NURSES' PERCEPTIONS REGARDING THE USE OF TECHNOLOGICAL EQUIPMENT IN THE INTENSIVE CARE UNIT SETTING OF A PUBLIC SECTOR HOSPITAL IN JOHANNESBURG

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DECLARATION

I, Phyllis Chifundo Khuntho Kanjakaya, declare that this research report is my own work. It is being submitted for the degree of Master of Science (Nursing) in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signature.....

Date...18th August 2014.....

Protocol Number M130526

DEDICATION

Special dedication to my husband Mtisunge, children, and mother for the love and untiring support throughout my study at the University of the Witwatersrand.

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ABSTRACT

An Intensive Care Unit (ICU) is an extreme technological environment where different types of equipment and devices, intended for the care of critically ill patients, are found. The use of technological equipment has assisted in reduction of morbidity, mortality, and length of hospital stay because the problems are diagnosed earlier. The purpose of the study was to explore the perceptions of nurses who work in the Intensive Care Units about the effects of the use of technological equipment, with the intention of making recommendations for clinical practice, education of nurses and further research. A quantitative, descriptive, prospective, and non-experimental study design was utilised in this study, as well as a non-probability sampling method. Participants (n=60) were drawn from neurosurgical, cardiothoracic and main ICUs. Data collection was done by use of questionnaire. Descriptive and inferential statistics were used to analyse data.

The results of this study revealed that the majority of Intensive Care Nurses identified the positive effects of using technology and they also identified some of the negative aspects of using technology. There was statistical significance between age and some negative effects of technology; "increases patient risk from misinterpretation of data", (p=0.02), "increases overall hospitalisation costs", (p=0.05), and "increases nurses psychological stress", (p=0.05). Additionally, there was statistical significance between experience of nurses and nurses' response on negative effects of technology; "technology extracts time from patients", (p=0.03) and "technology is complicated and not easy to handle", (p=0.03).

The research findings show that the some of the Intensive Care nurses are unaware of the negative effects of technology that might lead to exposing the patients to unnecessary risks. Therefore, recommendations for nursing practice, education, management, and research are proposed.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

OVERVIEW OF THE STUDY

1.0 INTRODUCTION

This chapter will provide the overview of the study and will comprise the background, problem statement, purpose, research questions, objectives and significance of the study and the research paradigm. I will also include an overview of the research methodology and design, validity and reliability of the study and ethical considerations.

1.1 BACKGROUND OF THE STUDY

An Intensive Care Unit (ICU) is an extreme technological environment where different types of technological equipment and devices, intended for the care of critically ill patients, are found (Almerud, Alapack, Fridlund & Ekebergh 2007). Laila et al (2011:545) defined technology as the interaction of people and tools to achieve some human purposes and so technological developments become incorporated into nursing practice. Ashworth (1990:150); Dean (1998:200) & Wilkinson (1992:195) cited the Collins Dictionary (1979) definition, which defined technology "as the application of practical or mechanical sciences or the knowledge and skills available to human society for art, science, or industry". On a medical perspective, Herdman (1985), as cited in Wichowiski (1994:1162), defined medical technology as "drugs, devices, medical and surgical procedures used in medical care and the organisational and supportive systems within which it is provided". In summary, technology means all the machineries, tools, knowledge and skills required for the provision of care. These definitions encompass

the many technologies nurses use including mechanical ventilators, cardiac monitors, extracorporeal membrane oxygenation (ECMO), infusion pumps, intra-aortic balloon pump, dialysis machines and many more.

The use of technological equipment has greatly evolved from the 1950's, after an epidemic of poliomyelitis, where patients were manually ventilated to support their respiratory function (Wiles & Daffurn, 2002). Currently, the use of numerous pieces of sophisticated technological equipment makes ICU a highly technological environment (Dean, 1998).

The use of technological equipment has become an integral part of clinical practice being widely used in ICU's and assisting many lives. There are different types of equipment that offer monitoring of vital parameters of patients, diagnosing and treatment of critically ill, support of vital organs (ventilators) and administration of drugs by use of infusion pumps (Kiekkas, Karga, Poulopoulou, Karpouhtsi & Koutsojannis 2006). This equipment has enhanced the nurses' ability to measure and modify a growing number of physiological processes (Carnevale, 1991:24).

The use of technological equipment has played a huge role in Intensive Care nursing practice, providing answers to uncertainty if properly utilised, as it offers solutions to problems and facilitates nursing practice (Kiekkas et al 2006). It provides life support to and continuous observation of patients, thus, leading to quick intervention to prevent complications and restore health. Pearson (1993) & Wichowski, (1994) stated that technology has saved numerous lives and improved quality of life for many people. In addition, technology has assisted in reduction of morbidity and mortality and length of

hospital stay because the problems are diagnosed earlier (Laila et al 2011; Pearson 1993).

Locsin (1995) stated that technology could bring patients closer to nurses, as it enhances their knowledge of the patient being cared for. As nursing care is being provided, the nurses become closer to their patients and get to know them better. In a study done by Alasad (2002:409), the nurses stated they "feel safe and in control" when using technology in ICU as the machines provide them with knowledge of what is happening to their patients' bodily function and are constantly updated with information about the patients' systems. Clinically, it may take a long time to recognise a potential problem but with technology, complications can be prevented by both early detection and intervention.

However, whilst recognising the benefits of technological use, it may be accompanied by problems that could increase the risk of not meeting psychological needs of patients. Overreliance on the use of technological equipment can result in Intensive Care nurses focusing almost totally on the technology and human needs that are measurable and visible (Almerud et al 2007; Locsin 1995; Wilkin and Slevin 2004). This could widen the gap between nurse and patient because of unconscious disregard of the patient as a person. This becomes a threat if technology is introduced without adequate preparation and education (Wilkinson, 1992).

Barnard (2000) highlighted that technology may increase demand, energy and attention from nurses. In order to meet needs, nurses require an understanding of the machinery and how it operates. Novice nurses, with little or no experience in the use of technology,

therefore spend most of their time trying to understand the machines since they perceive it as new and complex, consequently neglecting the patient (Walter 1995).

Additionally, Pearson (1993) and Wikstrom et al (2007) revealed that technology might dehumanise patient care and risks shifting the focus from the patients' psychological needs when it becomes the central focus. This leads to less patient care and less contact with patients, as they are viewed as objects and not human beings (Almerud et al 2007; Kongsuwan & Locsin 2011). The majority of attention goes to the machines, recording data and attending to alarms.

Technology has also increased the risk for patient safety due to physical hazards. Some problems may arise due to equipment design, reliability and malfunction. The increase in the number and complexity of equipment can easily lead to human errors (Kiekkas et al 2006). The increased reliance on technology and monitoring devices may decrease the nurses' assessment skills as they accept data without validation, thereby decreasing chances of recognising malfunctioning machines (Sandelowski 1997), all of which is detrimental to critically ill patients as their lives are put at risk.

1.2 PROBLEM STATEMENT

Studies conducted worldwide indicate that use of technological equipment has both positive and negative effects on patient care. Positively, it has enhanced better patient outcomes and decreased morbidity and mortality rates (Kiekkas et al 2006; Laila et al 2011; Pearson 1993), whilst negatively it has shifted Intensive Care nurses' focus from patients and dehumanised care leading to ignoring patients' needs (not being holistic)

and less contact with patients (Locsin 1995; Pearson 1993; Wikstrom et al 2007). Literature review shows that to date no studies have been done in South Africa to explore the perceptions of nurses regarding the use of technological equipment in ICU.

The study will seek to answer the following research questions:

- What are the perceptions of nurses regarding the use of technology in the intensive care units?
- What are the positive or negative effects of the use of technology on direct patient care?
- Is there a difference between nurses regarding the use of technology based on socio-demographic characteristics and perceptions of the nurse participants?

1.3 PURPOSE OF THE STUDY

The purpose of the study is to explore the perceptions of nurses who work in the intensive care units about the effects of the use of technological equipment, with the intention of making recommendations for clinical practice and education of nurses.

1.4 OBJECTIVES OF THE STUDY

The objectives of the study are:

- To describe the perceptions of nursing personnel who work in the Intensive Care Units regarding the use of technological equipment
- To determine the positive or negative effects of technological equipment on patient care in the Intensive Care Units

- To identify the relationship between demographic characteristics and the perceptions of nurse participants

1.5 SIGNIFICANCE OF THE STUDY

The significance of this study is to uncover the awareness of nurses towards the use of technological equipment in the Intensive Care Units, thereby making a positive contribution to patient outcomes by promoting integration of technology and caring. Additionally, the study will create an ethical awareness of the positive and negative aspects surrounding the use of technological equipment, which will assist unit managers and nurses to improve their technical competence in order to improve caring in such an extreme technological environment. Lastly, it will contribute to the caring that is guided by and respectful of patient's individualised needs.

1.6 PARADIGMATIC PERSPECTIVES

A paradigm is a world-view, a general perspective on the complexities of the world (Polit & Beck, 2012:11). It guides one's approach to inquiry. The researcher based the study on the following meta-theoretical, theoretical, and methodological assumptions.

1.6.1 Meta-theoretical Assumptions

According to Polit & Beck (2012:12), assumptions are basic principles believed to be true without proof or verification. The meta-theoretical assumptions assist researcher's view of a person, environment, health and nursing. The researcher followed Patricia

Benner's clinical wisdom in nursing practice (Brykczynski, 2010) from which the following assumptions were made:

- The person

The person is someone living in the world, who is a self-interpreting being, that is, the person does not come into the world pre-defined but gets defined in the course of living a life (Benner, & Wrubel, 1989). The expert Intensive Care nurses acquire knowledge and skills on the use of technology and integrate it with caring as they gain competence. Through the acquisition of the technical competence, they can feel confident in their work and interact well with the patients and their families, make good clinical and ethical judgement, prevent hazards in the technological environment and mentor the other nurses on nursing care.

- Environment

Environment is a social environment with social definition and meaningfulness. The ICU environment is both a physical and social environment. The physical environment includes the technology surrounding the patients whilst the social environment includes the nurse's attitude and norms (Merilainen, Kyngas & Ala-Kokko, 2010). The Intensive Care nurses' good conduct (attitudes) combined with a sense of membership in a profession where professional conduct is socially embedded, lived and embodied in the nursing practices (Day, & Benner, 2002) can ease the patients' stress and anxiety about being in a highly technological environment. These would assist the nurses to make a good clinical and ethical judgement. An Intensive Care nurses' awareness of the social

environment of the patient would assist them to include family members in patient care. This would also assist the patients and families to have a good understanding of the technology present in the Intensive Care Unit thereby enhancing cooperation on its use.

- Health

Health is a human experience of health or wholeness. The person who is critically ill should remain stable and be supported technologically to maintain the feeling of wholeness. As such, the Intensive Care nurses need to apply the technical expertise they have to restore health.

- Nursing

Nursing is a caring relationship that includes the care and study of the lived experience of health, illness and disease. The Intensive Care nurses should have knowledge, skills and competency in the provision of care and integrate the technology with caring.

1.6.2 Theoretical Assumptions

A theory is an integrated set of defined concepts and relational statements that presents a view of phenomenon and can be used to describe, explain, predict or control the phenomenon (Burns & Groves, 2007:34). This study, is based on the theoretical assumptions of Patricia Benner (Brykczynski, 2010), who identified several competencies and domains of nursing practice and a further five stages of skill

acquisition, which includes novice, advanced beginner, competent, proficient and expert (Benner, 1984). The theoretical assumptions that are applicable to the study include:

- Diagnosing and managing life-sustaining physiologic functions in unstable patients
- Using skilled know-how to manage a crisis
- Providing comfort measures for the critically ill
- Caring for the patient's family
- Preventing hazards in a technological environment
- Facing death: end of life care and decision making
- Communicating and negotiating multiple perspectives
- Monitoring quality and managing breakdown using the skilled know-how of clinical leadership
- Coaching and mentoring of others.

The central theoretical statement of this study is that the Intensive Care nurse's ability to integrate technology and caring depends on the technical competence of the nurse. The nurse should manage a crisis without neglecting the patient and family members, and should not lose focus of the patient when working with a variety of technology connected to the patient. In addition, when technology malfunctions, the Intensive Care nurse should quickly identify the problem before she/he loses focus of the patient.

1.6.2.1 Operational Definitions

Definitions for the purpose of this study are as follows:

- Intensive Care Unit

A designated area in the hospital where patients with actual or potential life threatening conditions are admitted for continuous monitoring, interventions and treatments by health care professionals. For the purpose of this study, the Intensive Care Units at one university-affiliated, public sector, tertiary level hospital will be used. Three adult Intensive Care Units, namely cardiothoracic, general, and neurosurgical will form part of the study setting. According to the classification by the South African Society of Anaesthesiology (SASA), public sector academic units are defined as level One ICUs (SASA, 2006).

- Intensive Care Nurse

A person, who has undergone additional specialised nursing education and training in the field of study and registered by the South African Nursing Council (SANC) as an Intensive Care Nurse. For the purpose of this study, all registered nurses working in the selected Intensive Care Units who are specialised as Intensive Care Nurses were considered eligible and invited to participate in the study.

- Technological Equipment

Technological equipment includes a number of dissimilar devices such as cardiac monitors, respirators, infusions pumps, syringe drivers and cardiac assist devices for example, the intra-aortic balloon pump and extra-corporeal membrane oxygenation devices commonly used in patient care in the Intensive Care Units.

- Perception

An idea, a belief, or an image someone has as a result of how somebody sees or understands something. A relevant example is the use of technological equipment. In this study, nurses' understanding with regards to the use of technological equipment and especially how it may affect patient care in a positive or in a negative way is measured by using a questionnaire developed by Laila et al. (2011).

1.6.3 Methodological Assumptions

Methodological assumptions assist to give form to the research context, of which influence the researchers decision about the research design (Botes, 1995). A quantitative, non-experimental, descriptive design was chosen as the most appropriate approach to gain the information required in this study. It is recognised that holistic nursing approach to patient care is an important component in nursing practice and a functional approach to research. The study was done to explore the impact of technology on nursing care that will assist to improve the nursing practice.

1.7 OVERVIEW OF RESEARCH METHODOLOGY

A quantitative, non-experimental, descriptive design was used to meet the study objectives. The study was conducted in the intensive care units at a university-affiliated, public sector and tertiary level hospital in Johannesburg. Three adult Intensive Care Units were chosen as ideal settings because they are supported by a wide array of highly sophisticated and expensive technological equipment and devices including the use of

complex investigations and imaging services as well as specialists contribution of all disciplines (Bersten, Son & Oh, 2003). The target population was all ICU trained registered nurses (n=85) working in the three Intensive Care Units at the selected study site. A non-probability, purposive random sampling was used to select the nurse participants (n=60) after consultation from a statistician.

Before the commencement of the study, ethical clearance and permission was obtained from the Department of Health (refer **Appendix D),** Chief Executive Officer (CEO) of the hospital (refer **Appendix E**), the nursing services manager and ICU managers to conduct the study. Data was collected using a self-administered questionnaire where a five-point Likert scale was used to rate the positive and negative effects of using technology.

Descriptive statistics was used to analyse the study variables and sample demographics (percentage, mean, and standard deviation). Analysis of variance (ANOVA) of the qualifications and the two age experience groups will be applied to compare the perceptions of nurses. The one sample t-test was used to test for significance of mean score differences.

1.8 ETHICAL CONSIDERATIONS

In order to consider the rights of the participants who require protection which include the right to self-determination, privacy, autonomy and confidentiality, fair treatment and protection from discomfort and harm (Burns & Grove, 2007), the following ethical

requirements were taken into consideration during and prior to commencement of the study.

The protocol was reviewed by the Department of Nursing Education and the University Postgraduate Committee to assess the feasibility of the proposed study. Thereafter, ethical clearance from the Human Research Ethics Committee (HREC) of the University of the Witwatersrand was obtained to conduct research (protocol number M130526). Later, permission to conduct the study was obtained from Department of Health and the Hospital Management to conduct research at the hospital (refer **Appendices I & J)**.

The participants meeting the criteria were invited to participate in the study. The participants signed informed consent form after reading and understanding the information sheet to show their willingness to participate in the study. Confidentiality and anonymity of the participants was maintained by the use of codes instead of names on the questionnaires. Participants' participation in the study was voluntary and withdrawal was at any time, without incurring penalty.

1.9 VALIDITY AND RELIABILITY OF THE STUDY

In this study, to guarantee validity and reliability, the design ensured that all considerations were similar, as much as possible, so that the conditions of data collection could not affect the truthfulness of the results. Statistical conclusions were ensured by the use of appropriate statistical tests to analyse the data with assistance from a biomedical statistician. In addition, the study did not deviate from the proposed

design and guidelines of the instrument in order to maintain and control possible errors in the data collection. Study results were generalised only to nurses who have the same and similar characteristics. A pilot study was conducted, with the results reviewed by a statistician who was involved during data collection, analysis, and interpretation.

1.10 PLAN OF THE STUDY

The outline of the study is as follows:

Chapter One:	Overview of the study
Chapter Two:	Literature review
Chapter Three:	Research design and methods.
Chapter Four:	Data analysis and results.
Chapter Five:	Summary, discussion of results, conclusions, and recommendations.

1.11 SUMMARY

This chapter has introduced the reader to the study and provided an outline to the study. It has covered the problem statement, the research questions, the purpose and objectives, the significance and the paradigmatic perspectives of the study, as well as an overview of the methodology including the research design, setting, population, sample and sampling, data collection, data analysis and validity. In addition, the ethical considerations have been presented.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will discuss the literature reviewed in relation to the study. It will cover literature on the history of ICU, history of technology, history of ICU in South Africa, types of technological equipment found in ICU, experiences of novice and experienced nurses on use of technology and results from studies done worldwide. The literature review will help the researcher to build a logical framework for the study and set it within a tradition of inquiry and a context of related studies (De Vos, Strydom, Fouche & Delport, 2006).

