THE EFFECTS OF INFORMATION TECHNOLOGY ON THE DELIVERY OF NURSING CARE: A COMPARATIVE STUDY

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Dissertation submitted in fulfilment of the requirements for the Degree in Masters of Technology in Nursing in the Faculty of Health Sciences at the Durban University of Technology.

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Date :

Declaration

This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Durban University of Technology or to any other institution for assessment or for any other purpose.

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Date

Approved for final submission

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PhD: Nursing

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Date

Abstract

Background

In response to the advances made in information technology (IT), many healthcare institutions worldwide have integrated IT into their healthcare systems. Some hospitals in South Africa have changed to a computer-based system for the delivery of nursing care and nursing documentation, whereas others still use a paper-based system. The main aim of introducing IT in nursing is to improve the quality of nursing care. Research has shown, however, that IT can negatively impact on the quality of nursing care rather than improve it. This study compared the delivery of nursing care in two public hospitals in the eThekwini district in KwaZulu-Natal: one hospital which uses a computer-based documentation system for patient care and one hospital which uses a paper-based documentation system.

Aim of the study

The aim of the study is to determine the effects of IT on the delivery of nursing care as experienced by registered and enrolled nurses working in the hospital setting.

Methodology

A quantitative comparative descriptive design was used in this study. The delivery of nursing care in a hospital which uses a computer-based documentation system for patient care was compared with a hospital which uses a paper-based documentation system. The participants in this study were registered and enrolled nurses working in the wards and units of the two selected hospitals. Data was collected through the administration of a questionnaire (Appendix G) directed at the registered

and enrolled nurses in the two hospitals involved in the study. One hundred percent of registered and enrolled nurses in the two selected hospitals at the time of data collection were approached and invited to participate in the study. One hundred and four participants for the hospital which uses a computer-based documentation system and 104 participants for the hospital which uses a paper-based documentation system were willing to participate in the study. Data was summarised and described using descriptive statistics such as frequencies, measures of central tendency such as means and modes, as well as means of variability such as range, variance and standard deviation. Graphs and tables were used to graphically represent the data. Data analysis was done using the Statistical Package for the Social Sciences (SPSS), version 22.

Findings

The effects of IT on the delivery of nursing care was measured by the quality of nursing documentation, the amount of time nurses have available for hands-on patient care and the reduction of medication errors. This study revealed that IT positively affected the experiences of nurses with the delivery of nursing care, with only a few exceptions.

Information technology did not decrease the use of unauthorised abbreviations. It also did not improve the time nursing care was rendered being reflected in nursing documentation. Errors being made when entering patient data from, for example, cardiac monitors, intravenous pumps or results to investigations into the patient's record were not decreased by IT. Furthermore, IT failed to improve nurses being alerted to drug interactions and to contra-indications of prescribed medications.

There were a few instances where IT had a negative effect on the delivery of nursing care. Information technology increased the need to copy the same data when creating and updating a nursing care plan as well as documenting nursing care. Although the need for taking telephonic orders was reduced through the use of IT, it was found that when nurses in the hospital with a computer-based documentation system took telephonic orders, errors were made more often than when nurses in the hospital with a paper-based documentation system took telephonic orders.

Dedication

I dedicate this dissertation firstly to my Lord and Saviour and also to my family for their support and understanding.

Acknowledgements

I would like to thank the many people who helped me and without whose assistance I could not have completed this dissertation.

I thank Dr. Petro Basson, my supervisor, who guided and supported me every step of the way.

Thank you to all the people who assisted me in making contact with the participants.

Thank you to the participants of this study for your valuable contributions.

I appreciate all the support and understanding from my manager and my colleagues.

I would like to thank my husband, Herman, my children, Sonja and Tayla, my mother, Sophia as well as my niece, Sara-Jane, for all your love, support and patience.

Lastly, but most importantly, I thank my Lord and Saviour, who gave me my gifts, guided me, strengthened me and enabled me to accomplish this.

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Acronyms

Acronym	Full words
CPOE	Computerised Physician/Provider Order Entry
DoH	Department of Health
EHR	Electronic Health Record
IT	Information technology
KZN	KwaZulu-Natal

CHAPTER 1

OVERVIEW OF THE STUDY

1.1 INTRODUCTION

This study investigated the effects of information technology (IT) on the delivery of nursing care by comparing the delivery of nursing care in two public hospitals in the eThekwini district in KwaZulu-Natal (KZN), one of which uses a computer-based documentation system and the other which uses a paper-based documentation system for patient care. Studies conducted by Mahler *et al*. (2007: 274, 275, 281) and Ammenwerth *et al*. (2010: 30, 33) have shown that although IT positively affects the delivery of nursing care, in some instances it has a negative influence. The aim of this study is thus to determine how IT affects the delivery of nursing care as experienced by registered nurses working in the hospital setting. Nursing care applicable to this study is the planning, implementation and documentation of nursing care. It includes the admission and discharge of patients, the administration of medication to patients, ordering of investigations ordered by the doctor for patients and receiving the results for these investigations, as well as communication with the doctor regarding patient care (Ammenwerth *et al.* 2010: 26).

1.2 BACKGROUND

During the past decades there has been an information explosion, which has resulted in a rapid advance in IT. Hospitals worldwide have integrated IT into their healthcare systems (Huston 2013: 1). Healthcare systems are also replacing paper-based documentation with electronic health records produced through computer-based documentation systems (Sweeny

2010: 528). Due to this, the use of IT in nursing is constantly increasing. The introduction of IT to nursing is aimed at improving the quality of patient care by facilitating the efficient delivery of nursing care, as well as resolving many of the difficulties experienced in nursing before the introduction of IT in the healthcare setting (Furst *et al.* 2013: 131). Research has shown, however, that IT can negatively impact on the quality of nursing care rather than improve it (Ammenwerth *et al*. 2010: 25).

There has been an increasing focus on the delivery of nursing care (Robles 2009: 32). Nursing care is the planning and implementation of nursing actions executed in patient care (Ammenwerth *et al*. 2010: 26) (refer to 1.8.1). The delivery of nursing care can be measured by the quality of documented nursing care, the amount of time nurses have available for hands-on patient care and a reduction in medication errors. Nursing documentation is the only evidence of nursing care given to the patient. The time nurses have available for patient care has a direct impact on the delivery of nursing care. The more time nurses spend with patients, the better the delivery of nursing should be (Kuo, Liu and Ma 2013: 2). Medication errors negatively impact on the quality of nursing care delivered. Ammenwerth *et al*. (2010: 34-37) used these criteria to measure the effects of the introduction of a computer-based information system on the delivery of nursing care.

One of the reasons for the increased focus on the delivery of nursing care is that patients have internet access to medical information where they previously did not. Another reason is because patients and their relatives demand quality service for the amount of money they need to pay for the healthcare they receive, especially considering the current economic

climate and the fact that patients are very aware of their rights (Murray 2010: 5). Consequently, there has been an increase in litigation where patients or their relatives are dissatisfied with the nursing care they or their loved one has received (Tzeng, Yin and Schneider 2013: 13). There is therefore a need for accurate and complete patient records, which comply with the requirements of legal record keeping (Mahler *et al*. 2007: 274).

1.2.1 Paper-based documentation

Paper-based documentation is frequently incomplete and does not always provide an accurate record of care rendered. They are sometimes lost, thereby exacerbating the problem of having an incomplete record of nursing care rendered (Furst *et al.* 2013: 131). The paper-based record may be inaccurate, where errors are made such as filing the incorrect patient's results in a patient's file (Rothstein 2010: 10). Paper-based documents are also not always accessible to all members of the multidisciplinary team working from different places (Robles 2009: 32). One example is when nurses are unable to refer to the patient's prescription card for the administration of medication because it is in the pharmacy for the dispensing of medication. Furthermore, paper-based documentation does not always comply with legal requirements (Mahler *et al.* 2007: 274). Entries may be illegible, dates or times may have been omitted, or there may be overwriting in an attempt to correct an error. Errors can also be made when entering patient data from cardiac monitors, infusion pumps or telephonically communicated results to investigations onto paper-based patient documentation (Robles 2009: 33). This leads to the credibility and validity of the nursing record being questionable.

Planned nursing care, when using paper-based documentation, may be inappropriate or inadequate (Ammenwerth *et al.* 2010: 29). Nurses may also fail to identify and appropriately act on patient risks such as allergies or high waterlow score, which would alert nurses to the fact that the patient is at risk of developing decubitus ulcers (Robles 2009: 33). Paper-based nursing care plans are often not amended when the patient's condition changes (Mahler *et al.* 2007: 278). As a result of this, nursing care is not tailored to the patient's needs. Poorly planned nursing care can result in poor quality nursing care (Robles 2009: 33). A reason for poor care planning may be because nursing care plans take so long to draw up (Ammenwerth *et al.* 2010: 30).

1.2.2 Time available for patient care

A common complaint from nurses today is that they do not have enough time for hands-on patient care. This negatively affects nursing care given to patients. Documentation of nursing care rendered using paper-based documentation takes up much of a nurse's time (Cipriano 2011: 289). One of the reasons for this is because there is often duplication involved with paper-based documentation (Ammenwerth *et al.* 2010: 30). An example of this is where the patient's diagnosis, allergies and co-morbidities need to be recorded on a variety of the patient's documents. Precious nursing time is also wasted on repetitive activities such as preparing admissions and discharge documentation, and placing patient stickers with all their details on each patient document (Furukawa, Raghu and Shao 2010: 944).

In addition to this, time is wasted transferring already-documented information from one document to another (Ammenwerth *et al.* 2010: 29). Time is also wasted when nurses need to wait for a chart before they can

do their work because the patient's chart is inaccessible at the time (Robles 2009: 32). A patient's chart may be inaccessible when the pharmacy chart is in the pharmacy for the dispensing of medication. Another example of why the patient's chart may be inaccessible is because the doctor is using the chart to write up notes or order treatment. Again, nursing time is wasted when nurses need to track down doctors to clarify doctors' orders which are unclear, due for example, to the doctor's handwriting being illegible, or to obtain more information where the doctor's order has been incomplete (Robles 2009: 34). Computerised systems help to eliminate illegible and incomplete doctors' orders (Al-Dorzi *et al.* 2011: 5-6). Furthermore, duties such as following up on, receiving and communicating results for ordered investigations such as blood tests and X-rays can be time consuming (Furst *et al.* 2013: 131-132). This takes up time which could have been better spent on hands-on patient care.

1.2.3 Medication errors

Medication errors, which can harm patients and even result in the death of patients, are common in hospitals (Poon *et al.* 2010: 1698). This is a huge concern in the healthcare setting and negatively impacts on the quality of nursing care delivered (Furst *et al.* 2013: 132). Medication errors frequently occur during the administration of the medication (Poon *et al.* 2010: 1698). Medication errors can result from the doctor's handwritten order failing to comply with the requirements for a legal medication script (Donyai *et al.* 2007: 233). The order may be illegible, resulting in medication errors being made by nurses when they misinterpret the illegible order (Simon *et al.* 2013: 6). Similarly, errors can be made where nurses misinterpret abbreviations the doctor has used. The order may also be incomplete, for example where the doctor fails to

indicate the route of the medication. Additionally, errors can be made when nurses make errors in transcribing an order or when taking down a telephonic order received from the doctor, resulting in the patient receiving the incorrect treatment (Tzeng, Yin and Schneider 2013: 14).

