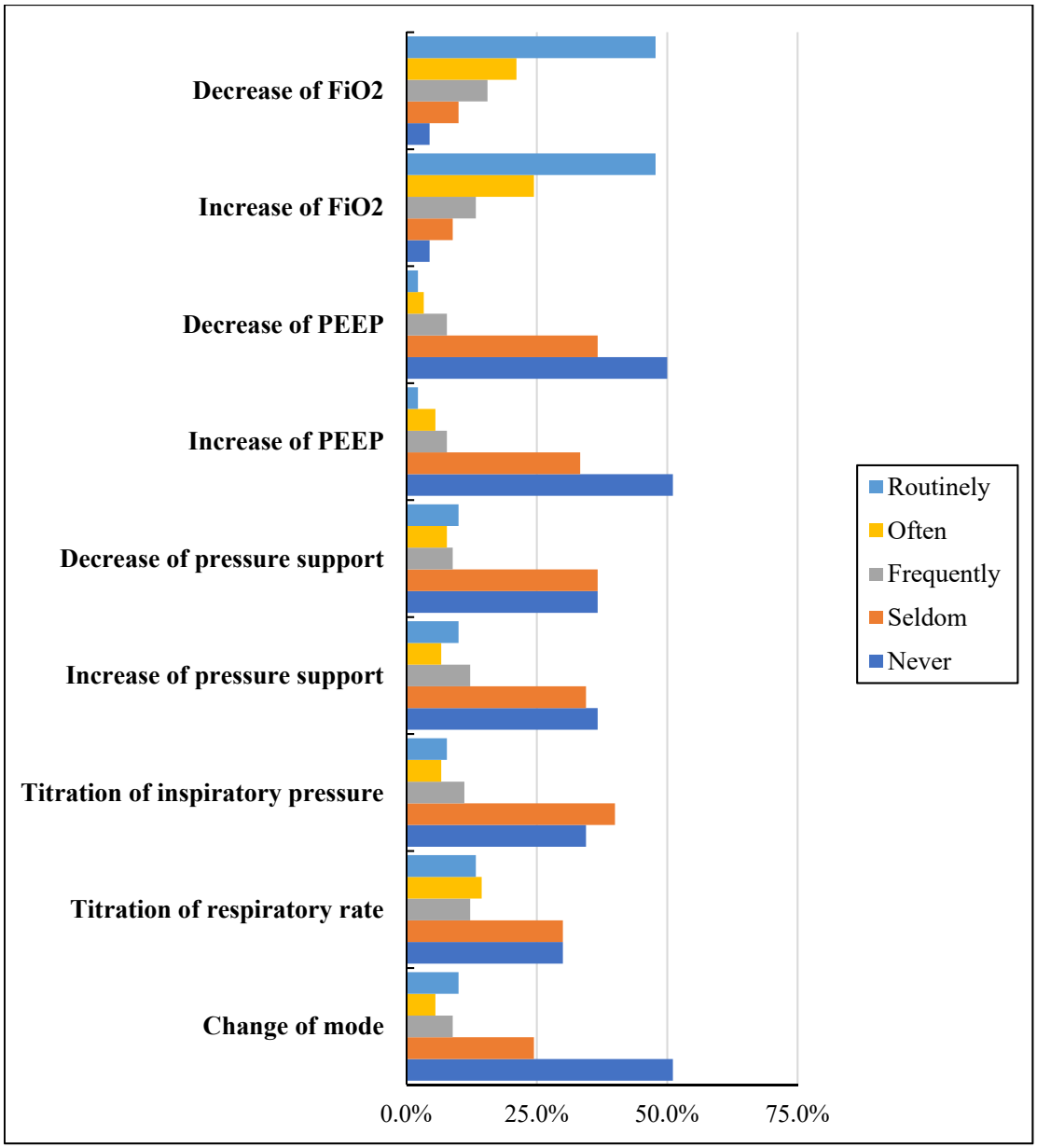


Figure 4.5 Perceptions of nursing influence

4.3.1.6 Independent titrations of ventilator settings

This section of the data collection questionnaire (see **Appendix A**) related to independent titrations of ventilation settings by nurses. One (item Q11) item comprising 10 (sub-items Q11.1 to Q11.10) sub-items was included in this section.

Ventilator settings titrated independently by nurses are shown in **Figure 4.6**.



Key: Never = 0%; Seldom=1-25%, Frequently=26-50%, Often=51-75%, Routinely=>75%

Figure 4.6 Titrations of ventilation settings by nurse respondents

The scores for independent titration in ventilation settings were collapsed to create two groups, whereby (1) = frequently changed (>50% of the time) and (2) = infrequently (<50% of the time). **Table 4.6** displays these results.