The Intensive Care Unit (ICU) is a section within a hospital that looks after patients whose conditions are life-threatening and need constant, close monitoring and support from equipment and medication to keep normal body functions going (Intensive Care Society, 2011). Almerud, Alapack, Fridlund & Ekebergh, (2007) also defined ICU as a high technological environment where different types of technological equipment and devices are found, intended for the care of critically ill patients. These definitions are similar, except that the Intensive Care Society's definition was more elaborate. ICU's have specialist monitoring and treatment equipment, with higher levels of staffing, that are highly trained in caring for the most severely ill patients. Monitoring of physiological data provides baseline data from which future assessment can be made and facilitates the response to various medical and nursing interventions (Elliot, Aitken, & Chaboyer, 2007).

Laila et al (2011:545) defined technology as the interaction of people and tools to achieve some human purposes and the technological developments became incorporated into nursing practice. Ashworth, (1990:150); Dean, (1998:200); Wilkinson, (1992:195) cited the Collins Dictionary (1979) definition, which defined technology as the application of practical or mechanical sciences, or the knowledge and skills available to human society for art, science or industry. On a medical perspective, Herdman 1985, as cited in Wichowiski (1994:1162), defined medical technology as drugs, devices, medical and surgical procedures used in medical care and the organisational and supportive systems in it is provided. In summary, technology means all the machinery, tools, knowledge and skills required in the provision of care. These definitions encompass the many technologies the nurses use including: mechanical ventilators, cardiac monitors, extracorporeal membrane oxygenation (ECMO), infusion pumps, intra-aortic balloon pumps, dialysis machines and many more.

2.2 HISTORY OF INTENSIVE CARE UNIT (ICU)

The concept of critical care nursing began in Britain in 1850, during the Crimean War, when this area was highlighted, due to the pioneering contribution of Florence Nightingale, who was nursing injured soldiers during the war. She isolated the most severely injured soldiers, placing them closer to the nursing station so they would receive more intensive care and were closely monitored until they got better (Ristagno and Weil, 2009; Weil and Tang, 2011).

In 1923, Dr Walter Dandy introduced the concept of post-operative recovery and developed a neurosurgical post-operative recovery area, where highly trained staff gave specialised nursing care (Ristagno and Weil, 2009). Recovery rooms provided transitional

care to patients undergoing major surgery, who were closely monitored whilst regaining consciousness after anaesthesia and nurses organised post-operative care. The paralysed patients were treated with iron lung respirators that required intensive supervision and care and nurses were recruited to take care of these patients (Fairman and Lynaugh, 2000). During this time, professional nurses became the first bedside specialists rendering critical care under the direction of neurological surgeons. This initial intensive care also became a model for post-operative management for military casualties during the Second World War (Ristagno and Weil, 2009).

During the 1950's, critical care medicine was introduced to take care of poliomyelitis epidemic patients who presented with neuromuscular paralysis that disturbed the spontaneous ventilation of the victims. Manual ventilation outside the operating theatre for non-surgical patients began in civilian hospitals (Crocker, 2007; Ristagno and Weil, 2009). During the second-world war, special care units were opened for severely wounded soldiers with life threatening problems in field hospitals, which provided intensive care by surgeons and professional nurses to injured soldiers. Later, civilian hospitals opened special care rooms, providing 24-hour service, for critically ill patients grouped together after triage. Any critically ill patients, other than post-operative patients, were admitted to these special care rooms (Intensive Care Society, 2003; Fairman and Lynaugh, 2000). These rooms were not built for use as ICUs, often established in a makeshift fashion, attached to the ends of existing wards with an open plan design and single rooms for special cases (Willes and Daffurn, 2002). The recovery units of the Second World War and recovery areas of the civilian hospitals had little or no equipment.

After the epidemic and Second World War, the hospitals maintained the Intensive Care Units and equipment. The modern ICU was established and recruitment and training of special professional nurses and medical experts began in the mid-20th century by Dr Peter Safar at the University of Pittsburgh, which was manned by full time trained critical care physicians (Weil and Tang, 2011). The nurses, who had backgrounds in operating theatres and medical surgical nursing and were usually resourceful and dedicated, were chosen to work in these units because they were perceived to be 'good nurses' who opted to work in this strange and challenging environment (Willes and Daffurn, 2002:135). Due to the unique nature of nursing, the nurses played a pivotal role at the interface of the patient with the technology, the healthcare team and their family. They were and are the constant figure in the physical environment and the equation of care. As they became more skilled and experienced, nurses played a role in the development of clinical practice (Willes and Daffurn, 2002) and in some circumstances; they were taking additional roles and responsibilities beyond their training.

Due to the highly technological environment, it was not easy for the inexperienced registered nurses to look after the intubated ventilated patients and hospitals started offering orientation programmes for new staff to allow them to learn about the routines and the care of patients and related technology. The medical staff and the more experienced nurses (Willes and Daffurn, 2002) provided this. In Australia in 1962, the first post- basic course in Intensive Care and recovery room nursing was established and endorsed as an additional course. Thereafter, several hospitals opened up Intensive Care nursing schools (Willes and Daffurn, 2002).

In the late 1960's, more sophisticated haemodynamic monitoring, respiratory support technologies were introduced, and the commitment to provide Intensive Care in hospitals was so rapid that most major hospitals opened Intensive Care Units. Appropriate ICU designs were built with good air conditioning, lighting, staffing and organisation requirements were developed and published (Ristagno and Weil, 2004; Willes and Daffurn, 2002). In addition, there were advances in practice and the understanding of life support biology and major advances in life support technology.

2.2.1 History of ICU in South Africa

The Intensive Care Units in South Africa evolved in the late 1960's, including a variety of single function units such as post-operative ventilation of cardiothoracic cases where pure respiratory cases were ventilated in pulmonary units (Mathihva, 2002; The Critical Care Society of South Africa, 2013).

In 1966, Intensive Care training was officially established as a postgraduate qualification, registered under the South African Nursing Council (SANC) as critical care nursing-general, making Intensive Care nurses clinical nurse specialists (De Beer, Brysiewicz & Bhengu, 2011).

In 1970, anaesthesiologists in Addington opened the first multidisciplinary unit, manned by the first fulltime intensivist, assisted by anaesthetic registrars and the mid 1970's saw ICUs opening in all public hospitals (The Critical Care Society of South Africa, 2013). As ICUs opened in many private and public hospitals, the ICU professionals formed an association called the Critical Care Society of South Africa (CCSSA), which consisted of

members of the medical and nursing care professions. The CCSSA set guidelines for the establishment of proper ICUs for the critically ill (Mathihva, 2002).

South Africa's ICUs are structured and graded according to the 1983 National Institute of Health consensus development conference. The units are graded from level I to level IV. The level I units are found in university affiliated tertiary referral hospitals, have sophisticated equipment and can manage a wide spectrum of critical illness disease process. They are manned by a medical director with 24-hour medical staff coverage (specialists, residents and Medical Officers) and the nurse to patient ratio is usually 1:1 but it may be 1:2 in some units (Mathihva, 2002).

The private health care sector runs profit driven level II to IV ICUs staffed by non-intensivists. Level II units are for single organ purpose such as coronary care units or neurosurgical ICU, Level III are community hospital ICUs with limited invasive monitoring and level IV are high dependency units (Mathihva, 2002; SASA, 2006).

2.3 HISTORY OF TECHNOLOGY

During the Second World War, most of the recovery units had little or no specialised equipment. Devices and techniques were invented and implemented to compensate for failure of a single organ system and to secure and maintain respiratory gas exchange, with medical students providing the manual ventilation of patients (Weil and Tang, 2011).

In the 1950's, with the high incidence of poliomyelitis where patients presented with paralysis of the respiratory muscles, evolved the spontaneous ventilation of non-surgical

patients. The introduction of manual mechanical ventilation for such non-surgical patients pioneered mechanical ventilation outside the operating room (Ristagno and Weil, 2004). The patients were assisted by use of 'iron lung' ventilators, also referred to as 'tank' ventilators, which provided negative pressure ventilation (Crocker, 2007; Weil and Tang, 2011). However, it was found out that despite the use of lung ventilators the mortality rate from the epidemic was still high because of hypercarbia. The machine was not effectively removing the gases. A manual method of positive pressure ventilation was invented by the anaesthetist, Ibsen Bjorn, who performed a tracheostomy on a 12 year old girl who was not improving on a negative pressure iron ventilator. He proposed using positive pressure ventilation through the tracheostomy, manually using a bag and the girl's condition improved rapidly as secretions were cleared and hypoxia and hypercarbia reversed. He used medical students to ventilate the patients manually (Crocker, 2007; Intensive Care Society, 2003; Ristagno and Weil, 2004; Weil and Tang, 2011). Others adopted the technique after observing its impact.

In the 1950's, there was improvement of artificial airways and the management of airways and early development of intermittent positive pressure ventilation. This led to chronological development of Piston ventilators, followed by the Bennet and the Bird intermittent positive pressure valves and the Emerson ventilator (Ristagno and Weil, 2004). Thereafter, there was evolution of mechanical ventilators with improved parameters such as pressure control modes, pressure support modes and positive end expiration pressure (PEEP).

Continuous cardiac monitoring, external AC and later DC defibrillation machines were also invented. These assisted greatly with the management of cardiac arrest in the special

care wards. These prompted the expansion of coronary care units where patients with cardiac problems were grouped together for monitoring (Weil and Tang, 2011; Wiles and Daffurn, 2002).

In 1943, a dialysis machine was invented to take care of single organ failure (renal failure) during the Korean War where soldiers and civilians were affected with haemorrhagic fever affecting the renal system (Weil and Tang, 2011). By 1960's, only a limited number of units had haemodialysis machines available to them (Wiles and Daffurn, 2002).

In 1960's, the pressure cycled Bird ventilators were slowly replaced by more sophisticated volume cycled ventilators (Wiles and Daffurn, 2002). In 1970's, there was evolution of automated cardiopulmonary monitoring devices with alarms, cardio-circulatory and blood gas monitoring. Increasingly, more sophisticated haemodynamic and respiratory methods of monitoring were introduced including quantitative measurements of ventilation, circulation and metabolism and the responses to interventions triggered by them such as monitoring of blood gases, vascular pressures and cardiac pacing (Ristagno & Weil, 2009).

Currently, major advances in life support technology have evolved that allow for prompt and better insight into physiological disturbances of patients. There is a better understanding of the disease process and technological advances have resulted in vast improvements in diagnostic and monitoring capabilities. This is evidenced by the evolution of advanced cardio-circulatory and blood gas monitoring, ventilators and circuits, intravenous therapy and venous access devices (Wiles and Daffurn, 2002). Analog monitors have given way to current digital displays and alarms with modern computer systems (Weil and Tang, 2011). Current training programmes in critical care medicine

prepares the critical care specialists in handling the technologies available in the Intensive Care Units.

2.4 THE ICU ENVIRONMENT

The word environment means the place in which people live and work, including all physical conditions that affect them. Kim (2000), as cited Merilainen, Kyngas & Ala-Kokko (2010), described environment as the physical, social, psychological and symbolic environment. The physical environment refers to the general surrounding of the patient or the environment in which they live, such as the ward and it can also be seen as a resource which makes people's actions possible, for example technology (Merilainen et al, 2010). Social environment refers to other people, attitudes, norms and institutions and it takes place in the physical space. The symbolic environment is made up by the social norms of culture, language, religion and community. It is also influenced by upbringing and education, the norms of behaviour set to individuals, role expectations as well as the ideas concerning health and sickness and taking care of patients that prevail in the community (Merilainen et al, 2010). The psychological environment refers to a private emotional environment that protects people from damage and includes the feelings, experiences and thoughts closely connected to the individual's own identity (Merilainen et al, 2010).

The ICU environment is a high technological environment with sophisticated equipment and devices meant for critically ill patients (Almerud et al, 2007; Merilainen et al, 2013). This place, where critically ill patients live and where Intensive Care nurses work, is characterised by high technological equipment offering a standard of monitoring, intervention and organ support that cannot be delivered in a general ward. Patients in ICU

are connected to continuous monitors for electrocardiogram, electronic read-outs of heart rate and invasive blood pressure, oxygen saturation and central venous pressure (Wikstrom & Larsson, 2003). The ICU nurses use data obtained from these monitors to gain knowledge about the physiological well-being of their patients as well as their response to treatment (O'Connell, 2008)

ICU is a stressful environment that can cause physical and psychological stress to the patients (Almerud et al, 2007; Merilainen, et al 2010). During the Intensive Care Unit period, the patients are constrained to a bed, equipment and ward environment for 24 hours a day; they are connected to various devices, exposed to noise, lighting, a room that is too hot or cold and various smells, all of which contribute to patient stress. In addition, being able to see other patients as care objects and the intense activities deriving from the health professionals providing medical and nursing care can aggravate the physical and mental stress to patients. They are unable to do things they are used to do because of weakness and the disease process (Almerud et al, 2007; Johansson, Berguom & Lindahl, 2012; So and Chan, 2004).

Sometimes the patients are unsure of what is happening to them, as the ICU Staff appear to pay more attention to the technology and adjustments of parameters on the monitors, without explaining the process. As such, this causes more stress to the already stressed patients (Almerud et al, 2007). Most of the nurses do not talk to their patients when doing procedures therefore do not explain what is being done, leaving the patients feeling neglected and scared because they do not know what is happening to their bodies.

Some factors such as change of shifts, communication difficulties due to the patient's condition, patient's disorientation as to time, place and what has happened and being away from the family members can promote stress (Almerud et al, 2007; Coyer, Wheeler, Wetzig & Couchman, 2007; Merilainen et al, 2013; Wilkin & Slevin, 2004). In addition, the loud noise from the machines and alarms indicating that something is wrong can cause further stress and disturb sleep patterns of the patients, especially if they are not informed about what is happening. Interventions such as relaxation, massage, therapeutic touch, empathetic physical contact and family presence may reduce the patients' feeling of isolation and loneliness thereby promoting comfort (Ashworth, 1990; Coyer et al, 2007).

Communicating difficulties is usually a source of stress to mechanically ventilated patients who have an endotracheal tube or tracheostomy for ventilation, leading to feelings of vulnerability and powerlessness (Coyer et al, 2007; Engstrom, Nystrom, Sundelin & Rattray, 2013). Therefore, if the patient fails to communicate and nobody seems to care about them, they feel depressed leading to more stress. In a study by Engstrom, Nystrom, Sundelin, & Rattray (2013) the participants described it was very hard being unable to communicate verbally due to weakness and tubes in their mouth and throat and this led to feelings of panic and frustration thereby increasing their psychological stress. Therefore the critical care nurses' understanding of the technological equipment would assist in understanding the patients' feelings and concerns.

In a study by McGrath (2008:1100), the nurse participants described ICU as an "alien environment" where they care for patients depersonalised and controlled by life-saving technology, making their surroundings unnatural. The environment is perceived as unfamiliar with different types of technology surrounding the patients who cannot talk and

make decisions for their care. It is therefore important for the Intensive Care nurses to deliver high quality care to the critically ill patients using the relevant technologies but also incorporating psychosocial care measures (Urden, 2006 as cited by Coyer et al, 2007)

However, the patients adapt to their environment and put their hope and trust in the skills of the staff and accept the ward environment and events taking place as routine (Almerud et al, 2007). Therapeutic interpersonal interactions may facilitate emotional comfort by increasing the patients' feelings of personal control through helping them to feel secure, informed and valued (Williams & Irurita, 2004). When the nurses have specialised advanced technical training they provide quality services and make good clinical decisions, which promotes trust and safety to the patients.

2.5 CARING INTENSIVE CARE UNIT

Caring in ICU is complex because of the technology present. It involves caring for patients undergoing life-threatening physiological crises and the patients' life depends on technology (machines), complexity of therapies, nursing, medical and technical resources (Beeby, 2000). It is a central feature of nursing based on relationship of trust and making someone comfortable (Noh et al, 2007). It is associated with perspectives, attitudes, and expectations of those caring. Gaut's Theory of Caring (1986), as cited by Wilkin & Slevin (2004), described knowledge and competence as major concepts of caring. He viewed caring as a process of therapeutic intervention that is helping and enabling. Intensive Care nursing has never been more important than when the comforting, caring presence of the nurse enables the patient to tolerate invasive, often frightening and sometimes painful technology (Wilkin, 2003).

Conversely, Wilkin (2003:1178) perceived caring as human behaviour that includes cognitive, affective, psychomotor and administrative skills within which professional caring may be expressed. It is a vital resource within the highly technological area of the ICU and is best described by the recipient of the care. Beeby (2000a:77), described caring attributes as "being attentive and showing concern for others, responsible and providing for another and regard fondness or attachment for another." These attributes are built on a therapeutic nurse-patient relationship. Since most of the ICU patients are unconscious, the Intensive Care nurses can show caring through touch and being there for the patient, totality of care, respect and recognition of patients as individuals and with families (Beeby, 2000).

Similarly, Bush & Barr, (1997:388); Wilkin, (2003:1183), categorised actions of caring as "reassuring, explaining, comforting, acting quickly and calmly, holding the patient's hands, sitting with the patient's family, crying with the patient and family over the diagnosis and blending caring with technology." These bring relief and sense of trust and security to the patients. The touching, speaking and gesturing while using equipment in ICU may also soften the impact of technology. The Intensive Care nurses would therefore bridge the gap between technology and caring if they use therapeutic touch with the patients (Wilkin, 2003). Their unique role can never be replaced by technological equipment in ICU, which must be treated as useful tools, never as a replacement for the art (Almerud, et al 2008; Dean, 1998). The technological equipment should assist the nurses to provide nursing care and so Intensive Care nurses have to remember that technology cannot talk to the patients and their families, listen to their fears and anxieties, or inform them of their progress (Wilkinson, 1992).