Medication errors are often made when the nurse needs to transcribe the doctor's order or during the administration of the medication (Poon *et al.* 2010: 1698). Errors can be made when nurses fails to check the 'five rights', in other words, that the correct medication is administered to the correct patient in the correct dosage via the correct route at the correct time (Tremblay 2010: iii).

1.2.4 Information technology

The aim of introducing IT to nursing is the improvement of the quality of patient care (Liu 2009: 7). Information technology is also aimed at contributing to enhanced patient safety and the facilitation of the efficient delivery of nursing care (Cipriano 2011: 286). Research conducted by Mahler *et al.* (2007: 274, 275, 281) and Ammenwerth *et al.* (2010: 30, 33) has shown that in some cases IT positively affects the delivery of nursing care, but in other cases it may impact negatively on it instead. One instance is where IT can increase the documentation workload, thereby reducing the amount of time nurses have for nursing care. Another instance is where the standardisation and uniformity of documentation is seen to impair critical thinking (Ammenwerth *et al.* 2010: 26, 32).

1.3 PROBLEM STATEMENT

Some hospitals in South Africa have changed to a computer-based system for the delivery of nursing care and nursing documentation, whereas others still use a paper-based system. It is claimed that IT saves

nurses' time, is more accurate than paper-based documentation and helps to prevent medication errors. There is the question of whether the use of IT in healthcare will improve the quality of nursing care in South Africa or have a negative effect instead. The effects of IT on the delivery of nursing care has been researched extensively in first-world countries, however it has not been well researched in developing countries. There is therefore the need to investigate how IT affects the delivery of nursing care in a developing country such as South Africa.

1.4 RESEARCH QUESTION

What is the effect of IT in healthcare on the delivery of nursing care in South Africa?

1.5 AIM OF THE STUDY

The aim of the study is to determine the effects of IT on the delivery of nursing care as experienced by registered and enrolled nurses working in the hospital setting.

1.6 OBJECTIVES OF THE STUDY

The objectives of this research are to determine the effects of IT on the delivery of nursing care as measured by:

- The quality of nursing documentation evidenced by:
    - The appropriateness of nursing care plans.
    - The compliance of nursing documentation with the legal requirements of recordkeeping.
    - The accuracy and completeness of the record of nursing care.
- The amount of time nurses have available for patient care when IT is used in nursing as opposed to when a paper-based documentation system is used.

- The reduction of medication errors as measured by:
    - The compliance of the doctor's medication script with the requirements for a legal script.
    - A reduction in the need for transcriptions and taking telephonic orders.
    - A reduction in errors when taking telephonic orders.
    - Alerting the nurse if any of the 'five rights' are incorrect.
    - Alerting the nurse of drug interactions, contra-indications and allergies.

1.7 HYPOTHESES

1.7.1 hypothesis

There is no relationship between the quality of the delivery of nursing care and the use of IT.

1.7.2 Alternate hypothesis

The quality of the delivery of nursing care is positively affected by the use of IT in nursing.

1.8 Brief description of Methodology

A quantitative comparative descriptive design is used in this study to compare the delivery of nursing care in two public hospitals in the eThekwini district in KwaZulu-Natal (KZN). A pilot study was conducted prior to the main study in order to detect any problems with the data-collection instrument and the data collection process.

1.9 LIST OF DEFINITIONS

1.9.1 Bar-coding medication administration: Bar-coding medication administration refers to a technology that ensures the five rights of

medication administration, in other words, that the correct medication is administered to the correct patient, at the correct time, in the correct dose via the correct route. This is done by means of scanning the patient's identity band and the medication to ensure that the five rights of medication administration are correct (Buerhaus 2013: 191).

1.9.2 Clinical decision support: Clinical decision support is a process for assisting health-related decisions by providing relevant and organised information with the purpose of improving health care delivery (Huston 2013: 8).

1.9.3 Computerised Physician/Provider Order Entry (CPOE): Computerised Physician/Provider Order Entry is a clinical software application designed for ordering medication electronically rather than on paper (Altuwaijri, Bahanshal and Almehaid 2011: 143).

1.9.4 Data interface: A data interface is a computer programme which connects different computer applications and allows for interaction between data from these applications (Sci-Tech Dictionary).

1.9.5 Electronic Health Record (EHR): The EHR is a digital repository of patient information which is stored and exchanged in a secure manner and is accessible to multiple authorised users (Hayrinen, Saranto and Nykanen 2008: 293).

1.9.6 Information processing: Information processing is defined as the generation, storing, manipulation and communication of patient information within an institution (Ammenwerth *et al.* 2010: 26)

1.9.7 Information technology (IT): For the purpose of this study, IT is defined as using technology to "retrieve, process and disseminate information electronically" by computer (Willmer 2007: 208). This includes retrieving health information such as blood results. It also includes organising health information (McCannon and O'Neal 2003: 339-340).

1.9.8 Medication error: An error made in the ordering, transcribing, dispensing, administering or monitoring of medication (Tremblay 2010: 13).

1.9.9 Nursing: The International Council of Nurses defines nursing as the care of the ill, well disabled or dying individuals, families, groups and communities, in a range of different settings; this includes health promotion and the prevention of illness (Definition of Nursing 2010). For the purpose of this study, nursing will be confined to the hospital setting.

1.9.10 Nursing care: Nursing care in this study is the planning, implementation and documentation of nursing care. It includes the admission and discharge of patients, the administration of medication to patients, ordering of investigations ordered by the doctor for patients and receiving the results for these investigations as well as communication with the doctor regarding patient care (Ammenwerth *et al.* 2010: 26).

1.9.11 Patient care: Patient care is the prevention, treatment and management of illness and includes the preservation of the mental of physical well-being through services provided by healthcare professionals (*The America Heritage Medical dictionary* 2007).

1.9.12 Patient safety: Patient safety is the absence of medical errors and accidental harm (Holden 2011: 11).

1.10 ETHICAL CONSIDERATIONS

Permission was obtained from the Department of Health (DOH) (Appendix C) and the management of each hospital (Appendices D and E) to use their hospital as the research setting, to distribute and collect questionnaires from registered nurses in their hospital who consented to participate, and to use the responses of these participants after ethical approval was obtained (Appendix A). Data collection only commenced once ethical approval and consent to conduct the proposed study had been received from the DOH and from both hospitals.

Ethical considerations, for example beneficence, respect for human dignity, justice and informed consent, will be discussed in chapter 3 (see section 3.10).

1.11 SIGNIFICANCE OF THE STUDY

The effects of IT on the delivery of nursing care and nursing documentation has been studied in first-world countries such as the United States of America (USA), Canada, Germany, England, Australia, Denmark and Austria. Some of these studies have investigated the impact of IT on nursing or compared the quality of nursing care (Ammenwerth *et al.* 2010: 25). Other studies investigated the effects of IT on the quality of nursing documentation before and after introduction of computer based documentation (Mahler *et al.* 2007: 274). Sweeny (2010: 528) discussed how advances in IT in perioperative nursing have the potential to improve the quality of nursing care by decreasing medication errors and reducing the time spent documenting nursing care. Robles

(2009: 31) studied the effects of IT on nurses' work, whereas Meadows (2002: 46) researched how IT can help nursing in light of the nursing shortage. The researcher has, however, not found any publications of studies conducted on the effects of IT on the delivery of nursing care in South Africa.

Some hospitals in South Africa have adopted computerised hospital information systems and use IT exclusively for the delivery of nursing care and nursing documentation, however many have not (Hamner, Issacs and Roode 2007: 63). Bearing in mind that the introduction of IT is expensive, as well as that there are negative effects resulting from computerised hospital information systems, the implications for introducing IT in nursing needs to be carefully considered before deciding to adopt a computer-based system for the delivery of nursing care (Weinger 2010: 2373). Considering this, as well as the controversy which exists in the literature concerning the effects of IT on the delivery of nursing care, this study will prove valuable. With the introduction of IT in the healthcare setting in South Africa, additional research is needed in settings other than those conducted in first-world countries such as the USA and Austria.

1.12 STRUCTURE OF THE DISSERTATION

- Chapter 1: Overview of the study

Chapter 1 provided an overview of the study by giving the background of the study, describing the significance of the study, presenting the problem statement, the aim and objectives of the study as well as outlining the relevant definition of concepts.

- Chapter 2: Literature review

Chapter 2 follows with a literature review on the available information concerning the electronic health record and how IT impacts on the time nurses have available for patient care and the prevention of medication errors.

- Chapter 3: Research methodology

The methodology of the study is discussed in chapter 3. The research design is described, as well as the study setting, study population and sampling method. In addition, the pilot study and data collection method are described, together with how the data will be analysed. The ethical considerations, strengths and limitations are also described.

- Chapter 4: Presentation of the results

The presentation of the findings of the study gathered from the data analysis and a summary of the results of the effects of IT on the delivery of nursing care are discussed in chapter 4.

- Chapter 5: Analysis and discussion of results

In chapter 5 the findings are discussed and concluded with recommendations for the use of IT in healthcare and for further study.

1.13 CONCLUSION

This chapter provided an overview of the study. The background of the study, the problem statement, the aim and objectives of the study as well as outlining the relevant definition of terms were presented. The next chapter is a literature review on the available information concerning the electronic health record, and how IT impacts on the time nurses have available for patient care and the prevention of medication errors.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 presented the background and rationale for this study. This chapter seeks to review what is currently known about the advances made in IT in nursing, as well as the impact that the use of IT in nursing has on patient care. The effects of the Electronic Health Record (EHR) in facilitating quality patient care and safety of the patient, the efficiency of nursing care by saving nurses' time, improving interdisciplinary communication and co-ordination of patient care, as well as improving the quality of nursing documentation, are all examined. Furthermore, the role of Computerised Physician/Provider Order Entry (CPOE) in the prevention of medication errors is explored. Conversely, there is a discussion about the ways in which IT has a negative impact on nursing care. Concerns are raised regarding IT failing to save nurses time, being unsuccessful in reducing medication errors, negatively affecting the quality of patient care and interfering with workflow.

2.2 ADVANCES MADE IN INFORMATION TECHNOLOGY IN NURSING

There are many advantages to using IT in nursing, the main focus however being assuring quality nursing care delivery (Hincapie and Warholak 2011: 499). Information technology in nursing has been defined as a "combination of computer science, information science and nursing science designed to assist in the management and processing of nursing data, information, and knowledge to support the practice of nursing and the delivery of nursing care" (Murray 2010: 3). It has also been described as the use of technology, research and professional experience to

manage nursing data, information and knowledge with the aim of improving practice and delivering better healthcare (Murray 2010: 3).