Table 4.6 Titrations of ventilation settings by nurse respondents

	Frequently >50% of the time		Infrequently <50% of the time	
	n	%	n	%
Increase of FiO2	66	73.3%	24	26.7%
Decrease of FiO2	63	70.0%	27	30.0%
Titration of respiratory rate	25	27.8%	65	72.2%
Decrease of pressure support	16	17.8%	74	82.2%
Increase of pressure support	15	16.7%	75	83.3%
Change mode	14	15.6%	76	84.4%
Titration of inspiratory pressure	13	14.5%	77	85.6%
Increase of PEEP	7	7.8%	83	92.2%
Decrease of PEEP	5	5.6%	85	94.4%

Key: PEEP=positive end expiratory pressure; FiO2=fraction of inspired oxygen concentration

Table 4.6 shows the titrations of ventilator settings in ranked order, with oxygen settings as the most frequently titrated setting, while PEEP settings were the lowest titrated setting.

4.2.1.7 Protocols and Guidelines

This section of the data collection instrument (refer **Appendix A**) related to use of protocols and guidelines. Four (items Q12 to Q14) items were included in this section. **Table 4.7** presents these results.

Table 4.7 Use of protocols and guidelines

Item	Statement	Yes		No		Uncertain	
		n	%	n	%	n	%
Q12	In your ICU, do you have guidelines/policy/protocol for management of mechanical ventilation?	33	36.7%	39	43.3%	18	20.0%
Q13	In your ICU, do you have a guideline/policy/protocol for weaning from mechanical ventilation?	33	36.7%	44	48.9%	13	14.4%
	If yes, does it contain information on management of patients failing weaning?	39	43.3%	39	43.3%	12	13.3%
Q14	In your ICU, do you have a guideline/policy/protocol for management of non-invasive ventilation?	34	37.8%	39	43.3%	17	18.9%

In this study, only about one-third (36.7%; n = 33) of the nurse's practiced in ICUs in which there were protocols and guidelines for ventilation management (item Q12). Similarly, about one-third (37.8; n = 34) of the respondents had a guideline for non-invasive ventilation management (item Q14). Of those who had protocols and guidelines, 43.3% (n = 39) had "*management of weaning failure*" and 36.7% (n = 33) had "*information for weaning*" (item Q13).

4.2.1.8 Automated weaning

This section of the data collection instrument (see **Appendix A**) related to use of automated weaning. Six (items Q15.1 to Q15.6) items were included in this section.

Table 4.8 presents these results.

Table 4.8 Use of automated weaning

Item		Never/seldom		Frequently, often or routinely		Uncertain	
		n	%	n	%	n	%
Q15.1	Pressure A/C	43	47.8%	43	47.8%	4	4.4%
Q15.2	Pressure SIMV	38	42.4%	49	**54.5%**	3	3.3%
Q15.3	TCPL SIMV	62	**68.9%**	20	22.2%	8	8.9%
Q15.4	TCPL A/C	46	51.1%	34	37.8%	10	11.1%
C15.5	Volume A/C	69	**76.7%**	17	18.8%	4	4.4%
C15.6	Volume SIMV	64	7.1%	20	22.2%	6	6.7%

Key: A/C=Assist Control; SIMV= Synchronised Intermittent Mandatory Ventilation, TCPL= Time-cycled Pressure Limited

A close three-quarters (76.7%; n = 69) of the nurse respondents had not worked in units that have "Volume A/C" modes available. The majority of the nurse respondents had not worked in units with "TCPL SIMV" (68.9%; n = 62), and "TCPL A/C" (51.1%; n = 49).

4.2.1.9 Ventilation management education

This final section of the data collection instrument (see **Appendix A**) related to ventilation education available to nurses in Intensive Care Units. Two (items Q16.1 and Q16.2) items were included in this section. **Table 4.9** presents these results.

Table 4.9 Ventilation management education for nurses in Intensive Care Units

Item	Statement	Yes		No		Uncertain	
		n	%	n	%	n	%
Q16.1	Do nurses receive education on ventilation during ICU orientation?	16	17.8%	72	80.0%	2	2.2%
Q16.2	Are opportunities available for ICU on-going professional development related to mechanical ventilation?	16	17.8%	63	70.0%	11	12.2%

Most (80.0%; n=72) of the nurse respondents indicated that ventilation management education was not provided during orientation in ICU, whilst 70.0% (n = 63) reported that on-going professional development opportunities were not available.

4.2.2 Comparative Results

4.2.2.1 Association between NICU nurses' autonomy and influence on independent decision making to manage mechanical ventilation

The results in Table 4.10 show that a higher rating in nurses' autonomy is associated with a higher influence on independent decision making to manage mechanical ventilation. Years of experience had no influence on independent decision making to manage mechanical ventilation.

Table 4.10: Association between NICU nurses' autonomy and influence on independent decision making to manage mechanical ventilation

	Unadjusted		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Nursing autonomy	1.54 (1.21-1.96)	<0.001*	1.55 (1.22-1.97)	<0.001*
Years of experience	1.06 (0.99-1.13)	0.120	1.06 (0.99-1.15)	0.104

Key: * = statistically significant

4.2.2.2 Association between nursing contributions and influence on independent decision making to manage mechanical ventilation

The results in Table 4.11 show that a higher rating in nursing contributions is associated with a higher influence on independent decision making to manage mechanical ventilation. Years of experience had no influence on independent decision making to manage mechanical ventilation.