McCormack (2004) as cited in O'Connell (2008:139) stated that the nature of the nurse-patient relationship is dependent on the context in which nursing care is delivered. In ICU, where technology can act as a barrier and compromise the communication between a nurse and patient, it can be very difficult to develop a therapeutic nurse-patient relationship (Johns, 2005). As such, nurses need to be aware of these barriers and minimise the effects of the technological equipment in order to engage in a therapeutic relationship with the critically ill patients and their families.

The Intensive Care nurses must be compassionate in order to maintain the relationship with the patients who are dependent on technology and the family. Since most of ICU patients are attached to devices that support them, the Intensive Care nurses must use their compassionate understanding, empathy and kindness to care for them (Kongsuwan & Locsin, 2011; Wilkin 2003). They must balance the technical skills and use of technological equipment and the caring roles by using the ability to observe, safeguard, relate to their patients as valued people and provide care that is focused on comfort (Coyer et al, 2007). They must understand the feelings and personal meanings being experienced by the patient and communicate that understanding to the patient (Wilkin, 2003). In so doing, the patients would feel assisted and supported by the nurses.

There is need for collaboration in care amongst the patient, family, other health professionals and the Intensive Care nurse. This enhances appropriate use of technology in the ICU environment. The patient and family must accept technology as a necessity and should realise its benefits (Kongsuwan & Locsin, 2011; Wilkin, 2003). When the patient and family accept the technology, they become cooperative which enables them to live with technology safely and comfortably (Kongsuwan & Locsin, 2011). Similarly, families

can collaborate in the caring for their loved ones and if they understand the care and technology used, they could talk to the patients to comply with the treatment. The collaboration between nurses and critically ill patients would also assist in achieving best practices. In this sense, the Intensive Care nurses would act as patients' advocates to promote their well-being. However, this needs to be done conscientiously as it can bring about an ethical issue of paternalism. Since most ICU patients are unconscious and unable to communicate they are not autonomous and the advocacy role can lead to paternalism thereby leading to an ethical dilemma (Wilkin, 2003).

Alasad, 2002; Kongsuwan & Locsin, 2011; Little, 2000; Wilkin and Slevin, 2004 observed that Intensive Care technical competency, knowledge and professional experience are most significant in the care of patients on life-sustaining technologies. Competency was described as having the skills, knowledge and experiences needed for effectively using technologies for care (Wilkin and Slevin, 2004). Competence gives the Intensive Care nurse a sense of control over the patients and technology used in the care of patients. Technology is incorporated in the care of the patients and Intensive Care is, largely, dependent on its technology (Wikstrom, 2003). When technology is used in conjunction with competent clinical judgement, it promotes safe and efficient care by the nurses (Haghenbeck, 2005). The competent nurses can effectively integrate the technology with caring by linking their knowledge and actions. This will make them confident with caring and have good clinical judgement (Kongsuwan and Locsin, 2011). In addition, Benner (1984) & Little (2000), stipulated that technology is more likely to be in 'a ready-to-hand' mode for those with technical competence, their activities are performed smoothly and where equipment is relatively unnoticed.

Normally, the novice nurses when developing their technological competence would try to cope with the intellectual, physical and technical demands of different equipment, shifting their focus from the patient to technology in order to gain competence in the equipment. As they become more experienced and comfortable with the technology, they would start concentrating on the patients rather than technology (Alasad, 2002; Almerud et al, 2008a). Technology would therefore, be seen merely as a tool to provide care.

However, technology has threatened the caring component of nursing. The Intensive Care nurses have been challenged to remain focused on the personal, individual and human character of nursing practice whilst simultaneously managing the technological environment (Wilkin & Slevin, 2004). High technology may dominate nursing care transforming the holistic care approach to a practice governed by rules that aim to ensure efficiency, precision, standardisation and regulation (Halmiton, 1988 as cited in Wilkin and Slevin, 2004). Many Intensive Care nurses experience difficulties in engaging meaningfully with unconscious patients whom they cannot communicate with and tend to put more attention on technological aspects of care (Villanueva, 1999 as cited in O'Connell, 2008). This concurred with the findings of the study done by Almerud et al (2007) to find out what it means to be critically ill or injured and cared for in technologically intense environment. The patients expressed they felt invisible as people, reduced to the status of organs, objects and diagnoses. Technology needs to be incorporated into the care but the patients feel neglected by the nurses who seemed to focus much on technology than on their physical and psychological needs. Hence Intensive Care nurses have to have technical competence in order for them to link between knowledge and actions, where the models chosen by the nurses continue to support the caring actions (Bush and Barr, 1997).

2.6 THE USE OF TECHNOLOGY IN ICU

Laila (2011:545) defined technology as interaction of people and tools to achieve some human purpose. It is designed to be invincible, invulnerable, objective, unfeeling and unpredictable, in contrast to the human characteristics of vulnerability, subjectivity and unpredictability. It is in this context that the Intensive Care nurse is challenged to care for patients (Cooper, 1993:26). Nurses with little or no experiences in the use of technology will perceive it as new, unfamiliar and complex (Walters, 1995). But in the modern ICU environment there is heavy reliance on technological equipment to carry out a range of functions such as monitoring patients' physiological status, support of vital functions (respiratory support) and delivering treatments in form of drugs (Brown & Cook, 2011: Kiekkas, Karga, Poulopoulou, Karpouhtsi, Papadoulas & Koutsojannis, 2006). The equipment includes ventilators, suction machines, cardiac monitors, infusion pumps, defibrillators, fluid and bed warmers, and Extracorporeal Membrane Oxygenation (ECMO), Intraaortic Balloon Pump (IABP), capnography and haemodialysis machines. The Intensive Care nurses must accept technology as part of ICU staff's everyday life (Almerud et al, 2008) and aim to use it competently and confidently.

According to Almerud et al (2008), good technology should provide information about patient, give parameters for the patient and save life, as well as being well-functioning equipment that will give correct readings of parameters. The advanced technology may assist the nurses to identify problems with patients and assist them to fully evaluate the humanistic physiological response of patients to care (Dean, 1998; Wilkin and Slevin, 2004). Technology has saved many lives and improved quality of life for many people by

ensuring better outcomes for patients' health and decreasing morbidity and mortality (Pearson, 1993; Laila et al, 2011.

Barnard (1997) described technology as a neutral object that does not make decisions but only solves problems. This entails manipulation of the technological equipment, by a person, for it to do its job and function effectively and that person acts as the master to the equipment. Thus, the technological equipment becomes an extension of the Intensive Care nurses' hands, eyes, ears and other senses (Ashworth, 1990) and they have to have technical knowledge and competence in order to manipulate the equipment and interpret the measurements (Locsin, 1995; Noh, Arthur & Sohng, 2002; Barnard, 1997). Technology can never replace the closeness and empathy of the human touch by Intensive Care nurses but it can improve the management of patients (Locsin, 1995; McGrath, 2008; Wilkin and Slevin, 2004). Therefore, the understanding technology, as a human way of understanding a patient more fully as a person, is the expression of a harmonious relationship between technological equipment and caring in nursing (Locsin, 1995:202).

High technology requires high technological skills, competence and mastery of technology by the Intensive Care nurses to control their working environment (Alasad, 2002; Beeby, 2000; Kiekkas et al, 2006; Laila et al, 2011; Noh, Arthur & Sohng, 2002). This means that if nurses have the aforementioned skills and mastery they would integrate well with the technology and caring without dehumanising the patients, thereby enhancing patient care and well-being. In trying to develop technological competence, the ICU nurses have to cope with the intellectual, physical and technical demands of the different types of technology. In the first instance, novice nurses have fear and stress of the technology and little by little, their technical competence improves. According to Alasad (2002) this period

is called “technical orientation and technical nurturing” where the nurses’ main focus is mainly on the technology rather than the patient on the machine. As a result, the nurse will frequently lose sight of the patient for the sake of gaining technical competence. Almerud (2008) also expressed that inexperienced nurses (novice) do not see beyond the machine, thus, they do not focus on the patient before gaining competence, but as they become more experienced and comfortable with technology, they start to concentrate on the patient and not the technology surrounding the patient (Alasad, 2002)

The degree of trust ICU nurses have in technology will influence the extent to which they use and rely on that technology (Browne & Cook, 2011:93) and the more reliable the machine the more trust nurses have in it, to the extent they may fail to monitor its efficiency. Hence, nurses with a high level of trust in equipment might assume the equipment is doing its job without frequently checking it and would only check the operation of the equipment when the alarm rings. However, nurses with less trust in the equipment would frequently check the accuracy of the equipment and be aware of the problem before the alarm rings (Browne & Cook, 2011).

2.6.1 Positive Effects Regarding Use of Technological Equipment in ICU

Machine technology can bring a patient closer to nurses because it enhances their knowledge of the person being cared for (Locsin, 1995:201; Kongsuwan & Locsin, 2011). Intensive Care nurses must understand technology as a human way of knowing a patient more fully as a person. The technologic competent nurse would view technology and caring as coexisting harmoniously in nursing (Locsin, 1995). Whenever the nurse is attending to the technological equipment, she/he would go closer to the patient and a

simple touch or reassurance would provide the psychological care. Technological competence may also assist nurses to work with patients harmoniously, thereby enhancing nursing care and bonding with the patients. In addition, Locsin (2005) commented that technologies are tools used to understand persons as participants of care. The nurses would better understand the patients' physiological functions thereby accepting their presentation as unique.

In a study done by Alasad (2002) to investigate the experiences of a group of critical care nurses regarding the use of technology in ICU, the participants expressed they felt safe and in control when using technology. The machines enable them to understand what is happening with the patient in terms of his/her bodily functions as they are constantly updated with information about the bodily systems. In addition, the technological equipment measures accurately compared to manual measurements (Ashworth, 1990) and the nurses have a sense of control over the situation so that they know what is happening with the patient. This will assist them in the provision of patient-centred nursing care.

The use of technological equipment helps to avoid frequent patient disturbance during the continual observation of their internal physiology, thereby promoting rest for the patient (Ashworth, 1990; Dean, 1998: Wilkinson, 1992; Wikstrom & Larsson, 2003). The critical care nurses do not need to wake or touch the patients each time they do procedures, such as checking vital signs (blood pressure, respiration rate, heart rate, temperature), as they can observe the machines and do the recordings and interpretations.

In studies by Kiekkas et al (2006) and Laila et al (2011) to discover nurses' perceptions regarding the use of technological equipment in Greece and Syria respectively, it was

found the use of technological equipment has contributed to easier completion of nursing duties thereby decreasing workload and professional fatigue of nurses. The equipment relieves the repetitive work so that treatment can be delivered whilst the nurse is doing other actions for the patient. Similarly, Ashworth (1990) & Wilkinson (1992) expressed technology can relieve nurses of repetitive work, such as, repeated observations, drug administration and precise fluid management, therefore increasing time to concentrate better on direct patient care.

In the review of literature by Dean (1998) & Sandelowski (2000), it was revealed that technology saves time, saves labour and measures accurately making nursing more scientific. This concurs with findings from Kiekkas et al (2006): Wikstrom et al (2007), that with technology a task is completed fast thereby saving time and reducing workload. In the studies done by Almerud (2008): Wikstrom et al (2007) nurses regarded technology as decisive when controlling and directing treatment and shapes care giving attributes. Wikstrom et al (2007:191) identified three themes in the study to explore the meaning of technology in Intensive Care, as follows; "technology is decisive," "technology is facilitating" and "technology complicates". The participants further stated that technology makes treatment more secure in that nurses do not solely rely on observations, because the machines support their observations and decreases their workload.

Technology facilitates in the division of labour. In a study by Wikstrom & Larsson (2004) to explore how technology intervenes and challenges the ICU staffs' knowledge in practice, the nurses expressed that technology intervenes in the division of labour. The nurses explained how technology helped in the division of labour when a new dialysis

machine was in place, those with knowledge of how to operate the machine were allocated to take care of the patient.

For expert Intensive Care nurses with technical and theoretical knowledge, the technology becomes an extension of the nurses' hands, eyes, ears and other senses. It is often a nurse who quickly perceives when something is going wrong with a patient, they use their senses intelligently as they work and reflect on what they observe and understand what is happening in the interaction between the patient and technical system (Ashworth, 1990; Benner & Wrubel, 1988). They automatically and unconsciously pay attention to those cues that are important and react accordingly; they do not consciously watch and listen to all the various sights and sounds around their patients as they work or the unit in general, but will quickly react to any cues that have important implications for patient welfare (Benner & Wrubel, 1988).

2.6.2 The Negative Effects Regarding Use of Technological Equipment in ICU

Technology dependency can create challenges and crises for nurses. Sandelowski, 1993 as cited in Locsin (1995:201), described technology dependency as reliance on equipment and techniques to manage the health care of patients. Technology dependency may come if nurses doubt their technology competences and have fear/stress over incompetence (Kongsuwan & Locsin, 2011). If too much focus is put on technology, it may dehumanise patient care in such a way that patients are not seen as human beings and their needs are not met holistically (Almerud et al, 2008; Dean, 1998; Pearson, 1993). Therefore, technology dependency impedes the possible close encounter with the patient and compromises the nurses' vision. By placing too much trust in technology one risks forgetting the patient as a human being and instead of bringing nurses and patients closer,

the nurses only become closer to the data on the computers (Almerud, 2008). The nurses interact more with the machines than the patients hence they talk less to the patients. In a study done by Almerud et al (2007) aimed to find out what it means to be critically ill or injured in technological intense environment, the patients expressed they felt invisible, reduced to the status of organs, objects and diagnoses as the care givers demonstrate keen vigilance over technological equipment, documented data, laboratory results and other measured parameters. Sandelowski, 1993 as cited in Haghenbeck (2005) expressed that increased reliance on technology may also decrease the critical care nurses' assessment skills, as they accept data without validating it, which decreases the chances that malfunctions will be recognised.

Technology can create extra work for nurses. Haghenbeck (2005) highlighted that technology creates extra work because the novice Intensive Care nurse needs to learn mechanical operation, use, maintenance and trouble-shooting techniques in order to use the machine safely and efficiently. A nurse with little or no experience in the use of technology will perceive it as new, unfamiliar and complex (Walters, 1995), becoming anxious when using the technology and would strive to master it thereby leading to diversion of focus from the patients to the machines.

The use of technological equipment may increase the demand on time, energy and attention of nurses (Alasad, 2002; Barnard, 2000; Beeby, 2000). Alasad (2002:412) stated that the nurses' ability to manage many complex pieces of technology simultaneously and be able to monitor their function and the patient's response to them, demonstrates a high competency level of the experienced critical care nurses. It is observed that novice nurses

fail to balance managing these technical demands and attending to the patients' 'basic' physical and psychological needs. Barnard (2000) described the demands associated with technology as monitoring patients, assessing and fixing, responding to electronic alarms and buzzers and delivering treatments. Additionally, one patient can be connected to many machines, for instance, a ventilator, an electrocardiogram (ECG) monitor and infusion pumps, all of which require attention and as a result, the nurses strive to meet the needs of the technological equipment hence creating a barrier between the nurse and equipment.

Sandelowski (2000) argues that technology is minimising the nurses' role of empathetic toucher, as they only touch the patient to obtain objective information. Technology has assumed the human touch and bedside manner of the nurses. With the use of technology, the patient's body is not necessarily touched to measure the parameters, the machine does its task at a pre-set time intervals making the nurses loose contact with the patient. As such, the patients are only touched when the nurses want to perform a procedure such as bed bath.

2.7 SUMMARY

The use of technology in ICU has assisted in the provision of nursing care in such a way that it has improved the morbidity and mortality rate. The nurses need to have technical competence for them to integrate well between technology and caring. Technical competence links knowledge and actions, when a nurse is comfortable with technology, he/she can concentrate on the patient and family (Locsin, 1999). The Intensive Care nurses must always strive to avoid dehumanising the patients and treat them as human beings with needs; psychological, physical, emotional and social. A simple touch could mean something to the patients because being in an alien ICU environment they need to be

reassured of their condition and safety, which is shown by the nurses' actions. However, unconscious disregard of the patient's needs leads to a feeling of dehumanisation and the nurses focus will shift from the patients to technology. Therefore, it is important for the ICU nurses to have the technical knowledge and skills for them to work diligently in a highly technological environment.

CHAPTER THREE

RESEARCH DESIGNS AND METHODS

3.1 INTRODUCTION

Research methods are the techniques researchers use to structure a study, gather and analyse information relevant to the research question in a systematic fashion (Polit and Beck, 2012:12).

This chapter will present the research methods and designs used in the study in detail. It will describe the research design, setting, population, sample, sampling, data collection, instrument used, ethical considerations, validity and reliability of the study.

The study explored the perceptions of nurses, who work in the Intensive Care Units, about the effects of the use of technological equipment, with the intention of making recommendations for clinical practice and education of nurses.

The following objectives were met in order to meet the purpose:

- To describe the perceptions of nursing personnel who work in the Intensive Care Units about the use of technological equipment
- To determine the positive or negative effects of technological equipment on patient care in the Intensive Care Units
- To identify the relationship between demographic characteristics and perceptions of nurse participants

3.2 RESEARCH DESIGN

A research design is a blue print for the conduct of a study that maximises control over factors that could interfere with the study's desired outcome. It directs the selection of a population, procedure for sampling, methods of measurement and plans for data collection and analysis (Burns & Grove 2007:38). In this study, a quantitative, non-experimental, descriptive design was used to explore the nurses' perceptions regarding the use of technological equipment.

Quantitative research is a formal, objective, systematic process in which numerical data are used to obtain information about the world (Burns and Grove 2007:17). The quantitative approach requires collection of information using an instrument (questionnaire) based on measures completed by the participants. In a quantitative study, the researcher maintains objectivity that means that values, feelings and personal perceptions cannot enter the measurement of reality (Burns and Grove 2007). Therefore, the researcher has chosen this design to avoid biases during the data collection phase and in addition, no variables will be manipulated by the study.

