The Use of Knowledge of Respiratory Physiology in Critical Care Nurses' Clinical Decision-making

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Arts

in

Nursing

at Massey University, Albany,

New Zealand.

Alison Margaret Pirret

2005

ABSTRACT

The knowledge and experience of expert nurses has long been recognised as contributing to early identification of patient problems, early intervention and an improved patient outcome. The present study sought to answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? An evaluation methodology using a managerial perspective was used to compare the use of knowledge of respiratory physiology in critical care nurses' clinical decision-making with the respiratory physiology recommended in the *New Zealand Standards for Critical Care Nursing Education* (Critical Care Nurses' Section, 2000).

Using intensity sampling, 27 nurses who had completed a critical care specialty practice programme and who were currently working in the critical care units of two tertiary hospitals in a large metropolitan city within New Zealand were selected. Quantitative and qualitative methods were used to collect data. Data analysis was completed using descriptive statistics, correlations and identification of common terms and themes.

The results showed that following completion of a critical care programme, critical care nurses demonstrated a low to medium level of knowledge of respiratory physiology in their clinical decision-making. In the total group, no statistically significant associations were found between the use of knowledge of respiratory physiology in clinical decision-making and age, experience, academic level, use of guidelines and protocols, standards and integrated care pathways, conference attendance, reading of journals and accessing the World Wide Web for literature. Qualitative analysis identified factors contributing to the low to medium use of knowledge as being nurses' high reliance on intuitive knowledge, lack of in-depth discussion of respiratory concepts in critical care programmes, lack of opportunity in the clinical practice environment to discuss respiratory physiology and lack of collaborative practice.

The study identified the need for more collaborative practice and for clinical nurse educators firstly, to have a closer relationship with the critical care programme providers to ensure adequate theoretical content and secondly, to work with nurses in the clinical setting.

PREFACE

This thesis is titled *The use of knowledge of respiratory physiology in critical care nurses' clinical decision-making*. The research has been completed to fulfil the requirements of a Masters of Arts (Nursing) degree through Massey University. The researcher for this study is Alison Pirret, who is employed as a registered nurse, intensive care, Middlemore Hospital and is also self-employed as a clinical nurse specialist intensive/acute care.

The primary supervisor for this thesis is Stephen Neville, Lecturer, School of Health Sciences – Albany, Massey University. The secondary supervisor for this research is Dr. Nick Nicol, Senior Lecturer, School of Health Sciences – Albany, Massey University.

Researcher

Alison Pirret
RN ICU Cert BA
Student
Master of Arts (Nursing)
Massey University, Albany
3 Jill Place
Manurewa
Auckland
Phone: 09 267 7323
Mobile: 021 112 6321
Email address: Pirret@xtra.co.nz

Primary Supervisor
Stephen Neville
RN, MA(Hons), FCNA(NZ)
Lecturer
School of Health Sciences - Albany
Massey University
Private Bag 102 904 NSMC
Auckland.
Phone: 09 443 9700 ext 9065
Email address: S.J.Neville@massey.ac.nz

Secondary Supervisor
Nick Nicol
RN BSc(Hons) PhD MRSNZ
Senior Lecturer
School of Health Sciences - Albany
Massey University
Private Bag 102 904 NSMC
Auckland.
Phone: 09 443 9700 ext 9070
Email address: N.Nicol@massey.ac.nz

Acknowledgements

The author of this research would like to acknowledge the research supervisors for their contribution in providing the valuable critique, which enabled this thesis to develop, and also the study participants and critical care units involved in this study, for their ongoing support during the study period.

Approval for this research was obtained from both the Massey University Human Ethics Committee and the Regional Ethics Committee. Due to the requirement to maintain confidentiality and anonymity of the participants and critical care units involved in this study, the specific Regional Ethics committee will not be named in this document.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TEXT BOXES

CHAPTER ONE: INTRODUCTION

The knowledge and experience of expert nurses has long been recognised as contributing to early identification of patient problems, early intervention and a positive patient outcome (White, 2003). Within the critical care specialty, critical care nursing knowledge and skills have been identified as important factors in achieving improved patient outcomes (Thorens, Kaelin, Jolliet & Chevrolet, 1995). A telephone survey by Endacott and Dawson (1997) showed that critical care nurses frequently review and alter planned interventions in response to changes in patient condition. The critical care nurse's ability to proactively predict and prevent complications, perform skilled and timely reduction in sedation, weaning from the ventilator, physical rehabilitation and psychological support have been identified as contributing to a reduction in complications and length of critical care stay (Galley & O'Riordan, 2003; Thorens et al., 1995). The critical care nursing profession's contribution to improving patient outcomes is evident in the ever-increasing amount of new research-based knowledge published in medical and nursing journals (Chaboyer, Dunn & Najman, 2000). The introduction discusses critical care nursing knowledge and skill development within the New Zealand context, outlines the research question and aims of the study and provides an overview of the thesis. Critical care nursing knowledge and skill development within the New Zealand context will be discussed first.

The New Zealand context

In New Zealand, the pursuit of critical care nursing knowledge and skills began soon after the early establishment of critical care units in the early 1960's. By the 1970's, post-registration critical care nursing programmes had been developed to provide nurses with the required specialty knowledge (Cribb, 1992). Today, nurses' education preparation needs have mostly been replaced by post-graduate critical care nursing programmes. The first New Zealand critical care nursing philosophy and standards outlined the requirement for nurses to have an ongoing education process and a commitment to the pursuit of knowledge and skills (Intensive Therapy Section, 1985; Pirret, 1994). This ongoing commitment to the development of clinical expertise through the pursuit of knowledge and skills is emphasised in the more

recent *Philosophy and Standards for Nursing Practice in Critical Care* (Critical Care Nurses' Section, 2002) and the *New Zealand Standards of Critical Care Nursing Education* (Critical Care Nurses' Section, 2000). The *Philosophy and Standards for Nursing Practice in Critical Care* contains a belief statement clearly outlining the obligation that critical care nurses have to utilising sound research-based knowledge in their practice, and work in partnership with members of the interdisciplinary team, to achieve a positive patient outcome. The *New Zealand Standards of Critical Care Nursing Education* provide the foundations for critical care curriculum development and recommend the physiological knowledge that enhances critical care nursing knowledge and skills.

The research question and aims of study

Although physiological knowledge has been outlined in the *New Zealand Standards of Critical Care Nursing Education* (Critical Care Nurses Section, 2000), since its publication there has been no quantitative or qualitative evidence that nurses are using this type of knowledge in their clinical practice. The Critical Care Nurses' Section has an interest in the professional development of critical care nurses. Hence, it is valuable to know whether the combination of a critical care specialty practice programme and the critical care practice environment enables nurses to use knowledge of physiology in their clinical decision-making.

The aim of this study is to answer the following research question: following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? Knowledge of respiratory physiology has been chosen over physiology of other body systems as all critical care patients require some type of respiratory care, either because of their primary respiratory problem or a respiratory problem associated with their primary illness. Hence knowledge of respiratory physiology is a common requirement of all nurses caring for patients in the critical care environment. There is no previous research that answers this research question.

Overview of the thesis

This thesis will be presented in seven chapters: introduction, literature review, research design, data analysis techniques, results, discussion and conclusion.

Chapter One: Introduction

The introduction has outlined the importance of critical care nurses' knowledge and experience in improving patient outcomes, and the historical development of critical care nurses' knowledge and skills in New Zealand. This chapter also introduces the research question and aims of the study.

Chapter Two: Literature review

The literature review describes the processes taken to identify the literature relevant to this research topic, the definition of clinical decision-making, an overview of decision-making theory, intuitive and analytical decision-making processes, an overview of factors that influence clinical decision-making, and critique of the literature discussed.

Chapter Three: The research design

The research design presents the theoretical framework, methodology and method used to answer this study's research question, strategies used to ensure a sound research process, ethical considerations, and mode of participant selection.

Chapter Four: Data analysis

Chapter four provides a brief overview of software programmes used to analyse the research data and the number of participants included in the data analysis. It is followed by a description of the specific quantitative and qualitative techniques utilised to examine the data.

Chapter Five: Results

Chapter five presents the results of the study, including participant demographics, factors that influence the professional culture within the critical care unit, access to

ongoing knowledge development, knowledge of respiratory physiology, factors that influence clinical decision-making, and issues raised in the general discussion.

Chapter Six: Discussion

Chapter six discusses the key finding of this study in relation to the New Zealand context and the international literature. It outlines the limitations of the research and future directions resulting from the thesis.

Chapter Seven: Conclusion

Chapter seven provides a summation of the thesis.

Summary

In summary, this chapter introduced the importance of critical care nursing knowledge and skill in improving patient outcome. This need for knowledge and skills is reflected in the historical development of critical care nurse education in New Zealand and the development of the *Philosophy and Standards for Nursing Practice in Critical Care* (Critical Care Nurses Section, 2002) and the *New Zealand Standards of Critical Care Nursing Education* (Critical Care Nurses Section, 2000). As discussed the aim of this study is to answer the research question: following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? Having introduced the research topic, the next chapter presents the literature review.

CHAPTER TWO: LITERATURE REVIEW

The previous chapter discussed the need for critical care nursing knowledge and skill to improve patient outcomes, and how this has been achieved in New Zealand through the development of education programmes and standards. This chapter presents the literature review, an essential part of the research process (Minichiello, Sullivan, Greenwood & Axford, 1999). Most research is undertaken within the context of an existing knowledge base: thus, the literature review provides an opportunity for researchers to familiarize themselves with the knowledge base surrounding their research topic (Polit & Hungler, 1995). One of the major functions of the literature review is to ascertain what is already known about the research subject. This enables the researcher to either selectively replicate a study to avoid unintentional duplication, or to identify the most suitable research methodology and methods that enable the research question to be answered (Minichiello et al., 1999; Polit & Hungler, 1995).

To assist in evaluating whether critical care nurses use knowledge of respiratory physiology in their clinical decision-making, which is the focus of this study, a review of the literature was completed. The format used by the author to discuss the literature review will now be outlined.

Format of literature review

To enable a clear and focused discussion of the literature pertaining to this research topic, the literature review will be presented in eight parts. The first part of the literature review describes the processes undertaken to identify the literature relevant to this research topic. This description provides an audit trail, which allows the researcher's peers to evaluate the research process.

The second part of the literature review discusses the definition of clinical decision-making. As the focus of this study is *the use of knowledge of respiratory physiology in critical care nurses' decision-making*, the author firstly needs to provide a clear description of how the term clinical decision-making is defined within this study.

The third part of the literature review provides an overview of decision-making theories. This overview highlights the main decision-making theories: information-processing theory, hypothetico-deductive theory, analytical theory and skill acquisition theory, providing discussion on how these theories are linked.

The fourth part of the literature review discusses intuitive and analytical decision-making processes. As all models of decision-making theory use either intuitive and/or analytical decision-making processes, these decision-making processes are important considerations when discussing clinical decision-making.

The fifth part of the literature review provides an overview of factors that influence clinical decision-making. These factors include knowledge, experience, academic exposure, age, evidence-based practice, use of clinical guidelines and protocols, appointment level, clinical and administrative support, the management structure within the unit, collaborative practice, the individual traits of the nurse, and critical thinking skills.

The sixth part of the literature review provides critique of the previous literature discussed. The choice of method used to measure clinical decision-making is a common problem found in many studies. Often these methods have measured nurses' perception of their decision-making abilities rather than their actual decision-making abilities. Due to the commonality of this problem and to avoid unnecessary repetition, this critique is discussed in a separate part.

The seventh part of the literature review provides discussion on role extension and expansion. Much of the recent literature on clinical decision-making in critical care is on role extension and expansion, with the view that these roles provide opportunities for nurses to develop clinical decision-making skills. Hence this discussion provides a somewhat limited critical care view on how clinical decision-making can be developed.

The final part of the literature review focuses on bioscience in clinical decision-making. As the topic of this research is the use of knowledge of respiratory physiology in critical care nurses' clinical decision-making, this part provides

specific discussion on the use of bioscience and physiology in nursing. The first part of the literature review addressing the literature review process will now be discussed.

The literature search process

As discussed in the introduction to this chapter, an important part of the research process is for the researcher to ascertain what is already known about the research subject. As researchers almost never conduct studies in an intellectual vacuum, they need to undertake their investigation within the context of existing knowledge. Therefore to become familiar with that knowledge base, a literature search is required (Polit & Hungler, 1995).

An important part of familiarizing oneself with the research subject is to be flexible and to think broadly about the key words and subject headings that could be related to the topic. Using the appropriate key words assists in identifying major literature relevant to the topic. As it is rarely possible for a computerized search to identify all relevant studies, additional research can be found by examining the references of published studies. Researchers who have examined the topic in their own research refer to major relevant studies as a means of providing context for their own investigations (Polit & Hungler, 1995).

A literature search was performed prior to designing the research and then repeated following collection of the research data to identify more recently published research. These literature searches were conducted utilising online databases through CINHAL, MEDLINE and EBSCO. Additional literature was obtained from references identified in the articles reviewed.

The first literature search performed used the key words *decision-making, clinical decision-making, knowledge utilization and critical care.* Due to the substantial amount of literature obtained using the key words clinical decision-making, this data base search was limited to literature published between 1997 and 2001. Placing no limitation on dates and using the key words knowledge utilization and critical care, no articles pertaining to the research topic were identified. Placing no limitation on

dates and using the key words clinical decision-making and critical care provided limited literature, with most relating to evidence-based practice and expanded practice.

The second literature search used the key words clinical decision-making and critical care, *bioscience in nursing* and *bioscience*. The literature search using the key words clinical decision-making and critical care was performed to identify literature published between 2001 and 2004 and identified the most current research-based literature. The literature search using the key words bioscience in nursing and bioscience was performed following review of a research article that used those terms to research knowledge of physiology in perioperative nursing practice (Prowse, 2003a). The literature search using the keywords bioscience in nursing and bioscience, with no limitation on dates, identified a small amount of literature. The second part of the literature review defining the term clinical decision-making will now be addressed.

Definition of clinical decision-making

As discussed earlier, the focus of this study was *the use of knowledge of respiratory physiology in critical care nurse decision-making* hence the term clinical decision-making was a key aspect of this investigation. For this thesis to be assessed for research validity, the researcher's interpretation of the term clinical decision-making needs to be clearly outlined.

Clinical decision-making forms the basis of expert nursing practice (Smith Higuchi & Donald, 2002) requiring both formal education and clinical experience (Kremer, Faut-Callahan & Hicks, 2002). There is no unequivocal definition of clinical decision-making (Hamers, Huijer Abu-Saad & Halfens, 1994). The term clinical decision-making is often used interchangeably with other terms, such as clinical thinking, clinical judgement, clinical inference and diagnostic reasoning (Hamers et al., 1994; Pugh, 2002; Thompson, McCaughan, Cullum, Sheldon & Raynor, 2002). For this research, clinical decision-making is defined as the process by which a clinician identifies, prioritises, establishes plans, and evaluates data, leading to the generation of a judgment (Grossman, Campbell & Riley, 1996). Clinical decision-

making requires the nurse to collect both subjective and objective clinical information to reach a decision on nursing intervention and care (Bakalis, Bowman & Porock, 2003; Pugh, 2002). Therefore clinical decision-making is a problem-solving activity that focuses on defining a patient problem and then selecting an appropriate treatment intervention (Smith Higuchi & Donald, 2002; White, 2003). The third part of the literature review, providing an overview of decision-making theory, will now be discussed.

Decision-making theory

The literature discusses a number of decision-making theories, some of which are closely linked to each other. These close linkages have made decision-making theory difficult to separate and interpret. The dominant decision-making theories discussed in the literature are information processing theory, hypothetico-deductive theory, analytical theory, and skill acquisition theory.

Information processing theory

Information processing theory is when one uses an information-processing system to interact with a problem task (Hamers et al., 1994). The memory of the information-processing system consists of two parts: the short-term memory and the long-term memory. The short-term memory holds limited information, normally no more than five to seven chunks. Chunks are recognisable stimulus patterns that are developed through learning. Long-term memory is where both factual and experimental knowledge is stored, which can be retrieved by short-term memory when required. All processes take their inputs and leave their outputs in short-term memory (Hamers et al., 1994).

The information processing theory distinguishes four stages in the reasoning processes; cue acquisition, hypothesis generation, cue interpretation and hypothesis evaluation. In the cue acquisition stage, data is obtained from a variety of methods. In the hypothesis generation stage about four to five hypotheses are generated from memory, based on only a few cues. During the cue interpretation stage, cues are interpreted as tending to confirm or refute the hypothesis, while during the hypothesis evaluation stage, the clinician reaches a diagnostic judgement (Hamers et

al., 1994). Because of the formation of hypothesis to reach a diagnostic judgement, information processing theory forms the basis of hypothetico-deductive theory (Ellis, 1997). Hypothetico-deductive theory will be addressed in the following discussion on information processing theory.

Information processing theory relies on any earlier knowledge "an individual has gained about the issues and areas concerned" (Lauri & Salentera, 2002, p. 94). Information processing theory is dependent on three characteristics: experience, knowledge and personal variability, with personal variability including interpersonal skills such as communication and perception (Hamers et al., 1994). Past experiences are stored in the long-term memory and these experiences positively influence the decision-making process by increasing its accuracy. Experience enables significant patterns to be recognized and enables the nurse to use complex chunks of familiar stimuli in the short-term memory. However experience is also thought to create bias in the decision-making process, thereby negatively influencing the decision-making results. The three main biases are frequency of occurrence, recency of experience and profoundness of memory. Knowledge is stored in the long-term memory and is necessary for all stages of the decision-making process. Without knowledge diagnoses cannot be made as "one cannot diagnose what one cannot understand (Hamers et al., 1994, p. 157).

Hypothetico-deductive theory

As discussed earlier, information processing theory forms the basis of the hypothetico-deductive theory. Hypothetico-deductive theory is regarded by some as the most influential clinical decision-making theory (Buckingham & Adams, 2000a). This theory originated from medicine, but has been applied to nursing. Hypothetico-deductive theory embraces two types of reasoning, induction and deduction. Induction is where data is collected and leads to a hypothesis. Deduction is where a hypothesis is used to predict the presence or absence of data (Buckingham & Adams, 2000a; Ellis, 1997). In nursing and medicine, hypothetico-deductive theory is defined as a process of determining patients' problems by the use of diagnostic reasoning (Lauri & Salantera, 2002). Research suggests that doctors use a hypothetico-deductive model to make diagnostic decisions (Ellis, 1997). It is thought that most nurses develop hypotheses early and use these hypotheses to direct the process of

data collection. The data is then used to evaluate each hypothesis until one hypothesis best fits with the data that is left (Buckingham & Adams, 2000b; Ellis, 1997).

Information processing, when used in the hypothetico-deductive model, involves components that include assessment, problem identification or diagnosis, planning or prescribing, implementation or intervention, and evaluation. A problem-solving process that incorporates these components is defined as the nursing process (Hamers et al., 1994).

Ellis (1997) studied the clinical decision-making processes of 17 medical, surgical and critical care nurses. The results of the study demonstrated that nurses used a hypothetico-deductive approach to decision-making using two categories of decision-making processes, the goal-directed process and the rule-out process. The goal-directed process occurred when the cause of the problem was unknown or was difficult to solve, therefore all actions that the nurse thought would assist in solving the problem and reaching the goal were implemented. Nurses with three years or more experience only used the goal-directed process. The rule-out process involved three categories; rule-out the problem, rule-out the cause and rule-out the action. The use of goal-directed and rule-out processes varied with task complexity. With simple tasks all nurses used the rule-out process, taking an action and observing the results. The simplest and quickest action was taken first. When problems were more complex, nurses stayed open-minded and considered a greater number of alternatives.

Analytical theory

Analytical decision-making theory is the use of a systematic process to reach a decision (Lauri & Salantera, 2002). These authors suggest analytical decision-making requires analysis, which involves a step-by-step conscious and logically defensible decision-making process. The typical characteristics of analysis include slow information processing, sequential use of cues, the use of logical rules and task-specific organization. This analytical decision-making theory is opposite to intuition. Characteristics of the intuitive process include "rapid information processing, simultaneous cue use, pattern recognition, the evaluation of cues at a perceptual

level, and the principles of weighted-average organization" (Lauri & Salantera, 2002, p. 94). Hence the type of problem solving task and the context in which the problem presents determines the type of decision-making theory used. Problems that need immediate decisions due to the life-threatening nature of the problem require intuitive type decision-making skills, enabling rapid problem identification, diagnosis, intervention and evaluation. Intuitive and analytical decision-making processes will be discussed in greater depth later in this chapter in the fourth part of the literature review.

Skill acquisition theory

Dreyfus (1979) and Dreyfus and Dreyfus (1986) developed a skill acquisition theory in which they described five stages that one must go through to acquire the skills of an expert. These five stages include novice, advanced beginner, competent, proficient and expert. Benner (1984) and Benner and Tanner (1987) found these same five stages in intensive care nurses' skills and decision-making. The novice stage is where the nurse has no experience of the situation in which they are expected to perform, therefore are reliant on rules to guide their performance. The advanced beginner stage is where the nurse has sufficient experience to develop the ability to identify some problems and determine what action is required. However, as the advanced beginner is only beginning to perceive recurrent meaningful patterns in their clinical practice, they are only able to demonstrate marginally acceptable performance. The competent stage reflects the nurse who has had two or three years experience and is now able to demonstrate conscious and deliberate planning. However, the competent nurse lacks the speed and flexibility of the proficient nurse and does not have a feeling of mastery or the ability to cope with and manage the many contingencies of clinical practice. The proficient stage is where the nurse perceives the situation as a whole, perceiving situations in terms of long-term goals. The expert stage is when the nurse no longer relies on rules or guidelines to understand the situation and take appropriate action. The expert nurse, because of an enormous background of experience, has an intuitive grasp of each situation and zeroes in on the problem without wasteful consideration of a large number of unnecessary diagnoses and solutions (Benner, 1984).

These five stages have formed the basis of the clinical career pathway for nurses in New Zealand, and are referred to within the *New Zealand Standards for Critical Care Nursing Education* (Critical Care Nurses Section, 2000) to identify the progression of knowledge and skill development within critical care nursing. In each of the five stages of skill acquisition, both intuitive and analytical processes are used (Lauri & Salantera, 2002). These processes, which forms the fourth part of the literature review will now be discussed.

Intuitive and analytical decision-making processes

As previously discussed, the literature identifies a number of clinical decision-making theories, including information-processing theory, hypothetico-deductive theory, analytical theory, and skill acquisition theory. Information processing theory forms the basis of hypothetico-deductive theory. Information-processing theory, hypothetico-deductive theory and skill acquisition theory use both intuitive and analytical decision-making processes however, analytical theory only uses an analytical decision-making process.

Clinical decision-making is a complex process requiring both intuitive and analytical processes (Burman, Stepans, Jansa & Steiner, 2002; Hicks, Merritt & Elstein, 2003; Lauri & Salantera, 2002; Pugh, 2002). Intuitive decision-making processes are preconscious and heavily reliant on sensory and perceptual data from multiple sources. Intuitive decision-making allows nurses to match common patient patterns developed from their previous clinical experience (Burman et al., 2002; Hicks et al., 2003). This matching of common patient patterns is often termed pattern recognition (White, 2003). Benner and Tanner (1987) defined intuition used in intuitive decision-making as understanding without rational.

The complexity of the task influences the decision-making process. Determinants of task complexity include the number of cues, dependability, redundancy, overlapping cues and irreducible uncertainty (Benner, 1984). The greater the number of cues represented, the more complex the task; the greater the dependability of the available cues, the fewer number of cues needed; the greater the redundancy, the easier the

task; the more the cues overlap in differential diagnosis, the more complex the task will be; and the more irreducible the uncertainty, the more complex the task will be (Hamers et al., 1994; Benner, 1984).

Intuition enables nurses to use their clinical experience to enable cue patterns to be associated with desired outcomes, so that interventions and treatments are automatically brought to mind and implemented (Buckingham & Adams, 2000a). This process enables rapid decision-making, which is essential in emergency situations where both nurses and doctors are required to make immediate decisions with often very limited information (Baumann & Bourbonnais, 1982; Croskerry, 2002; Ellis, 1997). Greenwood and King (1995) suggest that intuition is also an effective form of decision-making in every day nursing practice, as many of the decisions that nurses are involved in do not require the need for complex thinking. Intuition therefore provides short cuts to problems solving and clinical decision-making (Croskerry, 2002).

Intuitive clinical decision-making is strongly linked to heuristics with heuristic reasoning being an important element of intuition (Buckingham & Adams, 2000b; Cioffi, 1997; Cioffi & Markham, 1997). Heuristics are defined as cognitive short cuts (Thompson, 2003) and occurs as a result of experiential learning where the learners discover things themselves and develop "rules learned on the job" (Croskerry, 2002, p. 1201). As both heuristics and intuition provide short cuts to problem solving and clinical decision-making, they risk creating "clinical pitfalls" where incorrect clinical decisions result in a poor patient outcome (Croskerry, 2002; Harbison, 2001). Evidence suggests that these incorrect clinical decisions caused by cognitive errors, when viewed in hindsight, could have been prevented (Croskerry, 2002). Knowledge and experience have been recognised as factors that result in more high-quality decision-making. With increased knowledge and experience, clinicians become more aware of the clinical errors that can occur with heuristics, and develop strategies to prevent errors from occurring (Croskerry, 2002).

Analytical decision-making is the conscious use of beliefs and values that certain interventions will lead to a desired outcome (Hicks et al., 2003). Therefore, intuitive decision-making is based on "gut feeling," while analytical decision-making is based

on considered evaluations of data and systematic consideration of alternative courses of action (Kremer et al., 2002). Education encourages analytical decision-making to develop, providing an organised framework for the utilisation of knowledge. Experience however, encourages intuitive decision-making, assisting in the formation of pattern developments applicable to varying patient care situations (Hicks et al., 2003).

Nurses' clinical decision-making has been viewed traditionally as intuitive rather than analytical, with nursing knowledge and decision-making predominantly viewed as tacit, feminine and emotional. Medical knowledge and clinical decision-making however, has been traditionally viewed as analytical, rational and empirical (Buckingham & Adams, 2000a; Harbison, 2001).

Thompson (2003) suggests that nurses have a reliance on experiential knowledge and intuitive modes of decision-making. Tabak, Bar-tal and Cohen-Mansfield (1996), using two clinical scenarios, assessed the difference in the use of intuitive and analytic decision-making skills between novice and experienced nurses. The results showed that inconsistent information might cause expert nurses to switch from an intuition mode to a systematic and effortful search for relevant information, while novice nurses shift to intuition, suggesting that the development of expertise requires acquiring a good knowledge base.

Lauri and Salantera (2002) developed a decision-making instrument to assess the decision-making models used by nurses working in critical care, long and short term care, and psychiatric care in Canada, Northern Ireland, Norway, Sweden, Switzerland and the United States. The results showed that for nurses working in critical care, decision-making related to implementing, monitoring and evaluating patients was mainly intuitive and was similar in all of the countries. However decision-making in collecting data, processing it, identifying problems and creating plans of action varied and in addition there were some country differences. Finnish and Swiss nurses used more analytical weighted decision-making models than nurses from Canada, Northern Ireland and the United States. Lauri and Salantera found that length of nursing experience was not associated with the decision-making models

used. The fifth part of the literature review focusing on factors that influence clinical decision-making will now be discussed.