Information technology is meant to promote patient safety by minimising human error (Furst *et al.* 2013: 131). It also reduces repetitive activities such as preparing admissions and discharge documentation, thereby saving nurses time on administrative tasks and giving them more time for hands-on patient care (Furukawa, Raghu and Shao 2010: 944). Health IT has a number of components and includes the Electronic Health Record (EHR) and CPOE (Liu 2009: 2).

2.3 ELECTRONIC HEALTH RECORD

With the introduction of technology in the healthcare setting, many healthcare institutions in a number of countries around the world have adopted the EHR to replace traditional paper-based documentation (Liu 2009: 14). The EHR is a digital repository of patient information which is stored and exchanged in a secure manner and is accessible to multiple authorised users. It includes retrospective, current and prospective information and its main purpose is to support integrated, efficient and high quality health care (Hayrinen, Saranto and Nykanen 2008: 293). It includes an electronic record of patients' health information and data; computerised ordering of investigations; computerised, automatic display of test results; CPOE for the ordering of medication; computerised clinical decision support; electronic communication where data from all members of the multidisciplinary team in all settings are recorded and reported, as well as electronic billing and other administrative processes (Fetter 2009: 345-346).

There are several advantages to having electronic health records for patients. It is intended to address many of the problems posed by paper-based documentation systems (McGinn *et al.* 2011: 1). The primary purpose of the EHR is for planning patient care, documenting nursing care given and assessing whether the outcomes of nursing care have been achieved (Hayrinen, Saranto and Nykanen 2008: 292). A study conducted by Ammenwerth *et al.* (2010: 25) found that the introduction of a computer-based nursing information system significantly improved the quality of information processing in nursing. It showed improved support in planning patient care; more complete nursing documentation; a better overview of the patient; nursing documentation which complied with the requirements for legal record keeping and with improved availability; a reduction in the duplication of documentation and better workflow support through the use of task lists and checklists.

2.3.1 improves patient care

The EHR has been shown to improve the quality of patient care (Castillo, Martinez-Garcia and Pulido 2010: 2). It also enhances patient safety as well as the efficiency of healthcare delivery (Noblin *et al.* 2013: 1). Xue *et al.* (2012: 686) showed that the introduction of an EHR system had decreased infection and mortality rates. The EHR system improves decision making regarding patients' care (Blumenthal and Tavenner 2010: 501). It also supports cognitive work processes concerning patient care, thereby improving healthcare providers' awareness and keeping them informed of their patients. Additionally it improves the accuracy of orders due to order sets, a pre-specified set of orders the EHR recommends for particular patient conditions (Holden 2011: 18-19).

The EHR can improve the quality of nursing care by reducing medication errors, enhancing efficiency and improving patient safety and care (Xue *et al.* 2012: 683-684). King *et al.* (2014: 392) discussed how the use of the EHR enhanced overall patient care. Lee, Kuo and Goodwin (2013: 4-5) indicated that the adoption of the EHR reduced patients' length of stay as well as patient 30-day mortality rates. The shorter length of stay associated with the EHR may be due to the EHR facilitating more efficient ordering of investigations, procedures and medications. Xue *et al.* (2012: 686) also found that the introduction of the EHR reduced patients' length of stay.

The EHR includes computerised clinical decision support. Clinical decision support helps improve the quality of patient care by reducing errors (Lee, Kuo and Goodwin 2013: 1). Nurses can use IT to access evidence-based information, thereby keeping their knowledge current and ensuring their practice is of the highest quality (Baumbach 2006: 45-46). This enhances the quality of nursing care by ensuring treatment received is based on evidence and best practices (Huston 2013: 3). The findings of a national study by King *et al*. (2014: 400) showed that the majority of those who adopted EHR reported that it improved nursing care, clinical care, patient safety and efficiency. McGinn *et al.* (2011: 2) also discussed how the EHR contributed to safer and more efficient nursing care.

2.3.2 provides a single consolidated patient record

In addition, clinical data from various departments such as the laboratory, radiology, pharmacy and nursing is integrated into a single consolidated patient record, thereby reducing duplication (Cox 2006: 554). The advantage of having a single consolidated record per patient is that it is readily accessible by all members of the multidisciplinary team, can be

accessed from a variety of locations and is available all the time (Huston 2013: 2, 7). It also enhances the efficient retrieval of relevant patient information (Furst *et al.* 2013: 131). Noblin *et al.* (2013: 3) supported the opinion that the EHR facilitates quick retrieval of patient data. Holden (2011: 16-17) affirmed that healthcare providers stated that finding patient information was much simpler due to better organisation, as well as software features such as configurable displays, sorting options and alphabetising of patient data. Improved and convenient access to patient information has been reported to be one of the main advantages of the EHR (Bouamrane and Mair 2013: 5).

Another advantage of having a single consolidated patient record is that there is improved interdisciplinary communication and co-ordination of patient care between different members of the multidisciplinary team, which contributes to the efficiency of nursing care and continuity of patient care (Furukawa, Raghu and Shao 2010: 942). The EHR also allows for knowledge sharing between members of the multidisciplinary team, facilitating collaborative decision making concerning patient care (McGinn *et al.* 2011: 2).

The information provided in the EHR is always relevant and up-to-date (McGinn *et al.* 2011: 2). The EHR contains patients' records over an extended period of time, eliminating the need to keep asking the patient for a health history at every hospital visit (Rothstein 2010: 9). Nurses have also found that having access to the patient's health record prior to admission or transfer helps them to anticipate the patient's needs (Robles 2009: 31-33). It can prevent the loss of patient records due to natural disasters such as floods or fires, as the information is stored electronically (Goldschmidt 2012: 88). The EHR also has built-in safeguards to ensure

confidentiality and security of patients' records (Huston 2013: 7). This prevents access to sensitive and confidential information by unauthorised persons. The EHR eliminates the need for paper records, thus reducing storage space needs (Bouamrane and Mair 2013: 7).

2.3.3 Capacity for data interfaces and alerts

A major advantage of the EHR is the "capacity for data interfaces and alerts" (Robles 2009: 31). Patient data from, for instance, cardiac monitors, ventilators and intravenous pumps is automatically entered in the patient's electronic record, saving valuable nursing time and reducing data entry errors. Alerts for allergies, drug interactions and medication doses are automatic and enhance patient safety (Furst *et al.* 2013: 131-132). The EHR also has alerts for abnormal laboratory results received, and facilitates the ordering of appropriate tests. Importantly, it has reminders for the appropriate ordering of preventative care such as vaccines and screening for cancer, as well as to ensure care meets clinical guidelines for patients with chronic conditions (King *et al.* 2014: 392; 397). The EHR includes reminders, thereby ensuring that tasks are not forgotten (Bouamrane and Mair 2013: 6). This is a very useful function in a busy hospital environment, especially where nurses forgetting to do certain tasks may potentially be life-threatening to the patient. The EHR can also reduce safety risks by preventing information from being omitted due to human error (Sweeny 2010: 534).

Standardised documentation provided by the EHR facilitates quicker and easier recording (Goldschmidt 2012: 89). Templates for documentation facilitate more efficient and organised recording of nursing care (Furst *et al.* 2013: 131) and they also assist with more predictable and consistent recording of nursing care (Noblin *et al.* 2013: 6). Standardised nursing

care plans as well as suggestions for nursing care relevant to specific diagnoses, co-morbidities and risks, can assist nurses with planning and implementing the most appropriate nursing care (Furukawa, Raghu and Shao 2010: 944). An example is where a high waterlow score, identifying a patient being at risk for developing decubitus ulcers, triggers a care plan to prevent decubitus ulcer development. Standardised nursing care plans also facilitate nurses' use of evidence-based practice (Furst *et al.* 2013: 132). Mahler *et al.* (2007: 278) indicated that paper-based conventional nursing care plans are seldom adjusted during the patient's stay, however after the introduction of a computer-based documentation system it was found that the nursing care plans were amended significantly more often. This unquestionably contributes to high quality nursing care. The integration of clinical data facilitates interactions between various patient data elements, best practice, as well as critical thinking (Cox 2006: 554).

The EHR assists the prompt implementation of doctors' orders. It alerts doctors of any precautions or contraindications to medication being prescribed, or additional information required for an ordered investigation. This eliminates the need for nurses to track down the doctor or perform actions out of their scope of practice in an attempt to rectify the gaps in the doctor's order (Robles 2009: 33-34).

2.3.4 EHR improves the quality of nursing documentation

Furthermore, the EHR is aimed at improving the quality of nursing documentation by helping to fulfil the legal requirements for documentation and providing a more accurate and complete record of nursing care rendered (Ammenwerth *et al.* 2010: 29-30). The EHR improves the completeness of records and facilitates more detailed documentation (Noblin *et al*. 2013: 5). It also enhances the accuracy of documentation and provides more comprehensive information (Hayrinen,

Saranto and Nykanen 2008: 297-298). Mahler *et al.* (2007: 274) explain how electronic recording resulted in more complete documentation and a better integration of the nursing process into nursing record keeping. Compliance with legal requirements for documentation was shown to improve after the introduction of a computer-based documentation system. Dating and signing of nursing entries in particular improved significantly, due to nurses logging on with their own password and data entries being dated automatically. Nursing entries were also found to be more scientific and free of slang and phrases with negative connotations (Mahler *et al.* 2007: 280). Holroyd-Leduc *et al.* (2011: 733) outlined how the EHR eliminated the issue of nursing entries being illegible.

Accurate, complete, detailed and comprehensive patient documentation, which adheres to the principles of legal documentation, is essential in nursing today. The reason for this is because the public has access to medical information, such as surgical or diagnostic procedures and the latest treatment for various illnesses, which they did not have previously (Cipriano 2011: 289). Due to the public having access to this kind of information, they have certain expectations regarding nursing care and may question the care received (Quail 2015: 66). Additionally, the public are very aware of their rights and due to this, there is an increase in litigation in healthcare where the patients or their relatives are dissatisfied with the care they have received (Jylha, Saranto and Bates 2011: 188). Nowadays, nurses are being sued for negligence more than ever before (Tseng, Yin and Schneider 2013: 13).

Information technology can therefore help to reduce litigation as well as provide evidence of care rendered that is of better quality than that

provided with paper-based documentation, should a case go to court. Patient documentation is the only evidence of nursing care given to the patient. Even if excellent nursing care was given to the patient, if the documented nursing care fails to reflect the appropriate nursing care then the nursing care will be interpreted as inadequate by patients, their relatives and lawyers in the case of litigation (Furst *et al.* 2013: 133). Good documentation of nursing care given to patients is therefore essential. The data which is made available as a result of IT availability and usage can be used to defend the actions of nurses when there is an allegation of nursing negligence (Quail 2015: 49; 56).