Non-experimental is a type of quantitative research design applicable in situations where it is unethical and inherently difficult to manipulate the independent variable (Polit & Beck 2012). The non-experimental design was chosen because the study was conducted in a natural setting where no experimental treatment and interventions were done.

A descriptive study aims at gaining more information about the characteristics within a particular field of study and provides a picture of a situation as it naturally occurs (Burns

& Grove 2007:240). The study was descriptive as it aimed to describe the perceptions of nurses about the effects of the use of technological equipment in ICU and the findings will be analysed using descriptive statistics.

3.3 RESEARCH SETTING

According to Burns and Grove (2007), the research setting is the location in which a study is conducted. The setting for this study was Intensive Care Units at a university-affiliated, public sector and tertiary level hospital in Parktown, Johannesburg, which also serves as a teaching hospital and a referral hospital for a number of hospitals in its referral chain. It has a bed capacity of 1088 beds, serving patients from across Gauteng Province and neighbouring provinces and offers inpatient and specialist outpatient's services, mainly level 3 and level 2. The hospital offers a full range of tertiary, secondary and highly specialised services. It has five level I ICUs, which provide comprehensive care for a wide range of disorders (critical illnesses) with the continuous support of sophisticated equipment and level II ICU's that provide high care. The bed capacity for the hospital's ICU is 43, with the nurse to patient ratio of 1:1 or 1:2 at times depending on the complexity of the patients and unit.

However, in this study only three adult ICU's were chosen namely cardiothoracic, neurosurgical and main ICU. These three ICU's were chosen as ideal settings because they are supported by a wide array of highly sophisticated and expensive technological equipment and devices, including the use of complex investigations and imaging services, as well as specialists' contributions in all disciplines (Bersten, Son & Oh, 2003).

These units admit cardiothoracic, neurosurgical and general medical and surgical patients who are critically ill. Within the Intensive Care Units, the physicians are responsible for providing integrated care and overseeing management activities for efficient and consistent delivery of care. In contrast, nurses are responsible for performing complex nursing activities such as assessing, supporting and monitoring of critically ill patients haemodynamic and respiratory status.

The nursing staff consists of general registered nurses (untrained ICU nurses), ICU trained registered nurses and enrolled nurses. Most of the staff is trained at advanced postgraduate diploma level. Each ICU has a clinical facilitator who facilitates the clinical teaching of students in the clinical area. They teach new staff and students in the use of technological equipment and nursing care in general.

3.4 POPULATION

A population is all elements that meet the sample criteria for inclusion in a study (Burns and Grove, 2007). The target population in this study included all ICU trained registered nurses working in the Intensive Care Units at the selected study site. This was done purposively in order to gain existing perspectives regarding use of technological equipment in the ICU, because they use it every day and have undergone training. A preliminary record review undertaken in March 2013 indicated there are 85 (N=85) ICU trained registered nurses working in the three adult Intensive Care Units.

3.5 SAMPLE AND SAMPLING

A sample is a subset of the population that is selected for a particular study and members of a sample are the subjects (Burns and Grove, 2007). Sampling is the process of selecting a group of people, events, behaviours, or other elements with which to conduct a study (Burns and Grove, 2007). In this study a non-probability, convenience sampling was used to enrol the participants. According to Polit and Beck (2012), convenience sampling is the method of selecting the most readily persons as participants in a study. As such, all ICU trained registered nurses who were on duty when the researcher visited the wards, were given the questionnaires after giving an informed consent. Therefore, each ICU trained registered nurse working in the three adult Intensive Care Units (cardiothoracic, neurosurgery and main ICU) regardless of experience had an equal chance of participating in the study.

After consultation with the statistician, an adjusted sample size of 60 was reached with a confidence interval of 95% (1.96), margin of error of 10% and prevalence of 60%. This sample size was a representative sample where the results can be generalised to the population.

The sample size was calculated by using a statistical formula of:

$n^* = \frac{z^2 \times p(1-p)}{d^2}$ which is used for large samples.

Where n*=estimated sample size, z =Confidence interval at 95% (1.96), p=estimated prevalence of nurses' perceptions towards use of technological equipment 60% (0.6), d= margin of error at 10% (0.1).

Therefore $n^* = \frac{1.96^2 \times 0.6 (1-0.6)}{0.1^2} = 92$

Since the formula is for large samples, n* was bigger than the population size hence a formula for adjusting population was used:

$$n = \frac{n^*}{1+n^*/N}$$ where N=85, n*=92.

$$= \frac{92}{1+(92/85)}$$

$$=44$$

In this study, the researcher used a sample size of 60 ICU trained nurse participants after discussing with the statistician to ensure a representative sample.

The researcher visited the respective ICU's, with the assistance of the unit manager identified the trained ICU nurses who were approached to participate in the study and those who volunteered were enrolled in the study. This method was used to select the widest variety of participants who were representative of the population.

The study followed the following inclusion criteria for the nurses:

- Registered as general nurses by the South African Nursing Council and with additional qualification in Intensive Care nursing;
- Trained ICU registered nurses currently working in one of the three Intensive Care Units selected as research sites;
- Provided informed written consent for their voluntary participation.

Exclusion criterion for the study was untrained registered nurses, enrolled and auxiliary nurses, as their category of nursing is not expected to have the skills and in-depth knowledge of the use of technological equipment.

3.6 DATA COLLECTION

Data collection, is the actual gathering of information to address a research problem (Polit & Beck, 2012:725) and was conducted within one month, from 9th August to 30th August, in order to capture all the nursing shifts. The response rate was good and the nurses were willing to participate in the study.

3.6.1 Procedure

After obtaining approval to conduct the study from the post-graduate committee, ethics committee, Department of Health and the Chief Executive Officer for the hospital (refer **Appendices G, H, I & J**) data was collected from nurses who work in the three (n=3) ICUs using a questionnaire. Permission was also sought from the nursing services manager and the unit managers to use their units. The researcher visited all the ICUs (n=3) and observed the respective nurse unit allocation lists for selection of potential nurse participants. With the assistance of the unit manager, the researcher identified eligible study participants and approached them during break time to avoid disturbing the participants' work schedule.

The prospective participants received a brief explanation about the type of study and its purpose and the nurses who volunteered to participate were given an information letter to read regarding the details of the study. The voluntary nature of participation was emphasised in the information letter and after reading through and understanding it, written consent was obtained from the participants (refer **Appendix B and C**) indicating their willingness to participate in the study. The participants were given an envelope to use for

returning the questionnaires, which was sealed and posted in a sealed box allocated in each unit.

Data was collected by using self-administered questionnaires (refer **Appendix A**) which comprised three sections. The study maintained confidentiality and anonymity, however, the participants were asked to provide information on their age, gender, qualifications in nursing and duration of service in the units.

3.6.2 Data Collection Instrument

A survey instrument developed by Laila, Ahmed & Mogahed (2011), based on an extensive review of the literature (Barnard 2001; Kiekkas et al 2006; Wikstrom, Cederborg & Johanson 2007), was used to achieve the study objectives. Permission to use the instrument was obtained from the author (refer **Appendix F**). According to Burns and Grove (2007), questionnaires tend to be used in a descriptive study to gather a broad spectrum of information by the subjects, or beliefs, attitudes, opinions and levels of knowledge or intentions of the subject. Questionnaires were administered by consenting participants (self-administered).

The questionnaires contained three sections with closed-ended questions (refer **Appendix A**). The first section collects socio-demographic data; age, gender, area of practice, practice role, education level and experience in area of practice.

Section 2 assessed the positive effects of the use of technology. This section had three sub-topics: the perceptions of nurses about the positive aspects of using technological

equipment; positive aspects of using technology on nursing and practice; knowledge and skills and positive aspects of use of technology. This section comprised 11 items.

The third section assessed the negative aspects of using technology. This section was sub-divided into topics: negative aspects of use of technology; complexity of using technology, negative aspects of technology on nurse and nursing care. The section contained 15 items. The last section attempted to measure the level of competence by the nurses on the use of technological equipment. The nurses used a scale of 1-10 to grade themselves.

A five points Likert scale scoring method was used for each statement in Sections 2 and 3, where 1 stands for (strongly disagree), 2 (disagree), 3 (uncertain), 4 (agree) to 5 (strongly agree) to prevent a rote response. Participants giving a score of 4 and 5 were considered as agreeing with the facts, those giving a score of 1 and 2 were considered as disagreeing with the facts and those with a score of 3 were considered as neutral.

3.6.3 Validity and Reliability of the Instrument

According to Polit & Beck (2012:336), validity of an instrument is the degree to which an instrument measures what it is supposed to, whilst reliability is the degree of consistency with which an instrument measures the target attribute (Polit & Beck, 2012:331). A questionnaire or an instrument is considered reliable if the same result is obtained repeatedly when the questionnaire is re-administered. Thus, reliability pertains to scores not people.

Face and content validity was assessed by the developers in the sample of the original study (Laila et al. 2011), which was tested on a sample of 108 nurses working in the Intensive Care Units in Alexandria (Egypt) and Greece. No subsequent studies were found which utilised this questionnaire on independent samples of Intensive Care nurses, however these authors did comment on validity and reliability by a test-re-test technique of the instrument, the correlation coefficient was 84%. Further, the questionnaire was given for review by local domain experts, both doctors and nurses and found to be appropriate for the South African Intensive Care context.

Kiekkas et al (2006) did a similar study, experts validated the instrument, and a pilot study was done on 10 nurses to check for clarity.

3.7 DATA ANALYSIS

Data analysis is conducted to reduce, organise and give meaning to the data that has been collected (Burns and Grove, 2007). The raw data for the study was transferred to an excel spreadsheet for accuracy in analysing the data and a statistician was consulted to assist with analysing the data using a Stata package.

Descriptive statistics were used to analyse the study variables and sample demographics (percentage, mean and standard deviation). According to Burns & Groves (2007), descriptive statistics help the researcher to sort out data in a way that will give meaning and an insight to the problem. The 5-point Likert scale was collapsed to three levels; disagree, agree and neutral, where, strongly disagree and disagree mean disagree level, strongly agree and agree mean agree level and uncertain means neutral. Frequencies, percentages and tables were used to summarise the findings to each response.

Cronbach's alpha was also used to measure the internal consistency of the item scale. It measures, (from 0 to 1) how closely related a set of items are as a group. The closer the Cronbach's alpha coefficient is to 1.0, the greater the internal consistency of the items in the scale. (Tavakol & Dennick, 2011). In this study, the Cronbach alpha of >0.7 indicated a positive internal consistency for the scale with this specific sample. Other tests such as Fisher's Exact and Mann-Whitney were used to measure the association between two categorical variables.

The Analysis of Variance (ANOVA) of the qualifications, age and experience in the clinical area was applied to compare the perceptions of nurses. ANOVA is used to examine the differences amongst two or more groups by comparing the variability within each group (Burn & Groves, 2007:530). It provides a statistical test of whether' or not the means of several groups are equal. The one sample t-test, which is used to compare means of one or two groups of a sample (Burns & Grove, 2007), was used to test for significance of mean score differences. The t-test was used to compare the categorical data, age and gender and the nurses perception regarding the use of technological equipment. The researcher explored the similarities or differences in perceptions of nurses on technological use in relation to age and gender. Statistical assistance was sought from a statistician from the Medical Research Council (MRC).

3.8 PILOT STUDY

A pilot study was conducted, before commencement of the main study, using ten (n=10) participants at the selected study site. A pilot study is referred to as a small-scale implementation of the main planned investigation in an attempt to identify or discover any

possible deficiencies in the research instrument (De Vos et al. 2005). At the same time, the researcher familiarises his/herself with the research technique. In this way the strengths and weaknesses of the proposed study design, sample size and data collection instruments are learnt.

The participants who met the inclusion criteria were included in the pilot study. The researcher used random sampling to select the participants in all the three ICU wards. Ethical considerations were followed after participants were identified.

Participants indicated the language used was understandable, but two areas were revised. On demographic data of experience in area of practice, the participants remarked it was not clear and so 'years' was added in brackets; the last part where it measured competence of the nurses, was corrected to 'how competent do you think you are on the use of technological equipment?' Apart from these two areas, the rest of the questionnaire was clear and took each participant 10 to 20 minutes to complete. The results of the pilot study were not included in the main study.

3.9 ETHICAL CONSIDERATIONS

A study requires the researcher to consider the protection of human rights of the informants, which include: the right to self-determination, privacy, autonomy and confidentiality, fair treatment and protection from discomfort and harm (Burns & Grove, 2009). In order to consider all the rights, the following ethical requirements will be taken into consideration during and prior to commencement of the study.

The protocol was submitted for peer review to the Department of Nursing Education to assess the feasibility of the proposed study, to the University Postgraduate Committee for permission to conduct the study and to Human Research Ethics Committee (HREC) of the University of the Witwatersrand for clearance to conduct the study. Few corrections were made and approval to commence was granted (refer **Appendices G & H**.) Permission was obtained from the Department of Health (refer **Appendix I)** and Hospital Management (the Chief Executive Officer) to conduct research at the hospital (refer **Appendix J)**.

The participants who volunteered to participate in the study were given an information sheet to read which explained what the study was all about, the aim of the study and ethical issues about the study. The participants were asked to sign a consent form after reading and understanding the information sheet to show their willingness to participate in the study. Additionally, the participants were informed that participation was voluntary and they could withdraw at any time without incurring penalty. No coercion or monetary incentive was used to encourage participation in the study.

Confidentiality and anonymity of the participants were maintained by the use of codes during data collection and reporting. Anonymity refers to the protection of the participants in the study so that even the researcher cannot link the participants with the information provided (Polit and Beck, 2012). Confidentiality refers to protection of study participants so that identifying information is never publicly divulged (Polit & Beck, 2012). As such, no names were written on the completed questionnaires that were kept safely in a locked cupboard, which only the researcher and the research supervisor could access and during publication of results, the institution's name was not mentioned.

3.10 VALIDITY AND RELIABILITY OF THE STUDY

According to De Vos et al. (2005), study validity refers to the degree to which study findings are able to give truthful conclusions. The truthful considerations can be determined by statistical, internal construct and internal types of validity (Burns & Grove, 2007). Therefore, validity provides the main basis upon which decisions can be made that the study findings should be acceptable and officially added to the evidence based patient care practice.

In this study, the design ensured that all considerations are similar, as far as possible, so that the conditions of data collection may not affect the truthfulness of the results. Statistical conclusions were ensured by the use of appropriate statistical tests in analysing the data with assistance from a biomedical statistician. In addition, the study did not deviate from the proposed design and guidelines of the instrument in order to maintain and control possible errors in the data collection. Study results were generalised only to nurses who have the same and similar characteristics.

3.11 SUMMARY

This chapter has described the research methodology. This included the research design, setting, target population, sample and sampling, data collection method, data collection instrument, reliability and validity of the instrument, data analysis, ethical considerations and reliability and validity of the study. The following chapter will present the results and discussion of the findings.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

This chapter will describe the approach used for data analysis and interpretation of the findings. The data was collected from ICU trained registered nurses (n=60) in three wards: the cardiothoracic, neurosurgical and main ICU. The raw data was entered on a Microsoft Excel spreadsheet and then imported to software statistical package 'STATA,' with the help of a statistician, for analysis.

4.2 APPROACH TO DATA ANALYSIS

Descriptive statistics were used to report the findings on demographic data and the nurses' perceptions regarding the use of technological equipment to determine the frequency of responses. The descriptive tests included frequencies (f), percentages (%), means and standard deviations (SD). The graphic presentations, for example, bar graphs, pie charts, and tables were used to present data. The categories on the Likert scale were collapsed to facilitate presentation of the data. The five categories (strongly disagree, disagree, uncertain, strongly agree, agree) were collapsed into three categories; disagree, uncertain and agree. The uncertain category was maintained to avoid guessing of responses by the respondents. All figures were rounded up to two decimal points for easy presentation.

Cronbach's alpha (coefficient alpha) was used to measure how closely related a set of items were in a group. According to Polit & Beck (2012:724), Cronbach alpha is a widely

used reliability index that estimates the internal consistency of a composite measure composed of several subparts. The normal range of values is between 0 and 1, the closer the Cronbach's alpha is to 1, the greater the internal consistency (Tavakol, & Dennick, 2011). In this study, the internal consistency was measured at >0.7. Additionally, Fisher's Exact and Mann-Whitney tests were used to measure the association between two categorical variables and the nurses' perception regarding the positive and negative effects of technology. Testing was done at 0.05 level of confidence (p=0.05). Tables were used to present the findings.

Inferential statistics were also used to describe the relationships between the demographic data and the nurses' perceptions about the positive and negative effects of technological equipment use. According to Polit & Beck (2012), inferential statistics help to estimate population parameters from the sample statistics. The two-sample t-test and analysis of variance (ANOVA) were used. A t-test is a parametric statistical test for analysing the difference between two means (Polit & Beck, 2012) , whereas ANOVA, is a statistical procedure for testing mean differences amongst three or more groups by comparing variability between groups to variability within groups (Polit & Beck, 2012). The t-test and ANOVA were applied to compare the nurses' perceptions in relation to age, area of practice, practice role and experience. The use of the t-test was to test statistical significant differences between two group means and ANOVA to test statistical significance amongst three or more groups mean. Testing was done at 0.05 level of significance (p=0.05), with confidence interval of 95%.

4.3 RESULTS AND FINDINGS

4.3.1 Questionnaire Section 1: Nurses' Demographic Data

The demographic data section comprised six items namely gender, age, area of practice, practice role, educational level and experience in area of practice. Sixty (n=60) nurses were drawn from three ICUs; cardiothoracic, neurosurgical and main.