Factors that influence clinical decision-making

Numerous factors have been identified as having an influence on clinical decision-making. Knowledge and clinical experience have been identified as the most major influence on clinical decision-making. However, academic exposure, age, evidence-based practice, use of clinical guidelines and protocols, appointment level, clinical and administrative support, the management structure within the unit, collaborative practice, the individual traits of nurses, and critical thinking skills have also been identified as having some influence. The literature supporting these influences will now be discussed.

An early exploratory study by Baumann and Bourbonnais (1982) assessed factors that 50 critical care nurses considered relevant in making rapid patient care decisions and the decision-making of those nurses in crisis situations. Baumann and Bourbonnais identified knowledge and experience as the most important factors that enabled critical care nurses to make the rapid decisions. However, they also suggested that nurses had difficulty providing a rationale for their decisions. Girot (2000), using a quasi-experimental design and the 'Jenkins clinical decision-making in nursing scale,' assessed nurses' perception of their decision-making abilities. Following investigation of 82 nurses at four different stages of their academic development, Girot concluded that academic exposure rather than clinical experience influences decision-making in practice.

Bakalis et al. (2003) studied the clinical decision-making of Greek and English coronary care nurses. Using eight clinical scenarios, and a set of intervention cards, 60 participants (30 from each country) were required to chose a single card that best reflected their practice. The results of the study showed that increasing age; more experience, a higher academic level, and more medical cover resulted in higher levels of clinical decisions.

However, the influence of both education and clinical experience on clinical decision-making has been challenged. Using a non-experimental correlation design, Hicks et al. (2003) assessed 54 critical care nurses' clinical decision-making in three scenarios, one each representing low, moderate and high complexity tasks. The results of the research showed that education and experience were not associated with increased critical thinking skills and that only the years of critical care nursing experience increased the likelihood of decision-making consistency. The study also showed that, overall, intuitive decision-making processes resulted in more clinically consistent selection of interventions.

Using a correlational design, Hoffman, Donoghue and Duffield (2004) studied the relationship between occupational orientation, educational level, experience, area of practice, levels of appointment, age, and clinical decision-making, in 174 nurses. Occupational orientation included bureaucratic, paramedical and professional orientations of nurses. Paramedical orientation is when nurses are subordinate to doctors, believing that their job is to carry out medical orders. Bureaucratic orientation is where nurses defer authority and responsibility for decision-making to those above them, believing that managers in higher positions should make decisions for them. Professional orientation is where nurses have values and traits that lead them to believe that they have control over their own work and decision-making (Hoffman et al., 2004; Rhodes, 1985). The results showed that education and experience were not significantly related to decision-making. The factor that accounted for the greatest variability to clinical decision-making was nurses having a professional orientation, followed by level of appointment, area of clinical speciality and age. The results showed that the higher the level of appointment and the older the nurse, the higher the frequency of clinical decision-making.

The effect of level of appointment on clinical decision-making has also been identified in critical care research. Bucknall and Thomas (1996) examined the frequency in which 250 critical care nurses of varying levels of appointment (level one, level two and level three) made decisions to perform 10 critical care tasks. Using a questionnaire, decisions that were related to respiratory, cardiac and gastrointestinal management of patients were assessed. The questionnaire items included diagnostic decisions, therapeutic interventions and procedural decisions.

Although this study did not discuss the meaning of each of the three levels, i.e. novice, advanced beginner, competent, proficient or expert, the results showed that level three nurses made significantly more frequent decisions to perform tasks.

Much of the recent literature on clinical decision-making in critical care is in relation to evidence-based practice, due to the association evidence-based practice has with clinical expertise and clinical decision-making. The close association of these terms is evident in the definition of evidence-based practice. Evidence-based practice is defined as the application of the best available empirical evidence to clinical practice in order to aid clinical decision-making (Sackett, Rosenberg & Muir Gray, 1996) and requires clinical expertise. Clinical expertise "informs decision-making about the applicability of external scientific evidence to a patient care situation " (Glanville, Schirm & Wineman, 2000, p.3).

Taylor-Piliae (1998) provides a theoretical perspective related to establishing evidence-based practice in critical care nursing, and although not providing any new research, does succinctly summarise factors that influence evidence-based practice and hence clinical decision-making. Taylor-Piliae suggests clinical practice is affected by the characteristics of the nurse, the clinical setting and/or the evidence itself, suggesting that nurses who are more educated, attend conferences and read recent literature in regard to clinical practice are more likely to adopt new practices. This view is supported by McCaughan, Thompson, Cullum, Sheldon and Thompson (2002) who suggest that nurses with higher levels of mainstream education are more likely to engage in information retrieval strategies, rather than relying on information provided by a third party. The inability to obtain research and the lack of ability to understand the research reports are often cited as primary reasons for nurses not using research in practice (Funk, Tornquist & Champagne, 1995; Taylor-Piliae, 1998; Webb & Mackenzie, 1993). Hence Taylor-Piliae suggests systematic reviews and meta-analysis as a way of overcoming this problem.

Clinical guidelines and protocols, based on the best available evidence, have been identified as improving clinical decision-making (Thomson, Angus & Scott, 2000). Evidence suggests that most clinical decision-making lacks scientific evidence. Belknap, Siefert & Petermann (1997) found 74% of critical care nurses used

practices that were contrary to recommended practice. Clinical guidelines are seen as a method of improving the use of evidence in practice. Millenson (1997) suggests that prior to clinical practice guidelines, most health care decision-making lacked a scientific basis, with 85% of decision-making based on past training, personal experience and intuition. However the use of clinical guidelines as an answer to poor clinical decision-making has been challenged by Pugh (2002) who suggests that clinical guidelines do not always apply to an individual situation. Another problem with clinical guidelines and protocols is that they are not always based on the best evidence. A study by Thompson et al. (2002) revealed that only around one third of the 4000 documents examined in an acute area made reference to any kind of research and that it was impossible to identify the authorship of nearly 1,000 documents.

Considine and Hood (2000) suggest that clinical guidelines and protocols are intended to facilitate, not replace clinical decision-making and that both have the potential for patient care to be provided in strict accordance with these guidelines and protocols regardless of the individual circumstances of the patient. This could be problematic, as critically ill patients with multi-system dysfunction require flexible guidelines and protocols that provide for variations in patients' clinical condition (Hewitt-Taylor, 2004). Hewitt-Taylor (2004) suggests that competency in nursing is more than the ability to rigidly follow set guidelines or protocols, but includes the ability to respond to individual needs and to exercise professional judgment. Rule governed behaviour that is limited and inflexible is a characteristic of a novice nurse and is no longer used by the expert nurse to understand the patient situation and implement the most appropriate intervention (Benner, 1984).

Other literature identifies the importance of onsite clinical and administrative support in improving nurses' clinical decision-making by allowing opportunities to increase their knowledge base (Funk et al., 1995; Thompson et al., 2000). For this onsite clinical support to be effective in improving clinical decision-making the people providing this support need to have clinical credibility and trustworthiness (Thompson et al., 2000). McCaughan et al. (2002) found that message passing from credible clinicians was the most crucial component that persuaded nurses to consider using research findings in their clinical decision-making.

The literature suggests that it is nurses in the clinical nurse specialist and nurse consultant roles that are most likely to provide this level of support (Thompson, McCaughan, Cullum, Sheldon, Mulhall & Thompson (2001a; 2001b) as they are viewed as being more accessible and as having a direct connection to clinical practice (Thompson et al., 2002). Evidence suggests that clinical nurse specialists are able to bridge the gap between the clinical nurse specialist knowledge base and the day to day running of the clinical practice area (Thompson et al., 2002) by acting as a conduit, translating research findings into a straightforward language that is able to be understood by experienced nurses (McCaughan et al., 2002).

Clinical nurse specialists were identified by Thompson et al. (2002) as having a "stockpile of research-based material, extensive clinical, research and commercial networks and personal development strategies that included conferences and seminars and "the ability to separate good research from bad" (p. 33). However, when viewing the hierarchy of evidence, the professional opinion from these clinical experts is the lowest form of evidence, yet nurses tend to value their opinion over other sources of information available (Thompson, 2003). Funk et al. (1995) suggest that nurses have uniformly reported that increased administrative support and encouragement are needed to have time to read research and implement research findings into practice.

The type of management structure within the critical care unit and nurses' control over practice has also been identified as a factor that influences nurses' clinical decision-making. Shared governance has been identified as a nursing management innovation that legitimizes nurses' decision-making over practice (Kramer & Schmalenberg, 2003; Wade, 1999). Control over nursing practice implies clinical autonomy and professional autonomy. Clinical autonomy is defined as decision-making directly involving a clinical action that is beyond standard and routine nursing practice (Kramer & Schmalenberg, 2003). Professional autonomy by contrast, is defined as the socially granted and legally defined freedom to make independent practice decisions without having to seek evaluation from sources outside the profession (McKay, 1983).

A collaborative practice model between nurses and doctors has been identified as being influential in clinical decision-making within the critical care environment. Lack of collaborative practice has been found to limit nurse decision-making. Evidence suggests that patient morbidity and mortality can be influenced by the interaction and mutual decision-making between nurses and doctors working in the critical care unit (Knaus, Draper, Wagner & Zimmerman, 1986). Research suggests that when nurses report no interdisciplinary collaboration in decision-making, the predicted risk of a negative outcome for patients is significantly higher than when nurses report a fully collaborative decision-making process (Baggs, Ryan, Phelps, Richeson & Johnson, 1992; Baggs, 1994).

Stern, Stroh, Fiser, Cromwell, McCarthy & Prince (1991) suggest that nurses are not high frequency decision makers, but in fact are high-frequency information providers. Stern et al. argue it is the senior medical staff and often other professional staff with less training and less experience who make most of the clinical decisions. Research by Coombs (2003) demonstrates that power held by medicine affects the nursing role in the critical care environment. Coombs suggests that nurses are a marginalized group in decision-making and although their knowledge and skills have evolved, this has not been associated with a change in the role of the nurse in the critical care team. Coombs goes on to suggest that the nursing voice in the team remains constrained by the limitations placed by others and the nurses themselves. This lack of decision-making by nurses is supported by Manias and Street (2001) who, in their small critical ethnography study of four nurses during a ward round, demonstrated that nurses were predominately information providers, with the ward round predominantly serving the needs of medicine. This small sample size, however, limits the ability of these results to be generalised. Sample size is ideally determined by reaching theoretical saturation on the concepts being investigated (Minichiello et al., 1999), therefore small samples sizes risk not reaching theoretical saturation, thus not representing all phenomenon.

However, Cribb (1987) discussed this lack of critical care nurse involvement at ward rounds within the New Zealand context. Cribb identified the under utilization of the highly-trained nurse monitor by many medical staff, stating "every morning at doctors rounds we see medical staff grouped around the recording chart and the nurse

monitor standing aside. We frequently see nurses' valuable interpretation and explanation of events ignored. Often our only contribution to the round is the type of tracheal aspirate" (p. 4).

As mentioned earlier in this chapter, when discussing hypothetico-deductive theory, personal traits have been identified as having an effect on clinical decision-making. Theses traits may include the individual's interpersonal skills, including their communication and perception skills, and their physical, mental and emotional state at the time of the clinical decision-making process. These traits are thought to influence all stages of the clinical decision-making process as they can result in excessive data collection and cause overload. Overload results in the inability of the individual to focus on the relevant issues and leads to errors in judgment (Hamers et al., 1994).

Critical thinking skills have also been suggested as being necessary for a high level of clinical decision-making (Eng & Duke, 2003). In order to make effective clinical decisions, nurses require critical thinking skills to perform an accurate assessment, interpret the assessment data and decide on the best course of action. Having a theoretical knowledge base is recognized as being essential for critical thinking. The sixth part of the literature review providing critique of the literature research presented thus far, will now be discussed.

Problems associated with research methods

The factors that influence clinical decision-making are conflicting and remain unclear (Hicks et al., 2003; Hoffman et al., 2004). The conflicting evidence in the literature could be related to the methods used to assess clinical decision-making and the inability of these methods to truly analyse the complexity of the clinical decision-making process within the clinical practice environment. Much of the research into clinical decision-making has used questionnaires, case scenarios or nursing documentation. The use of questionnaires and patient scenarios to measure clinical decision-making has been criticised in the literature.

Questionnaires gather information of nurses' self-reported behaviours. The problem with these self-reports is that the behaviours nurses give may not reflect their actual behaviours (McCaughan et al., 2002). Often nurses may inflate their utilization of the decision-making process (McCaughan et al., 2002), which means they have a tendency to report the things they should be doing, rather than what they are actually doing (Thompson et al., 2002). Therefore, these self-reports tend to reflect the perception of the nurse's decision-making rather than their actual decision-making. This self-reporting inflation of utilization in the decision-making process is referred to as hindsight (Thompson, 2003). Hindsight works as "a favourable distortion of memory" and occurs when the relative importance of factors that influenced the nurse's judgement changes after the event (Thompson, 2003, p. 234). Using the 'Clinical Decision-making in Nursing Scale' to assess the perception of 520 nurses' clinical reasoning abilities, Byrnes and West (2000) found dissonance between the perceived abilities and actual abilities. However few other observational studies have been conducted to determine whether what nurses say they do correlates with what they actually do (McCaughan et al., 2002).

Research utilising case scenarios as a method to measure clinical decision-making requires the nurse to analyse a given scenario, or alternatively remember a previous scenario that the nurse was involved in. Getting the nurse to remember a previous scenario has the same problems of self-reporting and hindsight that are associated with questionnaires. Another problem with case scenarios is that they risk missing certain aspects of the complex critical care work setting (Smith Higuchi & Donald, 2002). As good decision-making is not simply about evidence but about balancing research, patient preferences and resource awareness within clinical practice (Thompson et al., 2002; Thompson, 2003), the use of case scenarios may not reflect the complex elements within the decision-making process. Most of the research using case scenarios measures the nurse's decision-making process based on what is deemed best practice, without asking nurses for the rationale behind their decision-making. Failing to ask nurses for a rationale behind their decision-making does not consider the complex elements that make up the decision-making process. Another problem associated with case scenarios is that they are often not under the same time constraints normally encountered in the actual working environment (Smith Higuchi & Donald, 2002). Case scenarios do not recognize that there is often more than one

approach to solve a patient problem, and that it is the quality outcome for the patient that is of prime importance rather than the decision-making process itself.

Research that uses patient documentation as a measure of clinical decision-making is limited, as the hospital work environment often limits the opportunity for thoughtful reflection about clinical situations prior to documentation in the chart. Smith Higuchi and Donald (2002) researched nurses' clinical decision-making by analysing the narrative notes of eight nurses working in an acute care setting. During the research nurses were frequently observed recording in their charts while standing in the hallway so they were able to monitor unwell patients. The researchers also observed that nurses were frequently interrupted during their documentation by requests from patients, visitors and other health care workers. As a result of this study, Smith Higuchi and Donald concluded that chart data represents only the minimum level of thinking used by nurses in clinical decision-making.

In summary, many of the studies that investigated clinical decision-making had limitations related to the methods used in the study. However all of the studies, even with their limitations, add to a widening knowledge base and enabled the researcher to become familiar with the knowledge pertaining to this research topic

Role extension and expansion

Over recent years much of the research on clinical decision-making in critical care has related to role extension or role expansion (Bowler & Mallik, 1998; Goldman, 1999; Hind et al., 1999; Last, Self, Kassab & Rajan, 1992). Role expansion is perceived as providing opportunities to develop accountable and responsible decision-making. The focus of critical care nurses on tasks has been identified as a factor that has limited the amount of nurse clinical decision-making (Bowler & Mallik, 1998), therefore an expanded role is thought to develop nurses' decision-making skills. However, one has to question which should come first, the role expansion or a high level of clinical decision-making? The focus on nursing practice should be improved patient outcomes and patients should not have to suffer while nurses work in an expanded role and develop their clinical decision-making abilities.

Hind et al. (1999) identified that there was support amongst nurses for an expanded role within the critical care environment, however these nurses required knowledge and experience in order to successfully address any patient complications that they may come across in that expanded role. Having the appropriate knowledge and skills ensures a high level of nurse clinical decision-making when these complications arise.

As part of the *Health Practitioners Competence Assurance Act* (2003), the Nursing Council of New Zealand has defined *Scopes of Practice* and the expected competencies of a registered nurse (Nursing Council of New Zealand, 2004a; Nursing Council of New Zealand, 2004b). The scope of practice for a registered nurse requires the nurse to "utilise nursing knowledge and complex nursing judgement to assess health needs and provide care" (Nursing Council of New Zealand, 2004b, p.1). Therefore, nurses in New Zealand now have a statutory obligation to develop their decision-making abilities within the registered nurse role before moving to extended or expanded roles. The eighth and final part of the literature review addressing bioscience in clinical decision-making will now be discussed.

Bioscience in clinical decision-making

Literature on the use of bioscience or physiological knowledge in nursing practice is very sparse. Toth and Ritchey (1984) developed a basic knowledge assessment tool (BKAT) to identify the basic knowledge for a critical care nurse. Identifying fundamental knowledge is necessary for safe clinical practice, hence identifying and correcting the knowledge deficits is an initial step in setting standards for critical care nursing practice (Toth & Ritchey, 1984). Using a 90-item questionnaire, the BKAT identified 7 basic knowledge areas. These knowledge areas are outlined in Table 2.1.

Although Toth and Ritchey (1984) identified areas of basic knowledge required, they did not identify the depth and detail of the knowledge required in each of those areas. It is the depth of knowledge that enables nurses to use a high level of decision-making and provide rationale for their decision-making processes. Since the development of the BKAT, there continues to be limited research on the

identification of depth and detail of knowledge required to support nursing practice (Prowse, 2003a).

Table 2.1. Basic Knowledge Areas (Toth & Ritchey, 1984)

Cardiovascular	**Monitoring lines**	**Endocrine**	**Pulmonary**
Angina Myocardial infarction Cardiogenic shock Electrocardiogram Pacemakers Cardiopulmonary resuscitation Drugs	Swan Ganz Arterial lines Central Venous Pressure lines	Diabetes Mellitus Thyroid Drugs	Ventilators Arterial blood gases Pulmonary care Pulmonary assessment Drugs
Neurology	**Nutrition and miscellaneous**	**Renal**	
Assessment Cerebrovascular accident Hypothermia Drugs	Tube feeding Total parenteral nutrition Diet in renal failure Gastrointestinal bleeding ICU patient psychosis Lines, infection	Assessment and care Peritoneal dialysis	

Prowse (2003a) studied bioscience in nursing in relation to perioperative specialty practice. Although the clinical context of Prowse's investigation was perioperative nursing, all specialty practice knowledge has commonalities related to the depth of knowledge required. This commonality is recognized in The Nursing Council of New Zealand's *Handbook for post-registration nursing practice programme providers* (Nursing Council of New Zealand, 1999), which outlines common standards for all specialty nursing practice programmes. In-depth knowledge of bioscience is common to all specialties, hence aspects of Prowse's research are transferable to the critical care context.

Prowse (2003a) argues that the focus and scope of specialty knowledge has changed considerably over time; however, the emphasis on knowledge and skills remains constant, as it centres on the pathophysiological processes of the human body. Prowse emphasizes that a sound knowledge base derived from anatomy, physiology, microbiology and pharmacology is an essential prerequisite for delivery of high quality care. As specialty practice involves complex technology, specialty practice requires a working knowledge of principles derived from physics and chemistry (Prowse, 2003a). This view is supported by Jordan and Reid (1997) who in an action research study of 52 nurses, found that patient care was enhanced when nurses applied knowledge of pathophysiology to problem solving activities in everyday practice.

Using an evaluative design, Clancy, McVicar and Bird (2000) compared the perception of 174 student and experienced nurses towards the use of biosciences in nursing practice. The results demonstrated that there was no improvement in bioscience knowledge in recent years and that experienced nurses lack confidence in articulating their knowledge to patients and other health professionals.

Grossman et al. (1996) was the only research paper identified in the literature search that assessed the use of physiological knowledge in critical care nurses' decision-making. Grossman et al. measured clinical decision-making of new graduate and experienced medical-surgical critical care nurses prior to a four-week critical care orientation programme and immediately after the programme. The study was conducted in an 800-bed tertiary, trauma level one institution in the United States of

America. Using a quasi-experimental design, data were collected using a clinical decision-making assessment (CDMA) tool before and after the four-week critical care programme. The CDMA tool assessed the decision-making of 71 nurses over a two-year period in four areas; physiological, psychosocial, technical and physical using open-ended questions related to clinical scenarios commonly seen in critical care. The results of the study showed nurses' test results were significantly better on the post-test scores than on the pre-test scores ($p = <.0001$). However the lowest pre-test and post-test scores were in physiology. Age was the strongest predictor with experience and educational preparation ranking second and third. Only age was statistically significant ($p = <.01$). Grossman et al. concluded the CDMA tool assessed nurses' needs and strengths in the four areas of clinical decision-making and signalled when nurses could progress off orientation. However, they identified the necessity to further assess the clinical decision-making of nurses as they progressed towards competent, proficient and expert levels of practice.

Grossman et al. (1996) assessed the use of physiological knowledge in critical care nurses new to critical care nursing. In New Zealand, the *New Zealand Standards in Critical Care Nursing Education* (Critical Care Nurses' Section, 2000) have the expectation that nurses reach a competent/proficient stage following the completion of a specialty practice programme, and reach proficient/expert stage with clinical experience and consolidation of the knowledge gained from the specialty practice programme. Although Grossman et al. concluded that the CDMA tool assessed clinical decision-making, they did not clearly define what depth of physiological knowledge used in decision-making was assessed. The *New Zealand Standards of Critical Care Nursing Education* (2000) have the underlying assumption that the physiological knowledge used by novice or advanced beginner nurses in their clinical decision-making is not as in-depth as the physiological knowledge used by proficient or expert nurses. As Grossman et al. did not define what depth of physiological knowledge was assessed, it is difficult to ascertain whether their CDMA tool is a reliable tool to determine the physiological knowledge used in proficient/expert nurses' clinical decision-making.

Completion of a literature search failed to provide any research measuring the use of knowledge of respiratory physiology in clinical decision-making by nurses who have

completed a critical care specialty practice programme. Although Grossman et al. (1996) assessed the use of physiological knowledge of critical care nurses, the participants in the research were novice nurses. Grossman et al. recognised the necessity to next assess the clinical decision-making of more experienced critical care nurses, such as those who have completed a critical care specialty practice programme. Hence, currently there is no research that answers the research question; following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making?

Summary

The purpose of this study was to answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? An essential part of ensuring that the research question could be answered was for the researcher to become familiar with the existing knowledge available on the research topic. This was achieved through review of the literature.

Literature searches were conducted using electronic databases CINHAL, MEDLINE and EBSCO, with additional literature being obtained from references identified in the articles reviewed. For this research, clinical decision-making was defined as the process by which a clinician identifies, prioritises and establishes plans and evaluates data, leading to the generation of a judgment. The literature identified four major decision-making theories, information processing, hypothetico-deductive, analytical and skill acquisition theory. The literature review highlighted that the decision-making processes used is dependent on the context of the clinical situation. Some clinical situations need rapid diagnosis and interventions: therefore, they require rapid decision-making processes such as those used information processing theory. Other more complex problems necessitate a more step-by-step conscious and logically defensible decision-making processes, such as those used in analytical theory. All decision-making theories used intuitive and/or analytical decision-making processes.

The available literature reviewed illuminated numerous and often conflicting factors that influence clinical decision-making, such as knowledge, experience, academic exposure, age, evidence-based practice, use of clinical guidelines and protocols, appointment level, clinical and administrative support, the management structure within the unit, collaborative practice, the individual traits of nurses, and critical thinking skills. However, a weakness common to many of the published studies is that the methods used to assess clinical decision-making, assess nurses' perception of their decision-making abilities rather than their actual decision-making abilities.

A feature of this literature research is that when compared to the general literature on clinical decision-making, literature on the use of bioscience in clinical decision-making is scant. Only one piece of literature that assessed the use of physiological knowledge in critical care nurses' decision-making was identified: however, this research only assessed nurses prior to and following a four-week orientation. Therefore, the literature search did not locate any research that answered the study question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making?

Having reviewed the literature in relation to clinical decision-making, the following chapter will discuss the research design this study uses to answer the research question, "following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making?"

CHAPTER THREE: RESEARCH DESIGN

The previous chapter explored the literature with regard to clinical decision-making. This chapter outlines the research design used to answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making?

This chapter presents the theoretical framework, methodology and method used to answer the research question, strategies used to ensure a sound research process, ethical considerations and mode of participant selection. Explicitly outlining the research design is a key aspect of the research process. The word research means to search again or to examine carefully (Minichiello et al., 1999). Research requires a rigorous, systematic investigation with the goal of refining existing knowledge or generating new knowledge (Minichiello et al., 1999). One fundamental purpose of research is to generate theories directed towards improving patient care. Research will only result in improved patient care if the researcher is able to demonstrate validity of the research results by clearly outlining the theoretical framework, methodology, and methods used to answer the research question.

The first part of the chapter discusses the theoretical framework, methodology and methods used in this study. An evaluation methodology taking a managerial perspective was chosen for this study, due to its ability to take both a quantitative and qualitative approach. The second part of the chapter presents the ethical considerations undertaken during the research, the techniques used for participant selection, and the criteria used within the study to ensure a sound research process. This chapter begins with an explanation of the theoretical framework underpinning this study.

Theoretical Framework

To justify the methodology and methods chosen to answer a research question, Crotty (1998) stresses the importance of the researcher being able to identify their epistemological and theoretical perspectives. Justification of the methodology and

methods enables the researcher to recognise the research as sound and depending on the type of research, to recognise the research as having results that provide generalisable conclusions. The epistemological stance of the researcher in this research was objectivism while the theoretical stance was post-positivism.

Objectivism is the epistemological view that scientific research can attain objective truth and meaning. Historically, objectivism has been the epistemology underpinning the positivist stance (Crotty, 1998). Truth from the positive stance is achieved through verification and replication of observable findings, assuming the existence of objective reality (Clark, 1998). Research from a positivist stance is quantitative and operates with what is known as the positivist "received" view (Clark, 1998; Guba & Lincoln, 1994).

Historically both medical and nursing literature has viewed empirical inquiry as being aligned solely with a positivist view (Clark, 1998). However, due to progress in scientific development and acceptance of the unobservable entities such as molecules, atoms and electrons, many positivists have been forced to reconsider their original denial of unobservable data. This has led to empirical research being increasingly underpinned by a post-positivist philosophy. Science from a post-positivist stance, like that of a positivist stance, requires precision, logical reasoning and attention to evidence, but is not limited to that which can be directly received. Evidence can be inferable such as in interviews and questionnaires. Clark (1998) argues that the triangulation of quantitative and qualitative methods in the same research study indicates a tacit acceptance of post-positivist philosophy.

The reason for the researcher's chosen epistemological and theoretical stance is the researcher's belief that for knowledge to be interpreted by the users, it needs to be communicated in a language that can be understood by the users. This means that for any knowledge to be communicated successfully, the communicator is required to know what knowledge is needed to be communicated, what is the likely acceptance of that knowledge and what result is wanted following the communication. Hence successful communication requires one to use language that can be readily received and translated into meaning by the receivers (McLennan, 1995).