2.3.5 Concerns regarding EHR

Alternatively, Mahler *et al.* (2007: 274, 275, 281) posited that the quality of nursing documentation is not necessarily improved by the introduction of the EHR. Holden (2010: 74) expressed that the EHR did not contribute toward a more complete record of nursing care, but rather that the record was less informative and less complete than with paper-based documentation. The issue of IT not necessarily resulting in better quality and use of patient information was also reported by Murray (2010: 2). Studies by Sahlstedt and Nahm (cited in Mahler et al. 2007: 275) have revealed that electronic recording has improved the quality of documented nursing care, whereas the study by Larabee (cited in Mahler et al. 2007: 275) found that there was no initial improvement in the quality of nursing documentation, this occurred only after the re-education of nurses. Furukawa, Raghu and Shao (2010: 951, 954) found that the EHR did not significantly improve patient outcomes; instead, it resulted in a longer length of stay for the patient and increased the rate of complications in patient care.

There is also a concern that the standardisation of documentation may impair critical thinking (Ammenwerth *et al.* 2010: 33). Mahler *et al.* (2007: 281) raised a concern that standardised nursing care plans may result in nurses using them without much thought going into the nursing care they are planning for the patient. Some are of the opinion that the use of templates discourages nurses from providing a complete record of care given (Furst *et al.* 2013: 131-132). Templates can also restrict nurses in what they are able to record (Noblin *et al.* 2013: 6). Holden (2011: 14) asserted that the EHR can deteriorate cognitive performance by degrading communication and collaboration, replacing traditional tasks with ones that are more challenging and changing healthcare providers' interpretation of patient data.

Moreover, the EHR may result in nurses' overreliance on technology, with nurses expecting the computer to prompt and alert them to what they would normally need to do independently (Cowen 2013: 28). This may impair nurses' critical thinking skills. The concern that nurses may not use their judgement to determine whether values correlate with the patient's current condition was raised by Robles (2009: 33). An example is when abnormal values are reflected on the EHR when all the patient is doing is moving in bed, or an electrode has come off. Robles (2009: 33) also highlighted the issue of the EHR performing certain functions, for example calculating fluid balance, cardiac output or body mass index, which nurses used to need to calculate themselves. Nurses may become over-reliant on the EHR and forget that patient assessment is their responsibility and that the computer cannot think critically, as nurses have been trained to do.

It has been reported that the EHR can divert attention away from the primary task because there is so much information on the system to focus on (Bouamrane and Mair 2013: 6). This may result in errors being made. Robles (2009: 33) propounded that having too many alerts hinders users of the system, instead of being helpful. There is also a concern that the EHR requires nurses to enter patient information away from the patient's bedside, resulting in delays in recording patient data as well as potential errors being made (Hegney *et al.* 2007: 17). Holden (2011: 19) expressed that sometimes it was difficult to find information due to an overload of information in the EHR system. In addition, it has been found that patient information can be challenging to access in the EHR, even for the technologically competent user (Holden 2010).

There have been many reports of patients being harmed due to errors in the EHR (Mertz 2012: 47). There is a risk of mistakenly entering data in the incorrect patient's record with systems which allow users to open multiple records at the same time (Bouamrane and Mair 2013: 6). This may result in patients being harmed, the death of patients and litigation.

There have also been reports of the EHR being inflexible and therefore interfering with existing work practices (Bouamrane and Mair 2013: 5). Technical limitations related to software or hardware are a concern of the EHR. Another issue is problems with the system such as the system being slow (McGinn *et al.* 2011: 4), unplanned downtime due to the host server going down, back-up failures and power failures (Schrieber 2013: 14). As a result, the EHR can interfere with the delivery of nursing care (McGinn *et al.* 2011: 5).

The EHR is intended to ensure information is not lost. It has been reported, however, that sometimes information was not in the system, for example old records or test results. There have been reports of results of investigations being made available on the system much later than they should be, sometimes even after the patient has been discharged. This clearly has a negative impact on the quality of patient care. Another shortcoming of the EHR is when information is copied and pasted, rather than creating relevant information. This is of particular concern if incorrect information is copied and pasted. Access to a computer or remote access gateway is sometimes a problem. It has also been mentioned that during the initial implementation phase technical support was at hand, but not afterwards (Holden 2010: 74-76).

Furthermore, there are concerns that the EHR may compromise the privacy and confidentiality of patient information within the healthcare organisation, or through electronic links to other organisations. Additionally, there are fears of a loss of personal and professional privacy (McGinn *et al.* 2011: 5). Rothstein (2010: 8-9) reported in detail that because numerous members of the healthcare team, for example doctors, nurses, pharmacists, laboratory and radiography departments, have access to the EHR, privacy and confidentiality of patient information is difficult to maintain. Furthermore, the EHR may decrease the face-to-face interaction with patients (Bouamrane and Mair 2013: 2).

Holden (2011: 13) asserted that EHRs can create errors, thereby negatively impacting patient safety. Shield *et al.* (2010: 316) reported that the EHR has unanticipated negative consequences. Patient safety and the efficiency of the EHR can be compromised if it is not correctly designed, implemented or installed (Sweeny 2010: 534). Unintentional

overbilling of patients can occur, negatively impacting on the cost of healthcare to the patient (Schrieber 2013: 14). It has also been reported that system failures may occur, which disrupts workflow (Bouamrane and Mair 2013: 5). Moreover, Holden (2011: 1) is of the opinion that EHRs do not directly improve nursing care, but that the effect is dependent on the efficacy of the system. The EHR can therefore positively as well as negatively impact on patient outcomes (Holroyd-Leduc *et al.* 2011: 735-736).

Another issue is that the implementation of the EHR is costly (Huston 2013: 2). Concerns include the lack of resources and funding, and considerable start-up costs. Equally important are the considerable ongoing maintenance costs. In addition to requiring substantial financial investment, it also needs the installation of complicated wireless network infrastructure, which is also costly (McGinn *et al.* 2011: 5). Implementation is also complex and requires much planning, policy development, staff training and rollout programmes (Naser 2012: 44). The implementation of an electronic documentation system may therefore not always be financially feasible.

Notwithstanding costs, the healthcare staff, for example nurses and doctors, whom the EHR is intended to benefit, may be resistant to changing the traditional ways of doing things. One reason for this resistance may be that they are not adequately computer literate. Continuous education and training is thus required to ensure that users of the EHR have the required skills (Kuo, Liu and Ma 2013: 2; 11). This is expensive and requires much time. Even for the computer literate individuals, extensive training is required when traditional ways of nursing and documentation, and ordering of medications and investigations, are

replaced with the EHR. Once again, this takes time and is costly. Another reason for resistance to the use of the EHR is that some users may have negative perceptions about the usefulness of the system (Naser 2012: 52). It is thus apparent that computer-based documentation is not the remedy for all the problems experienced with paper-based-documentation (Robles 2009: 32).

2.4 TIME SAVED

The EHR is intended to save nurses time. It can help nurses complete their nursing tasks and the relevant documentation more efficiently and effectively (Kuo, Liu and Ma 2013: 2). Holroyd-Leduc *et al.* (2011: 733) espoused that users of the EHR had more time for their patients. Robles (2009: 32) suggested that nurses spend more time on the computer when the EHR is initially implemented, but as nurses become more familiar with the processes of electronic recording, using the EHR for recording patient care is quick and efficient. It can eliminate the need to duplicate data through the re-usage of already documented patient data (Ammenwerth *et al.* 2010: 29, 30). Patient data, such as vital signs, can be recorded electronically through data interfaces, again eliminating the need to duplicate data available on the system (Furst *et al.* 2013: 131). As patient information is saved on the system, nurses will have immediate access to historical information in anticipation of an admission or transfer in (Meadows 2002: 47, 48). This will save nurses time by eliminating the need to obtain a history from the patient, as the information will already be available to the nurse. It will also save nurses time in eliminating the need to search for paper documentation. Patient information is also more easily retrieved, again saving nurses time (Hayrinen, Saranto and Nykanen 2008: 299).

Standardised and uniform nursing care plans and documentation, introduced through computer-based patient documentation systems, are intended to enable easier and quicker documentation and planning of patient care thereby saving nurses time (Furst *et al.* 2013: 132). Ordering and receiving of investigations is quicker and easier using the EHR, again saving nurses time (Fairly *et al.* 2013: 1). Time is saved as orders and the sending of requests for those orders are done electronically, eliminating the need for completing handwritten forms or making telephone calls. Results for ordered investigations are electronic, eliminating the need to take telephonic results or phoning for results when not provided promptly (Fairly *et al.* 2013: 6).

Moreover, time is saved because nurses do not need to phone the doctor for medication orders which are illegible or incomplete (Simon *et al.* 2013: 6). Some EHR systems have a feature that allows nurses to text-page doctors with requests, concerns or queries. Frequently there is a response from the doctor when she next logs onto the patient's chart (Robles 2009: 34). This saves nurses' time by eliminating the need to try to reach the doctor telephonically. IT can avoid nurses needing to perform unnecessary tasks, giving them more time for direct patient care (Cipriano 2011: 289).

Since electronic records are always accessible and investigation results are readily available, valuable nursing time is saved (Xue *et al.* 2012: 686). The EHR can be accessed by multiple users at the same time. For example, the doctor can be ordering medication and investigations, the nurse can be entering data and the laboratory can be checking patient details for ordered laboratory tests all at the same time. This is very convenient and saves nurses time in that they do not need to wait for the

patient record when someone else is busy with it before she can carry out her duties (Bouamrane and Mair 2013: 8).

It has been reported, however, that the EHR disrupts workflow and results in a break in communication, thereby negatively impacting on nursing care (Mertz 2012: 47). Studies have revealed that EHR use is time-consuming and not time-saving (McGinn *et al.* 2011: 6). Ammenwerth *et al.* (2010: 29) reported that the time nurses spent on documentation increased from 25% before the introduction of a computer-based information system, to 41% afterwards. Information technology can result in an increase in computer-related tasks, which will increase the amount of time nurses need to spend on the computer and decrease the time nurses have for patient care. It has also been reported that the EHR requires added administrative tasks, resulting in nurses having less time to spend on patient care (Ammenwerth *et al.* 2010: 30). McGinn *et al.* (2011: 5) established that the EHR has a negative impact on the relationship between patients and nurses, resulting in less contact with the patient due to the need to interact with technology. This interrupted the nurses' ability to deliver direct patient care. Once again, this results in less time available for patient care instead of saving nurses time (Bouamrane and Mair 2013: 5).

Fairly *et al.* (2013: 1; 4) asserted that in some instances the introduction of the EHR increased efficiency, thereby saving nurses time, however in other instances there was no change or even a reduction in efficiency. In some cases the EHR was reported as user-friendly, easy to use and thus an important tool in facilitating efficient work processes; in other cases the EHR was perceived as difficult to understand and use, with confusing screens, options and navigational aids. Inadequate interfacing of the EHR

with other IT systems can result in data not being available in the EHR. It may then be necessary to revert to paper-based systems where the gaps exist. An example is where the EHR is not connected to an external service provider such as the laboratory, with laboratory results thus needing to be retrieved using a paper-based system (McGinn *et al.* 2011: 4-5).