4.3.1.1 Gender

The results show the majority of participants were female, 88.63% (n=53) and less than a quarter were males 11.67% (n=7). This proves female dominance in the nursing profession, as it dates back to the history of nursing when women nursed wounded soldiers. The results are presented in **Figure 4.1** below:

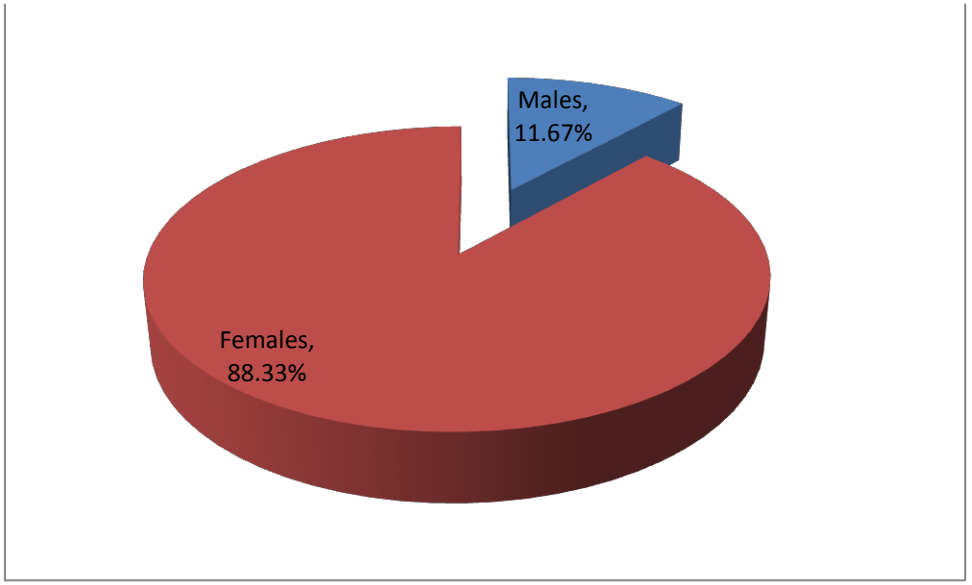

Figure 4.1: Nurses gender

4.3.1.2 Age

The current study revealed more than a quarter of nurses, 37.29% (n=22) were aged between 40 and 49 years, one quarter, 25.42% (n=15) were aged between 30 and 39 years, less than a quarter, 18.64% (n=11) were aged between 20 and 29 years and 18.64% (n=11) were between 50 and 59 years. The results are presented in the **Figure 4.2** below:

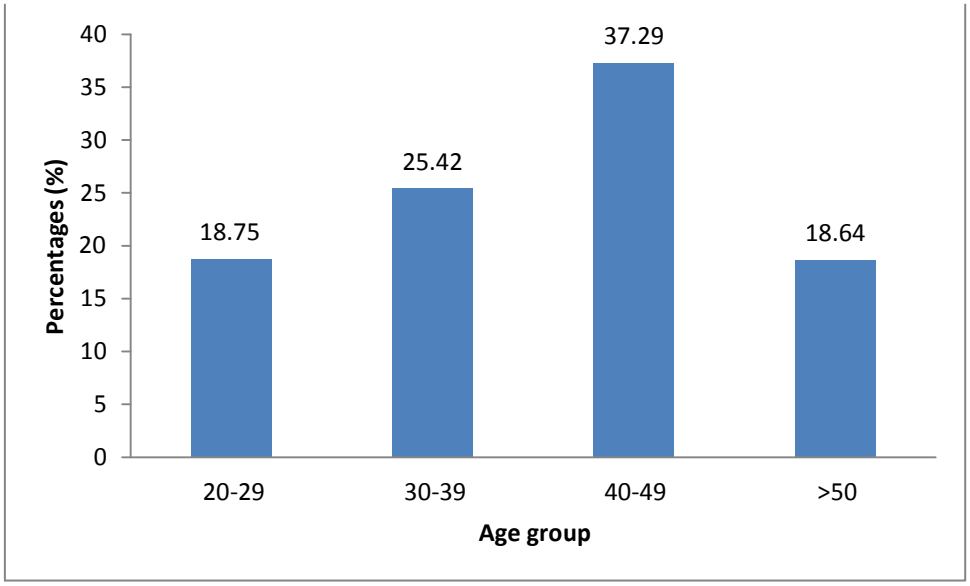

Figure 4.2: The Nurses age

4.3.1.3 Area of practice (unit)

Most of the nurses, 43.33% (n=26) were drawn from Cardiothoracic ICU, more than a quarter, 30% (n=18) were drawn from Neurosurgical ICU, and 26.67% (n= 16) from Main ICU. **Figure 4.3** presents the results.

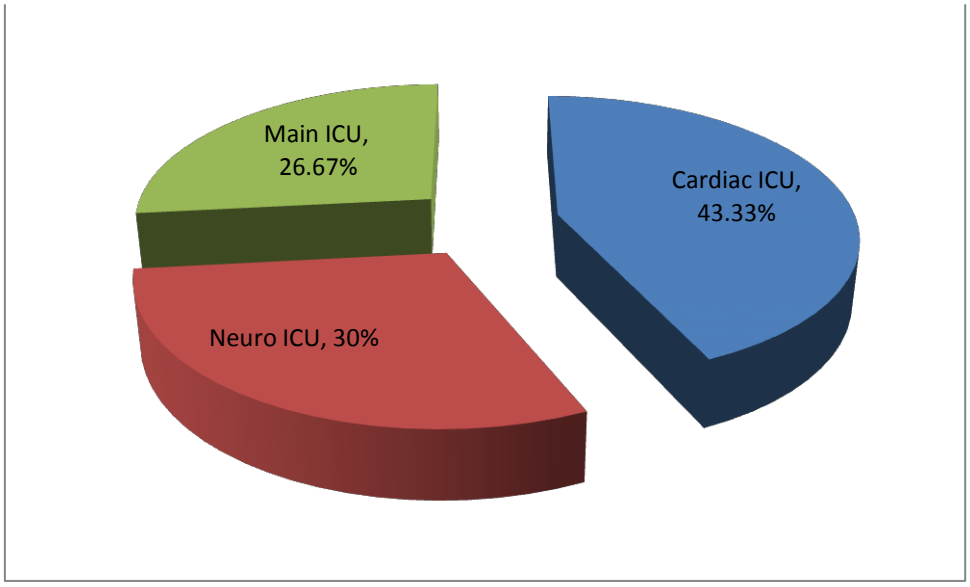

Figure 4.3: The nurses' area of practice

4.3.1.4 Practice role

The majority of participants, 95% (n=57) were clinical practice nurses, 3.33% (n=2) were nurse managers and 1.67% (n=1) was a nurse educator. The findings are presented in **Figure 4.4** below:

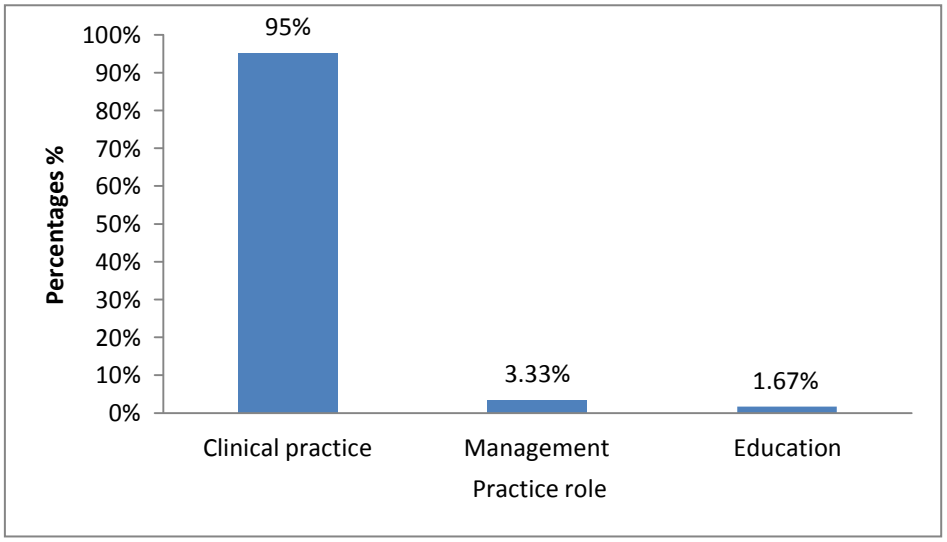

Figure 4.4: The Nurses' practice role

4.3.1.5 Educational level of nurses

The results showed the majority of nurses, 73.33% (n=44) were diploma holders and 26.66% (n=16) were degree holders. This might be because numerous nursing colleges offer courses at diploma level. These results may assist the Department of Health in upgrading nurses to degree levels. According to Rose, Goldsworthy, O'Brien-Pallas, & Nelson, (2008), a well- educated nursing workforce may promote authority in decision-making and assist in developing nurses' role within the health professional team, thus improving job satisfaction and job retention. The findings are presented in **Figure 4.5** below:

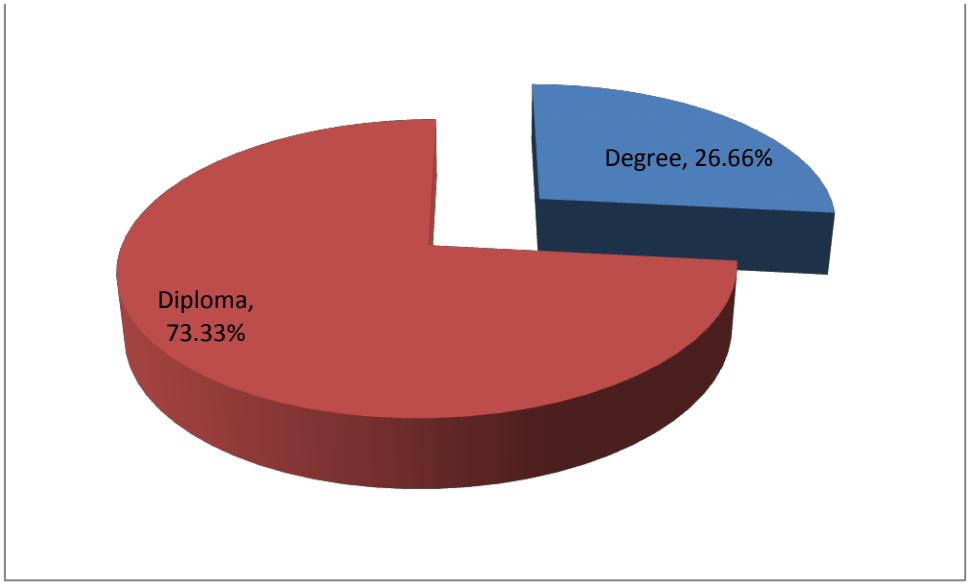

Figure 4.5: Educational level of the nurses

4.3.1.6 Experience of the nurses in the area of practice

The current study indicate more than a quarter of nurses, 32.73% (n=18) have 2 to 5 years work experience, a quarter of the participants, 25.45% (n=14) have more than

10 years' work experience, 23.64% (n=13) have less than two years work experience and 18.18% (n=10) have 5 to 10 years. The findings were presented in **Figure 4.6** below:

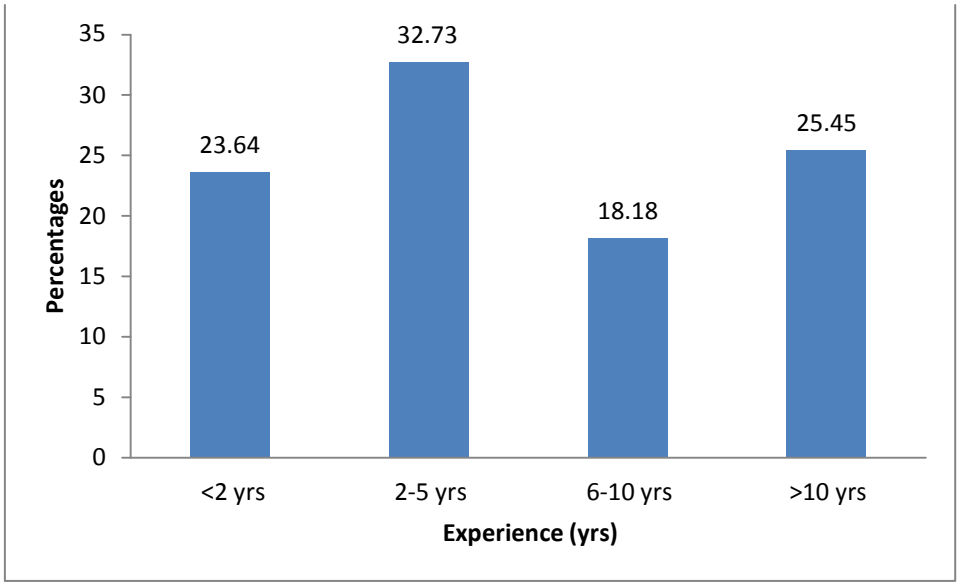

Figure 4.6: The experience of nurses in the area of practice

4.3.2. Frequency Responses of Nurses to Questionnaire (Section 2) Regarding Positive Effects of Technology

This section will cover tables on frequency responses to questionnaire on nurses' perceptions regarding positive effects regarding the use of technology.

4.3.2.1. Positive aspects of using technology on patients

The nurses' responses demonstrated that the majority 93.34% (n=56) agreed that the use of technology offers "higher care effectiveness", 90.00% (n=54) agreed technological use offered "higher patient safety through prompt and proper recognition of complications", 81.66% (n=49) agreed, "technology makes treatment more secure,

80.00% (n=48) agreed, "technological equipment directs and controls medication". The findings are presented in **Table 4.1** below:

Table 4.1: Positive aspects of using technology on patient

Item	Statement	Range of Likert Scale Responses							
		Did not respond		Disagree		Uncertain		Agree	
		n	%	n	%	n	%	n	%
A1	Higher care effectiveness	1	1.67	1	1.67	2	3.33	**56**	**93.33**
A2	Technological equipment directs and controls medication	2	3.33	5	8.33	5	8.33	**48**	**80.00**
A3	Higher patient safety through prompt and proper recognition of complications	2	3.33	1	1.67	3	5.00	**54**	**90.00**
A4	Technology makes treatment more secure	3	5.00	1	1.67	7	11.67	**49**	**81.66**

4.3.2.2 Positive aspects of using technology on nursing and practice, knowledge and skills

The nurses' responses indicated 90% (n=54) agreed "technology enhances patient care", 85% (n=51) agreed " technology improves nurses' knowledge and skills", 83.33% (n=50) agreed "technology helps in easy completion of nursing duties", 80% (n=48) agreed the use of technological equipment "requires high technical skills" and 78.33% (n=47) agreed technology helps in "faster completion of nursing duties." The findings are presented in **Table 4.2** below:

Table 4.2: Positive aspects of using technology on nursing and practice, knowledge and skills

Item	Statement	Range of Likert Scale Responses							
		Did not respond		Disagree		Uncertain		Agree	
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
B1	Easy completion of nursing duties	-	-	6	10.00	4	6.67	**50**	**83.33**
B2	Faster completion of nursing duties	-	-	3	5.00	10	16.67	**47**	**78.33**
B3	Improves nurses knowledge and skills	-	-	5	8.34	4	6.67	**51**	**85.00**
B4	Requires high technical skills	-	-	6	10.00	6	10.00	**48**	**80.00**
B5	Technology enhances patient care	-	-	2	3.33	4	6.67	**54**	**90.00**

4.3.2.3 Positive aspects of use of technology

The nurses' responses indicated the majority 70% (n=42) agreed that technology "increases nurses prestige", 46.67% (n=28) agreed, "technological equipment is the eyes and hands of nurses". The study also showed that a quarter of nurses 25% (n=15) were uncertain if technological equipment was the eyes and hands of nurses. The findings are presented in Table 4.3 below:

Table 4.3: Positive aspects of use of technology

Item	Statement	Range of Likert Scale Responses							
		Did not respond		Disagree		Uncertain		Agree	
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
C1	Increases prestige of nurses	5	8.33	5	8.33	8	13.33	**42**	**70.00**
C2	Technological equipment is the eyes and hands of nurses	2	3.33	21	35.00	9	15.00	**28**	**46.67**

4.3.3 Frequency Responses of Nurses to Questionnaire (Section 3) regarding Negative Effects of Technology

This section covers the negative aspects of nurses regarding technological use. It has three subparts: negative aspects of use of technology (A1-A6), complexity of using technology (B1-B4) and the negative aspects of use of technology on nurse and nursing (C1-C5).

4.3.3.1 Negative aspects of use of technology

The results showed the majority of nurses 56.66% (n=34) agreed that technology increases patients risk from improper handling of equipment, 48.33% (n=29) agreed technology "increases patients risk from misinterpretation of data" and 40% (n=24) agreed that technology lead to "focusing of interest on equipment and technical skills". However, more than half of the nurses 56.67% (n=34) disagreed "using technology leads to loss of human sensitivity about patients", 50% (n=30) disagreed "technology extracts time from patients" and 46.67% (n=24) disagreed that technology leads to "ignoring of physical needs of patients".