Table 4.11: Association between nursing contributions and influence on independent decision making to manage mechanical ventilation

	Unadjusted		Adjusted	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Nursing contributions	1.81 (1.38-2.38)	<0.001*	1.86 (1.40-2.47)	<0.001*
Years of experience	1.06 (0.99-1.13)	0.120	1.09 (0.99-1.20)	0.052

Key: * = statistically significant

4.3 OPEN-ENDED RESPONSES

Participants in this study chose not to elaborate by providing additional information on the space provided on the questionnaire (**Appendix A**) for open comments.

4.4 SUMMARY

This chapter discussed descriptive and comparative statistical tests that were used to describe and analyse the data collected. The data and interpretations of findings supported by the literature discussion were presented.

The following chapter will discuss the main findings of the study, limitations, conclusions and recommendations.

CHAPTER FIVE

SUMMARY OF STUDY, MAIN FINDINGS, RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

The final chapter of the report presents a summary of the study and main findings. This will be followed by a discussion of the limitations of the study and recommendations for clinical practice, nursing education and further research. The chapter concludes with the conclusion from the main findings.

5.2 SUMMARY OF THE STUDY

5.2.1 Purpose of the Study

The purpose of the study was to describe the role of neonatal nurses in the mechanical ventilation management in the NICU at two tertiary academic hospitals.

5.2.2 Objectives of the Study

The objectives of the study were:

- To describe NICU nurses' roles in key mechanical ventilation management practices using a questionnaire adopted from Rose *et al*. (2008).
- To relate the association between NICU nurses' autonomy and influence on independent decision making to manage mechanical ventilation
- To relate the association between nursing contributions and influence on independent decision making to manage mechanical ventilation

5.2.3 Methodology

Prior to commencing with the study, an ethical clearance certificate was obtained from the Human Research Ethics Committee of Witwatersrand University (refer **Appendix D**), followed by approval from the Gauteng Department of Health. Permission to collect data

using the study instrument was obtained from the developer (refer **Appendix H**). Approval to conduct the study was obtained from the Postgraduate Committee of the School of Therapeutic Sciences (refer **Appendix G**), as well as from the institutional management of the two tertiary academic institutions where the study took place (refer **Appendix E** and **Appendix F**).

Two NICUs from two tertiary academic institutions in Gauteng were used along with a cardiothoracic unit from one of the institutions that had neonatal patients. The population target was all professional nurses practicing in the NICUs of the institutions in question; 108 professional nurses were identified. The participants were selected through a census sampling method and a total sample of 90 (n=90) was obtained.

A questionnaire developed by Rose *et al*. (2008) titled "Survey of Mechanical Ventilation and Weaning Roles and Responsibilities" was utilised in the study. A pre-test of the modified instrument, following the three experts' feedback, was conducted to verify its applicability in the NICU context using professional nurse students completing their paediatric specialist training. The questionnaire consists of 34 close-ended multiple-choice questions (refer **Appendix A**). Section A collected the demographic data of all respondents, while section B required data on key ventilation decisions, staffing ratios, nurses' level of autonomy and influence in decision-making. Section D had questions on independent ventilation decisions, mechanical ventilation protocols, automated weaning modes and nurses' education on mechanical ventilation.

This study's objectives were met by using a non-experimental descriptive quantitative design. Data was analysed using descriptive and comparative statistics with the assistance of a statistician.

5.3 SUMMARY OF MAIN RESEARCH FINDINGS

In this current study, the demographic data showed that the largest group (35.6%) of nurse respondents were between the ages 30 to 39 years. Only about one third of the respondents had an additional qualification in Critical Care nursing (25.6%) and Child nursing (10.0%), respectively. In comparison to findings from a study by Rose *et al.* (2007) and Ladipo (2017) where the majority of the nurses (75.0% and 100% respectively) held a Critical Care

qualification, this number was reported to be higher than in other countries. It is evident that there is a need for more Intensive Care and Child-nursing trained nurses in the ICUs. According to the Australian Health Workforce Advisory Committee and The Australian College of Critical Care Nurses, the recommendation for nurses employed in the ICU is that a minimum of 50% of the nurses must have a postgraduate qualification (Rose *et al.,* 2007).

Forty-two percent (42.0%) of nurse respondents were shift leaders, which means they had additional responsibilities; however, shift leaders were not allocated to a patient. This is slightly less than the fifty-two percent (52%) nurse respondents which were shift leaders in the findings from a local study by Ladipo (2017). Around 28.9% of respondents had less than 10 years of experience in the respective Intensive Care Unit, which shows there are fewer nursing experts available in these ICUs. In this study, 54% of nurses practiced in a neonatal unit.