For any change to occur in practice as a result of new knowledge, the new knowledge needs to be understood and valued. While the positivist perspective remains dominant in medicine and nursing, a philosophical shift is occurring due to the realization that nursing outcomes are often context-dependent (Timmins, 2002). Timmins (2002), when discussing critical care in the 21st century, argues that nursing actions within the critical care context need to be "examined and documented using observation techniques incorporating both qualitative and quantitative methodologies" (p. 126).

Therefore, for the results of this study to be valued by both critical care medical and nursing personnel and contribute positively to critical care nursing practice, the epistemology underpinning this research methodology is objectivism, while the theoretical perspective is post-positivism. Objectivism and post-positivism allows both a quantitative and qualitative approach to answering this study's question. The methodology used to answer this research question will now be discussed.

Methodology

The methodology used to answer this study's question was an evaluation methodology taking a managerial perspective. Ovretveit (1998) states "the purpose of evaluation is to make someone's life better. As a result of an evaluation, someone should be better able to act or make a decision." (p. 23). Hence evaluation is closely linked to decision-making. Evaluation methodology has been used to evaluate many areas of nursing practice including critical care nursing practice. For example, Spooner, Keenan and Card (1997) used an evaluation methodology to describe the views of critical care nurses following the implementation of a shared leadership programme.

Ovretveit (1998) views evaluation methodology as having four perspectives: experimental, economic, developmental and managerial, with each of these perspectives having different aims. Experimental evaluation aims to discover the effects of an intervention and the cause of any effects. An economic evaluation aims to discover the quantity of resources consumed and quantify the consequences of that

resource utilization. A developmental evaluation aims to discover how to improve service, policy or organizational interventions, whereas a managerial evaluation aims to discover whether actual activities match the desired documented activities (Ovretveit, 1998).

Most health evaluations are carried out within one of these perspectives. Although scientific experimental perspectives have dominated health evaluation, which perspective the evaluator uses depends on the purpose of the evaluation, the nature of the evaluated and on the evaluator's training and disciplinary background (Ovretveit, 1998). All the perspectives aim to gather information in a systematic way using data gathering methods, which are established within each perspective. Ovretveit argues that there is a place for all perspectives, although which one is used depends on the purpose and questions to be answered, and what would be the most help and be most credible to the users of the evaluation.

A managerial evaluation in health care compares "actual activities against procedures and standards which are thought to ensure safety, efficiency, effectiveness and equity" (Ovretveit, 1998, p. 35). This study sought to answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? This was done by comparing the use of knowledge of respiratory physiology in critical care nurses' decision-making with the respiratory physiology recommended in the *New Zealand Standards in Critical Care Nursing Education* (Critical Care Nurses' Section, 2000).

Ovretveit (1998) describes both quantitative and qualitative methods as being appropriate in managerial evaluation, however he suggests that it is possible to combine elements of each of the perspectives. An evaluative methodology taking a managerial perspective has been chosen to answer the research question due to the ability of this methodology to take both a quantitative and qualitative approach (Ovretveit, 1998).

Research can take either a quantitative or qualitative approach (Minichiello et al., 1999). Quantitative research uses a deductive (also referred to as hypothetico-

deductive) approach, which establishes facts by making predictions and testing hypotheses that have already been stated. As discussed earlier when addressing the theoretical framework for this study, quantitative research operates from a positivist stance. Quantitative research has the advantage of being able to objectively analyse large amounts of data, allowing more powerful statistical analysis, thereby making the results more generalisable. On the other hand, qualitative research utilises an inductive approach, which establishes theory by approaching the area under investigation without any preconceptions, allowing the participants experienced phenomena to form emerging categories to produce new theory. Because qualitative research requires interpretation of data, some regard it as lacking objectivity (Minichiello et al., 1999). However the advantage of qualitative research is in its description and interpretation of contextual issues, which allow understanding and meaning behind individual's actions, hence providing an explanation for the study results (Minichiello et al., 1999).

As noted earlier by Timmins (2002), research in the critical care context needs to incorporate both quantitative and qualitative methodologies, allowing both scientific analysis and insight into critical care nursing practice to contribute to theory development. Therefore this study uses both approaches to add enrichment to the data, adding breadth through quantitative data collection and analysis and adding depth through qualitative data collection and analysis.

In summary, the epistemological stance of the researcher in this study was objectivism, while the theoretical stance was post-positivism. To answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making?, an evaluation methodology taking a managerial perspective was used. This enabled the researcher to use both quantitative and qualitative approaches to compare the use of knowledge of respiratory physiology in critical care nurses' decision-making with the respiratory physiology recommended in the *New Zealand Standards in Critical Care Nursing Education* (Critical Care Nurses' Section, 2000). The method used in this investigation will now be discussed.

Method

As noted, this study used both a quantitative and qualitative approach and methods to collect data. Data were collected over a six-month period between October 2003 and April 2004. Using multiple methods of data collection, information was obtained on participant demographics, factors that influence the professional culture within the critical care unit, access to ongoing knowledge development, knowledge of respiratory physiology and general participant comments on the use of knowledge of respiratory physiology to provide patient care.

Participants were interviewed towards the latter end of their clinical shift, or alternatively immediately following the shift in which they were, or had been, caring for a ventilated patient. Caring for a ventilated patient requires knowledge of respiratory physiology, therefore respiratory physiology would have been a key part of the participant's decision-making when providing patient care. The timing of the interview enabled the participant to focus directly on the care provided for a particular patient on that shift. Being able to focus directly on recent and specific patient events ensured participants focused on the actual clinical decision-making process related to specific patient care. This reduced the opportunity for participants to discuss in general their decision-making skills, hence reduced the likelihood of the research assessing nurses' perception of their clinical decision-making abilities rather than their actual clinical decision-making abilities.

After obtaining written and verbal consent, interviews occurred at a time suitable to participants, either during or immediately following the participant's clinical shift. These interviews were performed in a convenient, quiet and uninterrupted area within the critical care unit and lasted approximately one hour. Various parts of the interview were audiotaped. A semi-structured interview incorporating clarifying questions was used to encourage a detailed description of the respiratory rationale behind the decision-making process, and any other factors that may have influenced that decision-making process. Each interview was transcribed verbatim. The data were then analysed by the researcher and members of an expert panel. The method used to collect demographic data will now be discussed

Demographic data

Collection of demographic data included information of age, year of registration, number of years of general nursing experience (both part-time and full-time), the year the participant completed their critical care specialty practice programme, number of years of critical care experience (both part-time and full-time), number of years of clinical experience post completion of the critical care specialty practice programme (both part-time and full-time) and how many hours per week participants were currently employed (Appendix A). Data were collected on participants' current academic preparation and the type of critical care specialty programme the participant had completed. This included information on the academic level (hospital based, undergraduate or post graduate programme) and length of the critical care specialty programme (Appendix A). The method used to collect data on factors that influence the professional culture will now be discussed.

Factors that influence professional culture

Data collected on factors that influence the professional culture of the critical care unit included information on participants' perceived use of protocols and guidelines, standards and integrated pathways, participants' perceived level of both professional and management support for nursing practice and participants' access to ongoing knowledge development. Using a categorical scale of measurement, with categories of minimal, medium, abundant or other, data were collected on how participants graded the use of guidelines, protocols, standards and integrated care pathways in their practice. Using a categorical scale of measurement, with categories of limit or support, data were collected on whether participants thought the presence of these guidelines, protocols, standards and integrated care pathways supported or limited their clinical decision-making. Using a categorical scale of measurement, with categories of inadequate, adequate or excellent, data were collected on participants' perception of the availability of clinical and managerial support (Appendix A). The method used to collect data on access to ongoing knowledge development will now be discussed.

Access to ongoing knowledge development

Data collected on access to ongoing knowledge development included information on conference attendance, reading of medical and nursing journals and access to the

World Wide Web. Data were collected on the number and type of conferences attended over the previous three years, the number and types of journal articles read weekly or monthly and the number and type of websites accessed to retrieve information weekly or monthly (Appendix A). Methods used to collect data on knowledge of respiratory physiology will now be discussed.

Knowledge of respiratory physiology

Data were collected on knowledge of respiratory physiology, which included the use of knowledge of respiratory physiology in clinical decision-making, arterial blood gas analysis, knowledge of respiratory concept definitions and discussion of respiratory concepts in practice. As multiple methods were utilised to collect this data, methods employed to collect different aspects of knowledge of respiratory physiology will be discussed separately. Methods used to collect the data on the use of knowledge of respiratory physiology in clinical decision-making will now be discussed.

Use of respiratory physiology in clinical decision-making.

Data on the use of knowledge of respiratory physiology in clinical decision-making were collected, firstly by obtaining data on the respiratory-related tasks completed by the participant while caring for their ventilated patient during the clinical shift and then identifying the respiratory pathophysiology rationale behind those respiratory-related tasks. The list of respiratory-related tasks included chest auscultation, suctioning with or without pre-oxygenation, ventilator assisted hyperventilation techniques, manual patient ventilation using 'bagging', patient positioning, adjusting of the fractionated inspired oxygen, adjustment of ventilation modalities or regimes, taking of, or retrieving the results of an arterial blood gas, and administration of an analgesic, paralysing agent and/or a sedative (Appendix A).

Once participants had identified specific respiratory-related tasks, a taped interview using a semi-structured questionnaire was used to explore the reason why participants performed each of those specific tasks and what respiratory physiological knowledge participants used to provide rationale for performing that task (Appendix B). Exploring or probing participants' statements has been identified

as a useful method to enhance understanding of how and why things are said (Minichiello et al., 1999). This exploration or probing allowed participants to provide qualifiers, as a means to more accurately reflect participants' use of knowledge of respiratory physiology in their clinical decision-making. These taped interviews were then transcribed verbatim and analysed for application and understanding of specific respiratory concepts related to each of the respiratory-related tasks performed. The respiratory concepts analysed are those outlined in the *New Zealand Standards for Critical Care Nursing Education* (Critical Care Nurses' Section, 2000). These respiratory concepts include functional residual capacity, thoracic compliance, airway resistance, oxyhaemoglobin dissociation curve, hypoxaemia, hypercarbia, respiratory acidosis, respiratory alkalosis, metabolic acidosis, dead space, alveolar-arterial (Aa) gradient, ventilation-perfusion (VQ) mismatch, hypoventilation and increased red blood cell transit time. The method used to collect data on arterial blood gas analysis will now be discussed.

Arterial blood gas analysis.

Following the taped interview, data on participants' knowledge and skills in arterial blood gas (ABG) analysis were collected to further assess their knowledge base. Participants were given three different arterial blood gases and asked to interpret the blood gases and discuss what intervention(s) would be required to achieve a normal arterial blood gas result (Appendix C). Participants then wrote their answers on the ABG form and discussed their answers on tape. Taped discussion provided the participant with the opportunity to discuss areas of the ABG that were causing them concern and also provided the researcher with the opportunity to explore areas of participants' discussion that needed clarifying. Each interview was once again transcribed verbatim and used with the ABG form to assess participants' knowledge and skill in ABG analysis. The method used to collect data on participants' knowledge of respiratory concept definitions will now be discussed.

Knowledge of respiratory concept definitions.

Following the ABG analysis, to further assess participants' knowledge of respiratory concepts, data were collected on participants' understanding of respiratory concepts

and their definitions. This was performed using a card-matching exercise, where participants were asked to match each of the respiratory concepts to their definitions. The respiratory concepts required to be matched with a definition included functional residual capacity, thoracic compliance, airway resistance, oxyhaemoglobin dissociation curve, hypoxaemia, hypercarbia, respiratory acidosis, respiratory alkalosis, metabolic acidosis, dead space, Aa gradient, VQ mismatch, hypoventilation and increased red blood cell transit time (Appendix D). The method used to collect data on discussion of respiratory concepts in practice will now be discussed.

Discussion of respiratory concepts in practice.

At the completion of the card-matching exercise, participants were questioned on their familiarity with the respiratory concepts and their definitions and the degree in which the respiratory concepts were discussed in their critical care programme and clinical practice setting (Appendix D). These interviews were audiotaped and the interviews transcribed verbatim. Methods used to collect data on participants' general comments related to the use of knowledge of respiratory physiology to provide patient care will now be discussed.

General comments

The final part of the data collection consisted of a taped interview where participants had the opportunity to discuss any issues the research had raised, and to provide general comment on the use of knowledge of respiratory physiology used to provide patient care (Appendix D). These interviews were once again transcribed verbatim.

In summary, this study used both quantitative and qualitative methods to collect data. Using a questionnaire, taped interviews, ABG analysis and a card-matching exercise, data were collected on participant demographics, factors that influence the professional culture within the critical care unit, access to ongoing knowledge development, knowledge of respiratory physiology and participants' general comments on the use of knowledge of respiratory physiology used to provide patient care. Ethical considerations will now be discussed.

Ethical Considerations

The research study conforms to the ethical standards of scientific inquiry. Prior to implementation of this research, ethical approval was obtained from the Massey University Human Ethics Committee and the appropriate Regional Ethics Committee. Prior to the research gaining Regional Ethics Committee approval, written approval to complete the research was gained from the critical care unit managers of each research site, the regional Maori Research Review Committee and the Regional Development Office of the appropriate District Health Board. As noted in the preface of this thesis, in order to maintain confidentiality and anonymity of participants and critical care units involved in this study, the specific Regional Ethics committee will not be named in this document.

Throughout the research process, information was kept confidential and anonymous. Coded numbers were allocated to both units and each participant to ensure neither the unit nor the participant is linked to any specific data. Documentation of the unit's and participant's names and coded numbers were stored securely and separate to other collected research data.

Prior to consent being obtained, participants were given an information leaflet (Appendix F). The information leaflet provided contact details of the researcher and the researcher's supervisors and information on participant recruitment, project procedures, participant involvement, participant rights and committee approval statements. Participants were informed that the interview had three parts, consisting of filling out a questionnaire with the researcher, answering questions that will be audiotaped and later transcribed and a card matching exercise. Participants were also informed of the processes used to maintain confidentiality and anonymity and their right to withdraw from the research up to the time of the data being statistically analysed. Written informed consent was obtained from all participants prior to the interview process (Appendix G).

To ensure confidentiality was maintained, the transcribers signed a transcriber's agreement (Appendix H) and the expert panel signed confidentiality agreements. Participants were assured that all transcripts would be kept anonymous and that

neither participants, nor the units in which they work, would be linked with specific data. The participants were assured that tapes, transcripts and computer discs would be securely stored in the researcher's home. Participants were informed that data would be kept for five years as recommended by Massey University. Although participants discussed issues related to their patients during the interview process, no clinical data were collected on patients receiving care from any one of the participants.

In summary, ethical standards were maintained throughout the study by obtaining approval from the necessary ethics committees and District Health Board, secure storage of participant details, provision of adequate participant information, attention to informed consent processes, and the use of confidentiality and transcriber's agreements. The method taken to select participants for the research will now be discussed.

Participant Selection

Appropriate data collection techniques include selection of a sample group that best reflects the specialist population to ensure the results of the research are generalisable. As an evaluation methodology can use both quantitative and qualitative approaches (Ovretveit, 1998), varying sampling processes can be used. Intensity sampling (a qualitative sampling technique) was used for this research. Intensity sampling involves selecting participants with intensity of experience (Minichiello et al., 1999). This study used intensity sampling to select critical care nurses that had completed a critical care specialty practice programme and were currently working in the critical care environment. Intensity sampling takes into account the various levels and duration of critical care specialty practice programmes, assisting in ensuring the sample is representative of the general critical care nursing population.

Participants recruited into the research consisted of 28 registered nurses, who had completed a critical care specialty practice programme and who were working in a critical care unit within two tertiary hospitals in a large metropolitan city within New Zealand. Fourteen participants from each of the two critical care units were recruited

into the research. An advertisement placed on the notice boards in each of the two critical care units was used to recruit participants. However this recruitment strategy resulted in only one participant. The remaining 27 participants were recruited after being randomly approached by the researcher and asked to participate in the research. All critical care nurses that met the selection criteria were approached while on duty at random days and times. Of all the nurses that were approached in this manner, four nurses declined to participate in the research. The criteria used in the study to ensure research soundness will now be discussed.

Ensuring a sound research process

All research requires a sound research process. Methods of assessing whether the research process is sound differ according to the research approach. Quantitative research uses the specific criteria of objectivity, validity and reliability, and generalisability to assess research soundness.

Objectivity refers to the degree in which the results of the research are unbiased (Minichiello et al., 1999). To avoid bias, the researcher's opinions should not influence the way the research is conducted. Ovretveit (1998), when discussing evaluation methodology, also supports the need for the researcher to identify their biases, by spelling out their assumptions and limitations so evaluation research is not viewed at first sight as having considered everything.

Validity refers to the degree to which the research measures what it purports to measure and ensures that a true result is obtained from the research (Minichiello et al., 1999). Validity can be assessed using content-related validation and construct-related validation. Content-related validation is achieved by assembling a panel of experts to ensure that all the relevant constructs are assessed in the correct proportions. Construct-related validation refers to the extent to which a test may be said to measure a theoretical construct or concept (Minichiello et al., 1999).

Reliability refers to the ability of the research measurements to be consistent and reproducible, which means that if the research were to be repeated, the same results would be obtained (Minichiello et al., 1999). Generalisability, which is also referred

to as external validity, means the results of the research are applicable in other specific contexts (Minichiello et al., 1999). As many qualitative researchers do not believe that it is possible to always be objective and because the context of the research cannot claim reliability, other criteria are used to assess qualitative research soundness (Minichiello et al., 1999). These criteria include authenticity and trustworthiness (Koch, 2000; Minichiello et al., 1999).

Authenticity refers to the extent to which different underlying values of the researcher are made transparent (Koch, 2000). Trustworthiness includes credibility, transferability, dependability and confirmability (Burman et al., 2002). The use of a methodological log is an approach that enables trustworthiness and authenticity to be demonstrated by providing a clear record regarding the methods and decisions made during the course of the research.

As this study used both quantitative and qualitative approaches to answer the research question, a variety of approaches were used to ensure research soundness. Objectivity and authenticity were achieved through the researcher identifying actual and/or potential biases, thereby when preparing the research design limiting the effect of those biases on the research tool. Objectivity and authenticity were also achieved by the use of an expert panel to review the methodology and methods.

The researcher's biases are related to the author of this thesis being involved in the formation of the New Zealand education standards and interest in teaching physiology to nurses. The researcher coordinated and published the *New Zealand Standards for Certification in General Intensive Therapy Nursing Education* (Pirret, 1994) and chaired the committee to review The *New Zealand Standards of Critical Care Nursing Education* (Critical Care Nurses' Section, 2000), both of which outlined the physiological knowledge recommended to be covered in a critical care specialty practice programme. The researcher, as an independent clinical nurse specialist, teaches physiology to nurses, having the belief that the use of knowledge of physiology is necessary for quality clinical decision-making.

Validity was achieved through content-related validation and construct-related validation. Content-related validation was achieved by assembling a panel of critical

care nursing experts to assess whether the research process assessed the relevant constructs or concepts that make up critical care nursing knowledge in the correct proportions. This expert panel consisted of critical care nurses with expert critical care knowledge who were highly respected amongst their peers. The nurses who made up this expert panel were not related to the units involved in the research or the unit in which the researcher practised. Members of the expert panel were also from different critical care units and regions in New Zealand. Reliability and validity were also assessed by completion of a pilot study from which data were reviewed by the expert panel. Alterations to the research method were made following this review.

Construct-related validity was assessed by identifying constructs (also known as concepts) deemed by the critical care nursing profession as being part of critical care nursing knowledge. Construct validity was supported because the concepts being analysed were those identified in the *New Zealand Standards for Critical Care Nursing Education* (Critical Care Nurses' Section, 2000). The theoretical concepts included functional residual capacity, thoracic compliance, airway resistance, oxyhemoglobin dissociation curve, hypoxaemia, hypercarbia, respiratory acidosis, respiratory alkalosis, metabolic acidosis, dead space, Aa gradient, VQ mismatch, hypoventilation and increased red blood cell transit time. These theoretical concepts were reviewed by the expert nursing panel to ensure they measured critical care nursing knowledge used in critical care nurses' clinical decision-making.

Construct-related validation was achieved throughout the different stages of data collection. The transcripts obtained in the interviews to assess the use of respiratory knowledge in clinical decision-making were analysed for participants' understanding and application of the theoretical concepts in their clinical decision-making. The ABG analysis further explored the theoretical concepts of hypoxaemia, respiratory alkalosis, respiratory acidosis and metabolic acidosis. The card matching exercise focused specifically on participants' matching of the theoretical concepts to their definitions.

All potential participants were given an information leaflet outlining the aim of the research. Participants' prior knowledge of the topic has the risk to cause participants to revise their respiratory knowledge prior to the data collection, which may

influence the accuracy of the research data. To minimise this risk, multiple methods of data collection were used and all participants were required to sign a confidentiality agreement (Appendix E) preventing them from discussing the research interview process with others.

A methodological log was used to provide a clear record regarding the methods and decisions made during the course of the research. The use of a methodological log or audit trail allows the researcher's peers to review and evaluate the research for authenticity and trustworthiness (Minichiello et al., 1999). Although a methodological log was used, confidentiality and anonymity of participants was maintained.

Reliability was achieved by using appropriate data analysis techniques to identify statistical significance (See chapter four). Generalisability was attained by clearly outlining the research process. These clear outlines are essential in ensuring the research results can be replicated in a similar critical care environment.

In summary, this study attained research soundness by meeting the criteria of objectivity, authenticity, reliability and validity, trustworthiness and generalisability. Objectivity and authenticity were attained by the researcher identifying actual and potential biases; content-related validity was achieved by forming a panel of experts and conducting a pilot study; and construct-related validity was supported, as the concepts being analysed were those identified in the *New Zealand Standards for Critical Care Nursing Education* (Critical Care Nurses' Section, 2000). The use of a methodological log allowed authenticity and trustworthiness; reliability was met by use of appropriate data analysis techniques; and a clear outline of the research process provided generalisability.

Summary

The purpose of this study was to answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? This chapter identified the researcher's epistemological stance of objectivism and theoretical stance of post-

positivism underpinning the evaluation methodology used in this study. An evaluation methodology taking a managerial perspective was chosen for this study due to its ability to use both quantitative and qualitative approaches to compare the use of knowledge of respiratory physiology in critical care nurses' decision-making with the respiratory physiology recommended in the *New Zealand Standards in Critical Care Nursing Education* (Critical Care Nurses' Section, 2000).

The research design incorporated quantitative and qualitative methods used to collect data. Through the use of a questionnaire, taped interviews, ABG analysis and a card-matching exercise, data were collected on participant demographics, factors that influence the professional culture within the critical care unit, access to ongoing knowledge development, knowledge of respiratory physiology and participants general comments on the use of knowledge of respiratory physiology to provide patient care.

Throughout the study, procedures were incorporated to ensure research soundness and ethical standards were met. Having presented the theoretical framework, methodology and method used to answer the research question, strategies used to ensure a sound research process, ethical considerations and mode of participant selection, chapter four outlines the data analysis techniques used in this study.

CHAPTER FOUR: DATA ANALYSIS TECHNIQUES

The previous chapter outlined the research design used to answer the research question. An epistemological stance of objectivism and theoretical stance of post-positivism was identified as underpinning the evaluation methodology used in this study. The evaluation methodology taking a managerial perspective was chosen for its ability to use both quantitative and qualitative approaches, thereby allowing multiple methods to collect data.

This chapter discusses the quantitative and qualitative techniques used to analyse the data. The discussion begins with a brief overview of software programmes used and the number of participants included in the data analysis and is followed by a description of specific quantitative and qualitative techniques utilised to analyse the data. This description of the quantitative and qualitative techniques will be presented in parts; analysis of demographics, factors that influence professional culture, access to ongoing knowledge development, knowledge of respiratory physiology, factors that influence clinical decision-making and participants' general comments on the use of knowledge of respiratory physiology used to provide patient care. A brief overview of software programmes used and the number of participants included in the data analysis will now be presented.

Overview

The software programmes MINITAB 13 and Microsoft Excel were used to analyse quantitative data. Descriptive statistics including frequencies and percentages were used to calculate quantitative responses. Qualitative responses were recorded and analysed manually with a search for commonalities and themes.

Due to tape damage during the transcription process, the data of only 27 of the 28 participants recruited into the study were analysed. As the interview was crucial to the quantitative and qualitative data collection, loss of this data meant that aspects key to answering the research question could not be analysed. The researcher did not reinterview the participant due to the negative effect it may have had on the research results. The researcher had concerns that the participant's previous experience with

the interview process would cause the participant to reflect on their use of respiratory knowledge prior to the second interview thereby negatively influencing the accuracy of the research data to measure critical care nurse decision-making. Reflecting on practice improves professional knowledge (Boyer, 1996; Rolfe & Fulbrook, 1998) and due to awareness of this knowledge, results in participants reporting things they are supposed to be doing, rather than what they are actually doing (Thompson et al., 2002). Therefore, if the interview was repeated, this data risked measuring nurses' perception of their decision-making abilities rather than their actual decision-making abilities. Therefore to avoid participant reflection contaminating the research data, the author of this thesis removed the participant data from the data analysis. Techniques used to analyse the demographic data will now be presented.

Demographic analysis

Demographic data were collected on age, year of registration, number of years of general nursing experience (both part-time and full-time), the year the participant completed their critical care specialty practice programme, number of years of critical care experience (both part-time and full-time), number of years of clinical experience post completion of the critical care specialty practice programme (both part-time and full-time) and how many hours per week participants were currently employed. These demographic data were subjected to exploratory data analysis (EDA) for measures of central tendency and the degree of dispersion. Measures of central tendency included measures of the mean and median, while the degree of dispersion included measures of the range (Myles & Gin, 2000). Although the mean, medium and range are basic descriptive statistics, they are useful in providing information about the distribution of data.

The degree of dispersion provides information on the distribution of scores. Distribution resembling a symmetrical bell is described as a normal distribution. A normal distribution has a precise mathematical formula that has an equal number of scores above and below the middle point. A distribution where scores are located near one end is said to be skewed. Clustering of scores at the lower end of distribution is referred to as a positive skew, whereas scores clustered at the upper end is termed a negative skew. If there are only one or two outlying scores, these

scores are often removed from the data to prevent the data from distorting the mean and medium, thus preventing the researcher from forming interpretations that do not reflect the general population (Minichiello et al., 1999).

The t-test (specifically the two-sample t-test) was then applied to the demographic data to identify any similarities or differences between the participants in unit one and the participants in unit two. The t-test (t) is a statistical technique suitable to apply to small samples of data to identify statistical differences between two sample groups. The two-sample t-test is used to test a null hypothesis, which states that the two sample groups are equal (Minichiello et al., 1999; Snedecor & Cochran, 1989). By producing "a ratio of between-group differences to within-group variability" (Minichiello et al., 1999, p. 510), the t-test is able to specify different sampling distributions, thereby defining the probability of obtaining a particular result (Minichiello et al., 1999). Probability is used to reject a null hypothesis by determining whether a difference exists between the means of the two population groups. The degree of difference is expressed as the P-value, with a P-value (p) less than .05 being regarded as statistically significant (Dallal, 2004; Minichiello et al., 1999).