Additionally, 28.33% (n=17) were uncertain if the use of technology leads to focusing of interest on equipment and technical skills, 16.67% (n=10) were uncertain if technology increases patient risk from misinterpretation of data and 11.67% (n=7) were uncertain if technology increases patients risk from improper handling of equipment. This is very alarming considering that nurses use technology in their everyday work, but do not know its impact. The findings are presented in Table 4.4 below:

Table 4.4: Negative aspects of use of technology

Item	Statement	Range of Likert Scale Responses							
		Did not respond		Disagree		Uncertain		Agree	
		n	%	n	%	n	%	n	%
A1	Increases patients risk from improper handling of equipment	1	1.67	18	30.00	7	11.67	**34**	**56.66**
A2	Increases patient risk from misinterpretation of data	2	3.33	19	31.67	10	16.67	**29**	**48.33**
A3	Focusing of interest on equipment and technical skills	2	3.33	17	28.33	17	28.33	**24**	**40.00**
A4	Ignoring physical needs of patients	1	1.67	**28**	**46.67**	5	8.33	26	43.33
A5	Technology extracts time from patients	2	3.33	**30**	**50.00**	8	13.33	20	33.33
A6	Using technology leads to loss of human sensitivity about patients	1	1.67	**34**	**56.67**	4	6.67	21	35.00

4.3.3.2 Complexity of using technology

The majority of nurses 96% (n=58) agreed "nurses must be competent in managing technology and interpreting technological data", 63.33% (n=38) agreed "technology increases overall hospitalisation costs", 55% (n=33) disagreed "technology is complicated and not easy to handle", 41.67% (n=35) disagreed "technology can create ethical dilemmas". The results also indicated a high percentage of uncertainty on the complexity of using technology, as many participants indicated 'uncertain' in items B2, B3 & B4. This could mean the nurses are not aware of the impact of technology. The findings are presented in Table 4.5 below:

Table 4.5: The complexity of using technology

Item	Statement	Range of Likert Scale Responses							
		Did not respond		Disagree		Uncertain		Agree	
		N	%	n	%	n	%	n	%
B1	Nurse must be competent in managing technology and interpreting technological data	-	-	-	-	2	3.33	**58**	**96.67**
B2	Increases overall hospitalisation cost	-	-	9	15.00	13	21.67	**38**	**63.33**
B3	Technology is complicated and not easy to handle	2	3.33	**33**	**55.00**	10	16.67	15	25.00
B4	Technology can create ethical dilemmas	1	1.67	19	31.67	15	25.00	**25**	**41.66**

4.3.3.3 The negative aspects of use of technology on nurses and nursing

The current study indicated the majority of nurses, 70% (n=42) disagreed, "technology and machines often interfere with providing adequate nursing care", 68.33% (n=41) disagreed, "technical tasks have downgraded the nursing profession", 55% (n=33) disagreed, "because of the technology it is important to take a vacation regularly from ICU", 53.33% (n=32) disagreed, "technology restricts autonomy of nurses in making decisions" and 51.67% (n=31) disagreed, "technology increases nurses psychological stress". The results also revealed a high degree of uncertainty in the participants' responses. The findings are presented in Table 4.6 below:

Table 4.6: Negative aspects of use of technology on nurses and nursing care

Item	Statement	Range of Likert Scale Responses							
		Did not respond		Disagree		Uncertain		Agree	
		n	%	n	%	n	%	n	%
C1	Increases nurses psychological stress	1	1.67	**31**	**51.67**	14	23.33	14	23.33
C2	Important to take a vacation regularly from ICU	1	1.67	**33**	**55.00**	13	21.67	13	21.66
C3	Technology restricts autonomy of nurses in making decisions	2.	3.33	**32**	**53.33**	8	13.33	18	30.00
C4	Technical tasks have downgraded the nursing profession	1	1.67	**41**	**68.33**	7	11.67	11	18.34
C5	Technology and machines often interfere with providing adequate nursing care	1	1.67	**42**	**70.00**	5	8.33	12	20.00

4.3.4 Nurses' competence in the use of technology

The current results indicated more than one quarter, 30% (n=18) of the nurses graded themselves at eight, 23.33% (n=14) graded themselves between 10 and 11, 67% (n=7) graded themselves between 7 and 9. See Table 4.7 below**:**

Table 4.7 Nurses' competence on the use of technology

Score	**Frequency**	**Percentage**
Did not respond	4	6.67%
1	-	-
2	-	-
3	3	5.00%
4	1	1.67%
5	1	1.67%
6	7	11.67%
7	5	8.33%
8	18	**30.00%**
9	7	11.67%
10	14	23.33%

4.3.5 Item Test Correlation using Cronbach's Alpha on Positive Aspects of Technology

4.3.5.1 Positive aspects of using technology on patient

The current results showed a positive internal consistency on positive aspects of technology with an overall Cronbach's alpha of 0.79. Individual items scored in the range of 0.67 to 0.80. Item A1 "Higher care effectiveness" scored a Cronbach's alpha of 0.80, item A2 "Technological equipment directs and controls medical treatment" scored 0.73, item A3 "higher patient safety through prompt and proper recognition of complications" scored 0.67 and item A4 "Technology makes treatment more secure" scored 0.79. This means that there is a high level of consistency for the scale because the Cronbach's alpha is above the acceptable level of 0.7. See table below.

Table 4.8 Item-test correlation for positive aspects of using technology

Item	Statement	F	Item-test correlation	Average correlation	Cronbach Alpha
A1	Higher care effectiveness	60	0.69	0.57	0.80
A2	Technological equipment directs and controls medical treatment	60	0.79	0.48	0.73
A3	Higher patient safety through prompt and proper recognition of complications	60	0.85	0.40	0.67
A4	Technology makes treatment more secure	60	0.79	0.46	0.72
	Test scale			0.48	**0.79**

4.3.5.2 Positive aspects of using technology, on nursing and practice, knowledge and skill

The results showed a positive correlation of the scale items with an average Cronbach alpha of 0.80. All the individual items scored above the acceptable score of 0.7. The Cronbach alpha ranged from 0.70 to 0.81. Item B4 "requires high-technical skills" scored a Cronbach alpha of 0.81, item B2 "faster completion of nursing duties" scored 0.77, item B5 "technology enhances patient care" scored 0.76, item B3 "improves nurse's knowledge and skill" scored 0.73, item B1 "easy completion of nursing duties" scored 0.70. See Table 4.9 below:

Table 4.9 Item-test correlation for positive aspects of using technology on nursing and practice, knowledge and skill

Item	Statement	F	Item-test correlation	Average Correlation	Cronbach Alpha
B1	Easy completion of nursing duties	60	0.86	0.365	0.70
B2	Faster completion of nursing duties	60	0.72	0.449	0.77
B3	Improves nurse's knowledge and skill	60	0.79	0.409	0.73
B4	Requires high-technical skills	60	0.61	0.521	0.81
B5	Technology enhances patient care	60	0.74	0.440	0.76
	Test scale			0.437	**0.80**

4.3.5.3 Positive aspects of use of technology

The items in this section were too few to measure the item test correlation

4.3.6 Item Test Correlation using Cronbach's Alpha on Negative Aspects of Technology

4.3.6.1 Negative aspects use of technology

The results indicated a better Cronbach's alpha than the rest of the sub-scales. The overall Cronbach's alpha for the negative aspects of use of technology was 0.87, with individual items scoring within the range of 0.83 to 0.87. Item A5, "technology extracts time from patients" scored a Cronbach's alpha of 0.87, item A2, "increase patient risk from misinterpretation of data" scored 0.85, item A1, "increased patient risk from improper handling of equipment" scored 0.85, item A4, "ignoring physical needs of patients" scored 0.84, item A6, "using technology leads to loss of human sensitivity about patients" scored 0.84, item A3, "Focusing of interest on equipment and technical skills" scored 0.83. Generally, this indicates that the sub-scale has a good item correlation as it is above the acceptable Cronbach alpha of 0.7 and they are measuring the same items. See Table 4.10 below

Table 4.10 Item test correlation for negative aspects of technology

Item	Statement	F	Item-test correlation	Average Correlation	Alpha
A1	Increase patient risk from improper handling of equipment	60	0.75	0.64	0.85
A2	Increase patient risk from misinterpretation of data	60	0.74	0.54	0.85
A3	Focusing of interest on equipment and technical skills	60	0.85	0.49	0.83
A4	Ignoring physical needs of patients	60	0.82	0.50	0.84
A5	Technology extracts time from patients	60	0.69	0.56	0.87
A6	Using technology leads to loss of human sensitivity about patients	60	0.80	0.51	0.84
	Test scale			0.52	**0.87**

4.3.6.2 Complexity of using technology

The results indicate this sub-scale scored an overall Cronbach's alpha of 0.54, with individual item scores ranging from 0.32 to 0.58. The Cronbach's alpha for item B1, "nurse must be competent in managing technology and interpreting technological data" was 0.58, item B2, "increase overall hospitalisation" was 0.48, item B4, "technology can create ethical dilemmas" was 0.46, item B3, "technology is complicated and not easy to handle" was 0.32. This scale did not score well, all the items were scoring below the average of 0.7. The poor item correlation score may indicate the participants were not conversant with items or they did not understand the questions, hence the results are not acceptable. Table 4.11 presents the findings.

Table 4.11 Item test correlation for complexity when using technology

Item	Statement	F	Item-test correlation	Average Correlation	Alpha
B1	Nurse must be competent in managing technology and interpreting technological data	60	0.55	0.31	0.58
B2	Increase overall hospitalisation	60	0.64	0.23	0.48
B3	Technology is complicated and not easy to handle	60	0.75	0.14	0.32
B4	Technology can create ethical dilemmas	60	0.65	0.22	0.46
	Test scale			0.23	**0.54**

4.3.6.3 Negative aspects of use of technology on nurses and nursing care

The nurses' responses indicated there is a positive correlation amongst the items, with an overall Cronbach's alpha of 0.74 with item scores ranging from 0.67 to 0.72. Three items scored above the average (0.7) and two items were below average. The individual Cronbach's alpha score for the items were; item C4, "technical tasks have downgraded the profession," 0.72, item C1, "increase nurses psychological stress," 0.71, item C5, "technology and machines often interfere with providing adequate nursing care," 0.70, item C2, "important to take a vacation regularly from ICU," 0.69; item C3, "technology restricts autonomy of nurses when making decisions," 0.67. This means the item correlation test was positive and measuring the same items. Table 4.12 presents the findings.

Table 4.12 Item test correlation for negative aspects of use of technology on nurses and nursing care

Item	Statement	F	Item-test correlation	Average Correlation	Cronbach Alpha
C1	Increases nurses psychological stress	60	0.67	0.38	0.71
C2	Important to take a vacation regularly from ICU	60	0.73	0.35	0.69
C3	Technology restricts autonomy of nurses when making decisions	60	0.76	0.33	0.67
C4	Technical tasks have downgraded the profession	60	0.66	0.39	0.72
C5	Technology and machines often interfere with providing adequate nursing care	60	0.70	0.37	0.70
	Test scale			0.37	**0.74**

4.3.7 Comparative Statistics

This section presents the comparative analysis between the nurse's perceptions (positive and negative) and the categorical variables. Data were analysed to determine whether one construct i.e. age, gender, educational level and experience and total scores for positive and negative effects were statistically significant using the Fisher's Exact test, two sample t-test to test for significance of mean score differences and ANOVA to test more than two variables.

4.3.7.1 Fisher's Exact test results for positive effects of technology

The p-value value for age and positive effects of technology ranged from 0.01 to 0.77, the p-value for gender and positive effects of technology ranged from 0.27 to 1.00, the p-value for educational level and positive effects ranged from 0.13 to 0.959 and the p-value for experience and the positive effects of technology ranged from 0.01 to 0.70. The results showed that age was statistically significant for Item A1, "higher care effectiveness" with a p-value of 0.01, whereas, experience was statistically significant for item B2, "faster completion of nursing duties" and item B3, "improves nurses' knowledge and skills", with p-values of 0.01 and 0.02 respectively. Nothing was statistically significant for gender and educational level. The findings are presented in Table 4.13.

Table 4.13: Summary for Fisher's Exact test on categorical variables obtained for positive effects of use of technology

Item	Statement	Fisher's Exact test for categorical variable			
	Positive aspects of using technology on patients	Age	Gender	Education level	Experience
A1	Higher care effectiveness	**0.01***	0.65	0.82	0.62
A2	Technological equipment directs and controls medication	0.96	0.31	0.13	0.36
A3	Higher patient safety through prompt and proper recognition of complications	0.36	0.86	0.96	0.26
A4	Technology makes treatment more secure	0.77	0.46	0.19	0.32
	Positive aspects of using technology on nursing and practice, knowledge and skills				
B1	Easy completion of nursing duties	0.35	0.27	0.44	0.08
B2	Faster completion of nursing duties	0.22	0.38	0.76	**0.01***
B3	Improves nurses knowledge and skills	0.65	0.65	0.58	**0.02***
B4	Requires high technical skills	0.74	0.50	0.87	0.15
B5	Technology enhances patient care	0.28	1.00	0.89	0.36
	Positive aspects of use of technology				
C1	Increases prestige of nurses	0.23	0.74	0.93	0.47
C2	Technological equipment is the eyes and hands of nurses	0.38	0.77	0.83	0.70

Key *=statistically significant (p=0.05 and below)

4.3.7.2 Summary for Fisher's Exact test for frequencies on categorical variables obtained for negative aspects of use of technology

The p-value value for age and negative effects of technology ranged from 0.01 to 0.54, the p-value for gender and positive effects of technology ranged from 0.10 to 1.00, the p-value for educational level and positive effects ranged from 0.13 to 1.00, whilst the p-value for experience and the positive effects of technology ranged from 0.03 to 0.98. The results showed there was statistical significance between age and negative effects of technology on items A2, "increases patient risk from misinterpretation of data," B2, "increases overall hospitalisation costs," B3, "technology is complicated and not easy to handle" and C1, "increase nurses' psychological stress," with p-values ranging from 0.02 to 0.05. The results also show statistical significance between experience and negative effects on items A5, "technology extracts time from patients," with a p-value of 0.03 and item B3, "technology is complicated and not easy to handle," with a p-value of 0.03. Table 4.14 presents the findings.

Table 4.14: Summary for Fisher's exact test obtained for negative effects of use of technology

Item	Statement	Fisher's Exact test for categorical variable			
	Negative aspects of use of Technology	Age	Gender	Educational level	Experience
A1	Increases patients risk from improper handling of equipment	0.06	0.38	0.57	0.75
A2	Increases patient risk from misinterpretation of data	**0.02***	0.79	0.57	0.43
A3	Focusing of interest on equipment and technical skills	0.30	0.43	0.55	0.14
A4	Ignoring physical needs of patients	0.44	0.85	0.38	0.27
A5	Technology extracts time from patients	0.30	0.96	0.54	**0.03***
A6	Using technology leads to loss of human sensitivity about patients	0.48	0.14	0.48	0.63
	Complexity of using technology				
B1	Nurses must be competent in managing technology and interpreting technological data	0.27	0.30	0.10	0.98
B2	Increases overall hospitalisation costs	**0.05***	0.72	0.35	0.59
B3	Technology is complicated and not easy to handle	**0.05***	0.40	0.55	**0.03***
B4	Technology can create ethical dilemmas	0.42	0.92	0.61	0.14
	Negative aspects of technology on nurses and nursing care				
C1	Increases nurses psychological stress	**0.05***	1.00	0.39	0.74
C2	Important to take a vacation regularly from ICU	0.10	1.00	0.59	0.06
C3	Technology restricts autonomy of nurses in making decisions	0.20	0.68	0.27	0.19
C4	Technical tasks have downgraded the nursing profession	0.54	0.43	0.54	0.37
C5	Technology and machines often interfere with providing adequate nursing care	0.48	0.55	0.07	0.23

Key *= statistically significant (p=0.05 and below)

4.3.8. Analysis of the difference between two independent groups

4.3.8.1 Sample t-test and Mann-Whitney test on gender and nurses' perceptions (positive and negative effects) regarding technology

This section presents the association between the nurses' perceptions on the positive and negative effects of technology and gender. The current findings indicate there is an association between gender and competence, with a t-test p-value of 0.02, but no association between gender and positive effects of technology, with a t-test p-value ranging from 0.85-0.96 and Mann-Whitney test from 0.68 to 0.92. No statistical significance was observed for the negative effects of technology, t-test p-value ranged from 0.50 to 0.91 and p-value for Mann-Whitney test was from 0.50 to 0.74. Table 4.15 presents the findings.

Table 4.15: Two sample t-test and Mann-Whitney test, by gender, on the nurses' perceptions

Item	Statement	Males			Females			p-value	
	Positive Effects of the Use of Technology	f	Mean	SD	f	Mean	SD	t-test	Mann-Whitney test
2A	Positive aspects of using technology on patients	7	16.57	1.81	53	16.53	3.53	0.96	0.66
2B	Positive aspects of using technology on nursing and practice, knowledge and skills by age	7	20.43	3.31	53	20.36	3.29	0.96	0.92
2C	Positive aspects of use of technology	7	6.71	2.14	53	6.55	2.44	0.85	0.92
	Negative Aspects of Use of Technology								
3A	Negative aspects of use of technology	7	15.71	6.82	53	17.62	6.25	0.50	0.50
3B	Complexity of using Technology	7	13.57	3.82	53	13.76	2.65	0.91	0.74
3C	Negative aspects of technology on nurses and nursing care	7	11.29	3.25	53	12.23	4.33	0.51	0.65
	Competence								
4	Nurses competence	7	8.71	1.25	53	7.19	2.79	**0.02 ***	0.18

Key *= statistically significant (p=0.05 and below)

4.3.8.2 Sample t-test and Mann-Whitney test on educational level and nurses' perception (positive and negative effects) regarding technology

This section presents the association between the nurses' perceptions on the positive and negative effects of technology and educational level. The p-value for the t-test for positive effects of technology ranged from 0.06 to 0.50, p-value for negative effects of technology

ranged from 0.11 to 0.26 and the p value for competence was 0.05. The p-values for the Mann-Whitney tests for: a) positive effects of technology, ranged from 0.16 to 0.63, b) for negative effects of technology, from 0.16 to 0.23 and c) for competence was 0.097. The findings indicate there is statistical significance between educational level and competence with a p-value 0.05, but there is no association between educational level and the positive and negative effects of technology. Table 4.16 illustrates the findings.