The organisation and structure of the unit data showed the majority (56.7%) of the nurses reported a 1:2 nurse-to-patient ratio for invasive mechanical ventilation; similarly, 35.6% reported a 1:2 nurse-to-patient ratio for non-invasive mechanical ventilation. This is in contrast with Ladipo (2017), where were majority of the respondents (97, 3%) reported a 1:1 nurse-to-patient ratio for mechanically ventilated patients. An international survey conducted by Haughdal *et al*. (2013), found that in 92% of Norwegian ICUs the nurse to patient ratio for intubated patients was 1:1 and 69.0% of these ICUs had a nurse to patient ratio of 1:1 for patients receiving non-invasive mechanical ventilation. Similarly, findings from a local study by Ladipo (2017) indicated 97.3% of respondents had reported a nurse to patient ratio of 1:1.

Eighty percent of nurses reported that ventilation management education was not provided during Intensive Care Unit orientation and 70.0% indicated they were not offered on-going training. This is a significant difference in comparison to findings from Ladipo (2017) as the majority (89% and 86, 4%) of the respondents reported to have received ventilation management education during orientation and had been offered on-going education respectively. In this study three-quarters of nurses reported they had not worked in units that used automated weaning modes, whereas in the adult ICU study most (86%) respondents reported to be working in units with automated weaning modes (Ladipo, 2017). In comparison to Blackwood *et al's* (2013) data, 18.0% of PICUs reported limited use of

automated modes versus 55% in Adult ICUs, the lack of use thereof is believed to be due to little evidence, which supports the benefits of automated modes (Blackwood *et al.,* 2013). Findings from a study by Henderwood (2015) revealed there is a rise in the adoption of utilising automated ventilation modes in New Zealand's ICUs, with the majority of nurses (69.0%) reportedly using these modes, and 75% of these nurses said to be using the modes more frequently (>50% of the time). Thirty-six percent of nurses in this study, reported that weaning protocols were present in Intensive Care Units in contrast to 59% in the study by Ladipo (2017), and similarly, 43.3% reported the presence of protocols for the management of weaning failure. These results are slightly comparable to those of a local study, which incorporated all ICUs where a larger number (59.1% and 56.4%) of nurse respondents reported the presence of mechanical ventilation protocols and protocols for weaning failure respectively.

The *first objective* was to describe nurse's collaborative practices in key ventilator decisions and acting independently in titration ventilator settings.

Regarding key ventilator decisions, the findings showed that most nurses agreed that nurses and doctors collaborated on the titration of ventilation settings (90.0%), weaning readiness (85.6%), and weaning failure (80.0%). Similarly, this was reflected in the Norwegian survey, where 61.0% versus 82.0% of physician directors and nursing managers, respectively, reported collaboration of nurses and physicians in determining patients' weaning readiness. Contrasting with this, most nurses reported that doctors are less likely to collaborate with nurses when decisions to extubate the patient (54.4%) are made. These results contrast with those of a local study by Ladipo (2017), which revealed 74.6% of nurse respondents were less likely to collaborate with doctors in deciding patients' extubation readiness; this could indicate a common practice in this setting.

This study observed a marginal (2.2%) number of nurses input in making key ventilator decisions. Sixty percent of nurses in this study agreed the responsibility for ventilation decision lies at the level of seniority of a medical registrar and above. In their absence, all nurses (>50%), as opposed to only senior nurses (<30%), were perceived responsible for key ventilation decisions. This is in contrast with international findings, which suggested that senior nurses and senior doctors were greater contributors of inter-professional collaboration

in key ventilation decision making as opposed to their subordinates in the respective disciplines (Blackwood *et al.,* 2013)

Regarding independent titrations of ventilator settings without direct medical consultation, findings showed that nurses in this study reported a frequency of >50% of the time for an increase FiO2 (73.3%), decrease FiO2 (70.0%), titration of respiratory rate (27.8%), decrease pressure support (17.8%), increase pressure support (16.7%), change ventilation mode (15.6%), titration of inspiratory pressure (14.5%), increase PEEP (7.8%) and decrease in PEEP (5.6%). Haugdahl *et al.* (2013) and Rose *et al. (*2007) also revealed that the decision to adjust FiO2 was the most frequently made by the nurse independently, as seen in this study.

The *second objective* was to relate the association of nurses' autonomy and influence in decision making to independent titration of ventilator settings.

Relating to the level of nursing autonomy and influence in decision-making, findings revealed a median score of 6.0 for both. This suggests nurse respondents in this study perceived themselves to have reasonable levels of autonomy and influence in decision-making. These results lie midway in comparison to the Norwegian survey, which stated that nurse managers perceived nurses to have a higher level of autonomy and influence (median scores of 7 and 8) as opposed to doctors, who reported a different level of nurses autonomy and influence (M=5 and M=7) respectively (Haugda*hl et al.,* 2013).

In this study, nurses with a higher level of autonomy scores frequently (>50% of the time) titrate "respiratory rate, inspiratory pressure, increase pressure support and decrease pressure support" ($p<0.05$). Similarly, nurses with higher levels of influence in decision making mean scores frequently (>50% of the time) titrated "change of mode, respiratory rate, inspiratory pressure, increase pressure support, decrease pressure support, increase, increase PEEP, decrease PEEP" ($p<0.05$). The results are relatively comparable to those of Rose's (2008) findings, whereby independent decisions by nurses in adjusting FiO2, ventilation rate and pressure support were noted to be more frequent.