Categorical data were collected on participants' current academic preparation and the type and length of the critical care specialty programme completed. These data were analysed for the number of participants in each category and the two-sample t-test applied to identify any statistical differences between unit one and unit two groups. Techniques used to analyse factors influencing professional culture will now be discussed.

Analysis of factors influencing professional culture

Categorical data were collected on factors that influence the professional culture within the critical care unit, and included participants' rated use and value of protocols and guidelines, standards and integrated care pathways and the professional and management support within the critical care unit. These data were analysed for the number of participants in each category or the frequency of view

points in each category, and the two-sample t-test applied to identify any statistical differences between unit one and unit two groups.

Some participants requested discussion on the professional factors. These discussions were audiotaped and transcribed verbatim. The transcripts were then subjected to qualitative analysis to identify themes. Qualitative analysis also include thematic analysis, discourse analysis, ideological analysis and narrative analysis (Minichiello et al., 1999). Qualitative analysis uses an interpretive approach to seek understanding of how and why things are said. Hence the medium of qualitative analysis is " human language expressing the concepts of everyday experience as they pertain to a specific context " (Minichiello et al., 1999, p. 454). Thematic analysis is used to identify themes emerging from the data to construct theories (Minichiello et al., 1999).

Thematic analysis identifies all data that forms a pattern and then combines those patterns into themes. Themes are derived from patterns in conversation and vocabulary (Taylor & Bogdan, 1984) that when viewed alone, are meaningless (Leininger, 1985). Themes emerge when each participant's conversation is pieced together to form a comprehensive picture of the participants' collective experience. Once themes are identified, the literature is then used to support emergence of the themes (Aronson, 1994). Techniques used to analyse access to ongoing knowledge will now be discussed.

Analysis of access to ongoing knowledge

Categorical data on access to ongoing knowledge, which included conference attendance, reading of medical and nursing journals and access to the World Wide Web, were collected. These data were analysed for the number of participants in each category or the frequency of view points in each category, and the two-sample t-test was then applied to identify any statistical differences between the unit one and unit two groups. Techniques used to analyse knowledge of respiratory physiology will now be discussed.

Knowledge of respiratory physiology

Data on knowledge of respiratory physiology included data on the use of knowledge of respiratory physiology in clinical decision-making, ABG analysis, knowledge of respiratory concept definitions and discussion of respiratory concepts in practice. A correlation coefficient was then applied to aspects of this data to identify the relationship between areas of knowledge. The analysis for each part of this data collection will now be discussed beginning with the data analysis on the use of knowledge of respiratory physiology in clinical decision-making.

Use of knowledge of respiratory physiology in clinical decision-making

Using a questionnaire and interview, data were collected on the use of knowledge of respiratory physiology in clinical decision-making. These data were firstly analysed for the number of respiratory related tasks performed and the two-sample t-test was applied to identify any statistical differences between the unit one and unit two participants. The transcripts of the interviews exploring the reasons why participants performed each of the specific tasks, and what respiratory physiological knowledge participants used to provide rationale for performing those tasks, were analysed for understanding and application of the respiratory concepts. Measuring the understanding and application of a concept requires the conversion of a theoretical concept to a specific procedure. The process of converting theoretical concepts into variables that can be measured is known as operationalisation or providing an operational definition (Minichiello et al., 1999). Therefore concept analysis defines operational definitions that accurately reflect its theoretical base, thereby enabling theoretical concepts to be measured.

Respiratory concepts and varying levels of operational definitions used by participants in their clinical decision-making were tabled for analysis. This enabled the researcher to identify the type and level of respiratory knowledge used by participants to perform each of the tasks and also which respiratory concept they were using in their clinical decision-making. Participants' understanding and application of the respiratory concepts were then graded and classified into either demonstration of high knowledge, demonstration of medium to high knowledge, demonstration of medium knowledge, and demonstration of low knowledge. A panel of expert critical care nurses then validated these classifications.

Participants who were considered as having a high level of knowledge demonstrated clear articulation of the respiratory concept and a comprehensive understanding and application of the respiratory concept when providing a rationale for their nursing interventions. Participants who were considered as having a medium to high level of knowledge did not articulate the actual respiratory concept; however, when discussing the rationale for their nursing interventions, they did demonstrate a comprehensive understanding and application of the principles behind the respiratory concept. Participants who were considered as having a medium level of knowledge demonstrated only limited understanding and application of the respiratory concepts when discussing the rationale for their intervention. Participants who were considered as having a low level of knowledge were not able to provide a clear rationale for their nursing interventions, their rationale often being standard nursing practice within the unit or an intervention ordered by medical staff. An example of the method of grading and classification used for the concept VQ mismatch is outlined in the following chapter (See Table 5.5).

These classifications were then given a numerical value to enable EDA to measure the mean, median and range of demonstrated use of knowledge or respiratory physiology in clinical decision-making. These numerical values formed knowledge scores. The classification demonstration of high knowledge was given a knowledge score of four; medium to high knowledge a knowledge score of three; medium knowledge a knowledge score of two; and low knowledge a knowledge score of one. The two-sample t-test was then applied to this data to identify any statistical differences between the unit one and unit two participants. Techniques used to analyse the ABG interpretation will now be discussed.

Arterial blood gas analysis

As discussed in the previous chapter, data on participants' knowledge and skills in ABG analysis were collected to further assess their knowledge base. Each participant was given three ABGs and asked to interpret the ABG and discuss what intervention(s) would be required to achieve a normal ABG result. Participants then wrote their answers on the ABG blood gas form and discussed their answers on tape.

The data from the ABG form and the transcripts related to the ABG interviews were analysed for correct diagnosis and appropriate interventions. Prior to data analysis, the expert panel reviewed the ABGs for correct diagnosis and intervention(s) required to return the arterial blood gas to normal. Participant data were then analysed for identification of parameters outside the normal range, the diagnosis and the appropriate intervention. A numerical value was given for each correct answer to enable EDA for measures of mean, median and range. Percentage values were then applied to these scores to identify the knowledge and skill level of participants in ABG analysis. The Student's t-test was applied to this data to identify any statistical differences between unit one and unit two participants. The scores for each of the three ABGs were then analysed and classified into categories demonstrating high, medium to high, medium, and low knowledge. High knowledge was assessed as having a score of 80-100%, medium to high as a score of 70-79%, medium as a score of 60-69% and low as a score of 50-59%. Techniques used to analyse data on knowledge of respiratory concept definitions will now be discussed.

Knowledge of respiratory concept definitions

As outlined in the previous chapter, data were collected on participants' understanding of respiratory concepts and their definitions. This was performed using a card-matching exercise, where participants were asked to match each of the respiratory concepts to their definitions. The participants' matching of the respiratory concepts to their definitions were analysed for accuracy. These concepts and their matching definitions were reviewed by the expert panel prior to analysis. Numerical values were given to correct matching of the concepts to their definitions to enable EDA for measures of the mean, median and range. Percentage values were then applied to the scores to identify areas of high, medium to high, medium and low knowledge. As in the ABG analysis, high knowledge was assessed as having a score of 80-100%, medium to high as a score of 70-79%, medium as a score of 60-69% and low as a score of 50-59%. The Student's t-test was applied to this data to identify any statistical differences between the unit one and unit two participants. The correlation coefficient used to identify the relationship between aspects of respiratory knowledge will now be discussed.

Correlations between aspects of respiratory knowledge

Following analysis of the use of knowledge of respiratory physiology in clinical decision-making, ABG interpretation and respiratory concept definitions, Pearson's product-moment correlation coefficient (r) was applied to the data to identify the relationship between these aspects of respiratory knowledge. Prior to the correlation analysis, the correlation data was ranked to reduce the effect of outliers and prevent distortion of the correlation results. Outliers are data that plot well away from the main body of the data, and if not considered, result in gross distortion of the results. If the sample size is less than 50, as is the case of this study (N = 27), the effect of outliers is critical (Minichiello et al., 1999).

The Pearson's product-moment correlation coefficient is the most common measurement for correlation, being appropriate for interval and ratio variables and both ordinal and nominal data (Minichiello et al., 1999). Correlations are applied to data to build upon preliminary descriptive statistics measuring the mean, median and range (Minichiello et al., 1999) to identify the relationship between two quantitative variables (Myles & Gin, 2000). Correlation coefficients (r) are numbers covering the full range from 0, which describes no association to +1 or –1, which describes the strength of association. Generally, $r > .8$ is considered a very high association, .6 - .8 a high association, .3 to .6 a moderate association, and < .3 a low association (Minichiello et al., 1999). A value of -1.0 describes a perfect negative association while a value of 1.0 describes a perfect positive association (Minichiello et al., 1999; Myles & Gin, 2000). The limitation of correlation is that association does not necessarily imply causation (Myles & Gin, 2000). Techniques used to analyse discussion of respiratory concepts in practice will now be discussed.

Discussion of respiratory concepts in practice

As outlined in the previous chapter, participants were interviewed to gather data on their familiarity with the respiratory concepts and their definitions and degree in which the respiratory concepts were discussed in their critical care programme and clinical practice setting. These interviews were audiotaped and the interviews transcribed verbatim. These transcriptions were recorded and manually searched for common themes to enable understanding of the contextual issues influencing the use

of respiratory knowledge in clinical decision-making, hence providing some explanation for the quantitative results. Techniques used to analyse factors that influence clinical decision-making will now be discussed.

Analysis of factors that influence clinical decision-making

Following measurements of the use of knowledge of respiratory physiology in clinical decision-making, Pearson's product-moment correlation coefficient (r) was used to identify correlations between the ranked use of knowledge of respiratory physiology and factors related to demographics, professional culture and ongoing knowledge development. Techniques used to analyse participants' general comments on the use of knowledge of respiratory physiology to provide patient care will now be discussed.

Analysis of general comments

As outlined in the previous chapter, at the end stage of the interview, participants were given an opportunity for general comment on the use of knowledge of respiratory physiology to provide patient care. The transcriptions of these interviews were analysed for themes.

Summary

This chapter began with a brief overview of software programmes used and the number of participants included in the data analysis and was followed by discussion on specific quantitative and qualitative techniques used to analyse specific parts of the data generated. Quantitative analysis was used to examine demographics, professional culture within the critical care unit, access to ongoing knowledge and aspects of knowledge of respiratory physiology. The two-sample t-test was applied to this data to identify statistically significant differences between the participants in unit one and unit two. Pearson's product-moment correlation coefficient was performed on ranked data to identify relationships between the use of knowledge of respiratory physiology and factors related to demographics, professional culture and ongoing knowledge development.

Thematic analysis was used to provide understanding of the contextual issues influencing the use of respiratory knowledge in clinical decision-making. The transcriptions obtained from the interviews used to assess discussion of respiratory concepts in practice, and participants' general comments on the use of knowledge of respiratory physiology to provide patient care, were analysed for themes. As some participants requested discussion on the use of protocols and guidelines, standards and integrated pathways, the transcriptions from these interviews were also subjected to thematic analysis. Having discussed the techniques used for data analysis, chapter five will outline the results of the data analysis.

CHAPTER FIVE: RESULTS

The previous chapter outlined the techniques used for data analysis to answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? This chapter presents the results of the data analysis. The results will be presented in separate parts, which will include participant demographics, factors that influence the professional culture, access to ongoing knowledge development, knowledge of respiratory physiology, factors that influence clinical decision-making and issues raised in general discussion. The results from the demographic data analysis will now be presented.

Participant demographics

As discussed in chapter three, participants were selected from two tertiary critical care units within a large metropolitan city. As outlined in the previous chapter, demographic data that has been identified in the literature as having an influence on clinical decision-making were analysed. The total group (N = 27) consisted of one male and 26 female participants. The mean age of participants for the total group was 34.4 years (range = 26-61, median = 32), however this was significantly higher in unit two (mean = 38.7, range = 28-61, median = 34) when compared to unit one (mean = 29.8, range = 26-35, median = 30) ($t = 3.07$, $p = .008$). The mean number of years of general nursing experience prior to specializing in critical care nursing for the total group was 2.7 (range = 0-13, median = 1.5), with no statistical difference found between unit one and unit two participants ($t = .18$, $p = .859$). Most of this experience was full- time general nursing experience.

The mean number of years of critical care experience for the total group was 8.94 (range = 2-32.5, median = 7), however it was significantly higher in unit two (mean = 11.93, range = 4-32.5, median = 9.5) when compared to unit one (mean = 5.73, range = 2-12, median 5) ($t = -2.68$, $p = .017$). Once again most of this experience was full- time.

Table 5.1. Demographic Data of Total Group (N = 27)

	Mean	Median	Range	Standard deviation
Age	34.4	32	26-61	8.91
Years of general experience	2.66	1.5	0-13	3.10
Years of FT general experience	2.58	1.5	0-13	3.04
Years of PT general experience	0.07	0	0-2	0.38
Years of critical care experience	8.94	7	2-32.5	6.84
Years of FT critical care experience	7.44	5.5	2-25	5.21
Years of PT critical care experience	1.5	0	0-16.5	3.55
Years post critical care programme	6.01	5	0-32.5	6.88
Years FT post critical care programme	4.45	3	0-23	4.92
Years PT post critical care programme	1.54	0	0-16.5	3.67
Current full-time equivalent	0.86	1	0.2-1	0.22

FT (full- time); PT (part-time)

Table 5.2. Demographic Data of Unit One Participants (n = 13)

	Mean	Median	Range	Standard deviation
Age	29.77	30	26-35	3.06
Years of general experience	2.77	3	0-9.5	2.74
Years of FT general experience	2.77	3	0-9.5	2.74
Years of PT general experience	0	0	0	0
Years of critical care experience	5.73	5	2-12	2.81
Years of FT critical care experience	5.19	5	2-10	2.62
Years of PT critical care experience	0.54	0	0-5	1.45
Years post critical care programme	2.83	2	0-7	2.07
Years FT post critical care programme	2.33	2	0-5.5	1.74
Years PT post critical care programme	0.46	0	0-5	1.39
Current full-time equivalent	0.91	1	0.6-1	0.15

FT (full- time); PT (part-time)

Table 5.3. Demographic Data of Unit Two Participants (n = 14)

	Mean	Median	Range	Standard deviation
Age	38.71	34	28-61	10.42
Years of general experience	2.55	1.25	0-13	3.50
Years of FT general experience	2.41	1.25	0-13	3.38
Years of PT general experience	0.14	0	0-2	0.53
Years of critical care experience	11.93	9.5	4-32.5	8.16
Years of FT critical care experience	9.53	8.25	3-25	6.17
Years of PT critical care experience	2.39	0	0-16.5	4.63
Years post critical care programme	8.96	6	2-32.5	8.44
Years FT post critical care programme	6.43	4.5	0-23	6.07
Years PT post critical care programme	2.54	0	0-16.5	4.78
Current full-time equivalent	0.81	.95	0.2-1	0.26

FT (full- time); PT (part-time)

The mean number of years of experience post completion of the critical care programme for the total group was 6.01 (range = 0-32.5, median = 5), and was significantly higher in unit two (mean = 8.96, range = 2- 32.5, median = 6) than in unit one (mean = 2.83, range = 0-7, median = 2) (t = -2.64, p = .02). This experience was predominantly full-time critical care nursing experience, however the full-time critical care nursing experience of unit two was significantly higher than unit one (t = -2.42, p = .029).

The mean full-time equivalent (FTE) participants were currently employed was 0.86 (range = 0.2-1, median = 1), with no statistical difference between unit one and unit two (t = 1.24, p = .227). The demographic data of the total group (N = 27) is shown in Table 5.1, the unit one group (n = 13) in Table 5.2 and the unit two group (n = 14) in Table 5.3.

The education preparation of the total group was as follows: seven participants (25.93%) had a registered general nursing qualification; 12 participants (44.44%) had a bachelor degree, seven (25.93%) participants had a masters level qualification, of which six participants had a post-graduate certificate (critical care nursing) and one participant had a graduate diploma in advanced nursing practice in critical care nursing; and one participant (3.7%) had a masters degree.

The education preparation of the participants in unit two was higher than the participants in unit one, however this difference was not statistically significant (t = 1.30, p = .209). In unit one, three participants (23.08%) had a registered general nursing qualification, nine participants (69.23%) had a bachelors degree and one participant (7.69%) had a masters level qualification, that being a post-graduate certificate in critical care nursing. In unit two, four participants (28.57%) had a registered general nursing qualification; three participants (21.43%) had a bachelor degree, six participants (42.86%) had a masters level qualification (five having a post graduate certificate in critical care nursing and one having an advanced diploma in advanced nursing practice, majoring in critical care nursing) and one participant (7.14%) had a masters degree.

In summary, the mean age of the participants (N = 27) was 34.4 years. The mean number of years of critical care experience for the participants was 8.94, with most of that experience being full-time. The mean number of years post completion of the critical care programme was 6.01. When compared to unit one, these mean values were all significantly higher than the mean values of unit two. The mean number of years of general experience prior to critical care was 2.7. The mean FTE the participants were employed was 0.86. The participants' education preparation varied, with 25.93% having a registered general nursing qualification, 44.44% having a bachelor degree, 25.93% having a masters level qualification and 3.7% having a masters degree. Factors that influence the professional culture within the units will now be discussed.

Factors that influence professional culture

As discussed in chapter four, categorical data relating to factors that influence the professional culture within the units were analysed. These factors included the nurses' perceived use of protocols and guidelines, standards and integrated care pathways and the level of both professional and management support and ongoing knowledge development.

The participants of the total group (N=27) rated the use of protocols and guidelines, standards and integrated care pathways as follows: 23 participants (85.19%) rated the use of protocols and guidelines in their units as abundant while four (14.81%) rated them as medium; 19 participants (70.37%) rated the use of standards as abundant, seven (25.93%) as medium and one (3.7%) as minimal; while 10 participants (37.04%) rated the use of integrated care pathways as abundant, eight (29.63%) as medium and nine (33.33%) as minimal. There was no statistical difference in the ratings of the use of protocols and guidelines (t = -1.13, p = .273) and standards (t = -1.91, p = .072) by unit one and unit two participants. However unit one (n = 13) participants rated the use of integrated care pathways significantly higher than unit two (t = 3.55, p = .002).

When rating whether the use of these protocols and guidelines, standards and integrated care pathways supported or limited their practice, 18 participants (66.67%)

rated these as supporting their practice, six participants (22.22%) rated these as both supporting and limiting their practice and three participants (11.11%) rated these as limiting their practice. There was no statistical difference in the ratings between unit one and unit two ($t = .99, p = .333$).

Nine participants (33.33%) requested further discussion around the areas of protocols and guidelines, standards and integrated care pathways. Although three of the participants viewed these as being useful for staff new to the critical care environment, all of the nine participants discussed their limitations in regard to not meeting individualized needs of patients, inaccessibility, and preventing opportunity for creative nursing practice, ongoing knowledge development and clinical decision-making. Six participants commented on the need to "tweak" these protocols and guidelines, standards and integrated care pathways to meet the individualized needs of patients thus ensuring patient safety. Examples of participants' comments demonstrating these views are outlined in Box 5.1.

When rating the availability of credible and trustworthy nurses within their unit to support their clinical and professional practice, in the total group (N= 27), 11 participants (40.74%) rated it as excellent, 15 participants (55.56%) rated it as adequate and one participant (3.7%) rated it as inadequate. There was no statistical difference between the ratings by participants in unit one and unit two ($t = 1.53$, $p = .138$).

When rating a management structure that provides adequate professional and clinical support, in the total group 12 participants (44.445%) rated it as excellent, 12 participants (44.445%) rated it as adequate and three participants (11.11%) rated it as inadequate. There was no statistical difference between the ratings by participants in unit one and unit two ($t = 1.57, p = .13$).

When discussing the clinical, professional and management support within the unit, three unit two participants viewed lack of clinical and management support as a factor that limited their ongoing knowledge development and clinical decision-making. The views shared by these three participants are outlined in Box 5.2.

Box 5.1. Limitations of Protocols, Guidelines, Standards and Integrated Care Pathways on Clinical Decision-making

"I think the guidelines and standards that we have are very good for new people because they obviously aren't familiar....I don't always use them because there's not always one way to skin a cat as such and sometimes the guidelines are inappropriate for some patients." (Interview 18, p.1).

"Well for me personally I find doing something new, or for anybody who is new to the unit where lots of the things are new, then those guidelines are fantastic, the protocols and standards and things.....But not everything always fits in the square...and I can see where it limits if I want to do something outside of the regime or that's not the way we do it. But maybe there's a better way or a different way that's perfectly acceptable...they can breed a black and whiteness of there's only this way to do something, which can limit your thinking differently." (Interview 20, p.1).

"I find sometimes some other protocols in our department limit our practice in terms of being able to make your own nursing decisions and be an advocate and use your knowledge to base your nursing clinical decision-making on." (Interview 14, p1).

"You get into this kind of rigid mode of how it's always been done. That's just the way you do it rather than actually thinking about what you are doing." (Interview 15,p1).

"I think they can be quite limiting and unsafe for the patients. Not all of them are patient specified I suppose...a lot of nurses just stay within the limits of certain protocols and find themselves you know, quite up and down with their care, whereas I'd rather just you know tweak it and you know patient care is a lot safer." (Interview 9, p1).

"If you've got something happening and you need to act on it quickly, the chances are you are not going to go and hunt out the folder, which are sitting at the back of the nurses' station. There are best practice guidelines in the bed spaces, or there should be, but I find that people aren't in the habit of going to them if they have got something happening. They tend to do that if they've got the time. i.e. if something less critical is occurring...the ones I have come across here are really not user-friendly. The ideal would be to have a computer station in each room with an easily accessible website to each of those so you can flick it on screen whenever you needed it." (Interview 19,p.1)

Box 5.2. The Lack of Clinical and Management Support on Ongoing Knowledge Development and Clinical Decision-making

"We do have a lot of support for ongoing education and a lot of support by the senior management team to advance people, i.e. to expose them to new experiences and things. However, it is not across the board. Unfortunately the multidisciplinary team [the doctors] in this unit does not support, in my view, nurses extending their practice in the bed space so to speak.... I think it's a matter of autonomy." (Interview 23, p.5).

"I have probably had about three hours with our clinical nurse educator in the time that I came back to New Zealand and came to work here....I've probably worked here six years. Admittedly I've worked lots of weekend and lots of nights, but I've had about three hours with the educator, so I don't think that the educator is any use to me and least of all with respiratory physiology. I never see the clinical nurse consultant, except for I saw her 10 minutes yesterday....We use to have this thing here that a clinical support person who was a Level 4 person, but inevitably they were doing something else and they wouldn't clearly come near me for respiratory physiology." (Interview 22, p.2).

"Well I don't think that a lot of other nurses here do what I do. So if I've come to a blank and can't work out why something's happened to a patient, I am not sure if any of my other colleagues [are] going to be able to help me out any more. I think I probably would have turned up every stone in the brook to find out if it was this problem or that problem or if I failed to uncover something. There are a few people who I would trust. I have to say that they are people that haven't been trained here in New Zealand." (Interview 22, p1).

In summary, protocols, guidelines and standards were commonly used in both units, however the use of integrated care pathways were statistically higher in unit one than in unit two. Participants commented on the need to "tweak" policies and guidelines, standards and integrated care pathways, to meet the individual needs of patients, thus ensuring patient safety. However, most participants viewed them as supporting their practice. When rating the professional and management support within the unit, most participants rated it as excellent or adequate. Access to ongoing knowledge development will now be discussed.

Access to ongoing knowledge development

As outlined in the previous chapter, categorical data on access to ongoing knowledge development, including conference attendance, reading of medical and nursing journals and access to the World Wide Web, were analysed. Of the total group, 23 participants (85.18%) had attended a conference over the previous three years. Of the 23 participants, 19 participants (82.61%) attended a critical care nursing conference, three participants (13.04%) attended a nursing education conference and one participant (4.35%) attended a hospital-based seminar. There was no statistical difference between the participants in unit one and unit two ($t = 1.0$, $p = .328$). One participant who worked a 0.2 FTE and had not attended any conferences over the previous three years commented on the lack of funding to send part-time staff to conferences as the funding was allocated to nurses who were rostered more hours per week.

Twenty-five participants (93%) in the total group accessed nursing or medical journals to increase their knowledge. Of the total group, four participants (15%) accessed journals weekly, nine participants (33%) accessed journal monthly, 11 participants (41%) accessed journals one to six monthly and one participant (4%) accessed journals six to twelve monthly. There was no statistical difference between the participants in unit one and the participants in unit two ($t = -.05$, $p = .959$). One participant, when commenting on the frequency of accessing nursing and/or medical journals, identified how the pattern of accessing literature varied, dependent on what knowledge was required at the time. This is well explained in her following comment:

> I guess because it's not something I do in a uniform manner. Sometimes I will be looking at something or if I was doing a literature search or something, I would look at all sorts of articles for a week or maybe for three weeks then I might not look again for another month once I've found what I wanted to find, so that was why it says monthly because it's not. I guess you could average it out to monthly. (Interview 20. p.1).

Twenty-three participants (85%) in the total group (N = 27) accessed the World Wide Web for nursing and/or medical information. Of the total group, six participants (22%) accessed the World Wide Web weekly, seven participants (26%) accessed the World Wide Web monthly, eight participants (30%) accessed the World Wide Web one to six- monthly and two participants (15%) accessed the World Wide Web six to twelve- monthly. There was no statistical difference between unit one and unit two participants ($t = -.97$, $p = .343$).

In summary, 85% of the participants (N = 27) attended nursing and/or medical conferences over the previous three years. Of the total group, 93% of participants accessed nursing or medical journals to increase their knowledge, 15% accessing them weekly, 33% monthly, 41% one to six-monthly and 4% six to twelve-monthly. Of the total group 85% of participants accessed the World Wide Web for nursing and/or medical information, 22% weekly, 26% monthly, 30% one to six-monthly and 15% six to twelve-monthly. The results related to respiratory knowledge will now be discussed.

Respiratory knowledge

As discussed in chapter four, quantitative data on participants' use of knowledge of respiratory physiology in clinical decision-making, knowledge and skill in ABG analysis, understanding of respiratory concept definitions and discussion of respiratory concepts in practice were analysed. The results of this analysis will be presented in separate parts beginning with the use of knowledge of respiratory physiology in clinical decision-making.

The use of knowledge of respiratory physiology in clinical decision-making

As noted, data on the participants' use of knowledge of respiratory physiology in their clinical decision-making were analysed. This data consisted of the type respiratory-related tasks completed by participants during their clinical shift and the respiratory pathophysiological rationale for performing these tasks. The tasks completed by the nursing staff are identified in Table 5.4.

There was no significant difference between the overall type of tasks completed by unit one and unit two participants (t = .37, p = .717). Participants in unit two performed manual bagging more frequently than the participants in unit one due to their unit's suctioning protocol which required manual bagging to be completed as part of the suctioning procedure.

As discussed in the previous chapter, the use of respiratory physiology in clinical decision-making was analysed by classifying participants' knowledge into either demonstration of high knowledge, demonstration of medium to high knowledge, demonstration of medium knowledge and demonstration of low knowledge. Numerical values were then applied to each classification to formulate knowledge scores. An example of the method of grading and classification used for the concept VQ mismatch in relation to patient positioning is outlined in Table 5.5.