The amount of time nurses need to spend on documentation can be increased by IT (Furukawa, Raghu and Shao 2010: 944). It has been reported that writing with pen and paper is faster than typing. The need to scroll through information to locate the desired data is particularly time-consuming (Holden 2011: 23). Logging into and out of the EHR system can also be time-consuming (Holden 2011: 19, 21). Robles (2009: 33) is of the opinion that a well-designed computer-based documentation system is more time-consuming than paper-based documentation systems because it ensures the correct processes are followed, that policies are adhered to, and that shortcuts and the disregarding of rules are avoided. An increase in the time nurses need to spend on the computer and on documentation will consequently decrease the time nurses have for patient care (Funk 2011: 286).

Time is wasted when the CPOE is shut down for routine maintenance or when the system crashes, which has been reported as a common occurence. Moreover, in some instances nurses need to record the administration of medication on paper charts in addition to the CPOE, further wasting time (Koppel *et al.* 2005: 1201). The CPOE also requires the pharmacist to enter medication orders on the system before nurses are able to administer medication to patients. It has been reported that the pharmacy often makes mistakes. Nurses therefore need to check

what the pharmacy has entered on the system against the original orders to ensure that the orders have been correctly entered. This once again wastes nurses' time (Tremblay 2010: 90).

2.5 PREVENTION OF MEDICATION ERRORS

Medication errors can occur at any stage of medication administration, from ordering and dispensing to the administration of the medication (Liu 2009: 18). Transcription errors (nurses incorrectly writing down a previous order) also contribute to medication errors (Poon *et al.* 2010: 1699). Prescribing errors are a common cause of medication errors. Many prescribing errors involve incomplete or unclear medication orders written by doctors (Donyai *et al.* 2007: 231; 233). Medication errors can also occur where nurses fail to record that they have administered a medication, resulting in a double dose being administered to the patient. CPOE has been introduced in many healthcare institutions in response to the concerning incidences of medication errors (Altuwaijri, Bahanshal and Almehaid 2011: 143). It has been shown to reduce medication errors (Huston 2013: 3).

2.5.1 2.5.1 CPOE

Computerised systems for doctors ordering medication are aimed at improving patient safety by reducing medication errors, which are often a result of faulty prescriptions (Al-Dorzi *et al.* 2011: 1). They eliminate illegible orders and ensure that the information on the order is complete (Tremblay 2010: 6, 32-34). Prescribing errors have also been shown to be significantly reduced with the use of the CPOE. Prescription errors involving incomplete or unclear orders were found to be completely eliminated (Donyai *et al.* 2007: 233). The CPOE helps to prevent errors associated with similar drug names (Koppel *et al.* 2005: 1198). The

accuracy of orders are improved by the CPOE by eliminating the need for doctors to rely on memory (Holden 2010: 74). The doctor is able to order medications on the system even when they are not at the patient's bedside, eliminating the need for telephonic orders and thereby reducing the potential for a medication error (Niazkhani *et al*. 2009: 542). It has been found that the CPOE systems improve medication turnaround time, in other words the time taken from the ordering of the medication to delivery to the ward (Stone *et al.* 2009: 965). The orders reach the pharmacy and are delivered to the ward more quickly, thus resulting in the patient receiving medication more promptly than with paper-based prescriptions (Koppel *et al.* 2005: 1198).

In addition, the CPOE eliminates the need for nurses to transcribe medication orders as the system imports medication orders electronically, thus reducing the possibility of an error being made while transcribing (Niazkhani *et al.* 2009: 544). The CPOE produces clear, neat and legible typed orders, eliminating mistakes being made due to the incorrect interpretation of an illegible prescription (Huston 2013: 8). The results of a study by Poon *et al.* (2010: 1698) revealed how transcription errors were completely eliminated by the use of the CPOE.

2.5.2 Clinical decision support

Many CPOE systems have an integrated clinical decision support system (Tremblay 2010: 34-35). This offers evidence-based clinical support to the prescribing doctor, thereby preventing prescription errors (Al-Dorzi *et al.* 2011: 6). Kaushal *et al.* (2001: 2115) affirmed that clinical decision support systems dramatically reduced medication errors. An integrated alert system is also part of the CPOE, thereby warning the doctor of, for example, contra-indications, drug interactions, allergies and incorrect

dosages (Bey-Hwa *et al.* 2012: 3817). Importantly, it alerts the doctor to drug interactions (Koppel *et al.* 2005: 1198). These alerts have been reported to prevent potential medication errors (King *et al.* 2014: 392). Furthermore, the CPOE interfaces with the information in the EHR such as test results and clinical documentation, alerting the doctor of the appropriateness of medications based on findings from, for example, laboratory results (Prevent unintended consequences when rolling out computerized physician order entry 2009: 4).

2.5.3 Bar-coding verification system

A large portion of medication errors occur during the administration of medication to patients by nurses. The bar-coding verification system has been introduced to help prevent medication errors being made whilst administering medication; this has proved to be useful in the reduction of medication administration errors (Poon *et al.* 2010: 1698). The bar-coding system for medication administration verifies the 'five rights' before the administration of the medication; in other words that the correct medication is given to the correct patient, at the correct time, in the correct dose, via the correct route. The patient and the medication are identified with a bar-coded strip which the nurse scans before administering the medication, reducing mistakes made due to human error. If any of the 'five rights' are incorrect an error message is displayed, thereby alerting nurses and avoiding medication errors. The programme also detects other potential problems such as drug interactions; contra-indications and allergies; reduces the incidences of drug-to-drug interactions; the medication being administered where it is contra-indicated; allergic reactions and anaphylaxis (Furst *et al.* 2013: 132). Furthermore, it prevents missed doses of medication by alerting nurses if the medication is overdue.

The bar-coding system has been proven to be effective in preventing dispensing errors by pharmacists (Poon *et al.* 2010: 1699). A systematic review by Al-Dorzi *et al.* (2011: 6) showed a significant reduction in medication errors and adverse drug events, as well as a reduction in mortality rates. Poon *et al.* (2010: 1698-1699; 1701) demonstrated that there was a significant reduction in the rate of incorrect medications administered, medications given at the incorrect time, incorrect dosages of medications administered and administration documentation errors with the use of bar-coding system for medication administration.

The bar-coding verification system is usually used in combination with an electronic medication administration system, allowing nurses to automatically record the administration of medication by means of bar-coding (Poon *et al.* 2010: 1699). This will ensure the accurate recording of administered medication and also prevent the administering of double doses because nurses have failed to record that the medication had been administered. The bar-coding system prevents missed doses of medication by alerting nurses if the medication is overdue (Poon *et al.* 2010: 1699).

2.5.4 Access to information about medication

Furthermore, nurses are able to access information about medication, for example indications, usage and side-effects, facilitating the prevention of medication errors (Tremblay 2010: 5). This information ensures nurses are knowledgeable about the medications they are administering and also assists nurses to give patients relevant and factually correct health education about their medications (Buerhaus 2013: 193).

Although there are undoubtedly numerous advantages of the CPOE system, its effectiveness has been questioned. Stone *et al.* (2009: 961)

found that medication errors did not significantly decrease following the introduction of a CPOE system. Additionally, Stone *et al.* (2009: 960) indicated that the CPOE can increase efficiency, although refinements are required to improve patient safety. The system can result in new types of errors which can negatively impact on patient safety (Al-Dorzi *et al.* 2011: 1). Holroyd-Leduc *et al.* (2011: 732) established that mostly minor errors were prevented with the CPOE and that it could increase the frequency of duplicate orders as well as result in failures in the discontinuation of medications.

2.5.5 Disadvantages of CPOE

Koppel *et al.* (2005: 1197; 1200-1202) identified 22 types of unintended medication errors facilitated by the CPOE system. These errors included double-dosing patients; missing allergy alerts; medication ordered on the incorrect patient; the incorrect medication being ordered; errors of omission; duplicate medication orders and nurses being unaware that a medication had been ordered. Other examples include fragmented CPOE displays which prevent a comprehensive view of the patient's medication, incompatible orders and rigid formats for the ordering of medications, which result in the generation of incorrect orders. These errors will have a negative impact on patient safety and hence, on the quality of nursing care delivered (Bey-Hwa *et al.* 2012: 3818).

Some of the ways that the CPOE is thought to contribute to medication errors is where alarms are ignored, the system crashing and the doctor ordering medication on the incorrect patient's EHR. Ordering of medication on the incorrect patient's EHR is a result of the names of patients being close together on the system, the font being small and most alarmingly, that not all CPOE screens have the patient's name on

them. Double-dosing may occur because the process for ordering new or adjusting existing medications is a separate process from discontinuing medications. If the doctor therefore fails to discontinue existing medication when ordering new or adjusting existing medications, double-dosing may occur (Koppel *et al.* 2005: 1199-1201). It has been reported that it is difficult to determine the last dose administered or to see previous medication administration patterns (Tremblay 2010: 89). Errors involving the selection of the incorrect dose or frequency of medication administration have also been reported, as well as the inappropriate use or selection of default doses (Donyai *et al.* 2007: 235).

Koppel *et al.* (2005: 1200) explained that doctors prescribe the incorrect dosage of medication because they rely on the dosages listed in the CPOE display, which are based on the strength the pharmacy has in stock and not on clinical guidelines. An example is where the usual dosage of a medication is at 30mg but the pharmacy has a 10mg in stock, which is the dosage displayed on the CPOE screen, and the doctor incorrectly prescribes 10mg instead of 30mg.

Reports of increased mortality rates associated with the introduction of the CPOE are alarming. There is an instance where the mortality rate in a paediatric intensive care doubled after the introduction of a CPOE system (Mertz 2012: 47). Another case is where the mortality rate in a children's' hospital rose considerably after a CPOE was implemented (Prevent unintended consequences when rolling out computerized physician order entry 2009: 3).

Furthermore, it has been reported that some CPOE systems are difficult to use and learn. There have been reports that technology failures impact

negatively on the success of the CPOE. If the system crashes whist an order is being entered, the order will be lost. The order will then only be able to be re-entered once the system has restarted. It has been reported that this increases the risk of errors being made. Further reports indicate that system crashes are common. There are times when the CPOE needs to be shut down for routine maintenance. System shutdowns and crashes result in delayed medication orders and thus administration to the patient. Such system shutdowns may also result in medication being delivered to the incorrect patient when a patient has been moved during the shutdown, as the system will be unable to alert the pharmacy of the move. This may result in medication administration being delayed. Equally important, it may result in medication being administered to the incorrect patient due to a new patient being in the bed of a patient who had been moved during a system shutdown (Koppel *et al.* 2005: 1201). Tremblay (2010: 85) established that the efficiency of the CPOE is compromised by the lack of a bar-code on the medication, as well as the scanner not recognising the medication or the patient's identification band.