Table 4.16: Two sample t-test by educational level on nurses' perception

Item	Statement	Degree			Diploma			p-value	
	Positive Effects of the Use of Technology	f	Mean	SD	f	Mean	SD	t-test	Mann-Whitney test
Sec1 A	Positive aspects of using technology on patients	16	17.56	1.93	44	16.16	3.70	0.06	0.16
Sec 2B	Positive aspects of using technology on nursing and practice, knowledge and skills by age	16	20.81	2.86	44	20.21	3.42	0.50	0.63
Sec 2C	Positive aspects of use of technology	16	6.94	2.24	44	6.43	2.45	0.46	0.46
	Negative Aspects of Use of Technology								
Sec 3A	Negative aspects of use of technology	16	19.13	3.96	44	16.77	6.87	0.11	0.23
Sec 3B	Complexity of using technology	16	12.94	2.62	44	14.02	2.79	0.17	0.17
Sec 3C	Negative aspects of technology on nurses and nursing care	16	13.13	3.98	44	11.75	4.27	0.26	0.16
	Competence								
Sec4	Nurses competence	16	8.31	1.89	44	7.02	2.87	**0.05***	0.10

Key *= statistically significant (p=0.05 and below)

4.3.8.3 Summary for ANOVA for age and area of practice (unit) to the nurses' perceptions on the positive and negative effects of technology.

The results show no statistical significant differences between age and/or area of practice (unit) and the nurses' positive and negative perceptions of technology. The p-value ranged from 0.44 to 0.94 for age and positive effects of technology, 0.18 to 0.77 for age and the negative effects of technology and 0.52 for age and the nurses' competence. Whilst the p-value for area of practice (unit) and the positive effects of technology ranged from 0.42 to 0.75, for unit and negative effects, it ranged from 0.14 to 0.66 and finally the p-value for unit and the nurses' competence was 0.94. See Table 4.17.

Table 4.17 ANOVA for Age and Unit to the nurses' perceptions

Item	Statement	Age			Area of practice (Unit)		
	Positive Effects of the Use of Technology	df	MS	F (p-value)	df	MS	F (p-value)
Sec 2A	Positive aspects of using technology on patients	3	1.66	0.94	2	0.42	0.44
Sec 2B	Positive aspects of using technology on nursing and practice, knowledge and skills by age	3	7.19	0.59	2	3.19	0.75
Sec 2C	Positive aspects of use of technology	3	4.93	0.47	2	5.10	0.42
	Negative Aspects of Use of Technology						
Sec 3A	Negative aspects of use of Technology	3	14.16	0.77	2	22.27	0.58
Sec 3B	Complexity of using technology	3	12.82	0.18	2	3.25	0.66
Sec 3C	Negative aspects of technology on nurses and nursing care	3	9.41	0.67	2	34.88	0.14
	Competence						
Sec 4	Nurses competence	3	5.74	0.52	2	0.44	0.94

4.3.8.4. Summary of ANOVA for practice role and experience to the nurses' perceptions on the positive and negative effects of technology.

The p-value for practice role and positive effects of technology ranged from 0.15 to 0.51, practice role and negative effects of technology, 0.40 to 0.55 and practice role and nurses' competence was 0.00. The p-value for experience and positive effects of technology ranged from 0.02 to 0.67, experience and negative effects of technology, 0.19 to 0.86 and experience and nurses' competence, p=0.37. The results show there was statistical significant difference between practice role and the nurses' competence, p=0.00 and between experience and 'positive aspects of using technology on nursing and practice, knowledge and skills by experience", p=0.02. Table 4.18 presents the findings.

Table 4.18: ANOVA for practice role and experience to the nurses' perceptions

Item	Statement	Practice Role			Experience		
	Positive Effects of the Use of Technology	df	MS	F (p-value)	df	MS	F (p-value)
Sec 2A	Positive aspects of using technology on patients	2	21.50	0.15	3	6.70	0.67
Sec 2B	Positive aspects of using technology on nursing and practice, knowledge and skills by age	2	10.96	0.36	3	35.86	**0.02***
Sec 2C	Positive aspects of use of technology	2	3.99	0.51	3	7.67	0.28
	Negative Aspects of Use of Technology						
Sec 3 A	Negative aspects of use of technology	2	36.91	0.40	3	10.64	0.86
Sec 3B	Complexity of using technology	2	5.88	0.47	3	8.70	0.31
Sec 3C	Negative aspects of technology on nurses and nursing care	2	10.81	0.55	3	28.02	0.19
	Competence						
Sec 4	Nurses competence	2	57.11	**0.00***	3	7.98	0.37

Key *= statistically significant (p=0.05 and below)

4.3.9 SUMMARY

This chapter presented the results from the study and described the descriptive and inferential statistics used in the data analysis. The data was presented in the form of graphs and tables to enhance interpretation of the results.

The following chapter will present a summary of the study, the main findings and discussions, conclusion and recommendations.

CHAPTER FIVE

DISCUSSION OF THE RESULTS, CONCLUSION, AND RECOMMENDATIONS

5.1 INTRODUCTION

This final chapter will present the summary of the study, discussion of results and conclusion of the study. Furthermore, the limitations of the study, recommendations for nursing management and education, clinical practice and areas for further studies will be discussed.

5.2 SUMMARY OF THE STUDY

The purpose of the study was to explore the perceptions of nurses, who work in the Intensive Care Units, about the effects of the use of technological equipment, with an intention of making recommendations for clinical practice and education of nurses.

The objectives of the study were:

- To describe the perceptions of nursing personnel who work in the Intensive Care Units about the use of technological equipment
- To determine the positive or negative effects of technological equipment on patient care in the Intensive Care Units
- To identify the relationship between demographic characteristics and perceptions of nurse participant

5.2.1 Methodology

The study was done in three ICU's, at one of the public academic hospitals in Johannesburg. A quantitative, non-experimental, descriptive design was used to explore the nurses' perceptions regarding the use of technological equipment.

After obtaining approval from the Human Research Ethics Committee, the Department of Health, and the Chief Executive Officer for the hospital, a pilot study was conducted with 10 ICU trained nurses to assess feasibility of the study and to refine the questionnaire. Thereafter, the main study was conducted with 60 ICU trained nurses to assess their perceptions regarding the use of technology in the ICU. The use of a questionnaire developed by Laila, Ahmed & Mogahed (2011), which contained three sections with 11 items on positive effects of technology and 15 items on negative effects of technology and a rating scale of 10 for their competence, was to achieve the study objectives. A five-point Likert scale was used; strongly disagree, disagree, uncertain, agree, and strongly agree. During the presentation of the findings, the responses were collapsed into three; disagree, uncertain and agree.

Descriptive and inferential statistics were used to analyse the data with the assistance of a statistician. Figures and tables were used to present the findings.

5.3 MAIN FINDINGS AND DISCUSSIONS

5.3.1 Demographic Data

In this study, the first section of the questionnaire was the demographic data, which had six

parts: gender, age, area of practice, practice role, educational level, and experience in the area of practice. The findings showed the majority (83.33%) of the participants were female nurses. This proves the female dominance in nursing profession as it dates back to the history of nursing when women nursed wounded soldiers. Generally gender did not influence the nurses' responses to the positive and negative effects of using technology, except for competence where a statistical significance (p=0.02) was observed which was more evident in males than females.

The majority of participants (62.71%) were aged between 30 and 49 years, were active and some were nearing retirement age. Hence, this can be a wakeup call to the Department of Health to train more nurses to fill the gap. It was also found that most of the participants were drawn from cardiothoracic ICU. The results also showed a significant relationship between age and negative effects of technology, "increases patient risk from misinterpretation of data" (p=0.02), "increases overall hospitalisation costs" (p=0.05), "technology is complicated and not easy to handle" (p=0.05) and "increases nurses psychological stress" (p=0.05).

The majority of the participants (95%) were working in the clinical area and used technology in their everyday work. Amongst the participants, 73.33% were diploma nurses. This may assist the Department of Health to upgrade nurses to degree levels.

According to Rose, Goldsworthy, O'Brien-Pallas, & Nelson (2008), a well-educated nursing workforce may promote authority in decision-making and assist in developing nurses' role within the health professional team, thus improving job satisfaction and job retention. The findings also revealed statistical significance (p=**0.05**) between educational level and competence, more evident in degree nurses.

The majority of participants (81.82%) had more than two years of experience in ICU. According to Benner (1984), any nurse who has been in the same job for two to three years is referred to as competent. This nurse is able to demonstrate efficiency, good coordination of his/her job and has confidence in his/her actions. The experienced nurses have the intelligence and skills, automatically paying attention to cues that have important implications for patients' welfare and react accordingly (Ashworth, 1990). Additionally, the experience of nurses had a statistical significance on the negative effects of technology, "technology extracts time from patients" (p=0.03) and "technology is complicated and not easy to handle" (p=0.03).

5.3.2 The Positive Aspects of Technology

5.3.2.1 The positive aspects of using technology on patient

The current study showed that the majority of nurses (more than three quarters) identified the positive. They agreed "technology offers higher care effectiveness," "technological equipment directs and controls medication", "offers higher patient safety through prompt and proper recognition of complications" and "makes treatment more secure." These results may be related to nurses' daily interaction with patients through technology. The use of technology would provide the nurses with accurate readings of parameters, for example, the invasive blood pressures, which will lead to proper recognition of complications, hence proper management of the problem and providing the nurses with a sense of safety on patient care. This is consistent with the findings, in a qualitative study by Wikstrom et al (2007), that "technology directs and controls medical treatment" and "technology makes treatment safe." Laila et al (2011) who did a similar study in Greece

also support these results and the participants identified all the positive aspects of using technology on patients. Similarly, participants in a study by Alasad (2002), expressed they feel safe and in control when using technology, in such a way that they know what is happening to with the patient. Furthermore, the findings showed acceptable internal consistency of the scale items (α=0.79).

5.3.2.2 The positive aspects of using technology on nursing and practice, knowledge and skills

The current study revealed the majority of participants (more than three quarters) agreed that technology makes "easy completion of nursing duties" and "faster completion of nursing duties". The results are consistent with the study findings of Kiekkas et al (2006) and Laila et al (2011), who found that technology makes easier and faster completion of nursing duties. Technology has eased nursing activities in such a way, that nurses can look after several patients, monitor their vital functions, and give treatments at the same time, without actually straining themselves. In addition, the nurses are relieved from repetitive tasks there by increasing their time spent on direct patient care.

The nurses also agreed that technology "improves nurses' knowledge and skills." In the high technological environment, when the nurses or the technology is new, the nurses will strive to gain the knowledge and skills of how the technology works and how they can interpret the data. In so doing, they will seek ways on how to gain the knowledge and skills according to their needs by the use of continuous professional development (CPD). The results are consistent with the findings by Laila et al (2011) who said that new technology forces nurses to accept more knowledge and skills to help them with interpretation of data. The nurses agreed that use of technology "requires high technical skills." This finding is

similar to other studies conducted by Alasad (2002), Kiekkas et al (2006) and Laila et al (2011). In their study, Noh, Arthur & Sohng (2002) reported that high technology requires high technological skills and technology enhances patient care and well- being. Therefore the Intensive Care nurses are required to have technical skills, competence, and mastery for them to control their working environment, work in harmony with technology, and integrate well the technology and patient care. This would enhance patient care as the study current revealed. Additionally, the results showed acceptable internal consistency (α=0.80) of the scale items.

5.3.2.3 The positive aspects of use of technology

More than half of the Intensive Care nurses (70%) agreed that technology "increases prestige of nurses". This is similar to findings in Laila et al (2002), where nurses identified that technology increases the nurses' prestige, probably because of the improved image in front of patients and families who perceive them as experts in the technologies surrounding the patient. The nurses' prestige is increased by the nursing attributes, such as sophisticated knowledge and skills on technology, involvement with scientific progress and association with power and control. Barnard & Gerber (1999) expressed the use of technology is understood to be associated with increased respect and autonomy from peers, other healthcare workers and society. In contrast to the findings, the participants in a study by Kiekkas et al (2006) disagreed that technology increases the prestige of the nurses, probably because of decreased autonomy whereby nurses have no independence in the decision making about its use.

The nurses also perceived positively that technological equipment is the eyes and hands of nurses. This concurs with Ashworth (1990:153), who stated, "technology becomes an

extension of the nurses' hands, eyes, ears and other senses." The nurses spend most of their time with patients and with technology; they quickly perceive when something is wrong. The finding was consistent with a study done by Sandelowski (1997), who found that nurses see technology as offering a better way to see, hear, feel, and care in order to accomplish the purposes of nursing.

5.3.3. The Negative Aspects Technology

5.3.3.1. The negative aspects of use of technology

The participants agreed and disagreed with some of the negative aspects of the use of technology, but it was alarming to note many (16% on average) indicated they were uncertain about the negative aspects of technology. This is very disquieting, considering the nurses use technology in their everyday work but do not understand its impact. The nurses (57%) agreed that technology "increases patients' risk from improper handling of equipment" and 48% agreed that technology "increases patient risk from misinterpretation of data". This is consistent with the study by Kiekkas et al (2006), who studied the nurses' perception in Greece on the use of technological equipment in the critical care units. The nurses elaborated that the increased patient risk is due to human errors or mechanical faults, increased stress and decreased autonomy. However, the current findings are inconsistent to the findings by Laila et al (2010: 550), where the participants disagreed that technology increased patient risk from improper handling of equipment or misinterpretation of data.

In the current study, the ICU nurses agreed that technology lead to "focusing of interest on equipment and technical skills." This is consistent with the findings by Almerud (2008) in

a qualitative study, where they uncovered the meaning of being a caregiver in the technologically intense environment. The participants expressed that technology prevails as master, overshadowing the patient. For novice nurses, they strive to master the technology and in doing so, place too much focus on technology and the patient becomes an object. Sandelowski (2000) also wrote that nurses watch over technology instead of watching over the patients. In a study by Almerud et al (2007), which aimed at discovering what it meant to be critically ill or injured in a technological intense environment, the patients expressed they felt invisible as people, reduced to the status of organs, objects and diagnoses as the care givers kept vigilance over technological equipment, documented data, laboratory results and other measured parameters. However, the current results are inconsistent with the findings by Kiekkas et al (2006) and Laila et al (2011).

The current study also revealed that nurses disagreed that technology leads to ignoring physical needs of patients. The results are consistent with the findings from the studies done by Kiekkas et al (2006) and Laila et al (2011). Barnard & Sandelowski (2001) also argued that dehumanisation is not a result of equipment per se, but rather how the individual technology is used in specific contexts. Technology is not opposed to touch (humanised care) but is rather an object of touch even in the most intense technological environment.

The participants (50%) further disagreed in the current findings that technology extracts time from patients. This finding corresponds with those from the studies by Alasad (2002) and Barnard (2000). In Alasad's study, the participants expressed that even after becoming competent in managing technology the machinery is still considered to be taking most of the nurses' time. The demands are usually related to the alarms from the monitors, which needs the nurses' attention especially when a lot of technology is used on the patient. If a

patient is on ventilator, has more than two infusion pumps, feeding pumps and other monitors, all these machines have to be attended to and alarms can ring at different times resulting in the nurse moving up and down.

Additionally, the current study revealed that nurses (57%) disagreed that using technology leads to loss of human sensitivity about patients. The nurses' responses seemed to lack consistency because they previously agreed that technology leads to focusing of interest on equipment and technical skills. However, the findings are similar to Laila et al (2011). However, the results in Dean's (1998) study were inconsistent with the current findings. He stated that high technological environments dehumanise patients and cause stress for patients, their families, and nursing staff. Furthermore, the research revealed good internal consistency of scale items (α=0.89).

5.3.3.2. Complexity of using technology

Most of the nurses agreed on the negative effects of technology. In the current study, the nurses (96.67%) agreed, "nurses must be competent in managing technology and interpreting technological data". For a nurse to work accurately with technology, he/she must have knowledge of how the technology works and be proficient in synthesising data in order to make appropriate clinical judgement. According to Walters (1995), a nurse with little or no experience in the use of the technology will perceive it as new, unfamiliar and complex. Haghenbeck (2005) also stated that technology, when used with competent clinical judgement, promotes safe and efficient care by the nurse. Similarly, in a study by Kongsuwan & Locsin (2010), the participants perceived Intensive Care competency as most significant in their care for the patients using life-sustaining technologies. The nurses

must prevent and detect the patients' problems and complications when using different types of technologies.

The current study also revealed that technology increases overall hospitalisation cost. A great deal of money is required to run an ICU bed catering for the patient's needs. The patient will need oxygen, ventilator, infusion pumps, drugs, and specialised staff to take care of them, all of which are costly. However, Kiekkas et al (2006) study revealed that the nurses were split on whether technology increases overall hospitalisation costs. Nurses must learn to use technological resources cost effectively to avoid unnecessary expenses. Kiekkas et al (2006) expressed that the use of new, more sophisticated devices often increases direct cost, but it may also decrease indirect cost, through the reduction of hospitalisation time and avoidance of complications.

The nurses disagreed that technology is complicated and not easy to handle. The current findings are consistent with findings by Laila et al (2011). However, Wikstrom et al (2007) found that technology is not easy to handle in his qualitative study to explore the meaning of technology in an Intensive Care Unit. Some technologies are definitely not easy to handle and need more experience coupled with knowledge.

The current study showed the nurses (41.66%) agreed that technology could create ethical dilemmas. The findings are consistent with Wikstrom et al (2007), where they found that technology shapes the possibilities to achieve treatment that is more efficient but it may also be a source of ethical dilemmas. The dilemma comes when the issue of whether to continue or withdraw technology treatment for end of life treatment. However, in a study by Laila et al (2011), the results were in contrast to the current findings, the participants disagreed to the item. Furthermore, the results showed acceptable

internal consistency of scale items (α= 0.74).

5.3.3.3. The negative aspects of use of technology on nurses and nursing

In the current study, the nurses (51.67%) disagreed that technology increases nurses' psychological stress. In a survey conducted by McConnell, 1995 as cited in Haghenbeck (2005), the nurses expressed they felt stressed when using technology for direct patient care because they were concerned about harming the patients and mechanical ventilators were most frequently cited as causing increased stress. The stress especially comes, when nurses are not competent and do not have mastery in the technology. Walters (1995) further stated that a nurse with little or no experience will perceive technology as unfamiliar and complex, this will in turn cause psychological stress.