When asked to provide rational for the tasks completed, the mean knowledge score in the total group (n=27) was 15.96 (range = 6-30, median = 16). There was no significant difference between the mean scores of unit one and unit two (t = .62, p = .54). The mean knowledge score for unit one was 16.69 (range = 6-30, median = 17) whereas for unit two the mean score was 15.29 (range = 8-23, median = 15). The mean, range and median knowledge scores for each of the respiratory concepts are outlined in Table 5.6. For the total group, the mean number of respiratory concepts referred to when providing rational was 6.68 (range = 3-10, median = 6).

The results demonstrate that the most frequent respiratory concept used to provide rational for tasks is VQ mismatch (N = 27), ABG concepts (n = 25), oxyhaemoglobin dissociation curve (n = 24) and FRC and compliance (n = 21). The most infrequently used respiratory concepts were dead space (n = 0), Aa gradient (n = 0), red blood cell (RBC) transit time (n = 0) and airway resistance (n = 7).

The mean knowledge scores showed that participants demonstrated medium knowledge of VQ mismatch, ABG concepts, FRC and compliance and the oxyhaemoglobin dissociation curve. ABG concepts included the concepts of hypoxaemia, hypercarbia, hypoventilation, respiratory acidosis, respiratory alkalosis and metabolic acidosis. Participants demonstrated a low level of knowledge of airway resistance and no knowledge of dead space, Aa gradient and red blood cell transit time. These results showed that overall, participants demonstrated a low to medium use of knowledge of respiratory physiology in their clinical decision-making.

Of the total group, only 15 participants (55.56%) indicated they had adjusted ventilation modalities or regimes. Analysis of the mean knowledge scores show these participants demonstrated a medium to high knowledge of ventilation modalities. A higher number of participants in unit one (n = 9) adjusted ventilation regimes or modalities than the participants in unit two (n = 5), with participants in unit one demonstrating a statistically significant higher level of knowledge in this area than participants in unit two ($t = 3.03$, $p = .013$).

The mean knowledge score for ventilation modalities and regimes in the unit one participants was 3.44 (range 2-4, median 4) demonstrating a medium to high level of knowledge. However the mean score for ventilation modalities and regimes in the unit two participants was 2.4 (range 2-3, median 2) demonstrating only a medium level of knowledge. The unit environment could explain the reason for the difference in these results. In unit one, adjustment of ventilation modalities and regimes was an accepted part of the senior nurses' decision-making role, whereas in unit two, two participants commented that adjustment of ventilation modalities and regimes by the senior nursing staff was discouraged, with this decision-making role belonging to the medical staff.

Table 5.4. Tasks Completed by Participants

Task	**Unit one**	**Unit two**	**Total**
Chest auscultation	13	14	27
Suctioning	12	14	26
Preoxygenation	9	6	15
Hyperventilation	0	1	1
Manual bagging	2	13	15
Patient positioning	11	14	25
Adjusting FiO_2	7	4	11
Adjusting ventilation modality/regime	9	6	15
ABG taking/result retrieval	13	12	25
Administering analgesia	12	9	21
Administering paralyzing agent	3	2	5
Administering sedation	8	5	13

Table 5.5. Example of Grading and Classification of the Respiratory Concept VQ Mismatch

High Knowledge

"So generally the reason for turning and position is to help lung or alveoli ventilation. If there was a VQ or perfusion ventilation mismatch then hopefully you would help correct that. If I could see a chest x-ray and work out which side was the worst side, I would then probably put them worse side down for less period of time than the good side down. But I don't know what the chest x-ray showed and he was prescribed equal turns, so I am guessing that both sides of the chest were as bad as each other." (Interview 25, p.5)

Medium to high

"She's had her left lung done so I wanted to put that lung up so the air would gravitate towards that lung and that's her bad side so she would re-expand that side a bit better. If she wasn't very good then I'd position her with her good lung up and then her oxygenation would improve a little bit better." (Interview 9, p.3)

Medium

"Well the positioning was due to the already compromised pair of lungs that has already been diagnosed, like the right was pleural effusion and in the left was consolidation from aspiration etc. So it is very important to turn them from side to side or to stick to the order that has been ordered by the doctors, otherwise you are going to make the situation worse." (Interview 28, p.6)

Low knowledge

"I repositioned her because she hadn't been positioned for four hours....It wasn't really a respiratory reason for turning her, it was more so that I could do pressure area care. But also in this unit they do like to turn people a lot and I think that they do it for chest cares, so it is sort of like a standard thing here." (Interview 22, p.3).

Table 5.6. Knowledge Scores of Respiratory Concepts Used

Respiratory concept	Discussed by number of participants (N = 27)	Knowledge score mean	Knowledge score range	Knowledge score median
FRC Compliance	21	2.11	0-4	2.5
Airway resistance	7	0.58	0-3	0
Oxyhaemoglobin dissociation curve	24	1.94	0-4	2
ABG concepts	25	2.136	0-4	2
Dead space	0	0	0	0
Aa gradient	0	0	0	0
VQ mismatch	27	2.427	1-3.66	2.5
RBC transit time	0	0	0	0

High knowledge score (4), medium-high knowledge score (3), medium knowledge score (2). low knowledge score (1), not discussed (0).

In summary, the results identified participants demonstrated a low to medium use of knowledge of respiratory physiology in their clinical decision-making. The results of the participants ABG analysis will now be presented.

Arterial blood gas analysis

As discussed in the previous chapter, data on participants' interpretation of ABGs were analysed and then classified into categories demonstrating high, medium to high, medium and low knowledge. For the three arterial blood gases, the mean score for the total group (N = 27) out of a possible score of 41 was 28.59 (range 21-38, median 28). The mean scores in both unit one (n = 13) and unit two (n =14) were similar, with unit one having a mean score of 28.69 (range 21-38, median 30) while unit two had a mean score of 28.5 (range 24 – 35, median 27.5). These results show that the mean percentage participants achieved was 69.73% (range 51.22% - 92.68%) demonstrating a medium level of knowledge in ABG analysis. For the three arterial blood gases there were no statistical differences between the scores of the unit one and unit two participants ($t = .11, p = .913$).

Interpretation of ABG one showed a respiratory alkalosis and hypoxaemia. All participants identified the $PaCO_2$ as being outside the normal range, with 89% of participants providing the correct intervention. However, only 59% of participants defined it as a respiratory alkalosis. In the hypoxaemia component of the ABG, 96% of participants identified the PaO_2 and SaO_2 as being outside the normal range, with 89% of participants providing the correct intervention. However, no participant defined the problem as hypoxaemia. Four participants defined the problem as hypoxia while the remainder of participants defined the problem as low oxygenation, not defining specifically where the low oxygenation was occurring. The overall result shows that the mean percentage that the participants achieved for ABG one was 72.5%, demonstrating a medium to high level of knowledge.

In ABG two, showing hypoxaemia and a primary respiratory and metabolic acidosis, 96% of participants identified the PaO_2 and SaO_2 as being outside the normal range,

with 96% of participants providing the correct intervention. However once again no participants defined the problem as hypoxaemia, with four participants defining the problem as hypoxia and the remainder defining the problem as low oxygenation. All participants identified the $PaCO_2$ as being outside the normal range, with 89% of participants providing the correct intervention. However, only 48% of participants defined it as a respiratory acidosis. With the metabolic component of the ABG, 89% of participants identified the bicarbonate as being outside the normal range, with only 11% of participants providing the correct intervention. Only 41% of participants defined the problem as metabolic acidosis. The overall result shows that the mean percentage that participants achieved for ABG two was 64.71%, demonstrating a medium level of knowledge.

In ABG three, showing hyperoxaemia and respiratory acidosis, 89% of participants identified the PaO_2 and SaO_2 as being outside the normal range, with 81% of participants providing the correct intervention. No participants defined the problem as hyperoxaemia, with two participants defining the patient as being over-oxygenated and one participant defining the patient as being hyperoxic. With the respiratory acidosis component of the ABG, 96% of the participants identified the $PaCO_2$ as being outside the normal range, with 93% of participants providing the correct intervention. However, only 63% of participants defined it as respiratory acidosis. The overall result shows that the mean percentage that participants achieved for ABG three was 69.74%, demonstrating a medium level of knowledge.

The greatest knowledge deficit was in the areas of the primary respiratory and metabolic acidosis. Eight participants (29.63%) viewed the alteration in bicarbonate as a compensatory response, while six participants (22.22%) treated the low bicarbonate with intravenous sodium bicarbonate without first identifying and treating the cause of the metabolic acidosis.

In summary, ABG analysis showed participants demonstrated a medium knowledge in ABG analysis. The results also highlighted participants' lack of use of diagnostic terminology, for example no participants used the term hypoxaemia when interpreting a low PaO_2 and SaO_2. The results of participants' knowledge of respiratory concept definitions will now be presented.

Knowledge of respiratory concept definitions

As discussed in the previous chapter, data on participants' knowledge of respiratory concepts were analysed and given numerical values to identify high, medium to high, medium and low knowledge. For the matching of the respiratory concepts with their definitions, out of a possible total score of 14, the mean score of the total group was 11.7 (range 5-14, median 9). These results show a mean percentage for the total group of 83.57% (range 35.71% - 100%), demonstrating a high level of knowledge. The matching of the correct respiratory concepts with their definitions was significantly higher in unit one than in unit two ($t = 2.77$, $p = .013$). The mean score in unit one was 12.85 (range 11-14, median 12) while in unit two (n = 14) the mean score was 10.64 (range 5 – 14, median 12). Nine participants in the total group (four in unit one and five in unit two) confused the matching of hypercarbia, hypoventilation and respiratory acidosis, all concepts that are very similar. Excluding the incorrect matching of these similar concepts, the remainder of the incorrectly matched concepts is outlined in Table 5.7. The incorrect matching of these respiratory concepts was significantly higher in unit two than in unit one ($t = -3.15$, $p = .006$). Correlations between aspects of respiratory knowledge will now be discussed.

Correlations between aspects of respiratory knowledge

As discussed in the previous chapter, Pearson's product-moment correlation coefficient was applied to the ranked data to measure associations between the use of knowledge of respiratory physiology and the combined scores obtained from assessing the use of knowledge of respiratory physiology in clinical decision-making, ABG analysis and the matching of the respiratory concepts to their definitions. A high statistically significant positive association was seen in the total group ($r = .663$, $p = .00$), demonstrating the use of knowledge of respiratory physiology in clinical decision-making is positively associated with knowledge and skills in ABG analysis and understanding the respiratory concepts and their definitions. These associations differed when looking at the data in unit one and unit two. The unit one group showed a statistically significant high positive association ($r = .773$, $p = .002$), whereas the unit two group showed a statistically insignificant moderate positive

association (r = .505, p = .065). The results pertaining to discussion of respiratory concepts in practice will now be discussed.

Discussion of respiratory concepts in practice

As discussed in the previous chapter, data were analysed on discussion of respiratory concepts in practice, which included participant familiarity with the concepts and the degree to which concepts were discussed in participants' critical care programmes and clinical practice settings. The transcripts of these interviews were analysed for content and themes.

When discussing their familiarity with the concepts and their definitions, almost all participants perceived they were familiar with most of them. The concepts and definitions identified as being the least familiar were Aa gradient (30%), increased red blood cell transit time (74%) and the oxyhaemoglobin dissociation curve (37%).

Comments made by participants revealed that many of the respiratory concepts learned during completion of their critical care programme had been forgotten over time. Because participants were not discussing these concepts, they tended to forget them, therefore not use them in their clinical-decision-making. As one participant said "you do actually forget a lot because you're not using it every day from a respiratory point of view." In unit one, some of the respiratory concepts were included in the unit's orientation programme for new staff, however once nurses completed the orientation programme, this knowledge was not revisited. As one participant stated:

> As far as [functional] residual capacity and compliance and certain definitions, in this unit we get a booklet when we first start so it's included in there but that's the only time that it's discussed really, you just have to write in a definition. (Interview 17, p.7).

Participants from both unit one and unit two commented that the respiratory concepts were words that tended to be used in books and at conferences rather than in the clinical practice setting. Examples of participants' comments demonstrating these views are outlined in Box 5.3.

Table 5.7. Concepts Incorrectly Matched

	Unit one	Unit two	Total Group
Aa gradient	1	4	5
Red blood cell transit time	2	3	5
Hypercarbia	1	3	4
Respiratory acidosis	2	6	8
Hypoventilation	2	1	3
Functional residual capacity	1		1
Dead space	1	1	2
Oxyhaemoglobin dissociation curve	1	5	6
Respiratory alkalosis		4	4
Metabolic acidosis		4	4
Compliance		1	1
Airway resistance		1	1
Ventilation-perfusion mismatch		1	1
Hypoxaemia		1	1

When talking about the depth the respiratory concepts were discussed in participants' critical care programmes, 16 participants (59.26%) perceived the respiratory concepts were discussed in depth, two participants (7.41%) perceived the concepts were discussed in moderate depth and six participants (22.22%) perceived the discussion lacked depth. One participant (3.7%) described self-learning as the tool used in the critical care programme to learn the concepts. Due to the length of time since completion of their critical care programmes, two participants (7.41%) could not recall to what depth the respiratory concepts were covered. Six participants commented on respiratory concepts not discussed, which included five participants not recalling any discussion on red blood cell transit time, two participants not recalling any discussion on Aa gradient, two participants not recalling any discussion on functional residual capacity and one participant not recalling any discussion on VQ mismatch. Seven participants commented on not being able to clearly identify whether their knowledge of respiratory concepts originated from their critical care programmes or from their ongoing clinical experience.

When describing the depth and frequency the respiratory concepts were talked about in their clinical practice setting, some participants outlined the depth and frequency of the respiratory concepts discussed. They viewed the most frequent respiratory concepts discussed in the clinical practice setting as being respiratory acidosis, respiratory alkalosis, metabolic acidosis, hypoxaemia and hypoventilation, all concepts discussed on a day-to-day basis when doing ABG analysis and adjusting ventilation. Respiratory concepts viewed as being moderately discussed were compliance, airway resistance and hypercarbia, with the most infrequent respiratory concepts discussed being functional residual capacity, oxyhaemoglobin dissociation curve, Aa gradient, dead space, VQ mismatch and red blood cell transit time. There was no statistical difference between unit one and unit two in depth and frequency of respiratory concept discussion in the clinical practice setting ($t = .23$, $p = .82$).

Comments from unit two participants revealed that their clinical practice environment often did not provide an environment that was conducive to discussing the respiratory concepts. This is demonstrated in the following participant's comment:

> If you want to take it [respiratory concepts] up and have a conversation and pursue it with a registrar then yeah, but really it's not encouraged. It's not spoken about. It's not. You don't have people coming in saying what's going on here. Oh okay so why is that happening and what is that happening all the way down to cellular level.... You can just be task orientated and not take it back to cellular level and get away with that. And it is behind your motivation if you ask for more information or to understand why. It's just not something that the knowledge base is out there in the clinical setting for this unit. (Interview 17, p.7).

Unit two participants commented that they were often excluded from medical staff discussion when respiratory concepts related to their patients were being talked about. This exclusion was thought to limit knowledge base and reduce clinical decision-making. Examples of participants' comments demonstrating these views are outlined in Box 5.4.

One unit one participant identified the lack of senior critical care nurses as being a critical factor in how nurses use knowledge of respiratory physiology in their clinical decision-making. This participant stated:

> It depends on the Unit. I mean the unit that I work on at the moment has a lot of very junior staff, a lot of newly qualified staff. You know people that haven't even got a couple of years of medical ward or you know surgical ward background and I find knowledge here is quite poor. Units that I've worked on before, I've had much higher sort of staff....You had to have worked on the ward area for 2 years and they would take 2 people every 6 months. The two new people had a much higher knowledge and teaching and you were expected to do the intensive care course. (Interview 10, p.4).

Both unit one and unit two participants discussed the fact that they think about the principles of the respiratory concepts in clinical practice, but do not actually use the terminology. These participants viewed the clinical practice language related to the use of these concepts as being different to the theoretical language. Participants also commented that they were more likely to discuss the respiratory concepts when caring for the sicker patient. Examples of participant comments demonstrating these views are outlined in Box 5.5

Two participants from unit one commented that their unit had already identified a lack of respiratory knowledge in nurses' clinical decision-making and were currently developing an education programme to improve the level of knowledge amongst their nursing staff.

In summary, participants commented that respiratory concepts learned in the critical care programmes were forgotten over time with many participants perceiving the concepts as words that are used in books and at conferences rather than in the clinical practice setting. Although 59.26% of participants perceived the respiratory concepts were covered in depth in their critical care programmes, 22.22% perceived discussion on these concepts lacked depth. Participants perceived factors within the clinical environment, such as lack of inclusion into medical staff discussion, lack of opportunity to discuss theoretical concepts and the clinical language used by nursing staff as having a negative influence on the discussion of respiratory concepts. Factors that influence the use of knowledge of respiratory physiology in clinical decision-making will now be discussed.

Factors influencing the use of respiratory knowledge in clinical decision-making

As discussed in the previous chapter, Pearson's product-moment correlation coefficient was applied to the data to identify associations between the use of knowledge of respiratory physiology in clinical decision-making and factors related to demographics, professional culture and ongoing knowledge development. Prior to

the correlation analysis, the correlation data was ranked to reduce the effect of outliers and prevent distortion of the correlation results.

For the total group, there were no statistically significant correlations found between the use of knowledge of respiratory physiology in clinical decision-making and factors related to demographics, professional culture and ongoing knowledge development. However although not statistically significant, a moderate positive association was found between the use of knowledge of respiratory physiology in clinical decision-making and years of general experience (r = .313, p = .112), years of full-general general nursing experience (r = .333, p = .090) and rated use of integrated care pathways (r = .345, p = .078). A moderate negative association was found between the use of knowledge of respiratory physiology in clinical decision-making and length of critical care programme completed (r = -.342, p = .078). The correlation coefficients for the total group are outlined in Table 5.8.

Correlations between the use of knowledge of respiratory physiology in clinical decision-making and factors related to demographics, professional culture and ongoing knowledge development were also completed on both unit one and unit two data. In unit one there were no statistically significant correlations between the use of knowledge of respiratory physiology in clinical decision-making and other factors. However although not statistically significant, a moderate positive association was found between the use of knowledge of respiratory physiology in clinical decision-making and years of general experience (r = .523, p = .067), years of full-general general nursing experience (r = .523, p = .067), the rated use of integrated care pathways (r = .436, p = .136) and management support (r = .375, p = .207). A moderate negative association was found between the use of knowledge of respiratory physiology in clinical decision-making and length of critical care programme completed (r = -.353, p = .237), education preparation (r = -.413, p = .160), guidelines, standards and integrated care pathways supporting practice (r = -.316, p = .293) and conference attendance (r = -.390, p = .188). The correlation coefficients for unit one are outlined in Table 5.9.

In unit two there was a statistically significant high positive association between the use of knowledge of respiratory physiology in clinical decision-making and the rated

use of protocols and guidelines, standards and integrated care pathways in supporting practice ($r = .628, p = .016$). Although not statistically significant, the correlations identified a moderate positive association between the use of knowledge of respiratory physiology in clinical decision-making and reading of journals ($r = .416$, $p = .139$) and a moderate negative association between the use of protocols and guidelines ($r = -.347, p = .224$). The correlation coefficients for unit two are outlined in Table 5.10.

In summary, no statistically significant correlations were found in the total group between the use of knowledge of respiratory physiology in clinical decision-making and other factors related to demographics, professional culture and ongoing knowledge development. However a statistically significant high positive association was found in unit two between the use of knowledge of respiratory physiology in clinical decision-making and the rated use of protocols and guidelines, standards and integrated care pathways in supporting practice. The results of data analysis related to the participants general discussion will now be presented.

Issues raised in general discussion

As discussed in chapter four, all participants were given the opportunity to further discuss any areas related to the use of respiratory physiology to provide patient care that had not previously been discussed during the interview process. The transcripts of these discussions were analysed for themes. As a result of this analysis, five themes were identified, these being the high reliance on intuitive knowledge, the negative influence of lack of collaborative practice on nurses' decision-making, the effect of reduced medical resources on nurses' decision-making roles, the need for encouragement in the clinical environment to improve nursing knowledge and the individual professional responsibility nurses have to improve their knowledge base. These themes will be discussed separately beginning with discussion on the high reliance of intuitive knowledge.

Box 5.3. The Use of Respiratory Concepts in the Clinical Practice Setting

"I don't think I've looked at that since I did my study." (Interview 12, p.4).

"We just don't do that stuff in this unit so I just don't do it everyday any more" (Interview 16, p.4).

"You learn them and then you forget them to be perfectly honest" (Interview 17, p.7).

"Most of the concepts and definitions I haven't really been through since I did the course."(Interview 18, p.4).

"The sort of terms that you use to pass exams and day-to-day language it's a bit different." (Interview 10, p.3).

"Thoracic compliance, hypercapnoea, alveoli arterial gradient, functional residual capacity- its more in the textbook, increased red blood cell transit time, yeah, that's a book concept." (Interview 6, p.4).

"I mean these terms are not always sort of mentioned....You hear that if you go to the lectures." (Interview 28, p.6).

"All of them I have heard of at some stage, but tend to hear about them in a study day or at a conference." (Interview 24, p.3).

Box 5.4. Lack of Inclusion in Discussion of Respiratory Concepts in the Clinical Practice Setting

"They discuss if someone's alkalotic or acidotic and where the origin of it was from. But that would be doctors talking to other doctors and not talking to me but I would talk to my two junior nurses about it." (Interview 22, p.5).

"In the clinical practice setting by medical staff, a lot. But in this unit nursing staff tend to be excluded from that. We tend to be bystanders in these conversations....It is very frustrating because it causes a lot of deskilling when you first start here. But then you get used to it because it's just a day to day thing." (Interview 26, p.4).

"Again for the last seven years fairly little because its medical and they tend to take it away from us. Prior to this where I worked there was something that we thought about ourselves a lot more. [We] discussed it with each other and the medical team and respiratory therapists and what to do about it, whether it be positioning or drugs or different ventilation. So we've kind of lost a bit of instant knowledge." (Interview 16, p.4).

Box 5.5. The Clinical Language Associated with Respiratory Concepts

"I probably don't use the actual words but what they're about and the concept I do use when I'm thinking about my ventilation and making changes, but not actually the proper terminology." (Interview 2, p.5).

"I think they are discussed often. I think the language might be different. Um, I think yeah it depends on sort of people's knowledge or how long they've been at work. People would know perhaps to re-position their patient because their oxygenation was poor but they might not know that ventilation perfusion mismatch has occurred." (Interview 10, p.3).

"Thoracic compliance - people talk about resistance as opposed to compliance. So that's probably mentioned quite a lot when people bag if the guy is quite stiff as they say." (Interview 25, p.6).

"You talk about someone having increased thoracic compliance or being hard to bag but it is not actively talked about. Like if you are having problems ventilating your patient you might say there is airway resistance or his left chest is not ventilating properly, but the actual concepts are more an osmotic awareness of what is actually going on." (Interview 25, p.5).

"I don't think they're discussed at all often enough, not the actual terms. We might talk about a high or low CO_2 but we rarely kind of talk to each other in these terms which is a shame." (Interview 7, p.3).

"We do use it [respiratory concepts] here, but on the sicker patients." (Interview 9. p.6).

"Very infrequently, very infrequently. Except every now and then, you will have quite a difficult ventilated case. You know you will get an asthmatic or you will get something that stands out and then you will actually probably discuss it a bit more. If you happen to do something aside from routine ventilation then it will come up." (Interview 23, p.4).

"They are mostly only used when you have a particularly sick patient. Someone you know who's got pneumonia or needing nitric or asthmatic patients. But if you are not looking after those patients, you don't tend to think about it very much." (Interview 18, p.4).

Table 5.8. Correlations between the Use of Knowledge of Respiratory Physiology and Other Factors (N = 27).

Factor	Pearsons product-moment correlation coefficient (*r*)	P-value (*p*)
Age	.034	.865
Years general experience	.313	.112
Full-time general experience	.333	.090
Years critical care experience	-.023	.909
Years critical care experience post critical care programme	-.051	.802
Current FTE	-.075	.709
Type of critical care programme	-.003	.988
Length of critical care programme	-.342	.081
Education preparation	-.300	.128
Use of guidelines and protocols	-.195	.330
Use of standards	-.192	.337
Used of integrated care pathways	.345	.078
Support or limitation of protocols & guidelines, standards and integrated care pathways	.155	.441
Conference attendance	-.034	.868
Reading of journals	.027	.892
Frequency of journal reading	.125	.534
Web access	.087	.665
Frequency of web access	-.093	.646
Nursing support	-.087	.666
Management support	.281	.156

Table 5.9. Unit One Correlations between the Use of Knowledge of Respiratory Physiology and Other Factors (n=13)

Factor	Pearsons product-moment correlation coefficient (*r*)	P-value (*p*)
Age	.173	.572
Years general experience	.523	.067
Full-time general experience	.523	.067
Years critical care experience	.104	.734
Years critical care experience post critical care programme	.090	.770
Current FTE	-.136	.659
Type of critical care programme	.133	.713
Length of critical care programme	-.353	.237
Education preparation	-.413	.160
Use of guidelines and protocols	-.148	.630
Use of standards	-.140	.647
Used of integrated care pathways	.436	.136
Support or limitation of protocols & guidelines, standards and integrated care pathways	-.316	.293
Conference attendance	-.390	.188
Reading of journals	-.234	.442
Frequency of journal reading	.117	.703
Web access	.029	.926
Frequency of web access	-.166	.589
Nursing support	-.042	.893
Management support	.375	.207

Table 5.10. Unit Two Correlations between the Use of Knowledge of Respiratory Physiology and Other Factors (n=14)

Factor	Pearsons product-moment correlation coefficient (*r*)	P-value (*p*)
Age	.071	.809
Years general experience	.089	.763
Full-time general experience	.117	.690
Years critical care experience	.121	.680
Years critical care experience post critical care programme	-.038	.897
Current FTE	-.109	.710
Type of critical care programme	.020	.945
Length of critical care programme	-.235	.419
Education preparation	-.164	.576
Use of guidelines and protocols	-.347	.224
Use of standards	-.255	.378
Used of integrated care pathways	.223	.443
Support or limitation of protocols & guidelines, standards and integrated care pathways	.628	.016*
Conference attendance	.174	.551
Reading of journals	.416	.139
Frequency of journal reading	.167	.568
Web access	.204	.483
Frequency of web access	.113	.701
Nursing support	-.218	.455
Management support	.118	.689

*p<.05

Intuitive knowledge

Ten participants (one from unit one and nine from unit two) identified that much of the knowledge they used in critical care was intuitive, with a lot of knowledge being learned "on the job." Participants commented on the robotic nature of their work, with much of the nursing care being routine and automatic, with limited thinking about any physiological rationale behind what they do. Examples of participants' comments demonstrating these views are outlined in Box 5.6. The following participant's comment clearly highlights the debate in nursing that surrounds the use of intuitive and analytical knowledge:

> I mean it's the usual debate. I think of the analogy of the television you know, do you need to understand how it works to work a television. No you don't, you can adequately quickly changed channels and you don't blow yourself [up]...whether every nurse needs to have expert knowledge or you can get by if you just have a few....But then of course you have to get people to that level of knowledge...you don't just walk in at that level of knowledge, you have junior staff to get them to be senior staff. (Interview 10, p.4).

The negative influence lack of collaborative practice has on clinical decision-making will now be discussed.