Frequent error screens and the system being slow have a negative impact on the effectiveness of the CPOE. Shortcomings in relation to interface design can also result in too many 'prompt' windows, which can be distracting to the task at hand and result in some prompts being missed (Bey-Hwa *et al.* 2012: 3818, 3822). Koppel *et al.* (2005: 1200) declared that the CPOE alerts for allergies only after the medication has been ordered, and that doctors often ignore these alerts as they need to quickly scroll through numerous screens, together with the difficulties with discontinuing and reordering medications. The CPOE does not always reflect when the patient has received medication in another department,

for example the emergency room. Nurses would then need to make phone calls to confirm this before safely administering any further medication (Buerhaus 2013: 193). Excessive reminders, alerts and warning messages result in alert fatigue, and consequently the disregarding of such messages (Cowen 2013: 29). Moreover, it is possible to override alerts, resulting in errors being made (Prevent unintended consequences when rolling out computerized physician order entry 2009: 5). Tremblay (2010: 15) explained that the CPOE can be bypassed through using workarounds that enable nurses and doctors to thwart the safety features meant to assist with the prevention of medication errors. An example is where nurses keep a copy of patient and medication barcodes on the medication trolley, and use these to bypass the need to scan the patient identity band or the medication.

Another concern is that the CPOE may have a negative effect on communication between the nurse and the doctor (Cowen 2013: 27). Stone *et al.* (2009: 963) found that although the CPOE improved efficiency in the ordering process of medication, there was no substantial impact on the rate of medication errors. The findings from a study by Al-Dorzi *et al.* (2011: 5) demonstrated that the implementation of the CPOE failed to significantly reduce mortality or improve patient outcomes. Poon *et al.* (2010: 1698) established that although the bar-coding system reduced transcription and administration errors, as well as potential adverse effects, it did not eliminate them altogether.

2.5.6 sadvantages of the bar-coding verification system

Bar-coding medication administration can interrupt workflow, especially when the design is in conflict with nursing processes. There may be usability problems where the system has not been designed properly.

Medication names are sometimes cut off or illegible due to a smaller screen size in handheld devices. Nurses need to repeatedly scroll down long lists. The system does not accommodate flexibility in medication administration times. There are times when nurses are required to adjust medication administration times due to the patient being away from the ward or nil-by-mouth, for example. It is found that when this happens, nurses may override or work around the bar-coding medication administration system, compromising the safety benefits and features of the system (Prevent unintended consequences when rolling out computerized physician order entry 2009: 5). A study done by Buerhaus (2013: 191) has shown how bar-coding medication administration changes how nurses administer medication, resulting in potentially unsafe practices, such as nurses recording the administration of medication before actually administering the medication. In some instances, nurses are required to chart the administration of medication on a paper chart in addition to the CPOE. This may lead to confusion and result in errors being made (Koppel *et al.* 2005: 1201). The CPOE may also take more time than traditional paper- based prescriptions. For these reasons the introduction of a CPOE may be met with resistance. Moreover, the implementation of a CPOE and the training that is required is costly (Huston 2013: 2-3).

2.6 THE EFFECTS OF THE USE OF INFORMATION TECHNOLOGY IN NURSING

Although there are numerous advantages of IT in nursing, there are also several disadvantages. Computer-based documentation systems are intended to save nurses time so that they have more time available for their patients, however in many cases these systems may demand more time from nurses instead. On the one hand, computerised systems for

doctors ordering medication have been shown to reduce incidences of medication errors; on the other hand, there is controversy as to the effectiveness of a CPOE in the prevention of medication errors (Cowen 2013: 27). Research by Mahler *et al.* (2007: 274-275; 281) and Ammenwerth *et al.* (2010: 30; 33) demonstrated that in some cases IT positively affects the delivery of nursing care, whereas in other cases it may impact negatively on it instead. Liu (2009: 3) raised concerns about whether IT improves the quality of nursing care.

Previous studies have shown mixed results concerning the effects of IT on the delivery of nursing care. Although IT facilitates improved delivery of nursing care, it can also cause problems (Funk 2011: 285). Oroviogoicoechea and Watson (2009: 840) specified that an important problem identified with IT is the lack of adaptation to workflow, with the system not being clinically relevant but being designed for legal and management purposes instead of for the facilitation of quality patient care. Holden (2011: 11-12) was of the opinion that IT does not directly improve the quality of nursing care and patient safety, but rather that its effect is dependent on how the system works and whether it facilitates health care providers' cognitive work processes. He felt that if work systems are designed that support and enhance cognitive work processes, patient safety would be improved by the reduction of errors and the prevention of harm. Rahimi, Vimarlund and Timpka (2009: 359-360) supported this view in asserting that the implementation of IT in nursing does not automatically improve efficiencies, but that the integration of IT in workflow; ensuring compatibility between software and hardware; technical support as well as user involvement, education and training, had to be addressed for the system to produce the anticipated results.

It is important to strive toward continually making improvements in nursing. For this to occur, it is necessary to embrace the advances made in IT. It is also vital that the factors affecting the development of nursing, such as information technology, are fully understood. The use of IT in nursing has been criticised for focusing on the technologies at the expense of their appropriate use to improve nursing. A complete understanding of IT in nursing will prevent this from occurring. It is not an option to return to past practices which are outdated and no longer useful (Murray 2010: 1-2).

2.7 CONCLUSION

The literature review has shown that IT in nursing can positively affect the delivery of nursing care in some instances but can have a negative effect in other instances. The introduction of IT in nursing has resulted in unexpected and unforeseen problems. For the use of IT in nursing to produce the intended results of improving nursing care and patient safety, there needs to be a continuous focus on the effects of IT on nursing, in particular finding ways to resolve presenting problems. The next chapter will discuss the research methodology used to collect data and to analyse the findings of this study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter will describe the research methodology used in this study. The research design, the study population, sample size and method and the selection criteria will be presented. Data collection methods and data analysis methods will also be discussed.

3.2 RESEARCH DESIGN

A quantitative comparative descriptive design was used to compare the delivery of nursing care in two public hospitals in the eThekwini district in KwaZulu-Natal (KZN). The delivery of nursing care in a hospital which uses a computer-based documentation system for patient care was compared with a hospital which uses a paper-based documentation system.

Quantitative research is underpinned by a positivist paradigm. The positivist paradigm assumes that reality is fixed and orderly and can be studied objectively (Polit and Beck 2012: 12-14). Quantitative research is usually conducted using the traditional, scientific approach; this is an orderly, systematic and controlled method used to gather information. Further, quantitative research identifies variables and seeks to answer questions about the relationship between these variables. This involves collecting and analysing numeric information. Information needed for the study is gathered using formal instruments. Deductive, logistical reasoning is used to answer the research question. The findings in quantitative research are based on empirical evidence. Empirical evidence is objective evidence, gathered by researchers by using their

senses (Polit and Beck 2012: 12-14, 22, 726, 738-739). The study was conducted using an orderly and systematic method to collect the numerical data required to determine the relationship between the identified variables. Data was collected using a questionnaire, which is a formal data collection instrument. Deductive and logistical reasoning was used in the analysis of the data in order to answer the research question.

Quantitative studies can be classified as either experimental or non-experimental. In experimental studies the researcher actively introduces an intervention or treatment and observes its effect. In non-experimental studies, however, the researcher collects data without making any changes or introducing treatments (Polit and Beck 2012: 55). As this study will be exploring the relationship between variables, a non-experimental design is most suitable for the study.

A comparative descriptive study was suitable for this study, as it is designed to describe the variables and the differences between groups to determine whether they differ on any of the variables. A comparative descriptive design investigates differences in variables in two or more groups which occur naturally in their setting and describes those differences (Grove, Burns and Gray 2013: 217).

Researchers frequently use comparisons in quantitative studies as a context for interpreting their results. Studies can be designed to examine a variety of types of comparison. The most common type is the comparison between two or more groups (Polit and Beck 2012: 181-182). The delivery of nursing care in a hospital which uses a computer-based documentation system for patient care was compared with a hospital which uses a paper-based documentation system.

A descriptive study design aims at acquiring more information about the characteristics in a particular field of study by showing situations as they naturally occur (Grove, Burns and Gray 2013: 215). This study gained more information about the effects of IT on the delivery of nursing care as experienced by registered and enrolled nurses working in different hospitals.

3.2.1 Variables

The differences in variables in two public hospitals in the eThekwini district in KZN was investigated, one hospital using a computer-based documentation system and one using a paper-based documentation system. The independent variable in this study is the use of IT in nursing. The dependent variable is the delivery of nursing care, measured by the quality of nursing documentation, the amount of time nurses have available to spend on hands-on patient care and the reduction of medication errors. The independent variable is the variable that is believed to affect the dependent variable. The dependent variable is the variable dependent on, or caused by, the independent variable (Polit and Beck 2012: 51). By determining whether the variables differ in the two hospitals, it can be determined how IT affects the delivery of nursing care.

3.3 STUDY SETTING

The study setting is the location where the research was conducted and may be naturally occurring, partially controlled or highly controlled (Grove, Burns and Gray 2013: 709). This study was conducted at two public hospitals in the eThekwini district in KZN, one hospital which uses a computer-based documentation system for patient care and one hospital which uses a paper-based documentation system. The public hospital

using a computer-based documentation system was chosen as it is the only public hospital in the eThekwini district which uses a computer-based documentation system. The public hospital using a paper-based documentation system was chosen as it uses only a paper-based documentation system, whereas there were some public hospitals in the eThekwini district that use a combination of paper and computer-based documentation systems. No hospitals in the private sector were included in the study because there are no private hospitals in KZN that use only computer-based systems for patient care.

3.4 STUDY POPULATION

A study population is all the elements in a given universe meeting certain criteria for inclusion in a study (Grove, Burns and Gray 2013: 44; 703). It is all the individuals with the same common characteristics (Polit and Beck 2012: 738). The researcher's definition of the population depends on the sample criteria, the similarity of the subjects in the setting, together with which population is accessible and can be best represented by the study sample (Grove, Burns and Gray 2013: 44). The study population in this study was all the registered and enrolled nurses in the two hospitals in the eThekwini district in KZN involved in this study. The reason for choosing both registered and enrolled nurses for this study is because both categories of staff are responsible for the planning and documentation of nursing care as well as the administration of medication.

3.5 SAMPLING METHOD

Sampling is the process of choosing a part of the population to represent the entire population (Polit and Beck 2012: 742).

3.5.1 SAMPLING METHOD: SETTING

Convenience sampling was used in selecting the two hospitals used in the study. Convenience sampling is a non-probability sampling technique where the most conveniently available people are used for the study (Grove, Burns and Gray 2013: 363). The two hospitals used were chosen as they are situated in the town in which the researcher resides. There is only one hospital in the eThekwini district which uses IT solely for the delivery of nursing care. This hospital was thus the only hospital which could be used in this study as the hospital which a computer-based documentation system.

3.5.2 SAMPLE METHOD: STUDY POPULATION

One hundred percent of registered and enrolled nurses on duty in the two selected hospitals at the time of data collection were invited to participate in the study.