In this study, the role of the nurses who worked in units with weaning protocols frequently (>50% of the time) titrated "change of mode, respiratory rate, inspiratory pressure, increase pressure support, decrease pressure support and decrease PEEP." It could be argued that the

presence of protocol can enhance nurses' level of autonomy in decision making, as noted in the study of Blackwood *et al.* (2013).

The *third objective* was to identify the nurses' level of independent decision making in oxygen and PEEP titrations.

Regarding independent titrations made to ventilation settings, 73% of the nurses reported independent titrations with oxygen settings as the most frequently titrated setting, while positive end-expiratory pressure settings were the least (<7,8%) titrated setting; similar findings were also reflected in Henderwood (2015) and Haugdahl (2013). This difference may account for the fact that changes to oxygen settings are less complicated for a nurse to make than making changes to positive end-expiratory pressure settings.

Nurses with higher-level influence in decision making, who worked in units with weaning protocols, scored frequently (>50% of the time) titrate positive end-expiratory pressure ($p<0.05$). In contrast, nurses with a higher level of experiences scored frequently (>50% of the time) titrate oxygen settings ($p<0.05$). This contrasted with the findings from Henderwood (2015) in one New Zealand study, which stated that the presence of ventilation protocols did not show any statistical influence on nurses' decision-making in any of the ventilation settings. Although some studies have proven that the presence of protocols resulted in an increase in nurses' decision-making, the medically orientated nature of these protocols does not warrant a true definition of nurses' autonomy in clinical decision-making (Rose *et. al.,* 2008; Wongrastrai *et. al.,* 2014).

5.4 LIMITATIONS OF THE STUDY

The following limitations in this study are worth noting:

- The use of convenience sampling plus a small sample.
- The use of level three Neonatal Intensive Care Units at two tertiary public sector hospitals

Generalisation of findings are restricted by the abovementioned limitations, however replication of the study in other Neonatal Intensive Care Units of other public sector hospitals should be undertaken to support or oppose these findings.

There is insufficient literature on the role of nurses in the mechanical ventilation management in the NICU from a South African perspective. Literature indicates there are studies that have focused on the role of Intensive Care nurses in the mechanical ventilation management in adult ICUs (Ladipo, 2017). Based on findings of this study, the following recommendations are made:

5.5 RECOMMENDATONS

5.5.1 Recommendations for Clinical Practice

Findings of the study showed the majority of NICU nurses display a borderline level of autonomy and influence in clinical practice where key mechanical ventilation management decisions are concerned. Moreover, they were not accustomed to the use of mechanical ventilation management protocols. These results coincide with findings of previous studies. NICU nurses should be sensitised to the idea of mechanical protocol usage. Just as in the previous local study, a nurse-led mechanical ventilation management protocol is recommended to assist in enhancing the autonomous decision making practices of NICU nurses.

5.5.2 Recommendations for Nursing Education

It is evident from current and previous study findings that NICU nurses are limited in terms of being afforded opportunities for ongoing professional development in mechanical ventilation management. It is therefore recommended that programmes be put in place to reinforce nurses' knowledge; this may include educational orientation programmes for newly appointed nurses in the NICUs, as well as continued in-service training that incorporates evidenced-based practice and multidisciplinary involvement in these trainings.

5.5.3 Recommendations for Further Research

The study was conducted at two institutions, and therefore findings obtained could only afford the researcher's generalisation to be based on those two institutions. It is recommended that a replication of this study from a larger population in other local public sector NICUs be undertaken in order to support findings of this study. A qualitative study exploring nurses' perceptions with regard to their role in mechanical ventilation management is also recommended.

5.6 CONCLUSION

The purpose of this study was to describe the role that NICU nurses in two tertiary academic institutions in Gauteng play during mechanical ventilation management. The aim was to clarify this role in order to facilitate a better understanding of what is expected of an NICU nurse during this therapeutic treatment and to ensure efficient patient care. Interdisciplinary collaboration appeared to be one well-established role demonstrated in the findings, with nurses displaying a borderline level of autonomy and influence in key decisions made during mechanical ventilation management, including weaning.

The use of mechanical ventilation management protocol appears to be lacking amongst nurses. Only one third of the nurses in the study reported the presence of mechanical ventilation weaning protocols. It was also observed that a large number of nurses in the NICU reported that ventilation management education was not provided during their orientation and small number of nurses practicing in the NICU held a postgraduate critical care qualification or a postgraduate child nursing qualification, which raises the need for continued professional development through on-going training programmes. The role of an NICU nurse therefore still requires further clarification.