Lack of collaborative practice

Eight unit two participants discussed the negative influence lack of collaborative practice had on their clinical decision-making. Participants in unit two commented that their two-hourly suctioning followed by bagging, patient turning regime and ventilator alterations were decided by the medical staff, with no nursing involvement in that decision-making process. This medical control was seen as limiting clinical decision-making as nurses were either not allowed to make autonomous decisions pertaining to their patient care or as some participants described " expected to think." Examples of these views demonstrated by the unit two participants are outlined in Box 5.7.

This perceived medical control was an accepted part of the unit culture with new experienced critical care nurses fitting into and accepting this unit culture soon after beginning in the unit. The ease with which experienced critical care nurses coming from a previous culture of autonomous nurse decision-making and fitting into a culture of medical control, is described in the following participant's statement:

> When I first came over it felt so strange. Having somebody telling me when to turn and having somebody telling me what noradrenalin to put on or the fact that here it's prescribed to be bagged, whereas in [country stated] it was much more of a clinical decision. So when I first came over it was very, very strange, but you do adjust to doing it and you get use to it. (Interview 25, p.3).

Another participant new to the unit two culture commented on the ease with which nursing staff accepted the medical control over clinical decision-making and the negative effect it has on knowledge development and clinical decision-making. In her discussion on medical prescription of patient positioning she commented:

> At the stage I am at here, I am comfortable with it but I am constantly surprised that the nursing staff accepts it so readily. You know after being at [New Zealand critical care unit stated], while I was there you used more knowledge as an intensive care nurse in lots of ways compared to the experience I am having here caring for the critically ill patients...we were expected to be able to identify whether the ET tube is the right place, and we were expected to have some knowledge [that] the central line was reasonably okay as well and it just surprises me that when I did ask somebody if the chest x-ray had been reviewed, they didn't really know, so I don't know, but they don't seem to mind. I think it could be frustrating further down the track, when you want to utilise the knowledge that you've got and apply it specifically to your patient. (Interview 27, p.3).

However, although this medical control was identified as limiting nursing knowledge development and clinical decision-making, it was also regarded by two unit two participants as a way of maintaining safe practice within a unit with various levels of nursing expertise. This view is described in the following participant's comment:

> I think there could be more autonomy here but I can understand the reasoning behind the way the doctors are about that and I think it makes for a very safe environment....I think when you are a new nurse to a new environment and you are new to intensive care, I think you just become very task orientated and being told to do that is a good thing and then as your experience comes, your rational comes and your knowledge base comes. I can understand from a doctor's perspective that it is a large unit. We have a lot of nurses that are all coming and going at different times and they are all at different stages and we need to have everything standardised and it's just their way of keeping the standard up. It can be frustrating sometimes that you have to ask for the most simplest of things. From the doctors [perspective] you are not allowed to use your initiative. (Interview 17, p.3).

The effect of reduced medical resources on clinical decision-making will now be discussed.

Effect of reduced medical resources

The discussion of unit two participants highlighted the need for, and acceptance of, autonomous nurse decision-making in certain clinical situations, such as when there is a sudden deterioration in the patient's condition or a lack of junior medical staff expertise. As one participant stated "it is only when you get a set of new registrars you need to think, oh hang on, what are we doing here because they don't know either." This alteration in acceptance of autonomous nurse decision-making when junior medical staff expertise is lacking is perfectly described in the following participant's comment:

> When I first graduated and came here as [a junior nurse] I was comfortable with that. I was happy that there was the safety net of the doctors as I developed my own practice. So when I went to [country stated] I had had three years of ICU, so that was a bit of a shock to me to be thrown in and have to make decisions in the middle of the night, medical decisions really, because we didn't have the medical staff there. Once I got over the shock of that and took advantage of the education offered, I really quite liked having that extra responsibility and being able to just kind of stretch your wings a little bit...then I came back and worked in the same unit and found that your wings are quickly clipped again and you can fight that, and sometimes you do. You pick your battles, but you know, you pretty much know that that's the way it is and that's not going to change any time soon. But occasionally you know on nights when you might have new registrars and no intensivists, you get to fly a little more as well. You get to change some ventilation settings or whatever. (Interview 24, p.5).

One unit two participant commented that once the critical care nurse was recognized by the medical staff as being experienced, they were more able to take on more autonomous decision-making roles. As one participant said when commenting on prescribed suctioning and patient positioning "Although sometimes they do let the more experienced nurses make that decision themselves." (Interview 14, p.3). The need for encouragement in the clinical practice environment to improve clinical decision-making will now be discussed.

Need for encouragement

Two unit two participants identified the need for more clinical encouragement to develop knowledge and decision-making. The participants identified the need for nurse educators to work with them in the clinical practice setting and challenge their knowledge and decision-making abilities. As one participant said while discussing the lack of encouragement:

> In this place we are not encouraged to go over it. We don't have an educator that will come round and do for example have a look and say let see what's happening with your blood gas and what do you thinks happening and what's actually happening with that, is that an increase in that or a decrease in that. There's none of that education that goes on. Even though as senior nurses, it is not encouraged, you are not expected to actually know the answers. All you have to do is perform your task and look to see whether it falls in limits or not and if it's outside of limits. (Interview 17, p.6).

One participant also discussed the need for all nurses to share their knowledge base with other nurses, stating "I think that this sort of thing can stimulate you, it can stop you from being a monkey, a trained monkey." (Interview 22, p.5).

Although ABG analysis is seen as a normal part of the critical care nurses' role, participants from both unit one and unit two discussed the need for more support in this area. As one unit one participant said "I think we are still not very familiar with blood gases interpretations because not every nurse will go and look at the individual blood gases. Some people just do it and wait for somebody to advise us." Another unit one participant commented "I think maybe they need to encourage people to interpret their own blood gases more often or just come and ask what they think about the blood gas first before they get different treatment." (Interview 6, p.4). The individual professional responsibility of the nurse to improve their clinical decision-making will now be discussed.

Box 5.6. The Use of Intuitive Knowledge in Critical Care Nursing

Yes, you know you are so use to the tasking bit of it and sometimes because you are so busy and taken up ...it takes you a while to sort of recognise and think back about the theory of all this terminology and things....Because sometimes we can be so task orientated and miss out on something." (Interview 28, p.6).

"I think most of them that are experienced do it instinctively. The major problem is that they don't actually think about what they are doing." (Interview 26, p.5).

"I think a lot of things you do in nursing is intuitive. Like you've learnt over the years and you just do it. But then when you have to rationalise it, I can rationalise why I do it, but there would be a lot of physiology that I don't understand why things are occurring with the patient." (Interview 25, p.7).

"You've seen other nurses do it. So you know, where have I picked that up from? Why do I do it? It makes sense in my head but that's my own rationale really, I don't know if that's confirmed from literature. I think it's a real shame really. I think it's only just over time that you pick up on things that you know when to alert a doctor." (Interview 17, p.8).

"You could almost be robotic here and do it for the sake of doing it and that would be safe but you are not really increasing your knowledge and the patients are not getting the best care." (Interview 14, p.6).

"I know my knowledge is pretty much on the job. Kind of pick it up as I go." (Interview 21, p.4).

"I think when you go, do your shift work, you come and you do your job and sometimes you're too busy to think about, or you just don't stop and think, why am I doing this and what's the concept behind that?" (Interview 5, p.5).

"I think a lot of what I do is unthinking or unanalysed when I do it." (Interview 16, p.4).

"I think we can be very lazy because we don't have to think." (Interview 27, p.6).

"I mean we've all worked with people who are happy to know the minimum that they need to know and can get away with that in their practice, because they are well supported in the clinical environment, either by other senior nurses or charge nurse or doctors. I think because we have doctors on the floor 24 hours a day and that we do rounds three to four times a day, that you always have that backstop and you know you have that backstop in the back of your mind." (Interview 24, p.4).

Box 5.7. The Negative Effect of Lack of Collaborative Practice on Clinical Decision-making

"The nurses are getting it through more education, but they don't get a chance to exhibit it here because for example with ventilation you are not encouraged to change the ventilation on your patient, it is just not something that is encouraged here....It is breeding a whole new lot of critical care nurses, who haven't worked in other critical cares, who don't think for themselves. Because the doctors, let's face it, they get busy they can't be there all the time and it disadvantages the patient in the end. I think." (Interview 23, p.5).

"We have a tendency in this unit to just go along with what's changed and then you lose, what you don't use, you lose basically." (Interview 23, p.1).

"So I guess that brings up another point that yes we have the safety net of the doctors here but are we allowed to only do so much anyway. You know we are only expected to practice to a certain level because the doctors are there to make the final decision." (Interview 24, p4).

"If you have a patient that desaturates suddenly, you do make those decisions, in more of an emergency situation because you know something's not right and their sats are dropping and often that happens when you have just turned someone and they don't like it. You make that decision to turn them back and suction them outside the normal two hourly orders that are charted. You do do that in some circumstances but it would be nice to make that part of your planned care and make more of a difference like that." (Interview 14, p.3).

" We would do the blood gas. We would write it up, if it falls out of normal parameters, we would tell the doctor. The doctor would come and analyse it and then they would adjust." (Interview 17, p.4).

"There is such a tight medical rein on our unit. They've just got the finger on the pulse most of the time but maybe I can anticipate things more for my patients that other people can." (Interview 22, p.6).

Individual professional responsibility

Five participants (one from unit one and four from unit two) recognised that any lack of knowledge base and clinical decision-making was of their own doing. These participants recognised the need for individual professional responsibility to increase their knowledge and practice more autonomous decision-making. As one participant said:

> Generally speaking nurses tend to get along on not remembering stuff. And I know I'm guilty of that from my own training that the stuff I revisited last year during my course that I know I've gone over before and it's just not stayed in my brain because I don't speak it every day. If I articulated it every day then I would remember it and I think until you do, until you start being in a position that you need to teach then.... [I] think we could do better actually; apply our brains a bit more. (Interview 19, p.6).

In summary, five themes were identified: nurses' high reliance on intuitive knowledge, the negative effect medical control has on nursing decision-making, the effect of reduced medical resource on nurses' decision-making roles, the need for encouragement in the unit to improve nursing knowledge and the responsibility individual nurses have to improve their knowledge base.

Summary

This chapter presented the results of the data analysis, which included participant demographics, factors that influence the professional culture within the critical care unit, access to ongoing knowledge development, knowledge of respiratory physiology, factors that influence clinical decision-making and issues raised in general discussion. As previously discussed, the aim of this study was to answer the research question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? The results of this thesis demonstrate that following completion of a critical care specialty practice programme, nurses use a low to medium knowledge

of respiratory physiology in their clinical decision-making. The results showed participants demonstrated a medium knowledge in ABG analysis and highlighted participants' limited use of diagnostic terminology.

In the total group, no statistically significant associations were found between the use of knowledge of respiratory physiology in clinical decision-making and age, experience, academic level, use of guidelines and protocols, standards and integrated care pathways, conference attendance, reading of journals and accessing the World Wide Web for literature. However, a statistically significant high positive association was found in unit two between the use of knowledge of respiratory physiology in clinical decision-making and the use of protocol and guidelines, standards and integrated care pathways to support clinical decision-making. Qualitative analysis demonstrated the need to "tweak" protocols and guidelines, standards and integrated care pathways to meet individual patient needs and maintain patient safety.

Qualitative analysis identified the factors contributing to the low to medium use of knowledge of respiratory physiology in clinical decision-making as being nurses' high reliance on intuitive knowledge, lack of in-depth discussion of respiratory concepts in critical care programmes, lack of opportunity in the clinical practice environment to discuss respiratory physiology and the lack of collaborative practice. Having presented the results of the research, the next chapter discusses the key findings outlined in this chapter in relation to the New Zealand context and international literature.

CHAPTER SIX: DISCUSSION

As discussed in the previous chapter, the results demonstrated that following completion of a critical care specialty practice programme, nurses use a low to medium knowledge of respiratory physiology in their clinical decision-making. Quantitative analysis of the total group showed no statistically significant associations between the use of knowledge of respiratory physiology in clinical decision-making and age, experience, academic level, use of guidelines and protocols, standards and integrated care pathways, conference attendance, reading of journals and accessing the World Wide Web for literature. However a statistically significant high positive association was found in unit two between the use of knowledge of respiratory physiology in clinical decision-making and the use of protocol and guidelines, standards and integrated care pathways to support clinical decision-making. The results of the qualitative analysis demonstrated the need to "tweak" protocols and guidelines, standards and integrated care pathways to meet individual patient needs, thus maintaining patient safety. It also identified factors contributing to the low to medium use of knowledge of respiratory physiology in clinical decision-making as being nurses' high reliance on intuitive knowledge, lack of in-depth discussion of respiratory concepts in critical care programmes, lack of opportunity in the clinical practice environment to discuss respiratory physiology and lack of collaborative practice.

This chapter discusses the findings described above in relation to the New Zealand context and international literature. This discussion will be presented in parts, beginning with discussion on the use of knowledge of respiratory physiology in clinical decision-making and factors that influence clinical decision-making. This will be followed by discussion on intuitive and analytical decision-making processes, clinical language, critical care programmes, clinical support, autonomous and collaborative practice and individual professional responsibility. The final part of the chapter will discuss the limitations of this study and future directions this research has illuminated. The use of knowledge of respiratory physiology in clinical decision-making will now be discussed.

The use of knowledge of respiratory physiology in clinical decision-making

As previously noted, the results of this research showed that following completion of a critical care programme, critical care nurses demonstrated a low to medium level of knowledge of respiratory physiology in their clinical decision-making. The participants in this study demonstrated medium knowledge of VQ mismatch, ABG concepts, FRC and compliance and the oxyhaemoglobin dissociation curve, a low level of knowledge of airway resistance and no knowledge of dead space, Aa gradient and red blood cell transit time. The results of the ABG analysis demonstrated nurses had a medium level of knowledge in ABG analysis.

The findings in this study demonstrating nurses' low to medium use of knowledge of respiratory physiology in clinical decision-making reflect those found in previous research assessing nurses' understanding of general physiology. Grossman et al. (1996) when examining physiological, psychosocial, technical and physical knowledge in critical care pre and post a four-week critical care orientation programme, found knowledge in all areas increased, however the lowest pre and post scores were physiology. Clancy et al. (2000) and Baumann and Bourbonnais (1982) illuminated the difficulty nurses had explaining the biological basis of their practice.

Knowledge base derived from physiology is an essential pre-requisite for delivery of high quality care (Prowse, 2003a), contributing to early identification of patient problems and early intervention (White, 2003). As discussed in chapter one, critical care nursing knowledge and skills result in improved patient outcomes (Thorens et al., 1995; White, 2003). Critical care nurses frequently review and alter planned interventions in response to changes in patient condition (Endacott & Dawson, 1997), proactively predict and prevent complications, perform skilled and timely reduction in sedation, weaning from the ventilator, physical rehabilitation and psychological support, thereby reducing complications and length of critical care stay (Galley & O'Riordan, 2003; Thorens et al., 1995). Therefore the low to medium use of knowledge of respiratory physiology in critical care decision-making identified in this study is a concern due the potential of it to limit clinical decision-making, thereby negatively affecting patient outcome. Prowse (2003a) suggests the reasons

for nurses having a low level of bioscience knowledge is related to lecturers having difficulty teaching biosciences and nurses having difficulty learning bioscience. These two factors result in nurses being unable to draw on a sound bioscience knowledge base to inform their practice. Despite better qualified lecturing staff and the move into higher education, the bioscience in nurse education has not changed significantly (Prowse, 2003a). This lack of change is thought to be due to inadequate appreciation of knowledge development taking place within the social context (Prowse, 2003b). This may suggest that for respiratory knowledge to be improved, critical care nurse specialists with expert bioscience knowledge, and the ability to apply that knowledge to the critical care context, are best suited to teach respiratory physiology. However, critical care specialists firstly may not have the necessary in-depth knowledge of physiology to teach the subject and secondly, may not have the teaching skills to present complex physiology in a format that can be understood by nurses. Hence to improve understanding of respiratory physiology it may be necessary for lecturers of bioscience and clinical nurse specialists to work closely together, combining knowledge of applied physiology and teaching skills, thus ensuring nurses are able to draw on a bioscience knowledge base to inform their practice.

The Health Practitioners Competence Assurance Act (2003) requires nurses to practice within their scope of practice (Nursing Council of New Zealand, 2004a). The scope of practice for a registered nurse requires nurses to use nursing knowledge and complex nursing judgement when performing patient assessment and provide patient care based on substantial scientific and professional knowledge and skills (Nursing Council of New Zealand, 2004). The low to medium use of knowledge of respiratory physiology in clinical decision-making found in this study suggests nurses do not have substantial scientific knowledge, and therefore may have difficulty meeting this legislative requirement.

In light of these research findings, the critical care profession now has the responsibility to improve the use of knowledge of respiratory physiology in critical care nurse decision-making thus enhancing nurses' ability to fulfil both their legislative and professional responsibilities. These responsibilities will be discussed

later in this chapter. The quantitative analysis of factors that influence clinical decision-making will now be discussed.

Factors that influence clinical decision-making

As mentioned earlier in this chapter, quantitative analysis of the total group showed no statistically significant associations between the use of knowledge of respiratory physiology in clinical decision-making and age, experience, academic level, use of guidelines and protocols, standards and integrated care pathways, conference attendance, reading of journals and accessing the World Wide Web for literature. However a statistically significant high positive association was found in unit two between the use of knowledge of respiratory physiology in clinical decision-making and the use of protocol and guidelines, standards and integrated care pathways to support clinical decision-making. This finding may be due to the lack of nursing autonomy and control over practice experienced by many of the unit two nurses, and the view that more autonomy and control could be gained with implementation of further protocols and guidelines, standards and integrated pathways. Robinson (2001) identifies the need for procedures and protocols to be developed by clinical experts and for nursing staff at the bedside to make decisions about practice. This, Robinson argues, ensures the clinical work is meaningful and that the nurse has power to make a change.

As discussed in chapter two, the factors that influence clinical decision-making are conflicting and remain unclear (Hicks et al., 2003; Hoffman et al., 2004). Factors that have been identified as having an influence on clinical decision-making include knowledge, experience, academic exposure, age, evidence-based practice, use of clinical guidelines and protocols, appointment level, clinical and administrative support, the management structure within the unit, collaborative practice, the individual traits of nurses and critical thinking skills.

Like those found in the literature, this study also found some conflicting results, firstly between the quantitative results for the total group and one sub-group and secondly between the quantitative and qualitative results. Although the quantitative analysis for the total group showed no statistically significant association between

the use of knowledge of respiratory physiology in clinical decision-making and the use of guidelines and protocols, standards and integrated care pathways to support clinical decision-making, it did show a statistically significant high positive association in unit two between these two factors. Although the quantitative analysis did not agree with findings in the literature that identified management structure as being a factor in clinical decision-making, the qualitative analysis found that management structure influenced collaborative practice, thereby influencing clinical decision-making. This influence of management structure on collaborate practice will be discussed later in this chapter.

The findings of this study showing no statistical correlation in the total group between clinical decision-making and education and experience, support those found in other research. Hicks et al., (2003) and Hoffman et al., (2004) both showed that education and experience were not associated with clinical decision-making. However the quantitative results of this study do not support other literature which views age (Bakalis et al., 2003), knowledge (Baumann & Bourbonnais, 1982), experience (Bakalis et al., 2003; Baumann & Bourbonnais, 1982), academic exposure (Bakalis et al., 2003; Girot, 2000; Taylor-Piliae, 1998), conference attendance (Taylor-Piliae, 1998), reading of literature (Taylor-Piliae, 1998), clinical and administrative support (Funk et al., 1995; McCaughan et al., 2002; Thompson et al., 2000) and management structure (Kramer & Schmalenberg, 2003; Wade, 1999) as having an influence on clinical decision-making. The results found in this study that differ from those found in other research may be explained by the focus of this study being on the use of knowledge of respiratory physiology in clinical decision-making. This research clearly focused on nurses' analytical decision-making abilities, hence may differ from studies that have assessed nurses' intuitive clinical decision-making abilities.

The statistically significant high positive association found in unit two between the use of knowledge of respiratory physiology in clinical decision-making and the use of protocol and guidelines, standards and integrated care pathways to support clinical decision-making supports the view shared by Thompson et al., (2002) who argue that when based on the best available evidence, they improve clinical decision-making. The qualitative results of this study added to this quantitative result by firstly

highlighting the need for nurses to "tweak" protocols and guidelines, standards and integrated care pathways to meet individualized patient needs, thus maintaining patient safety, and secondly the limitation they had on preventing opportunities for creative nursing practice and ongoing knowledge development. These findings support the views shared by those who find protocols and guidelines, standards and integrated care pathways do not always meet the individualized needs of patients, and that they risk developing rule-following behaviours characteristic of the novice nurse, thus preventing nurses from providing holistic high quality care (Considine and Hood, 2000; Hewitt-Taylor, 2004; Pugh, 2002). Intuitive and analytical decision-making processes will now be discussed.

Intuitive and analytical decision-making processes

One third of the participants in this study identified their knowledge base as being intuitive, with a lot of knowledge being learned "on the job. " Participants commented on the robotic nature of their work, with much of the nursing care being routine and automatic, with limited thinking about any physiological rationale behind what they do. Participants commented that they were more likely to discuss the respiratory concepts when caring for the sicker patient, which suggests nurses move from intuitive to more analytical thinking when providing care for more complex patients. These findings support those found in the literature, which views clinical decision-making as requiring both intuitive and analytical processes (Burman et al., 2002; Hicks et al., 2003; Lauri & Salantera, 2002; Pugh, 2002). Nurses tend to use intuitive processes when dealing with everyday tasks that do not require the need for complex thinking (Greenwood & King, 1995). However, they switch to more analytical processes for more complex tasks and when more thinking is required. (Hamers et al., 1994; Benner, 1984).

The high use of intuitive knowledge identified in this study could be explained by the specialization of critical care nursing. Specialization is linked to intuitive decision-making processes. As competence grows, practice becomes mindless and routine, resulting in intuitive practice, while limiting opportunities for nurses to think about what they are doing (Andrews, 1996; Heath, 1998). Many of the participants in this research had specialized in critical care nursing for many years, and as a result the

work had become routine. Therefore, this experience perhaps contributed to the strong use of intuitive decision-making processes identified in this study.

Tabak et al. (1996) found that for nurses to switch from an intuitive mode to an analytical mode of thinking, a good knowledge base is required. Analytical decision-making involves a step-by-step conscious and logically defensible decision-making process (Lauri & Salantera, 2002). The low to medium level of knowledge of respiratory physiology found in this study that demonstrated nurses were unable to provide a conscious and logically defensible rationale for their nursing care, identified inadequate knowledge of respiratory physiology, and hence an inability to switch from an intuitive to an analytical mode of thinking.

Although intuitive decision-making processes are important in clinical practice particularly when rapid decision-making is required (Baumann & Bourbonnais, 1982; Croskerry, 2002; Ellis, 1997), over-reliance on intuitive decision-making processes can have a negative effect on patient outcome. As discussed in chapter two intuitive decision-making processes are linked to heuristics, which cause cognitive errors and adverse patient outcomes (Croskerry, 2002; Harbison, 2001). The *New Zealand Philosophy and Standards of Nursing Practice in Critical Care* (Care Nurses' Section, 2002) require nurses to utilise sound research-based knowledge in their practice, and to work in partnership with members of the interdisciplinary team to achieve a positive patient outcome. This reliance on intuitive knowledge suggests firstly, nurses are not utilising research based knowledge in their practice and secondly, as intuitive decision-making processes risk cognitive errors; they have a greater risk of making a judgement error, which may result in a poor patient outcome. Hence this reliance on intuitive decision-making processes may be preventing nurses from meeting their professional obligations outlined in the critical care standards. The effect clinical language has on the use of knowledge of respiratory physiology in clinical decision-making will now be discussed.

Clinical language

This research identified a lack of familiarity by nurses with the theoretical language used to provide rationale for their nursing care. Some participants suggested that they

used the principles of respiratory concepts in their clinical practice, but the clinical practice language related to the use of these concepts was different from the theoretical language. As one participant said, "You talk about someone having increased thoracic compliance or being hard to bag but it is not actively talked about." (Interview 21, p.4). The use of this clinical nursing language has been previously recognised by Prowse (2003b) who interpreted the term "shifting any air" as referring to understanding about tidal volumes. It has been thought, however, that nurses were able to use a more formal language in more formal situations when required to explain complex ideas (Prowse, 2003a). This ability to use a more formal language was not evident in this study. Although some participants did demonstrate a high level of knowledge of respiratory physiology in their clinical decision-making, the research results showed that as a group, nurses were only able to demonstrate a low to medium level of knowledge of respiratory physiology when asked to provide rationale for their nursing care.

This lack of theoretical language was also evident in the ABG analysis. Although most participants identified when components of the ABG were outside normal range, and in all but metabolic acidosis, applied the correct intervention, few participants used diagnostic terminology. For example, in ABG one and two no participants used the term hypoxaemia to interpret a low PaO_2 and SaO_2. In ABG one, only 59% of participants used the term respiratory alkalosis to interpret a low $PaCO_2$. In ABG two, only 48% of participants used the term respiratory acidosis to interpret a high $PaCO_2$ while 41% of participants used the term metabolic acidosis to interpret a low bicarbonate. In ABG three, only 63% of participants used the term respiratory acidosis to interpret a high $PaCO_2$ and no participants used the term hyperoxaemia to interpret a high PaO_2 and SaO2.

This lack of ability of nurses to provide physiological rationale for their nursing interventions has been previously identified by Clancy et al. (2000) who found nurses lacked confidence in articulating their knowledge to patients and other health professionals. If nurses' contribution to patient care is to be valued by the critical care interdisciplinary team, nurses must be able to use a formal language to adequately articulate the rationale behind the care they provide. This is supported by Smith Higuchi and Donald (2002) who argues that expert clinical practice requires

both psychomotor and affective skills, and complex thinking processes, to enable nurses to clearly describe the cognitive aspects of their practice and enhance their role as members of the professional health care team. The effect critical care programmes have on the use of knowledge of respiratory physiology in clinical decision-making will now be discussed.

Critical care programmes

This study identified that most participants learned the majority of respiratory concepts in their critical care programme. However, the depth to which these concepts were discussed varied. Although over half of the participants (59.26%) perceived the respiratory concepts were discussed in depth, almost one quarter of participants (22.22%) perceived discussion lacked depth. This lack of adequate teaching of respiratory concepts when combined with nurses' low to medium use of knowledge of respiratory physiology in clinical decision-making is a concern to those responsible for educational development of nurses as it appears these programmes lack adequate critical care specialty content. As previously mentioned, this could be due to lecturers having difficulty teaching biosciences and bioscience not being related to the clinical context, therefore nurses are unable to draw on a sound bioscience knowledge base to inform their practice.

Although the *New Zealand Standards for Critical Care Education* (Critical Care Nurses' Section, 2000) state the coordination of critical care programmes are the combined responsibility of an academic and clinical coordinator, anecdotal evidence suggests that as programmes have moved from hospital-based programmes to post-graduate level, clinical nurse educators and clinical nurses specialists have become less involved in curriculum review and student assessment. This lack of collaboration between the critical care units and tertiary education providers may be one factor responsible for the low to medium use of knowledge of respiratory physiology in clinical decision-making found in this study. This need for collaboration between critical care units and tertiary education providers is supported by Roche (2002) who found a combined education approach between the education faculty instructor and clinical nurse educator enhanced nursing knowledge and clinical decision-making.