3.6 SAMPLE SIZE

The sample size is the number of participants recruited and willing to participate in a study (Grove, Burns and Gray 2013: 708). As per communication with a statistician (7 October 2013), a sample size of 110 participants was selected for the hospital which uses a computer-based documentation system and 110 participants for the hospital which uses a paper-based documentation system. This was calculated using a Wilcoxon (Mann-Whitney) rank-sum test with a 0.05 two-sided significance level, and will have 90% power to reject the null hypothesis (based on the two category probabilities for each group).

The registered and enrolled nurses in both hospitals were very reluctant to participate in the study when approached by the researcher. The

researcher therefore found contact people (registered and enrolled nurses who worked in those hospitals) in both hospitals to assist with the distribution and collection of the questionnaires. After four months of data collection, and with the assistance of these contact people in each hospital, only 104 participants for the hospital which uses a computer-based documentation system and 104 participants for the hospital which uses a paper-based documentation system were willing to participate in the study. Two hundred and eight questionnaires of the required 220 questionnaires were thus collected. Thus 95% of the recommended sample size was obtained.

3.7 SELECTION CRITERIA

Inclusion criteria:

- Registered and enrolled nurses working in all the general wards and specialised units i.e. maternity, high care and intensive care units, except outpatient departments, the trauma department and theatre in the two hospitals involved in the study were included in the study.
- They were permanent employees, who had worked for six months or more in their respective hospitals. The reason for this is because staff members who have worked less than six months, and who do not work permanently in the respective hospitals, might not be experienced in the documentation system used in that hospital.

Exclusion criteria:

- Registered and enrolled nurses working in outpatient departments, the trauma department and theatre in the two hospitals involved in the study were excluded from the study. The reason for this is because nurses working in outpatient departments, the trauma department and

theatre do not use the same documentation as the nurses in the wards and units; they do not administer medication to patients in the same capacity as in the wards and units; and they do not perform the same kind of nursing care as the nurses in the wards and units. Nursing care given in outpatient departments, the trauma department and theatre is very different from that in a ward or a unit.

- Registered and enrolled nurses working for less than six months in their respective hospitals, as well as staff members who are not permanent employees, were excluded in the study. The reason for this is because the registered and enrolled nurses involved in the study needed to be experienced in the documentation system used in their hospital.

3.8 PILOT STUDY

A pilot study is a smaller scale of the proposed study. It is conducted prior to the main study to identify any problems and thereby refine the research instrument and data collection process (Grove, Burns and Gray 2013: 703). A pilot study was conducted prior to the main study in order to detect any problems with the data-collection instrument and the data collection process. Eight participants were used in the pilot study, four nurses from each of the two hospitals involved in the study. From the experience of the pilot study, required changes were made to the letter of information and consent as well as to the questionnaire. The changes made to the letter of information and consent included removing the need for participants to indicate their name and identity number on the consent form. Some participants felt uncomfortable with indicating this on their consent form. A number of potential participants who declined participation in the pilot study indicated that they would have participated if they were not required to indicate their name and ID number on the

consent form. The changes made to the questionnaire involved the rephrasing of some of the questions which participants of the pilot study indicated were unclear.

Leon, Davis and Kraemer (2011: 626-628) and van Teijlingen and Hundley (2001) outlined the importance of not using the collected data or the participants used in the pilot study within the main study, to prevent contamination. If amendments were made to the research instrument as a result of the findings of the pilot study, data from the pilot study could be flawed or inaccurate. The concern with using pilot study participants in the main study is that they have already been exposed to the research and may respond differently from those who have not previously experienced it. Neither data collected from the pilot study, nor the pilot participants, were included in the main study.

3.9 DEVELOPMENT OF THE RESEARCH INSTRUMENT

The research instrument was developed from a questionnaire which was devised by Eske Ammenwerth (Ammenwerth *et al*. 2010: 35-37). Written permission to use the questionnaire was obtained (Appendix H). The questionnaire was amended to meet the objectives of the study and to answer the research question. The statements in the research instrument were structured using a four-point Likert scale where 1 = strongly agree, 2 = agree, 3 = disagree and 4 = strongly disagree. A Likert scale is a measure of the opinions or attitudes of a subject (Grove, Burns and Gray 2013: 699). It contains a number of statements by which respondents rate their level of agreement or disagreement (Polit and Beck 2012: 732). The questionnaire also included demographic characteristics of the participants.

3.9.1 alidity

Validity is the extent to which an instrument measures the concept being studied. Content validity is concerned with how well an instrument represents all the components of the variable being measured (Grove, Burns and Gray 2013: 393-394). The content validity of the instrument was validated through the literature review, by testing it through doing a pilot study and also by presenting the questionnaire to experts in the field to evaluate it for content validity.

3.9.2 Reliability and stability

The reliability of an instrument refers to the degree to which it can be depended on to consistently give the same results if used over and over again on the same person or if used by different researchers. Reliability is evaluated by stability, internal consistency and equivalence. The stability of an instrument refers to the extent to which similar results are obtained from the same individuals at two different times. Internal consistency is the extent to which all items measure the same variable (Grove, Burns and Gray 2013: 394-397).

One of the ways of establishing whether an instrument is reliable is by a test-retest. A test-retest is where the instrument is administered on two different occasions. If the scores from the test and retest are strongly correlated, the instrument is stable. The correlation between the two sets of scores collected at the two administrations is measured using the Cronbach alpha coefficient (Leech, Barrett and Morgan 2015: 53-62).

The stability of the instrument was verified by a test-retest. The instrument was administered to 50 participants twice, two weeks apart.

Test-retest reliability was analysed using the intra-class correlation coefficient (ICC) with a 95% confidence interval. The Cronbach alpha for 42 out of the 52 questions was equal to or above 0.6, indicating that the reliability of the instrument was acceptable. Minor changes were made to the ten statements which had a Cronbach alpha of below 0.6, indicating poor reliability. These changes included rephrasing of the statements, as the reason for the poor reliability of these questions was because they were unclear to the participants in the test-retest. These statements were crucial within the study and could lead to important information being collected; they were therefore not deleted from the questionnaire. This was done in consultation with a statistician on 30 August 2014. Neither data collected from the test-retest, nor the participants involved in the test-retest, were included in the main study.

The spilt-half method was used to verify the instrument's internal consistency. Split-half reliability is determined by administering the instrument once, then dividing the items on the instrument into two equal halves (Grove, Burns and Gray 2013: 391). The correlation between the two halves is then calculated using the Spearman-Brown coefficient. If there is a strong correlation between the two halves, the instrument is reliable (Eisinga, te Grotenhuis and Pelser 2013: 637-641). The questionnaire was divided into two halves, the one being the odd numbered statements and the other being the even numbered statements in the questionnaire. The correlation between the halves was analysed using the Spearman-Brown coefficient. The Spearman-Brown coefficient was 0.9, indicating a very strong correlation between the two halves of the questionnaire, and hence that the questionnaire has a very strong internal consistency.

3.10 DATA COLLECTION

Data was collected through the administration of a questionnaire (Appendix G) directed at the registered and enrolled nurses in the two hospitals involved in the study. Registered and enrolled nurses in the two hospitals were approached and invited to participate in the study.

When approached by the researcher, the nurses in the two hospitals were disinclined to participate in the study. The reason the nurses did not want to participate in the research when approached by the researcher may have been because the researcher did not work in either of these two hospitals and was therefore not known by them. This may have resulted in the nurses not trusting the researcher. The researcher's colleagues helped her to make contact with three registered/enrolled nurses in the hospital with a paper-based documentation system and two registered nurses in the hospital with a computer-based documentation system, who were willing to assist the researcher with distribution and collection of questionnaires. The nurses in the two hospitals were willing to participate in the research when approached by these contact people, as they worked in the same hospital as them and knew them. The researcher delivered the questionnaires (Appendix G) and the letters of information and consent (Appendix F) to the nurses who were assisting her. In turn, they distributed the questionnaires and letters of information and consent to those registered and enrolled nurses who were willing to participate in the study, and collected them once completed. The researcher then collected the completed questionnaires and consent forms from the nurses who were assisting her.

The nurses who assisted the researcher in the distribution and collection of the questionnaires were not used in the study. The distribution and collection of the questionnaires was done during tea and lunch times and therefore did not interfere with the duties of the nurses assisting the researcher. After four months of data collection, and with the assistance of these contact people in each hospital, only 104 participants for the hospital which uses a computer-based documentation system and 104 participants for the hospital which uses a paper-based documentation system were willing to participate in the study.

3.11 DATA ANALYSIS

Data analysis is the methodical organisation and synthesis of data collected in quantitative research and the testing of hypotheses using this data (Polit and Beck 2012: 725). Descriptive statistics are used to explore differences between or among groups (Grove, Burns and Gray 2013: 217). Inferential statistics are used to draw conclusions regarding the differences between groups in the population from which the samples were drawn and the relationship between the variables in the population (Leech, Barrett and Morgan 2015: 84). Both descriptive and inferential statistics were used to analyse the data in this study.

The scores for the experiences of nurses regarding the effects of IT were computed from their responses. Data from the questionnaires was captured and analysed using Statistical Package for the Social Sciences (SPSS) version 22. Data was summarised and described using descriptive statistics such as frequencies, measures of central tendency such as means and modes, as well as means of variability such as range, variance and standard deviation. Graphs and tables were used to graphically represent the data.

Inferential statistical analysis was used to test the hypotheses. Independent samples *t*-tests were performed to determine whether there were statistical differences in the experiences of nurses with the delivery of nursing care between those who worked in the hospital with a paper-based documentation system, and those who worked in a hospital with a computer-based documentation system. The independent *t*-test is used to compare two independent groups (Leech, Barrett and Morgan 2015: 332). The null hypothesis was rejected where the *p*-value was less than 0.05. Where the p-value was more than 0.05, the null hypothesis was accepted. The goal of the data analysis was to describe the differences experienced by registered and enrolled nurses in the two hospitals with regards to the effects of information technology on the delivery of nursing care.

3.12 ETHICAL CONSIDERATIONS

3.12.1 Beneficence

Beneficence is the obligation of researchers to minimise harm and maximise the benefits to the participants (Polit and Beck 2012: 152). There were no known risks of harm to participants involved in the study. Participants were informed that the benefits of participating in the study included that the results of the study would inform hospitals of the effects of IT on the delivery of nursing care, thereby enabling hospitals to make informed decisions about the use of IT within the hospital setting.

3.12.2 Respect for human dignity

Respect for human dignity includes the right to self-determination and the right to full disclosure. The right to self-determination means that prospective participants may decide of their own free will whether to participate in a study without the risk of prejudice. The right to full

disclosure means that the researcher has fully explained what the nature of the study is, that the potential participant has a right to refuse participation, what the researcher's responsibilities are as well as what the risks and benefits are of participating in the study (Polit and Beck 2012: 154).

There was full disclosure to the prospective participants by the researcher fully describing the nature of the study, their right to refuse participation, the researcher's responsibilities as well as the risks and benefits of participating in the study. Prospective participants were informed that participation was voluntary and that they could withdraw from the study at any time without penalty or prejudice. This disclosure was done in writing. All of the above mentioned explanations were included in the letter of information and consent the prospective participants were given.