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APPENDIX A

NURSES' ROLE IN MECHANICAL VENTILATION WEANING PRACTICES IN NEONATAL INTENSIVE CARE UNITS IN ACADEMIC TERTIARY CARE

SECTION A: Biographical Data

1. What age group do you belong to:

20-29 years	
30-39 years	
40-49 years	
50-60 years	
>60 years	

2. Please list your nursing academic qualifications

3. State the year you qualified (years of experience) as an Intensive Care nurse

4. Indicate your position in the ICU by ticking one of the following:

ICU nurse	Shift leader	Unit manager

5. Indicate your clinical area by ticking one of the following:

Neonatal ICU	
Paediatric ICU	
Cardiothoracic ICU	

SECTION B: KEY VENTILATION DECISIONS, STAFFING RATIOS, AUTONOMY AND INFLUENCE

1. Who determines the initial selection of ventilator settings?

a	Doctors only	
b	Nurses only	
c	Doctors and nurses in collaboration	
d	Other	

If other, please specify _____

1.1 Identify the seniority of doctors responsible for initial selection of ventilator settings

a	Consultants only	
b	Registrars and above	
c	Interns and above	
d	Other	

If other, please specify _____

1.2 If applicable, the seniority of nurses responsible for initial selection of ventilator settings

a	Senior nurses only (e.g. clinical nurse specialists, nurse managers, educators	
b	All nursing staff (once orientated to the ICU environment)	
c	Other	

If other, please specify _____

2. Who evaluates the patient's response to mechanical ventilation and titrates settings if required?

a	Doctors only	
b	Nurses only	
c	Doctors and nurses in collaboration	
d	Other	

If other, please specify _____

2.1 Identify the seniority of doctors responsible for titration of ventilator settings

a	Consultants only	
b	Registrars and above	
c	Interns and above	
d	Other	

If other, please specify _____

2.2 If applicable, identity the seniority of nurses responsible for titration of ventilator settings

a	Senior nurses only (e.g. clinical nurse specialists, nurse managers, educators)	
b	All nursing staff (once orientated to the ICU environment)	
c	Other	

If other, please specify _____

3. Who decides when a patient is ready to wean?

a	Doctors only	
b	Nurses only	
c	Doctors and nurses in collaboration	
d	Other	

If other, please specify _____

3.1 Identify the seniority of doctors responsible for determining weaning readiness

a	Consultants only	
b	Registrars and above	
c	Interns and above	
d	Other	

If other, please specify _____

3.2 If applicable, identify the seniority of nurses responsible for determining weaning readiness

a	Senior nurses only (e.g. clinical nurse specialists, nurse managers, educators)	
b	All nursing staff (once orientated to the ICU environment)	
c	Other	

If other, please specify _____

4. Who decides the method of weaning from mechanical ventilation?

a	Doctors only	
b	Nurses only	
c	Doctors and nurses in collaboration	
d	Other	

If other, please specify _____

4.1 Identify the seniority of doctors responsible for determining the method of weaning

a	Consultants only	
b	Registrars and above	
c	Interns and above	
d	Other	

If other, please specify _____

4.2 If applicable, identify the seniority of nurses responsible for determining the method of weaning

a	Senior nurses only (e.g. clinical nurse specialists, nurse managers, educators)	
b	All nursing staff (once orientated to the ICU environment)	
c	Other	

If other, please specify _____

5. Who decides when a patient is ready to extubate?

a	Doctors only	
b	Nurses only	
c	Doctors and nurses in collaboration	
d	Other	

If other, please specify _____

5.1 Identify the seniority of doctors responsible for determining readiness for extubation.

a	Consultants only	
b	Registrars and above	
c	Interns and above	
d	Other	

If other, please specify _____

5.2 If applicable, identify the seniority of nurses responsible for determining readiness for extubation.

a	Senior nurses only (e.g. clinical nurse specialists, nurse managers, educators)	
b	All nursing staff (once orientated to the ICU environment)	

c	Other	

If other, please specify _____

6. Who decides when a patient is failing a weaning trial?

a	Doctors only	
b	Nurses only	
c	Doctors and nurses in collaboration	
d	Other	

If other, please specify _____

6.1 Identify the seniority of Doctors responsible for determining weaning failure

a	Consultants only	
b	Registrars and above	
c	Interns and above	
d	Other	

If other, please specify _____

6.2 If applicable, identify the seniority of nurses responsible for determining weaning failure

a	Senior nurses only (e.g. clinical nurse specialists, nurse managers, educators)	
b	All nursing staff (once orientated to the ICU environment)	
d	Other	

If other, please specify _____

7. What is the nurse-to-patient ratio for patients receiving mechanical ventilation in your ICU?

a	1:1 ratio	
b	1:2 ratio	
c	1:3 ratio	
d	Other	

If other, please specify _____

8. What is the nurse-to-patient ratio for patients receiving non-invasive ventilation in your ICU?

a	1:1 ratio	
b	1:2 ratio	
c	1:3 ratio	

d	Other	

If other, please specify _____

9. How would you rate nursing autonomy with regard to mechanical ventilation practices? Please circle the number on the scale below (10 represents the highest level of autonomy and 1 represents the lowest level).

1	2	3	4	5	6	7	8	9	10

10. How often do nursing contributions influence decisions made regarding mechanical ventilation? Please circle the number on the scale below (10 represents very often and 1 represents seldom).