Russell (2001) suggests one of the reasons that biological sciences is poorly understood and applied to practice is the lack of guidelines from professional bodies to ensure the education processes focus on the appropriate aspects. However this cannot be used as the reason for the low to medium use of knowledge of respiratory physiology in clinical decision-making found in this study. The professional body for New Zealand critical care nurses have provided clear guidelines for critical care programme in their professional standards since 1994 (Pirret, 1994; Critical Care Nurses' Section, 2000). This professional body has a nominated clinical advisor to the Nursing Council of New Zealand to assess critical care curriculum content submitted to Nursing Council for approval (Critical Comment, 2003). Hence, it appears that the guidelines and standards provided by the professional body are not being adhered to, and therefore not being met.

If nurses graduating from critical care programmes have not been given appropriate context-based theoretical knowledge, they do not have the foundations necessary for high-level clinical decision-making. The aim of the *New Zealand Standards of Critical Care Nursing Education* (Critical Care Nurses' Section, 2000) is to provide a framework to develop nurses from the advanced beginner to a proficient level of nursing practice. Therefore, failure of critical care programmes to meet these standards limits nurses' ability to achieve proficient level of nursing practice, thus limiting nurses' ability to move into advanced practice roles.

As previously mentioned, the literature has previously identified that since specialty education has been integrated into universities with subject specialist teaching provided, nurses are still finding biosciences difficult to learn and apply to patient care (Prowse, 2003a). Endacott and Dawson (1997) point out that the knowledge underpinning decision-making cannot be taught in isolation from the clinical environment. This is supported by Eraut (as cited in Prowse, 2003b) who argues theoretical knowledge cannot be applied 'off the shelf' but requires the knowledge base in a practice context to be worked out and thought through" (p 133). This process is referred to as situation cognition, which is where knowledge development takes place within a social context. Effective patient care is only achieved once bioscience-based knowledge is used in practice and modified by experience (Prowse

& Lyne, 2000), therefore applying knowledge to the practice context is an essential part of knowledge development (Prowse, 2003b). As Pugh (2002) highlights:

> Nurses do not live and work in a vacuum. The practice of nursing is always situated within a practical context, which is multifaceted and may critically influence the delivery of nursing care. Therefore it is relevant to identify the context for a specified area of nursing and its implications and impact on nursing practice (p. 32).

To ensure theoretical knowledge is applied to the practice context, a review of curriculum content and knowledge and skill assessment is required. This view is supported by Howard and Steinberg (2002) who suggest that as clinical education moves to the tertiary education sector, nursing faculty members need to develop and implant newer methods to assess the efficacy of these settings in providing the knowledge, competence and skills necessary for effective clinical practice. The effect of lack of clinical support on the use of knowledge of respiratory physiology in clinical decision-making will now be discussed.

Clinical support

This research identified that if respiratory concepts are not discussed in the clinical practice setting, understanding and application of the concepts are lost over time. Participants in this study saw many of the respiratory concepts as words that tended to be used in books and at conferences rather than in the clinical practice setting.

This research illuminated the lack of discussion of respiratory concepts in the clinical practice setting. The participants perceived that the most frequently discussed concepts were those related to ABG analysis, such as respiratory acidosis, respiratory alkalosis, metabolic acidosis, hypoxaemia and hypoventilation; moderately discussed concepts were compliance, airway resistance and hypercarbia; most infrequently discussed concepts were functional residual capacity, oxyhaemoglobin dissociation curve, Aa gradient, dead space, VQ mismatch and red blood cell transit time. As most patients presenting to critical care with a primary respiratory condition require oxygenation and/or ventilation as part of their treatment, the ability to understand and apply the concepts of VQ mismatch, Aa gradient and the oxyhaemoglobin

dissociation curve is essential for a high level of decision-making to be achieved, yet these concepts were the most infrequently discussed.

As previously discussed, participants commented that often the respiratory concepts were only discussed when caring for the more critically ill patients. This may be due to the more critically ill patients being outside the routine nature of everyday work, causing nurses to move from an intuitive mode to an analytical mode of thinking when faced with more complex problems. However, if the knowledge learned is not used regularly it may be lost and therefore not available when needed to provide care for those more critically ill patients. Information process theory suggests that long-term memory is a network of knowledge gained from education and experience. Effective decision-making therefore depends on the degree to which nurses can adapt to the limitations of short and long-term memory. As both short and long term memory are limited, knowledge that has rarely been used may be difficult to access when it is required (Kremer et al., 2002). Therefore knowledge of respiratory physiology needs to be applied to patient care on a daily basis so it can be utilised when called for.

It has been suggested that the theory practice gap is less than some believe (Pelletier, Duffield & Adams, 2000), however this research identifying low to medium use of knowledge of respiratory physiology in clinical decision-making suggests that the theory practice gap exists in critical care nursing. If critical care knowledge gained from completion of a critical care programme is lost so quickly, critical care education in its current form does not improve analytical decision-making, therefore is an inefficient and ineffective use of both financial and educational resources. To enable critical care education programmes to increase nurses' knowledge and analytical decision-making, measures must be implemented to ensure knowledge gained from these programmes is retained and utilised in the clinical setting.

The above findings could be explained by lack of visibility and clinical support by clinical nurse educators and clinical nurse specialists. Participants in this study identified the need for clinical nurse educators or clinical nurse specialists to work alongside them in the clinical setting to enhance their practice. The participants of both units expressed a need to be challenged to provide rationale for their care and

assistance in interpreting arterial blood gases and determining the most appropriate intervention. Previous literature has recognised clinical support as a factor that improves clinical decision-making. As discussed in the literature review, onsite clinical and administrative support improves nurses' clinical decision-making by allowing opportunities to increase their knowledge base (Funk et al., 1995; Thompson et al., 2000). Clinical nurse educators, clinical nurse specialists and clinical nurse consultants have direct connection to clinical practice and therefore are able to act as a conduit, translating research findings into a straightforward language that is able to be understood by experienced nurses (McCaughan et al., 2002; Thompson et al., 2002).

Clinical nurse educators, specialists and consultants are in an ideal position to develop new strategies to ensure theoretical knowledge is applied to the practice context. Active teaching and learning strategies such as nursing rounds, questioning by clinical nurses specialists and reflective practice have been identified as methods to link theory to practice, ensuring that knowledge is applied to the practice context (Eng & Duke, 2003). This research identifies the need for clinical nurse educators and specialists to return to the bedside to increase nurses' theoretical and clinical knowledge base and enhance the practice of developing critical care nurses. Visibility and staff support are reported as important and effective traits of nurse leaders (Gleason Scott, Sochalski & Aiken, 1999), therefore the return of clinical nurse educators and specialists to the bedside will enhance their visibility and clinical effectiveness. The effect lack of autonomous and collaborative practice has on the use of knowledge of respiratory physiology will now be discussed.

Autonomous and collaborative practice

This research identified the negative effect lack of autonomous and collaborative practices have on clinical decision-making. No participants from unit one identified lack of collaborative practice as an influencing factor on their decision-making, although 57% of unit two participants raised it as an issue. The difference between the two units could be explained by the variation in the units' management structure. The nursing management structure in unit one was based on a shared governance model, referred to by the unit as 'shared leadership,' which has been recognized as a

nursing management innovation that legitimizes nurses' decision-making (Kramer & Schmalenberg, 2003; Wade, 1999).

Unit two participants identified rigid regimes related to nursing activities dictated by the medical staff, such as with suctioning and patient positioning, as limiting nurses' autonomous clinical decision-making. The effect lack of autonomy has on nursing knowledge is highlighted in the results of this study, showing unit one participants to demonstrate a statistically significant higher level of knowledge in ventilation modalities and regimes than participants in unit two. In unit one, adjustment of ventilation modalities and regimes was an accepted part of the senior nurses' decision-making role, whereas in unit two, adjustment of ventilation modalities and regimes by the senior nursing staff was discouraged, with this decision-making role belonging to the medical staff. This suggests that knowledge in specific areas, such as ventilation modalities, improves if nurses are empowered to practice autonomously. These results support those of Hoffman et al., (2004) who found that the greatest influence on clinical decision-making was nurses having control over their own work and decision-making.

Unit two participants identified how autonomous nursing decision-making changes with reduced medical resources. Participants reported that when there were registrars new to the critical care area and/or intensivists were unavailable, nurses took on a more autonomous role in clinical decision-making. As one participant said "you get to fly a little more." Participants also reported autonomous decision-making was more likely to occur in emergency situations, such as when patients' suddenly becomes hypoxaemic. These findings support those found in other literature. Smith Higuchi and Donald (2002) found clinical decision-making opportunities were more likely to occur where medical staff were on site for a limited time period, whereas Prescott, Dennis and Jacox (1987) found that in emergency situations when doctors are absent, nurses independently make decisions and implement actions that normally would require doctor involvement.

Lack of collaborative practice limits nurse decision-making and negatively affects patient outcome. Knaus et al., (1986) found patient morbidity and mortality was influenced by the interaction and mutual decision-making between critical care

nurses and doctors working in the critical care. Baggs et al., (1992) and Baggs (1994) found patients' outcome improved when a collaborative decision-making process was used. Hence it is in the interest of patient care to have autonomous decision-making and collaborative practice. Autonomy and control over nursing practice, and collaborative nurse-physician relationships, have been identified as key factors that enable hospitals to recruit and retain staff (Gleason Scott et al., 1999). With the current worldwide shortage of registered nursing staff (Yox, 2004), nursing autonomy and control over practice and collaborative practice needs to be developed if critical care units wish to recruit and retain nursing staff.

Registered Nurses in New Zealand now have both a legislative and professional responsibility to practice both autonomously and collaboratively. *Scopes of Practice* (Nursing Council of New Zealand, 2004) requires registered nurses to "practice independently and in collaboration with other health professionals" (p. 1). The *Philosophy and Standards for Nursing Practice in Critical Care* (Critical Care Nurses' Section, 2002) state the need for nurses to works in partnership with patients, significant others and members of the interdisciplinary team for a positive patient outcome. Hence, there is now a need for the critical care profession to look at strategies to ensure autonomous decision-making and collaborative practice is established in all critical care units, thus enabling nurses to meet both their legislative and professional requirements. The individual professional responsibility of the nurse will now be discussed.

Individual professional responsibility

The results of this study highlighted the need for nurses to take responsibility for their knowledge base and autonomous decision-making, and as one participant said, "apply our brains a bit more." This research identified that under half of the participants accessed medical and nursing journals and the World Wide Web weekly to monthly. The reason for this relatively low use of journals and the World Wide Web to retrieve information was not assessed in this research. However, the results of this thesis support findings in other studies. Thompson (2002), following over 180 hours of observation, identified that the only text based resources accessed for information were the British National Formulary, nursing and medical notes and

local protocols or guidelines. Previous research has identified nurses as having an aversion to statistical material in research publications, with research information being seen as overwhelming in both volume and style of presentation. These studies have also identified that nurses are very selective on the type of articles they read, more readily reading literature if the articles lacked academic language and accepting literature if the academic credentials of the research authors had clinical credibility (Bakalis et al., 2003; McCaughan, 2002; Funk et al., 1995; Thompson et al., 2002).

The busy nature of nurses' work has also been identified as a factor, with nurses more likely to go for what is seen as the most sensible answer rather than what is the right answer (McCaughan, 2002). The results of these previous studies conclude that for nurses to access journals and the World Wide Web for their knowledge development, they need more relevant and readable research and a better understanding of the research process (Funk et al., 1995). The limitations of this study will now be discussed.

Limitations of the Study

While the findings of this study have provided significant results, several limitations should be noted. This study was carried out in two tertiary units within a large metropolitan city. This makes it difficult to generalize the results to provincial critical care units, which generally have less access to post graduate critical care education and less medical resources. The small sample population of 27 critical care nurses prevented more powerful statistical analysis to be applied to the quantitative results, hence a larger sampler size may give different results.

This research did not consider nurses' appointment level, something that was identified by Bucknall and Thomas (1996) as contributing to critical care nurses' decision-making. Bucknall and Thomas found that nurses' decision-making improved with a higher appointment level, that being level one, two or three. An assumption can be made that the participants in this study, having all completed a critical care programme, were practising at competent, proficient or expert levels of practice. Therefore this study, by not considering appointment level, missed an opportunity to examine the relationship between appointment level and the use of

knowledge of respiratory physiology in critical care decision-making. However, this study has provided insight into the use of knowledge of respiratory physiology in clinical decision-making and has added to the body of knowledge on that subject. As Hamers et al. (1994) state, "failure to study the process of knowing and understanding that underlies practice precludes an adequate description of clinical decision-making, which, in turn, prevents the development of a methodology for systematically improving it" (p. 161).

Future Directions

This study has illuminated key areas within critical care nursing practice that need to be developed if nurses are to meet their legislative and professional nursing responsibilities. This research has identified that nurses use a low to medium use of knowledge of respiratory physiology in their clinical decision-making and has highlighted factors that have influenced this low to medium level of knowledge. Legislative and professional requirements of nurses are already clearly documented in the *Scopes of Practice* (Nursing Council of New Zealand, 2004), *Handbook for Post-Registration Nursing Practice Programme Providers* (Nursing Council of New Zealand, 1999), *Philosophy and Standards for Nursing Practice in Critical Care* (Critical Care Nurses' Section, 2002) and *New Zealand Standards for Critical Care Nursing Education* (Critical Care Nurses' Section, 2000). If critical care nurses are going to utilise sound research-based knowledge in their practice and work in partnership with members of the interdisciplinary team to achieve a positive patient outcome, strategies to overcome these negative influences need to be implemented. The author of this thesis suggests:

- Clinical nurse educators and/or clinical nurse specialists have a closer relationship with critical care programme providers, thus ensuring theoretical content meets that outlined in the *New Zealand Standards for Critical Care Nursing Education* (Critical Care Nurses' Section, 2000).

- Clinical nurse educators and/or clinical nurse specialists work with nurses in the clinical setting to develop nurses' theoretical knowledge and familiarity with theoretical language required to provide rationale for nursing care.

- Development of collaborative practice environments that encourage and develop nursing autonomy thereby increasing nurses' contribution to interdisciplinary practice and patient outcome.

It is only through implementation of new strategies that critical care nurses will develop a high level of knowledge of respiratory physiology in their clinical decision-making thereby being able to meet their legislative and professional obligations, and have the necessary knowledge and skills to move into advanced practice roles.

Summary

This chapter has discussed the key findings of this study in relation to the New Zealand context and international literature. The results of this research support the findings in other studies. The low to medium use of knowledge of respiratory physiology in clinical decision-making found in this study support other literature suggesting that nurses have difficulty applying physiology to practice. This study showed no statistically significant associations between the use of knowledge of respiratory physiology in clinical decision-making and age, experience, academic level, use of guidelines and protocols, standards and integrated care pathways, conference attendance, reading of journals and accessing the World Wide Web for literature. However a statistically significant high positive association was found in unit two between the use of knowledge of respiratory physiology in clinical decision-making and the use of protocol and guidelines, standards and integrated care pathways to support clinical decision-making. These results support studies that show no correlation between clinical decision-making and education and experience and a correlation between clinical decision-making and the use of protocols and guidelines, standards and integrated care pathways supporting practice. However, the results disagree with those found in literature purporting a correlation between clinical decision-making and age, knowledge, experience, academic exposure, conference attendance, reading of literature, clinical and administrative support and management structure. Factors that influenced the use of knowledge in respiratory physiology in this study support other studies, which found increased analytical

decision-making processes, collaboration between critical care units and tertiary education providers, on-site clinical specialist support and autonomous and collaborative practice improve clinical decision-making. This study illuminated three key areas within critical care nursing practice that need to be developed if nurses are to meet their legislative and professional nursing responsibilities. Firstly, clinical nurse educators and/or clinical nurse specialists need to have a closer relationship with the critical care programme providers to ensure critical care theoretical content is adequate. Secondly, clinical nurse educators and/or clinical nurse specialists need to work with nurses in the clinical setting to develop nurses theoretical knowledge and familiarity with theoretical language required to provide rationale for nursing care. Thirdly, collaborative practice environments need to be developed that encourage and nurture nursing autonomy.

CHAPTER SEVEN: CONCLUSION

This thesis outlined the research process taken to answer the question, following completion of a critical care specialty practice programme, do nurses use knowledge of respiratory physiology in their clinical decision-making? Chapter one introduced the research question and aims of the study and addressed how critical care nurses' knowledge and experience improve patient outcomes. This chapter also discussed the historical development of critical care nurse education in New Zealand and the development of the *Philosophy and Standards for Nursing Practice in Critical Care* (Critical Care Nurses' Section, 2002) and the *New Zealand Standards of Critical Care Nursing Education* (Critical Care Nurses' Section, 2000).

The literature review

Chapter two discussed the processes taken to identify the literature relevant to this research topic, the definition of clinical decision-making, decision-making theory, intuitive and analytical decision-making processes, factors that influence clinical decision-making and a critique of the literature. The literature searches were conducted utilising online databases through CINHAL, MEDLINE and EBSCO, with additional literature being obtained from references identified in the articles reviewed. For this research, clinical decision-making was defined as the process by which a clinician identifies, prioritises, establishes plans, and evaluates data, leading to the generation of a judgment (Grossman et al., 1996).

Four decision-making theories were discussed: information processing, hypothetico-deductive; analytical; and skill acquisition theory. The literature review highlighted that decision-making processes used are dependent on the context of the clinical situation. Some clinical situations require rapid diagnosis and interventions, due to the life-threatening nature of the problem, and therefore require rapid decision-making processes such as those using information processing theory. Other more complex problems requires more step-by-step conscious and logically defensible decision-making processes, such as those used in analytical theory. All decision-making theories use intuitive and/or analytical decision-making processes. Education develops analytical decision-making as it provides an organised

framework for the utilization of knowledge, whereas experience develops intuitive decision-making as it assists in forming pattern development applicable to varying patient care situations.

The literature review also highlighted numerous and often conflicting factors that influence clinical decision-making, such as knowledge and clinical experience, academic exposure, age, evidence-based practice, use of clinical guidelines and protocols, appointment level, clinical and administrative support, the management structure within the unit, collaborative practice, the individual traits of nurses and critical thinking skills. However, a major problem with the literature on clinical decision-making is that the methods used to assess clinical decision-making measure nurses' perception of their decision-making abilities rather than their actual decision-making abilities. A feature of the literature review was that, when compared to the general literature on clinical decision-making, literature on the use of bioscience in clinical decision-making was scant.

The research design

Chapter three outlined the research design. The epistemological stance of the researcher in this research was objectivism while the theoretical stance was post-positivism. This study used an evaluation methodology, taking a managerial perspective to answer the research question. This methodology was chosen for its ability to use both quantitative and qualitative approaches to compare the use of knowledge of respiratory physiology in critical care nurses' decision-making with the respiratory physiology recommended in the *New Zealand Standards in Critical Care Nursing Education* (Critical Care Nurses' Section, 2000).

The research design incorporated quantitative and qualitative methods used to collect data. Through the use of a questionnaire, taped interviews, ABG analysis and a card-matching exercise, data were collected on participant demographics, factors that influence the professional culture within the critical care unit, access to ongoing knowledge development, knowledge of respiratory physiology and participants' general comments on the use of knowledge of respiratory physiology to provide

patient care. Throughout the study, procedures were incorporated to ensure that the research was sound and ethical standards were met.

Data analysis techniques

Chapter four provided a brief overview of software programmes used and the number of participants included in the data analysis, followed by a description of specific quantitative and qualitative techniques used to examine the data. Due to tape damage during the transcription process, the data of only 27 of the 28 participants recruited into the study were analysed. MINITAB 13 and Microsoft Excel were used for quantitative analysis of demographics, professional culture within the critical care unit, access to ongoing knowledge and aspects of knowledge of respiratory physiology. The two-sample Student's t-test was applied to this data to identify statistically significant differences between the unit one and unit two participants. Pearson's product-moment correlation coefficient were performed on ranked data to identify relationships between the use of knowledge of respiratory physiology and factors related to demographics, professional culture and ongoing knowledge development.

Thematic analysis was used to provide understanding of the contextual issues influencing the use of respiratory knowledge in clinical decision-making. The transcriptions obtained from the interviews used to assess discussion of respiratory concepts in practice and participants' general comments on the use of knowledge of respiratory physiology to provide patient care were analysed for themes. As some participants requested discussion on the use of protocols and guidelines, standards and integrated pathways, the transcriptions from these interviews were also subjected to thematic analysis.

Research results

Chapter five presented the results of the data analysis. The results of this thesis demonstrate that following completion of a critical care specialty practice programme, nurses use a low to medium knowledge of respiratory physiology in their clinical decision-making. The results showed that participants demonstrated a

medium knowledge in ABG analysis, and highlighted participants' limited use of diagnostic terminology.

In the total group, no statistically significant associations were found between the use of knowledge of respiratory physiology in clinical decision-making and age, experience, academic level, use of guidelines and protocols, standards and integrated care pathways, conference attendance, reading of journals and accessing the World Wide Web for literature. However a statistically significant high positive association was found in unit two between the use of knowledge of respiratory physiology in clinical decision-making and the use of protocol and guidelines, standards and integrated care pathways to support clinical decision-making.

Qualitative analysis demonstrated the importance of "tweaking" protocols and guidelines, standards and integrated care pathways to meet individual patient needs, thus maintaining patient safety. It also identified factors contributing to the low to medium use of knowledge of respiratory physiology in clinical decision-making as being the high reliance nurses have on intuitive knowledge, lack of in-depth discussion of respiratory concepts in critical care programmes, lack of opportunity in the clinical practice environment to discuss respiratory physiology and the lack of collaborative practice.

Discussion

Chapter six discussed the key finding of this study in relation to the New Zealand context and the international literature and outlined the limitations of the study and future directions. The low to medium use of knowledge of respiratory physiology in clinical decision-making found in this study support other literature suggesting that nurses have difficulty applying physiology to practice. The results of this research support studies that show no correlation between clinical decision-making and education and experience, but a correlation between clinical decision-making and the use of protocols and guidelines, standards and integrated care pathways supporting practice. However, the results disagreed with those found in literature purporting a correlation between clinical decision-making and age, knowledge, experience,

academic exposure, conference attendance, reading of literature, clinical and administrative support and management structure.

The qualitative results of this study support those that found increased analytical decision-making processes, collaboration between critical care units and tertiary education providers, on-site clinical specialist support and autonomous and collaborative practice improve clinical decision-making.

This research illuminated key areas within critical care nursing practice that need to be developed if nurses are to meet their legislative and professional nursing responsibilities. These included clinical nurse educators and/or clinical nurse specialists having a closer relationship with the critical care programme providers to ensure critical care theoretical content is adequate. Clinical nurse educators and/or clinical nurse specialists working with nurses in the clinical setting should also develop nurses' theoretical knowledge and familiarity with theoretical language required to provide rationale for nursing care. Finally collaborative practice environments should be developed that encourage and nurture nursing autonomy and nurses' contribution to interdisciplinary practice.

Summary

In summary, if the critical care nursing profession wish to meet legislative and professional standards and develop advanced practice roles, the knowledge base of nurses needs to improve. Therefore, these factors limiting knowledge development and clinical decision-making need to be addressed. Critical care nurses have to decide whether they wish to practice as one participant described, like "trained monkeys", relying on intuitive knowledge and going about their work in a robotic fashion. Nurses now have a professional and legislative responsibility to work in a professional partnership within interdisciplinary teams to achieve positive patient outcomes, or as described by one participant "stretch [their] wings.... and fly a little more."

Critical care nurses need to rise to the challenge and improve their use of knowledge of respiratory physiology in their clinical decision-making. Nurses need to take

action to ensure that the respiratory concepts outlined in the *New Zealand Standards of Critical Care Nursing Education* (Critical Care Nurses' Section, 2000) are adequately addressed in the critical care programmes they complete and that the critical care setting provides an environment conducive to theoretical knowledge development and autonomous clinical decision-making. This environment requires clinical nurse educators and/or clinical nurse specialists to work with nurses in the clinical setting to challenge and develop nurses' knowledge and encourage the use of a theoretical language that enables nurses to clearly articulate rationale for their nursing care. This environment requires a collaborative approach to patient care that encourages nurses' autonomous decision-making. If nurses' wings are constantly being clipped, nurses will not have the ability to fly when required and patient outcome will suffer.

As patient care within the critical care setting becomes more complex, critical care nurses need to take on more responsibility for their care. This responsibility places a social and ethical obligation of the critical care nursing profession to provide well-educated nurses who effectively use their critical thinking abilities to make decisions that result in best possible patient outcomes (Hicks et al., 2003).

REFERENCES

Andrews, M. (1996). Using reflection to develop clinical expertise. *British Journal of Nursing, 5*(8), 508-513.

Aronson, J. (1994, Spring). A pragmatic view of thematic analysis. *The Qualitative Report, 2*(1). Retrieved December 6, 2004 from http://www.nova.edu/ssss/QR/BackIssues/QR2-1/aronson.html

Baggs, J.G., Ryan, S.A., Phelps, C.E., Richeson, J.F., & Johnson, J.E. (1992). Collaboration in critical care: The association between interdisciplinary collaboration and patient outcomes in a medical intensive care unit. *Heart & Lung, 21*(1), 18-24.

Baggs, J.G. (1994). Development of an instrument to measure collaboration and satisfaction about care decisions. *Journal of Advanced Nursing, 20*(1), 176-182.

Bakalis, N., Bowman, G.S., & Porock, D. (2003). Decision-making in Greek and English registered nurses in coronary care units. *International Journal of Nursing Studies, 40*(7), 749-760.

Baumann, A., & Bourbonnais, F. (1982). Nursing decision-making in critical care areas. *Journal of Advanced Nursing, 7*(5), 435-446.

Belknap, D.C., Seifert, C.F., & Petermann, M. (1997). Administration of medications through enteral feeding catheters. *American Journal of Critical Care, 6*(5), 382-392.

Benner, P. (1984). *From Novice to expert: Power and excellence in nursing practice*. Menlo Park: Addison-Wesley.

Benner, P., & Tanner, C. (1987). Clinical Judgement: How expert nurses use intuition. *American Journal of Nursing, 87*(1), 23-31.

Bowler, S., & Mallik, M. (1998). Role extension or expansion: A qualitative investigation of the perceptions of senior medical and nursing staff in an adult intensive care unit. *Intensive and Critical Care Nursing, 14*(1), 11-20.

Boyer, E.L. (1996). Clinical practice as scholarship. *Holistic Nurse Practitioner, 10*(3), 1-6.

Buckingham, C. D., & Adams, A. (2000a). Classifying clinical decision-making: A unifying approach. *Journal of Advanced Nursing, 32*(4), 981-989.

Buckingham, C. D., & Adams, A. (2000b). Classifying clinical decision-making: Interpreting nursing intuition, heuristics and medical diagnosis. *Journal of Advanced Nursing, 32*(4), 990-998.

Bucknall, T., & Thomas, S. (1996). Clinical decision-making in critical care. *Australian Journal of Advanced Nursing, 13*(2), 10-17.

Burman, M.E., Stepans, M.B., Jansa, N., & Steiner, S. (2002). How do NPs make clinical decisions? *The Nurse Practitioner, 27*(5), 57-64.