The nurses (55%) disagreed to the statement that it is "important to take a vacation regularly from ICU", which is inconsistent with the findings by Laila et al (2011). Similarly, the nurses (53.33%) disagreed that technology restricts autonomy of nurses in making decisions. This is probably because of lack of involvement in decision making regarding some technology and/or depending on the unit managers for decision-making.

The nurses (68.33%) disagreed that technical tasks have downgraded the nursing profession, which is similar to the findings by Laila et al (2011). In support of the findings, Walters (1995) stated that technology is beneficial to the clinical practice nurses because it provides them with ways of extending care. However, Barnard (2000) found that technology could be a form of medical dominance, or even an alteration of the free will of nurses. Usually machines are controlled by medical doctors and meet the needs of medical practice rather than nursing and the doctors give instructions for their use.

Additionally, the current study showed that 70% of the nurses disagreed that technology and machines often interfere with providing adequate nursing care. This is related to the earlier findings that technology enhances nursing care. Noh et al (2002) and Laila (2011) supported the current finding and the lowest scores were recorded for the same item that technology and machines often interfere with providing adequate nursing care. The current study further revealed poor internal consistency (α=0.54) of scale items, which may indicate the participants were not conversant with items or they did not understand the questions.

5.4 Limitations of the Study

The study was done at one setting; one public tertiary hospital and no private hospital was included due to limited time and resources. The time constraints were there to fulfil the course requirement of two years. Thus, the study findings cannot be generalised to all tertiary hospitals in South Africa.

The other limitation was the design of the study. It was a quantitative type of study where the use of standardised structured instruments influences decisions. The participants are limited to answer what the researcher has structured without explanation. Additionally, Knowledge produced might be too abstract and general for direct application to specific local situations, contexts, and individuals

5.5 RECOMMENDATIONS OF THE STUDY

Based on the findings of the study, the following recommendations have been made to improve nursing practice, education, and research.

5.5.1 Recommendations for Clinical Nursing Practice

- The results showed that majority of nurses were unaware of the negative effects of technology (pages 64-66) which might affect nursing care. Therefore, there is need for strengthening of continuous professional development programmes to improve their knowledge on use of technology thereby promoting quality nursing care.
- The results further showed that use of technology can lead to increasing patients risk from improper handling of equipment and misinterpretation of data, and focusing of interest on equipment and technical skills (page 64). Therefore, Intensive Care Nurses should have in service training on equipment use frequently and whenever new equipment is introduced for proper knowledge and skills. As a measure of quality assurance, the management should ensure adequate orientation to the newly recruited nurses in the ICU and provide supportive supervision of the nurses and that Intensive Care Nurses are maintaining a balance on technical tasks and nursing care.

5.5.2 Recommendations for Nursing Management

- The nurses also identified that technology increases overall hospitalisation cost (page 65). There ICU managers should ensure that the equipment is being taken care of and serviced regularly to reduce the cost. The nurses should have trainings on equipment maintenance of equipment.

5.5.3 Recommendations for Nursing Education

- The Intensive Care Nurses identified that technology can lead to increased patient risks from misinterpretation of data. Additionally, they identified that nurses must be competent in managing technology and interpreting technological data (page 64). As such, clinical instructors and nurse educators should provide induction courses and in service training to all nurses working in ICU to impart knowledge and skills on use technology and interpretation of data.
- The current finding revealed that there are 73.33% of Diploma nurses (page 59). Therefore, it is recommended that the Department of Health should consider upgrading the nurses to degree level in order to improve quality care. In addition, postgraduate training should be strengthened and aimed at focusing on new advanced technology

5.5.4 Recommendations for Nursing Research

- Since the study was done at one setting, there is need to do a replica study at different sites in order to generalise the results to South Africa
- There is need to do a quantitative study in order to validate the results because a quantitative study influences the participants responses

5.6 CONCLUSION

The nurses working at the study site identified all the positive aspects of using technology. The Intensive Care nurses were aware that technology increases patients risk from improper handling of equipment and misinterpretation of data, increases overall

hospitalisation cost, technology can create ethical dilemmas, leads to focusing of interest on equipment and technical skills. They further identified that a nurse must be competent in managing technology and interpreting technological data. However, they did not identify all the negative aspects of using technology, which might be due to the nurses' lack of proper knowledge on technological equipment use. The findings also demonstrated good correlation amongst the scale items and statistical significance between experience and easier and faster completion of nursing duties.

In general, the nurses need to have technological competence and be able to utilise technology in order to reduce mortality and morbidity from critical illness. The nurses should also strive to humanise technology by balancing technology and caring. They should remember that technology cannot talk to the patients and their families, listen to their fears and anxieties, or inform them of their progress. It is the responsibility of the nurses to ease the impact of technology to the patients and families as they see it as potentially dangerous and frightening.

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APPENDIX A

NURSES PERCEPTION REGARDING THE USE OF TECHNOLOGICAL EQUIPMENT IN INTENSIVE CARE UNITS

DATA COLLECTION TOOL

SECTION 1: DEMOGRAPHIC DATA

1.1 Research Code Number

1.2 Gender

Male	
Female	

1.3 Age (Years)

20-29	
30-39	
40-49	
50-59	
>60	

1.4 Area of Practice

Cardiothoracic ICU	
Neurosurgical ICU	
Main ICU	

1.5 Practice Role

Clinical Practice	
Management	
Education	

1.6 Educational Level

Degree in nursing	
Diploma in nursing	

1.7 Experience in area of practice (years)

SECTION 2

POSITIVE EFFECTS OF USE OF TECHNOLOGY

Positive aspects of using technology on patients		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
A1	Higher care effectiveness					
A2	Technological equipment directs and controls medical treatment					
A3	Higher patient safety through prompt and proper recognition of complications					
A4	Technology makes treatment more secure					

Positive aspects of using technology on nursing and practice, Knowledge and skills		Strongly Disagree	Disagreed	Uncertain	Agree	Strongly Agree
B1	Easy completion of nursing duties					
B2	Faster completion of nursing duties					
B3	Improves nurse's knowledge and skill					
B4	Requires high-technical skills					
B5	Technology enhances patient care					

Positive aspects of use of technology		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
C1	Increases prestige of nurses					
C2	Technological equipment is the eyes and hands of nurse					

SECTION 3

NEGATIVE ASPECTS OF TECHNOLOGY

Negative aspects of use of technology		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
A1	Increased patient risk from improper handling of equipment					
A2	Increased patient risk from misinterpretation of data					
A3	Focusing of interest on equipment and technical skills					
A4	Ignoring physical needs of patients					
A5	Technology extracts time from patients					
A6	Using technology leads to loss of human sensitivity about patients					

Complexity using technology		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
B1	Nurse must be competent in managing technology and interpreting technological data					
B2	Increased overall hospitalisation cost					
B3	Technology is complicated and not easy to handle					
B4	Technology can create ethical dilemmas					

Negative aspects of use of technology on nurse and nursing care		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
C1	Increases nurses psychological stress					
C2	Important to take a vacation regularly from ICU					
C3	Technology restricts autonomy of nurses in making decisions					
C4	Technical tasks have downgraded the nursing profession					
C5	Technology and machines often interfere with providing adequate nursing care					

How competent do you think you are in the use of technological equipment?

1	2	3	4	5	6	7	8	9	10

APPENDIX B

NURSES' PERCEPTIONS REGARDING THE USE OF TECHNOLOGICAL EQUIPMENT IN THE INTENSIVE CARE UNIT SETTING OF A PUBLIC SECTOR HOSPITAL IN JOHANNESBURG

INFORMATION LETTER

Dear Colleague,

My name is Phyllis Kanjakaya and I am a student at the University of the Witwatersrand, in the Department of Nursing Education, registered for the degree of Master of Science in Nursing (Intensive Care Nursing). I hope to conduct a research project to explore the perceptions of nurses who work in the Intensive Care Units regarding the effects of the use of technological equipment, in order to make recommendations for clinical practice, education of nurses and further research. A self-administered questionnaire with three sections will be used. The first section will collect demographic data, whereas the second and third sections will employ a 5-point Likert scale to assess the perceptions of nurses about the positive and negative aspects regarding the use of technological equipment respectively.

I hereby invite you to participate in the study. Participation is voluntary and you may choose not to participate or to withdraw from the study at any time, without any penalties. Anonymity and confidentiality will be ensured and your identification will not be disclosed or reported in the study. You will derive no direct benefit from participating in the study. I hope that the results of the study will provide valuable information regarding positive and negative effects on technological use and how it affects nursing practice. Results of the study will be available to you should you so wish. If you consent to be part of the study, please complete the attached consent form and return it to me in the enclosed stamped addressed envelope.

The appropriate people, Human Research Ethics Committee of the University of the Witwatersrand, Gauteng Department of Health and this health care institution have approved the study and its procedures.

Thank you for taking time to read this information letter. Should you require any further information regarding the study or your rights as a study participant, please contact me in the Department of Nursing Education or on the following telephone number: 0732338961.

APPENDIX C

NURSES' PERCEPTIONS REGARDING THE USE OF TECHNOLOGICAL EQUIPMENT IN THE INTENSIVE CARE UNIT SETTING OF A PUBLIC SECTOR HOSPITAL IN JOHANNESBURG

PARTICIPANT CONSENT

I _____(name) give permission to be included in the study. I have read and understood the content of the information sheet and have been given the opportunity to ask questions I might have regarding the procedure and my consent to being included in the study.

_____ _____

Date Signature

_____

Witness

APPENDIX D

Phyllis Kanjakaya University of the
Witwatersrand Department of
Nursing Education Faculty of Health
Sciences
7 York Road
Parktown 2193

National Department of health, Gauteng Province,
Republic of South Africa,
Cnr Thabo Sehume and Struben Streets,
Private Bag X828
Pretoria 0001

Dear Sir/Madam,

Re: REQUEST TO CONDUCT RESEARCH AT THE JOHANNESBURG HOSPITAL

I am currently a registered student at the University of the Witwatersrand in the Department of Nursing pursuing a Master of Science degree in nursing. I am hereby asking for permission to undertake research at The Johannesburg Hospital. The title of my research is: *"Nurses' perceptions regarding the use of technological equipment in intensive care unit setting of a public sector hospital in Johannesburg*".

Technological equipment has become an integral part of clinical practice and has played a great role in nursing practice. It is widely used to save lives of patients in ICU thereby reducing morbidity and mortality. Literature shows that technology has assisted to provide continuous observation of patients and life support thus leading to optimising patient care. However, overreliance on technology has negatively affected nursing practice by dehumanising patient care. The nurses pay less attention to patients' psychological needs as their focus is shifted to technological equipment. Therefore intensive care nurses need to be aware of such effects in order to improve nursing practice and avoid unsafe practices.

The aim of this study is to explore the perceptions of nurses who work in the intensive care units about the effects of the use of technological equipment, with an intention of making recommendations for clinical practice, education of nurses and further research.

I would like to assure you that the institution's name and personnel involved in the study will not be divulged in the research report. Informed consent will be obtained from all participants and a copy of the research report will be available to you.

I hope to conduct my research at the three adult ICUs (Cardiothoracic ICU, Coronary Care Unit and General ICU) once my proposed study has been approved by the Human Research Ethics Committee of the University of Witwatersrand.

Yours sincerely,

_____

Phyllis Kanjakaya

MSc Nursing student Date _____

APPENDIX E

Phyllis Kanjakaya University of
the Witwatersrand Department of
Nursing Education Faculty of
Health Sciences
7 York Road
Parktown 2193

The Chief Executive Officer
Johannesburg Hospital
5 Jubilee Road
Parktown. 2193

Dear Mrs Mogopodi-Bogoshi,

Re: REQUEST TO CONDUCT RESEARCH AT THE JOHANNESBURG HOSPITAL

I am currently a registered student at the University of the Witwatersrand in the Department of Nursing pursuing a Master of Science degree in Nursing. I hereby ask for permission to undertake research at The Johannesburg Hospital. The title of my research is *"Nurses' perceptions regarding the use of technological equipment in intensive care unit setting of a public sector hospital in Johannesburg*".

Technological equipment has become an integral part of clinical practice and has played a great role in nursing practice. It is widely used to save lives of patients in ICU thereby reducing morbidity and mortality. Literature shows that technology has assisted in providing continuous observation of patients and life support, leading to optimising patient care. It also helps to bring patients closer to nurses. However, overreliance on technology has negatively affected nursing practice by dehumanising patient care. The nurses pay less attention to patients as their focus is shifted to technological equipment. Therefore, intensive care nurses need to be aware of such effects in order to improve nursing practice and avoid unsafe practices.

The aim of this study is to explore the perceptions of nurses who work in the Intensive Care Units about the effects of the use of technological equipment, with the intention of making recommendations for clinical practice, education of nurses and further research.

I would like to assure you that the institution's name and the personnel involved in the study will not be divulged in the research report. Informed consent will be obtained from all participants and a copy of the research report will be available to you if so requested.

I hope to conduct my research at the three adult ICUs (Cardiothoracic ICU, Neurosurgical ICU and Main ICU) once my proposed study has been approved by the Human Research Ethics Committee of the University of Witwatersrand.

Yours sincerely,

_____

Phyllis Kanjakaya

MSc Nursing student Date _____

APPENDIX F

PERMISSION FROM AUTHOR TO USE QUESTIONNAIRE

From: samaher laila [mailto:samaherlaila@yahoo.com]
Sent: 14 April 2013 10:14
To: Shelley Schmollgruber
Cc: samaherlaila@yahoo.com
Subject: Re: urgent request for permission

Dear colleague
Sorry for the delayed response
I agree to use the tool which is attached via a Email
I Wish good luck for you and I hope informing me with the results of the study

--- On **Thu, 28/3/13, Shelley Schmollgruber <*schmoll@iafrica.com*>** wrote:

From: Shelley Schmollgruber <schmoll@iafrica.com>
Subject: urgent request for permission
To: samaherlaila@yahoo.com
Cc: shelley.schmollgruber@wits.ac.za
Date: Thursday, 28 March, 2013, 6:41 PM

Dear Professor Laila Samaher ,

My name is Shelley Schmollgruber. I am the postgraduate coordinator in the Department of Nursing Education of the University of the Witwatersrand in Johannesburg, South Africa. I am currently supervising a research study and my MSc student has expressed particular interest in an aspect of your work. It is entitled "Nurses' perceptions regarding the use of technological equipment in the critical care units" Journal of American Science 2011, vol 7, no. 10, pp. 545 552
On behalf of my student I would like to request your permission to use the instrument as we are conducting a similar study in our South African context. Would it be possible to send us a copy of the instrument along with your permission to use the instrument. If you are in agreement we can forward a copy of the proposal to you once our ethics committee has approved the study. We anticipate that the study will be completed by early 2014.

I am looking forward to your response.
Kind regards
Shelley Schmollgruber
Senior Lecturer Intensive and Critical Care Nursing
Department of Nursing Education,
Faculty of Health Sciences
University of the Witwatersrand

.

APPENDIX G

APPROVAL FROM POSTGRADUATE ASSESSORS

APPENDIX H

M130526

R14/49 Ms Phyllis K Kanjakaya

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130526

NAME: (Principal Investigator)	Ms Phyllis K Kanjakaya
DEPARTMENT:	Department of Nursing Education CM Johannesburg Academic Hospital
PROJECT TITLE:	Nurses Perceptions Regarding the Use of Technological Equipment in the Intensive Care Unit of a Public Sector Hospital in Johannesburg
DATE CONSIDERED:	31/05/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Shelley Schmollgruber
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 21/06/2013

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX I

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

OUTCOME OF PROVINCIAL PROTOCOL REVIEW COMMITTEE (PPRC)

Researcher's Name (Principal investigator)	Phyllis Kanjakaya
Organization / Institution	Department of Nursing Education, School of therapeutics, Faculty of Health Sciences
Research Title	Nurses' perceptions regarding the use of technological equipment in the intensive care unit setting of a public sector hospital in Johannesburg
Protocol number	P010713
Date submitted	01/07/2013
Date reviewed	17/07/2013
Outcome	Approved
Date resubmitted	N/A
Date of second review	N/A
Final outcome	N/A
Date of final outcome	N/A

Provincial Protocol Review Committee (PPRC) comments:

- Recommended

Approved / ~~not approved~~

Dr Bridget Ikalafeng, PPRC: Chairperson

Date 25/07/2013

APPENDIX J

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

CHARLOTTE MAXEKE JOHANNESBURG ACADEMIC HOSPITAL

Enquiries:
Ms. L. Mngomezulu
Tell: (011): 488-3793
Fax: (011): 488-3753
02nd December 2013

Ms. Phyllis Kanjakaya
Master of Science (Nursing)
University of Witwatersrand

Dear Ms. Kanjakaya

RE: "Nurses perceptions regarding the use of technological equipment in intensive care unit setting of a public sector hospital in Johannesburg"

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

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

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

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

Approved ~~/ not approved~~

Ms. M.M. Pule
Acting Chief Executive Officer

APPENDIX K

Gill Smithies

Proofreading & Language Editing Services

59, Lewis Drive, Amanzimtoti, 4126, Kwazulu Natal

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

To	Dr S Schmollgruber
Address	Wits Dept of Nursing Education
Date	27/11/2013
Subject	NURSES' PERCEPTIONS REGARDING THE USE OF TECHNOLOGICAL EQUIPMENT IN THE INTENSIVE CARE UNIT SETTING OF A PUBLIC SECTOR HOSPITAL IN JOHANNESBURG – P Kanjakaya
Ref	SS/gs/004

I, Gill Smithies, certify that I have proofed and language edited:

Chapters 1 to 5 and Table of Contents: Nurses' perceptions regarding the use of technological equipment in the Intensive Care Unit setting of a public sector hospital in Johannesburg, to the standard as required by Wits Dept. of Nursing Education.

Gill Smithies

27/11/2013