1	2	3	4	5	6	7	8	9	10

SECTION C: INDEPENDENT VENTILATION DECISIONS, PROTOCOLS, AUTOMATED WEANING AND NURSE EDUCATION

1. How often do nurses make and implement the following decisions independently? (without direct consultation with a doctor):

	Never (0%)	Seldom (25%)	Frequently (26-50%)	Often (51-75%)	Routinely (>75%)	Uncertain
1.1 Change of mode						
1.2Titration of respiratory rate						
1.3 Titration of inspiratory pressure						
1.4 Increase of pressure support						
1.5 Decrease of pressure support						
1.6 Increase of PEEP						
1.7 Decrease of PEEP						
1.8 Increase of FiO2						
1.9 Decrease of FiO2						

2. In your ICU, do you have guidelines/policy/protocol for management of mechanical ventilation?

Yes		No		Uncertain	

3. In your ICU, do you have a guideline/policy/protocol for weaning from mechanical ventilation?

Yes		No		Uncertain	

3.1 If yes, does it contain information on management of patients failing weaning?

Yes		No		Uncertain	

4. In your ICU, do you have a guideline/policy/protocol for management of non-invasive ventilation?

Yes		No		Uncertain	

5. Are there any automated weaning modes used in your ICU? Please add any other modes in empty boxes provided below (if applicable)

	Never (0%)	Seldom (25%)	Frequently (26-50%)	Often (51-75%)	Routinely (>75%)	Uncertain
5.1 Pressure A/C						
5.2 Pressure SIMV						
5.3 TCPL SIMV						
5.4 TCPL A/C						
5.5 Volume A/C						
5.6 Volume SIMV						

6. Do nurses receive education on ventilation during ICU orientation?

Yes		No		Uncertain	

6.1 If YES please describe (optional)

7. Are opportunities available in your ICU for on-going professional development related to mechanical ventilation?

Yes		No		Uncertain	

7.1 If YES please describe (optional)

THANK YOU FOR TAKING THE TIME TO COMPLETE THE QUESTIONNAIRE

APPENDIX B

NURSES' ROLE IN MECHANICAL VENTILATION MANAGEMENT IN NEONATAL INTENSIVE CARE UNITS IN ACADEMIC TERTIARY CARE

INFORMATION LETTER

Dear Colleagues
My name is Tsholofelo Matlhola and I am a student enrolled in the Masters' in Child Nursing programme at the University of the Witwatersrand. As part of my study programme, and in order to complete my requirements for this programme, I am required to conduct a study under the supervision of Dr. Ntombifikile Klaas, my research supervisor.

The purpose of the study is to describe the role of professional nurses in the mechanical ventilation management in NICU at a tertiary academic hospital. This is done with the aim of ultimately making recommendations that will inform clinical practice and in-service training on mechanical ventilation management.

I would therefore like to invite you to participate in the study; participation is voluntary. You may choose not to participate or to withdraw from the study at any given time and this will not be held against you. Please note that your completion and posting of the questionnaire in the sealed box provided in the unit indicates you have consented to participate in the study.

Please be informed that the study will be conducted in the form of a questionnaire consisting of three sections with 34 items, which should take about 5 – 10 minutes of your time. Any information gathered during this study, which is identifiable to you, will remain anonymous and confidential and will only be accessible to the supervisor and myself. You have the right to withdraw from the study at any given time and this will not be held against you. The report of the study will be submitted to the University of the Witwatersrand Nursing Department and results can be made available to you should you wish.

If you have further questions you would like to ask before making a decision, please feel free to contact me on 0767147019, or email me on 369660@students.wits.ac.za.

Further enquiries concerning the study can be made to the University of Witwatersrand Human Research Ethics Committee (Medical) personnel as follows: Professor Clement Penny – Chairperson - on (011)7172301, or email Clement.Penny@wits.ac.za
Ms. Zanele Ndlovu - Administrative officer - on (011)7171252/1234/2700/2656, or email zanele.ndlovu@wits.ac.za

Thank you for taking the time to read this letter.

Yours Sincerely,

_____
Tsholofelo Matlhola: MSC Child Nursing Student

Dr. N. Klaas: Research Supervisor

APPENDIX C

NURSES' ROLE IN MECHANICAL VENTILATION MANAGEMENT IN NEONATAL INTENSIVE CARE UNITS IN ACADEMIC TERTIARY CARE

CONSENT FORM FOR PARTICIPATION IN THE STUDY

I _____(Name of participant), give permission to be included in this research study.

I have read and understood the contents of the information sheet. I have also been given the opportunity to ask questions regarding the procedure and my consent to being included in the study.

I hereby declare my voluntary participation in the study.