Byrnes, M., & West, S. (2000). Registered nurses' clinical reasoning abilities: A study of self-perception. *Australian Journal of Advanced Nursing, 17*(3), 18-23.

Chaboyer, W., Dunn, S., & Najman, J. (2000). Developing specialty knowledge: The case of Australian critical care nursing. *Intensive and Critical Care Nursing, 16*(1), 13-17.

Cioffi, J. (1997). Heuristics, servant to intuition in clinical decision-making. *Journal of Advanced Nursing, 26*(1), 203-208.

Cioffi, J., & Markham, R. (1997). Clinical decision-making by midwives; Managing case complexity. *Journal of Advanced Nursing, 25*(2), 265-272.

Clancy, J., McVicar, A., & Bird, D. (2000). Getting it right? An exploration of issues relating to the biological sciences in nurse education and nursing practice. *Journal of Advanced Nursing, 32*(6), 1522-1532.

Clark, A.M. (1998). The qualitative-quantitative debate: moving from positivism and confrontation to post-positivism and reconciliation. *Journal of Advanced Nursing, 27*(6), 1242-1249.

Considine, J., & Hood, K. (2000). Emergency department management of hip fractures: Development of an evidence based clinical guideline by literature review and consensus. *Emergency Medicine, 12*, 329-336.

Coombs, M. (2003). Power and conflict in intensive care clinical decision-making. *Intensive and critical care nursing, 19*(3), 125-135.

Critical Comment (2003, April). *Nursing Council Nomination.* 7.

Croskerry, P. (2002). Achieving quality in clinical decision-making: Cognitive strategies and detection of bias. *Academic Emergency Medicine,* 9(11), 1184-1204.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process.* Sydney: Allen & Unwin.

Cribb, A. (1987). Who needs intensive care trained nurses anyway?!, Paper presented at the meeting of the Northern Regional Australian and New Zealand Intensive Care Society, Auckland, New Zealand.

Cribb, A. (1992). *Historical context of critical care nursing in New Zealand.* Paper presented at the meeting of the Australia and New Zealand Intensive Care Society, Auckland, New Zealand.

Critical Care Nurses' Section. (2000). *New Zealand standards for critical care nursing* (2nd ed.). Wellington: New Zealand Nurses' Organization.

Critical Care Nurses' Section. (2002). *Philosophy and standards for nursing practice in critical care* (3rd ed.). Wellington: New Zealand Nurses' Organization.

Dallal, G. E. (2004). *The Little Handbook of Statistical Practice*. **Retrieved December 5, 2004 from http://www.tufts.edu/~gdallal/LHSP.HTMDallal**

Dreyfus, H.L. (1979). *What computers can't do: The limits of artificial intelligence*. New York: Harper and Row.

Dreyfus, H.L., & Dreyfus, S. E. (1986). *Mind over machine*. New York: The Free Press.

Ellis, P.A. (1997). Processes used by nurses to make decisions in the clinical practice setting. *Nurse Education Today, 17*(4), 325-332.

Endacott, R., & Dawson, D. (1997). Clinical decisions made by nurses in intensive care - results of a telephone survey. *Nursing in Critical Care, 2*(4), 191-196.

Eng, G.P., & Duke, M. (2003). Developing critical thinking skills through active teaching and learning strategies: A literature review. *Singapore Nursing Journal, 30*(3), 24-31.

Funk, S. G., Tornquist, E. M., & Champagne, M.T. (1995). Barriers and facilitators of research utilization. *Nursing Clinics of North America, 30*(3), 395-407.

Galley, J., & O'Riordan, B. (2003). Guidance for nurse staffing in critical care. *Intensive and Critical Care Nursing, 19*(5), 257-266.

Girot, E. (2000). Graduate nurses: Critical thinkers or better decision makers? *Journal of Advanced Nursing, 31*(2), 288-297.

Glanville, I., Schirm, V., & Wineman, N. (2000). Using evidence-based practice for managing clinical outcomes in advanced practice nursing. *Journal of Nursing Care Quality, 15*(1), 1-11.

Gleason Scott, J., Sochalski, J., & Aiken, L. (1999). Review of Magnet Hospital Research: Findings and implications for professional nursing practice. *JONA, 29*(1), 9-18.

Goldman, H. G. (1999). Role expansion in intensive care: Survey of nurses' views. *Intensive and Critical Care Nursing, 15*(6), 313-323.

Greenwood, J., & King, M. (1995). Some surprising similarities in the clinical reasoning of "expert" and "novice" orthopaedic nurses: Report of a study using verbal protocol and protocol analyses. *Journal of Advanced Nursing, 22*(5), 907-913.

Grossman, S., Campbell, C., & Riley, B. (1996). Assessment of clinical decision-making ability of critical care nurses. *Dimensions of Critical Care Nursing, 15*(5), 272-279.

Guba, E. G., & Lincoln, Y.S. (1994). Competing paradigms in qualitative research. In N.K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research.* Thousand Oaks, CA: Sage.

Hamers, J.P., Huijer Abu-Saad, H., & Halfens, R.J. (1994). Diagnostic process and decision-making in nursing: A literature review. *Journal of Professional Nursing, 10*(3), 154-163.

Harbison, J. (2001). Clinical decision-making in nursing: Theoretical perspectives and their relevance to practice. *Journal of Advanced Nursing, 35*(1), 126-133.

Heath. H. (1998). Reflection and patterns of knowing in nursing. *Journal of Advanced Nursing, 27*, 1054-1059.

Hewitt-Taylor, J. (2004). Clinical guidelines and care protocols. *Intensive and Critical Care Nursing, 20*(1), 45-52.

Hicks, F.D., Merritt, S.L., & Elstein, A.S. (2003). Critical thinking and clinical decision-making in critical care nursing: A pilot study. *Heart & Lung, 32*(3), 169-180).

Hind, M., Jackson, D., Andrews, C., Fulbrook, K., Galvin, K., & Frost, S. (1999). Exploring the expanded role of nurses in critical care. *Intensive and Critical Care Nursing, 18*(3), 147-153.

Hoffman, K., Donoghue, J., & Duffield, C. (2004). Decision-making in clinical nursing: Investigating contributing factors. *Journal of Advanced Nursing, 45*(1), 53-62.

Howard, E. P., & Steinberg, S. (2002). Evaluations of clinical learning in a managed care environment. *Nursing Forum, 37*(1), 12-20.

Intensive Therapy Section (1985). *Intensive Therapy Nursing Standards*. Wellington: New Zealand Nurses' Association.

Jordan, S., & Reid, K. (1997). The biological science in nursing: An empirical paper reporting on the applications of physiology to nursing care, *Journal of Advanced Nursing, 26*(1), 169-179.

Knaus, W.A., Draper, E. A., Wagner, D.P., & Zimmerman, J.E. (1986). An evaluation of outcome from intensive care in major medical centers. *Annals of Internal Medicine, 104*(3), 410- 418.

Koch, T. (2000). Having a say: Negotiation in fourth-generation evaluation. *Journal of Advanced Nursing, 31*(1), 117-125.

Kramer, M., & Schmalenberg, C.E. (2003). Magnet hospital nurses describe control over nursing practice, *Western Journal of Nursing Research, 24*(4), 434-452.

Kremer, M.J., Faut-Callahan, M., & Hicks, F.D. (2002). A study of clinical decision-making by certified registered nurse anesthetists. *AANA Journal, 70*(5), 391-397.

Last, T., Self, N., Kassab, J., & Rajan, A. (1992). Extended role in ICU. *British Journal of Nursing, 1*(13), 672-675.

Lauri, S., & Salantera, S. (2002). Developing an instrument to measure and describe clinical decision-making in different nursing fields. *Journal of Professional Nursing, 18*(2), 93-100.

Leininger, M. M. (1985). *Qualitative research methods in nursing.* Orlando, FL: Grune & Stratton.

Manias, E., & Street, A. (2001). Nurse-doctor interactions during critical care ward rounds. *Journal of Clinical Nursing, 10*(4), 442-450.

McCaughan, D., Thompson, C., Cullum, N., Sheldon, T.A., & Thompson, D.R. (2002). Acute care nurses' perception of barriers to using research information in clinical decision-making. *Journal of Advanced Nursing, 30*(1), 46-60.

McKay, P. S. (1983). Interdependent decision-making: Redefining professional autonomy. *Nursing Administration Quarterly, 7*(4), 21-30.

McLennan, R. (Ed.). (1995). *People and enterprises: Organisational behaviour in New Zealand* (2nd ed.). Sydney: Harcourt Brace & Co.

Millenson, M.L. (1997). *Demanding medical excellence: Doctors and accountability in the information age*. Chicago: University of Chicago Press.

Minichiello, V., Sullivan, G., Greenwood, K., & Axford, R. (1999). *Handbook for research methods in health sciences*. Sydney: Addison-Wesley.

Myles, P.S., & Gin, T. (2000). *Statistical methods for anaesthesia and intensive care*. Oxford: Butterworth Heinemann.

Nursing Council of New Zealand. (1999, May). *Handbook for Post-Registration Nursing Practice Programme Providers.*

Nursing Council of New Zealand (2004a). *Health practitioners Competence Assurance Act 2003*. **Retrieved December 2, 2004 from http://www.nursingcouncil.org.nz/hpca.html**

Nursing Council of New Zealand (2004b). *Scopes of Practice*. **Retrieved December 2, 2004 from http://www.nursingcouncil.org.nz/scopes.html**

Ovretveit, J. (1998). *Evaluating health intervention.* Buckingham: Open University Press.

Pelletier, D., Duffield, C., & Adams, A. (2000). Australian clinicians and educators identify gaps in specialist cardiac nursing practice. *Australian Journal of Advanced Nursing, 17*(3), 24-30.

Pirret, A. (Ed.). (1994). *New Zealand standards for certification in general intensive therapy nursing education.* Auckland: New Zealand, Intensive Therapy Section.

Polit, D.F., & Hungler, B.P. (1995). *Nursing research: Principles and methods* (5th ed.). Philadelphia: Lippincott.

Prescott, P., Dennis, K., & Jacox, A. (1987). Clinical decision-making of staff nurses. *IMAGE: Journal of Nursing Scholarship, 19*(2), 56-62.

Prowse, M.A. (2003a). Learning and using biosciences in nursing: Part one: A review of the literature. *Journal of Advanced Perioperative Care, 1*(3), 85-93.

Prowse, M.A. (2003b). Learning and using biosciences in nursing: Part two: Achieving patient outcomes in perioperative practice. *Journal of Advanced Perioperative Care, 1*(4), 129-135.

Prowse, M.A., & Lyne, P. A. (2000). Revealing the contribution of bioscience-based nursing knowledge to clinically effective patient care. *Clinical effectiveness in nursing, 4*(2),67-74.

Pugh, D. (2002). A phenomenologic study of flight nurses' clinical decision-making in emergency situations. *Air Medical Journal, 21*(2), 28 -36.

Rhodes, B. (1985). Occupational ideology and clinical decision-making in British nursing. *International Journal of Nursing Studies, 22*(3), 241-257.

Robinson, C.A. (2001). Magnet Nursing Services Recognition: Transforming the Critical Care Environment. *AACN Clinical Issues, 12*(3), 411-423.

Roche, J.P. (2002). A pilot study of teaching clinical decision-making with the clinical educator model. *Journal of Nursing Education, 41*(8), 365-365.

Rolfe, G., & Fulbrook, P. (1998). *Advanced Nursing Practice.* Oxford: Butterworth Heinemann.

Russell, A. (2001). Overview of research to investigate pressure relieving surfaces. *British Journal of Nursing, 10*(21), 1421-1417.

Sackett, D.L., Rosenberg, W.M.C., & Muir Gray, J.A. (1996). Evidence-based medicine: What it is and what it isn't. *British Medical Journal, 312*(7023), 71-72.

Smith Higuchi, K.A., & Donald, J.G. (2002). Thinking processes used by nurses in clinical decision-making. *Journal of Nursing Education, 41*(4), 145-153.

Snedecor, G.W., & Cochran, W.G. (1989). *Statistical methods.* Ames, Iowa: The Iowa State University Press.

Spooner, S. H. Keenan, R., & Card, M. (1997). Determining if shared leadership is being practiced: evaluation methodology. *Nursing Administration Quarterly, 22*(1), 47-56.

Stern, H. P., Stroh, S.E., Fiser, D.H., Cromwell, E.L., McCarthy, S. G., & Prince, M.T. (1991). Communication, decision-making and perception of nursing roles in a pediatric intensive care unit. *Critical Care Nursing Quarterly, 14*(3), 56-68.

Tabak, N., Bar-tal, Y., & Cohen-Mansfield, J. (1996). Clinical decision-making of experienced and novice nurses. *Western Journal of Nursing Research, 18*(5) 534.

Taylor, S. J., & Bogdan, R. (1984). *Introduction to qualitative research methods: The search for meanings*. New York: John Wiley & Sons.

Taylor-Piliae, R.E. (1998). Establishing evidence-based practice: Issues and implications in critical care nursing. *Intensive and Critical Care Nursing, 14*(1), 30-37.

Thomson, P., Angus, N., & Scott, J. (2000). Building a framework for getting evidence into critical care education and practice. *Intensive and Critical Care Nursing, 16*(3), 164-174.

Thompson, C. (2003). Clinical experience as evidence in evidence-based practice. *Journal of Advanced Nursing, 43*(3), 230-237.

Thompson, C., McCaughan, D., Cullum, N., Sheldon, T., Mulhall, A., & Thompson, D. (2001a). The accessibility of research-based knowledge for nurses in United Kingdom acute care settings. *Journal of Advanced Nursing, 36*(1), 11-22.

Thompson, C., McCaughan, D., Cullum, N., Sheldon, T., Mulhall, A., & Thompson, D. (2001b). Research information in nurses' clinical decision-making: What is useful? *Journal of Advanced Nursing, 36*(3), 376-388.

Thompson, C., McCaughan, D., Cullum, N., Sheldon, T., & Raynor, R. (2002). The value of research in clinical decision-making. *Nursing Times, 98*(2), 30-34.

Thorens, J.B., Kaelin, R.M., Jolliet, P., & Chevrolet, J.R. (1995). Influence of the quality of nursing on the duration of weaning from mechanical ventilation in patients with chronic obstruction pulmonary disease. *Critical Care Medicine, 23*(11), 1807-1815.

Timmins, F. (2002). Critical care nursing in the 21st century. *Intensive and Critical Care Nursing, 18*(2), 118-127.

Toth, J.C. & Ritchey, K.A. (1984). New from nursing research: The basic knowledge assessment tool (BKAT) for critical care nursing. *Heart & Lung, 13*(3), 272-279.

Wade, G. (1999). Professional nurse autonomy: Concept analysis and application to nursing education. *Journal of Advanced Nursing, 30*(2), 310- 318.

Webb, C., & Mackenzie, J. (1993). Where are we now? Research-mindness in the 1990s. *Journal of Clinical Nursing, 2*(3), 129-133.

White, A. H. (2003). Clinical decision-making among fourth-year nursing students: An interpretive study. *Journal of Nursing Education, 42*(3), 113-120.

Yox, S. B. (2004). An interview with ANA president Barbara Blakeney. *Medscape Nurses,6*(1). **Retrieved January 10, 2005, from http://www.medscape.com/viewarticle/474867.**

LIST OF APPENDICES

APPENDIX A: CLOSED-ENDED QUESTIONNAIRE

Form to be completed by the interviewer with the participant present.

Unit Number	
Participant Allocated Number	

(To be ticked)

On the shift you have just completed, or currently completing, did you care for a ventilated patient?	Yes	No

If no, the interview is required to be rescheduled.

Demographic Data

Age	
Year completed nursing preparation programme	
Number of years general nursing experience	
Were these years of general nursing experience full time or part- time (please specify)	
Year completed critical care specialty practice programme	
Number of years critical care experience	
Were these years of critical care experience full time or part-time (please specify)	
Number of years experience post completion of critical care specialty practice programme	
Were these years of experience post completion of your critical care specialty programme full time or part time (please specify)	
How many hours per week are you currently working in a critical care?	

(To be ticked)

Type of Critical Care Specialty practice programme	Hospital	Level 7	Level 8	Other
Length of Specialty practice programme	< 6mths	6-<12mths	12-18mths	Other(specify)
Education preparation	RGON/RCpN	Bachelor(specify)	Masters(specify)	Other(specify

Using the classification minimal, medium, abundant or other, how do you rate the use of the following in your unit? (Please circle)

Guidelines/protocols	Minimal	Medium	Abundant	Other
Standards	Minimal	Medium	Abundant	Other
Integrated care pathways	Minimal	Medium	Abundant	Other

(Please circle)

Do you find the presence of practice guidelines, protocols, standards, and integrated care pathways support or limit your clinical decision-making?	Support	Limit

For the following section, please circle the answer that most reflects your practice.

Have you attended any nursing/medical conferences/seminars the past 3 years	Yes	No		
If yes, to the previous question, what type of conferences/seminars were they?	Hospital	Critical care nursing	Nursing education	Other (specify)
Do you read nursing/medical journal articles?	Yes	No		
If yes, to the previous question, how often would you read journal articles?	Weekly	monthly	1-<6mthly	6-12mthly
Do you access the web for nursing/medical literature?	Yes	No		
If, yes to the previous question, how often would you access the web for this literature?	Weekly	Monthly	1-<6mthly	6-12mthly

For the following section, please circle the answer that rates the following?

The availability of credible and trustworthy nurses within the unit to support your clinical and professional practice?	Inadequate	Adequate	Excellent
A management structure that provides adequate professional and clinical support	Inadequate	Adequate	Excellent

Today, while caring for your ventilated patient, did you complete the following tasks? (Please circle)

Chest auscultation	Yes	No
Suctioning with or without pre-oxygenation	Yes	No
Hyperventilation techniques	Yes	No
Manual patient ventilation using "bagging"	Yes	No
Patient positioning	Yes	No
Adjusting of fractionated inspired oxygen	Yes	No
Adjustment of ventilation modalities or regimes	Yes	No
Taking of, or retrieving the results of an arterial blood gas	Yes	No
Administer an analgesic	Yes	No
Administer a paralysing agent	Yes	No
Administer sedation	Yes	No

APPENDIX B: OPEN-ENDED QUESTIONNAIRE

This part of the interview will be taped. You may ask for the audiotape to be turned off at any time during this interview.

Only the completed tasks identified in the closed-ended questionnaire will be discussed at this section of the interview.

For each of the following completed tasks you performed while caring for your ventilation patient, why did you do that task and what respiratory physiological knowledge did you use to provide rationale for that given task?

Chest auscultation

Suctioning with or without pre-oxygenation

Hyperventilation techniques

Manual patient ventilation using "bagging"

Patient positioning

Adjusting of fractionated inspired oxygen

Adjustment of ventilation modalities or regimes

Taking of, or retrieving the results of an arterial blood gas

Administration of an analgesic

Administration of a paralyzing agent

Administration of a sedative

APPENDIX C: ARTERIAL BLOOD GAS ANALYSIS

Would you please interpret the following arterial blood gases and discuss what is/are the required intervention(s) that would be needed to achieve a normal arterial blood gas result?

pH	7.54	
$PaCO_2$	26 mmHg	3.4 kPa
PaO_2	48 mmHg	6.4 kPa
Bicarb	22	
O_2 Sat	0.89	

pH	7.03	
$PaCO_2$	53.2 mmHg	7 kPa
PaO_2	53.2 mmHg	7 kPa
Bicarb	14	
O_2 Sat	0.87	

pH	7.15	
$PaCO_2$	70 mmHg	9.3 kPa
PaO_2	206 mmHg	27.5 kPa
Bicarb	24.5	
O_2 Sat	1.0	

APPENDIX D: CARD MATCHING

You will now be asked to perform a card matching exercise. You will be given 2 sets of cards, one set with respiratory physiological concepts and one set with the definitions for each respiratory physiological concept. Please match the concept with the correct definition.

N.B. The last two columns of this form are for the interviewer's use.

Card		Matched with card (identify card number)	Correct	Incorrect
A	Functional residual capacity			
B	Thoracic compliance,			
C	Airway resistance			
D	Oxyhaemoglobin dissociation curve			
E	Hypoxaemia			
F	Hypercarbia/Hypercapnoea			
G	Respiratory acidosis			
H	Respiratory alkalosis			
I	Metabolic acidosis			
J	Dead space			
K	Alveolar-arterial gradient			
L	Ventilation-perfusion mismatch			
M	Hypoventilation			
N	Increased transit time			

This section of the interview will be audio taped. Please ask if you wish the audiotape to be turned off at any time during this interview.

Would you describe your familiarity with the concepts written on the cards and their definitions?

Would you describe to what depth the concepts written on the cards were discussed in the critical care specialty practice programme you completed?

Would you describe to what depth and how often, the concepts written on the cards were or are discussed in your clinical practice setting?

Finally, do you wish to provide any general comment on respiratory physiological knowledge used to provide patient care?

The interview is now complete. Thank you for your time and support.

APPENDIX E: CONFIDENTIALITY AGREEMENT

Research Title: The use of respiratory physiological knowledge in critical care nurses' clinical decision-making

I (Full Name - printed)

agree to keep confidential all information concerning the project .....

.....

.....

..... (Title of Project).

Signature: ..... **Date:** .....

Full Name - printed .....

APPENDIX F: INFORMATION LEAFLET

Study title: The use of respiratory physiological knowledge in critical care nurses' clinical decision-making

Researcher: The researcher is Alison Pirret, employed as a staff nurse, intensive care, Middlemore Hospital and self-employed as a clinical nurse specialist intensive/acute care, to fulfil the requirements of a Masters degree in Nursing through Massey University. Alison's contact details are:

Phone (09) 267 7323
Mobile 021 112 6321
Email Pirret@xtra.co.nz.

The primary research supervisor is Stephen Neville, Lecturer, School of Health Sciences – Albany. Stephen can be contacted on (09) 09 443 9700 ext 9065. The secondary research supervisor is Nick McNicol, Senior Lecturer, School of Health Sciences – Albany. Nick can be contacted on (09) 443 9700 ext 9070.

Introduction
You are invited to take part in a study designed to assess the use of respiratory physiological knowledge in critical care nurse's clinical decision-making. Participation is entirely voluntary. As participant selection will not be completed until October 2003, you will have until that time to consider participation in the study.

About the study
The aim of the research is to interview a total of 30 critical care nurses who have completed a critical care specialty practice programme and who are currently working in one of the two identified critical care units, to determine what factors influence the use respiratory physiological knowledge in their clinical decision-making. If willing participants exceed the desired number (fifteen from each unit), randomisation will be used to select participants. This will mean every 2nd alphabetically listed surname will be selected until a total of 15 participants have been obtained.

The time span of the study from the selection of participants to the availability of the results is expected to be 18 months.

If you agree to take part in the study, you will be asked to be interviewed for 1 to 1.5 hours during or following a shift in which you have been caring for a ventilated patient. These interviews will take place at your workplace or in a convenient location.

The interview will have three parts and will consist of filling out a questionnaire with the researcher, answering questions that will be taped and later transcribed, and a card matching exercise.

Once the research is complete, audiotapes will be wiped cleaned. Collected data will be safely stored for 5 years as recommended by Massey University. The transcripts will then be shredded and computer discs wiped and cleared of all material.

Benefits, Risks and Safety
A benefit of this study is that the Critical Care Nurses' Section (CCNS) of the New Zealand Nurses Organisation (NZNO) will receive a summary of this study. The CCNS can then use the information gained in the study to influence standards of practice to further develop critical care nursing. There are no risks to you as a participant.

Excluding the time taken for the interview, there will be no financial costs incurred by the participant. As a participant you will not receive any payment or reimbursement of expenses.

Participation
Your participation in this study is entirely voluntary. You do not have to take part in this study. Once you have become a participant of this study, you may withdraw at any time without having to give a reason, up until the data is statistically analysed.

General
You have a right to ask any questions concerning the study at any time during your participation and to decline to answer any particular question. You may have a friend, family or whanau support to help you understand the risks and/or benefits of this study and any other explanation you may require. If you require any further information about the study please contact Alison Pirret. Alternatively you can also contact Stephen or Nick at the above numbers.

As a prerequisite of a registered nurse practicing in the critical care area is a proficient use of spoken and written English, the interviews will be completed in English. No interpreters will be provided.

During the interview process, you do not have to answer all the questions and you may stop the interview at any time. You also have the right to ask for the audiotape to be turned off at any time during the interview.

Tapes, transcripts and computer discs will be stored safely in the researcher's home. You will not be required to provide clinical data on patients receiving care from you.

If you have any queries or concerns regarding your rights as a participant in this study, you may wish to contact your professional organisation.

If you have any queries or concerns regarding your rights as a participant in this study you may wish to contact your professional organisation.

Confidentiality
If you agree to take part in the study, you will be asked to sign a consent form so that the information you have given can be used. You will also be asked to sign a confidentiality form so study results are not influenced by discussion of the study with other participants.

No material which could personally identify you will be used in any reports on this study. Any information that you give will be treated in strictest confidence. To ensure your information is kept confidential and anonymous, a coded number will be allocated to you and the unit in which you work. This will ensure neither you, nor your unit, is linked to any information you provide.

A panel of expert critical care nurses will view parts of the transcripts to assist with the validity of the study. To maintain confidentiality, the transcriber is required to sign a transcriber's agreement, and the panel of experts will sign a confidentiality agreement.

Results
Once all information has been analysed a summary of the study will be made available to you. A report of the results of the research will be given to the CCNS. There may be a delay between data collection and the publication of the results

Statement of approval
This study has received ethical approval from the Auckland Ethics Committee.
This study has received ethical approval from the Massey University Human Ethics Committee.

Please contact the researcher if you have any questions about this study.

APPENDIX G: CONSENT FORM

Name of study: **The use of respiratory physiological knowledge in critical care nurses' clinical decision-making.**

I have read and understand the information sheet dated _____ for volunteers taking part in the study designed to _____ _____		
I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.	**Yes**	**No**
I have had the opportunity to use whanau support or a friend to help me ask questions and understand the study.	**Yes**	**No**
I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time and this will no way affect my continuing academic/employment progress.	**Yes**	**No**
I understand that my participation in this study is confidential and that no material which could identify me will be used in any reports on this study.	**Yes**	**No**
I have had time to consider whether to take part.	**Yes**	**No**
I know whom to contact if I have any side effects to the study.	**Yes**	**No**
I know whom to contact if I have any questions about the study.	**Yes**	**No**
I consent to my interview being audiotaped.	**Yes**	**No**
I wish to receive a copy of the results.	**Yes**	**No**

I _____ (full name) hereby consent to take part in this study.

Date

Signature

Full name of researcher

Contact phone number of researcher

Project explained by

Project role

Signature

Date

(A copy of the consent form to be retained by the participant)

APPENDIX H: TRANSCRIBER'S AGREEMENT

Title of Research: The use of respiratory physiological knowledge in critical care nurses' clinical decision-making

I ..... (Full Name - printed) agree to transcribe the tapes provided to me.

I agree to keep confidential all the information provided to me.

I will not make any copies of the transcripts or keep any record of them, other than those required for the project.

TRANSCRIBER

Signature: ..... Date: .....

WITNESS

Signature: ..... Date: .....

Full Name - printed .....