Date ……... Signature ……

APPENDIX D

Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Miss Tsholofelo Matlhola

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180920

NAME: (Principal Investigator)	Miss Tsholofelo Matlhola
DEPARTMENT:	School of Therapeutic Sciences Nursing Education
PROJECT TITLE:	Nurses' role in mechanical ventilation management in neonatal instensive care units in academic tertiary care
DATE CONSIDERED:	28/09/2018
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Ms S Khoza, Dr N Klaas and Prof S Schmollgruber
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	07/12/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in **September** and will therefore be due in the month of **September** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date 18/12/2018

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX E

Approval Letter from Hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Enquiries:
Ms. G. Ngwenya
Office of the Nursing Director
Tell: (011): 488-4558
Fax: (011): 488-3786
27 December 2018

Ms. Tsholofelo Matlhola
Department of Nursing Education
University of Witwatersrand
NHRD REF: GP_201811_004

Dear. Tsholofelo Matlhola

RE: **"Nurses' role in mechanical ventilation management in neonatal intensive care units in tertiary care"**

Permission is granted for you to conduct the above recruitment activities as described in your request provided:

1. [redacted] Academic hospital will not in anyway incur or inherit costs as a result of the said study.
2. Your study shall not disrupt services at the study sites.
3. Strict confidentiality shall be observed at all times.
4. Informed consent shall be solicited from patients participating in your study.

Please liaise with the Head of Department and Unit Manager or Sister in Charge to agree on the dates and time that would suit all parties.

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

Supported / not supported
pp Ms. M Pule
Ms. M.M Pule
Nursing Director
Date: 27/12/18

Approved / not approved
Ms. G. Bogoshi
Chief Executive Officer
27.12.2018

APPENDIX F

Approval from Hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

PERMISSION TO CONDUCT RESEARCH

Date: 10th December 2018

TITLE OF PROJECT:

Nurses' Role in Mechanical Ventilation Management in Neonatal Intensive Care Units in Academic Tertiary Care.

UNIVERSITY: Witwatersrand

Principal Investigator: T P Matlhola

Department: Paediatrics

Supervisor : Dr N Klaas

Permission Head Department (where research conducted): Yes

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Academic Hospital. The CEO / management of Chris Hani Baragwanath Academic Hospital is accordingly informed and the study is subject to:-

- Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.
- The Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- The MAC will be informed of any serious adverse events as soon as they occur
- Permission is granted for the duration of the Ethics Committee Approval.

Recommended
(On behalf of the MAC)
Date: 10/12/2018

Approved/Not Approved
Hospital Management
Date: 12 12 2018

APPENDIX G

Postgraduate Approval Letter

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050

Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

29 September 2020
Person No: 369660
PAG

Miss TP Matlhola
P O Box 1195
Kuruman Central
8462
South Africa

Dear Miss Tsholofelo Matlhola

Master of Science in Nursing: Approval of Title

We have pleasure in advising that your proposal entitled *Nurses' role in mechanical ventilation management in neonatal intensive care units in academic tertiary care* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

100 1922 2022

APPENDIX H

Permission To Use Instrument

Dear Shelley+
Of course your student can have my permission to use the tool. I would ask that we are acknowledged as the source in any presentations and publications. I would also love to receive a copy of her results.
Kind regards
Louise

From: Shelley Schmollgruber [mailto:schmoll@iafrica.com]
Sent: Thursday, March 16, 2016 4:18 AM
To: Louise Rose
Subject: Request for permission

Dear Professor Rose,
My name is Shelley Schmollgruber, I am the Postgraduate Research Coordinator in the Department of Nursing, University of the Witwatersrand in Johannesburg, South Africa.

I am currently supervising an MSc student who has identified one of the instruments developed by you as suitable for her study design. The article is entitled: Decisional responsibility for mechanical ventilation and weaning: an international survey. Published in Critical Care, 2001: 15-R295. The student will be conducting the study in two major university-affiliated public hospitals.

Our student has accessed the instrument used in this study from the additional files of the above-mentioned publication. However, as this student is undertaking formal studies, our University policies require that she obtain written permission from the developer of the instrument.

Would you please be so kind and consider our request to use the instrument in her study. I anticipate the student would complete the study within the next three months. It is our university policy for the award of the degree that the student prepares a manuscript for consideration for publication.

A short email response from you will be sufficient for our purpose of having obtained permission.

Kind regards

APPENDIX I

Language Editing and Proofing

Gill Smithies

Proofreading & Language Editing Services

59, Lewis Drive, Amanzimtoti, 4126, Kwazulu Natal

Cell: 071 352 5410 E-mail: moramist@vodamail.co.za

Work Certificate

To	Dr. Shelley Schmollgruber
Address	Wits Dept. of Nursing Education
Date	09/04/2020
Subject	Thesis: NURSES' ROLE IN THE MECHANICAL VENTILATION MANAGEMENT IN NEONATAL INTENSIVE CARE UNITS IN ACADEMIC TERTIARY CARE
Ref	SS/GS/31

I, Gill Smithies, certify that I have proofed the following for language, grammar and style:

Nurses' role in the mechanical ventilation management in Neonatal Intensive Care Units in academic tertiary care: Chapters 1 to 5 and Appendices, by T. Matlhola, to the standard as required by Wits Dept. of Nursing Education.

Gill Smithies