3.12.3 Justice

Justice is a participant's right to privacy and to be treated fairly (Polit and Beck 2012: 157). The selection of participants was fair and non-discriminatory, as 100% of registered and enrolled nurses on duty at the time of data collection were given the opportunity to participate. The researcher demonstrated respect for all forms of human diversity. The researcher did not show any prejudice towards those who refused to participate or who withdrew from the study after agreeing to participate. Participants were able to contact the researcher at any point in the study to clarify information. Participants were treated with courtesy and tact at all times. Confidentiality was maintained by ensuring that information the participants provided would not be publicly reported in such a way that would identify them, and the provided information will also not be made accessible to others. Participants' names did not appear on the

questionnaires. The name of the hospital did also not appear on the questionnaire. The privacy of participants was maintained by the researcher ensuring that the research was not more intrusive than it needed to be.

3.12.4 Informed consent

Informed consent means that participants have been given enough information about the research, that they understand the information and that they are voluntarily allowed to agree or decline participation (Polit and Beck 2012: 157). Prospective participants were fully informed by the researcher about the nature of the study and its benefits. Written informed consent (Appendix F) was obtained from participants agreeing to participate in the study.

3.12.5 Ethical approval

Once ethical clearance had been obtained, letters of permission (Appendix B) were sent to the two hospitals involved in the study to obtain permission to conduct the study in those hospitals. Permission was obtained from the Department of Health (DOH) (Appendix C) and the management of each hospital (Appendices D and E) to use their hospital as the research setting; to distribute to, and collect questionnaires from, registered nurses in their hospital who consented to participate; and to use the responses of those participants. Data collection only commenced once ethical approval had been obtained from the DUT (Appendix A), and consent to conduct the proposed study had been received from the DOH and from both hospitals.

3.13 STRENGTHS AND LIMITATIONS

3.13.1 Strengths

A strength of this study is that it compared two populations. In each population, participants were from different wards and units. Another strength is that the results of this study can help guide hospitals in the decision whether to adopt a computerised documentation system.

3.13.2 Limitations

A limitation of this study is that the private sector was not included because there were no private hospitals in KZN which use only computer-based systems for patient care. Another limitation of this study is that the findings reflect nurses' experiences of the effects of information on the delivery of nursing care and that the outcomes were not independently measured. A sample size of 110 participants for the hospital which uses a computer-based documentation system and 110 participants for the hospital which use a paper-based documentation system will have 90% power to reject the null hypothesis. Despite approaching one hundred percent of registered and enrolled nurses on duty in the two hospitals at the time of the data analysis, however, after four months of data collection only 104 participants from each of the two identified hospitals were willing to participate in the study. A sampling method from probability sampling would have enhanced the robustness of the study, and thus the use non-probability sampling is a further limitation of this study.

3.14 CONCLUSION

This chapter on methodology described the research design, the study population, sample size and method and selection criteria, as well as data collection methods and data analysis methods. Chapter four will present the results of the study.

CHAPTER 4

PRESENTATION OF THE RESULTS

4.1 INTRODUCTION

This study was designed to determine the effects of information technology (IT) on the delivery of nursing care. The previous chapter described the methodology used to conduct the study. This chapter presents the findings that were gathered from the data analysis. The outcomes of the statistical tests in the data analysis and the significance of the outcomes are presented and interpreted. The chapter concludes with a summary of the results.

One hundred percent of registered and enrolled nurses on duty in the two selected hospitals at the time of data collection were invited to participate in the study. One hundred and four participants for the hospital which uses a computer-based documentation system, and 104 participants for the hospital which uses a paper-based documentation system, were willing to participate in the study. Two hundred and eight questionnaires of the required 220 questionnaires were thus collected (95%). Table 4.1 shows that half (50%) of the participants worked in the hospital with a paper-based documentation system and half (50%) of the participants worked in the hospital with a computer-based documentation system.

Table 4.1 Type of documentation system participants' hospital uses.

Type of hospital	Frequency	Percent	Valid Percent	Cumulative Percent
Paper-based	104	50.0	50.0	50.0
Computer-based	104	50.0	50.0	100.0
Total	208	100.0	100.0	

The independent variable in this study is the use of IT in nursing care. The dependent variable is the experiences of nurses with the delivery of nursing care, measured by the quality of nursing documentation, the amount of time nurses have available to spend on hands-on patient care and the reduction of medication errors. By determining whether the variables differ in the two hospitals, it can be determined how IT affects the delivery of nursing care.

The hypotheses of this study were:

1. The null hypothesis was that the delivery of nursing care is negatively affected by the use of IT in nursing.
2. The alternate hypothesis was that the delivery of nursing care is positively affected by the use of IT in nursing.

The objectives of the data analysis were to:

1. Describe the demographic characteristics of participants.
2. Determine any statistically significant difference in the effects of IT on the delivery of nursing care, as experienced by registered and enrolled nurses working in the hospital which uses a computer-based documentation system for patient care and the hospital which uses a paper-based documentation system.

3. Determine whether the use of IT in nursing positively or negatively affects the delivery of nursing care.

4.2 DEMOGRAPHIC CHARACTERISTICS

The description of the demographic characteristics includes the type of ward the participants worked in, the gender and age of the participants and the period of time the participants worked in their respective hospitals.

4.2.1 Type of ward/unit participants worked in

Participants were requested to indicate the type of ward or unit they worked in by choosing from a list of types of wards and units. The list of wards and units that participants could choose from was confined to the main disciplines of nursing. Participants were given an option of 'other' to choose from if the ward they were working in was not included in the provided list, and requested to indicate the type of ward. One of the inclusion criteria for the study was that participants needed to be working in a ward or unit. Nurses working in outpatients, the trauma department and theatre were excluded. The researcher therefore needed to know exactly which ward they were working in when they indicated 'other'.

Tables 4.2 and 4.3 illustrate that the largest percentage (29.3%) of participants worked in surgical or medical wards (27.7%). The percentage of participants who worked in paediatrics was 16.8%. A smaller percentage of participants worked in psychiatry (9.7%), orthopaedics (6.7%), high care units (5.3%) and maternity wards (2.9%). Only 1 % (n = 2) of participants worked in intensive care units.

Table 4.2 Type of ward/unit participants work in.

Ward	Frequency	Percent	Valid Percent	Cumulative Percent
Medical	57	27.7	27.7	27.7
Surgical	61	29.3	29.3	56.7
Orthopaedic	14	6.7	6.7	63.5
High care	11	5.3	5.3	68.8
Intensive care	2	1.0	1.0	69.7
Other	63	30.3	30.3	100.0
Total	208	100.0	100.0	

Table 4.3 Description of ward if 'other'.

Ward if 'other'	Frequency	Percent	Valid Percent	Cumulative Percent
Maternity	6	2.9	2.9	73.4
Paediatrics	35	16.9	16.9	90.3
Psychiatry	20	9.7	9.7	100.0
Total	63	30.3	30.3	

4.2.2 der of participants

Participants were asked to indicate whether they were male or female. The information in Table 4.4 indicates that the majority of participants (85%) were female and only 15% were male. This is because nursing is a female-dominated profession.

Table 4.4 Gender of participants.

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	177	85.0	85.0	85.0
Male	31	15.0	15.0	100.0
Total	208	100.0	100.0	

4.2.3 Age of participants

Participants were requested to indicate their age in years. Figure 4.1 represents the data obtained. The age of the participants ranged from 20 to 64 years of age. The mean age of the participants was 38.24 years of age. The majority of participants (62.9%) were between the ages of 30 and 49 years. The percentage of participants between 20 and 29 was 21.1%. A smaller percentage of participants (14%) were aged 50 to 59. Only 2% of the participants were between the ages of 60 and 64 years.

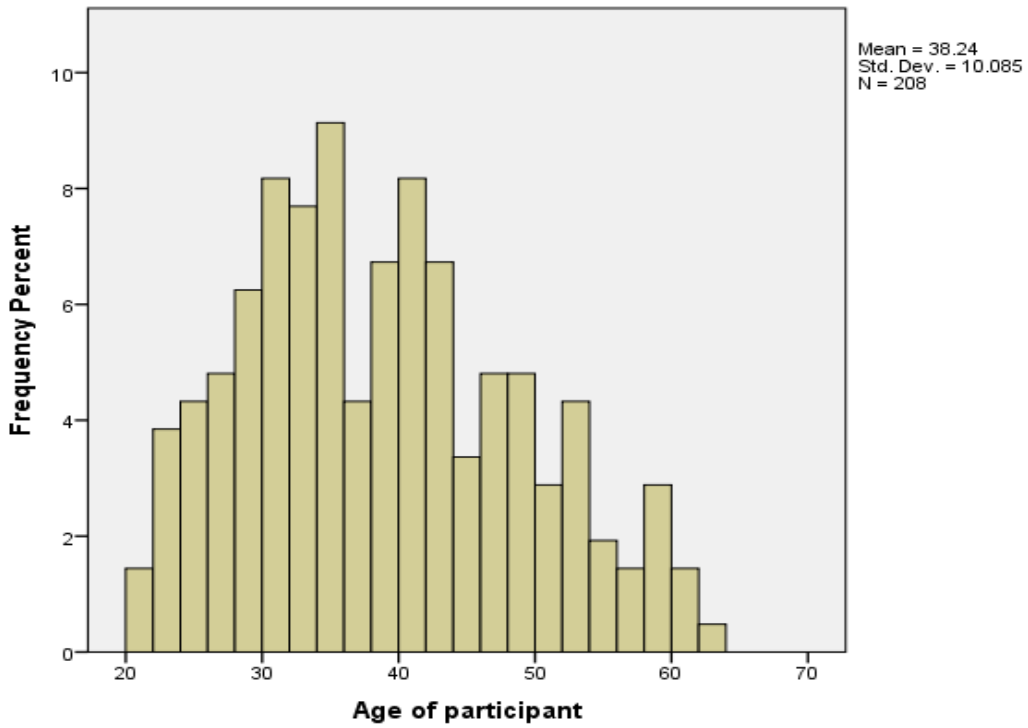

Figure 4.1 Age of participants.

4.2.4 Period of time worked in respective hospitals

One of the criteria for inclusion in the study was that participants had worked for six months or more in their respective hospitals, and were thus experienced in the documentation system used in that hospital. Therefore participants were asked to indicate how long they had worked in their respective hospitals.

The data in Figure 4.2 shows that participants had worked in their respective hospitals for between one and 35 years. The mean years worked by participants in their respective hospitals was 7.4 years. The largest part (76.5%) of participants had worked in their respective

hospitals between 1 and 9 years. A much smaller percentage (19%) of participants worked in their respective hospitals for 10 to 19 years. Only 3.5% of participants worked in their respective hospitals between 20 and 29 years and 1% between 30 and 35 years. It can be deduced from these findings that the majority of nurses in the two hospitals in which the study was conducted do not stay in employment for more than 9 years.

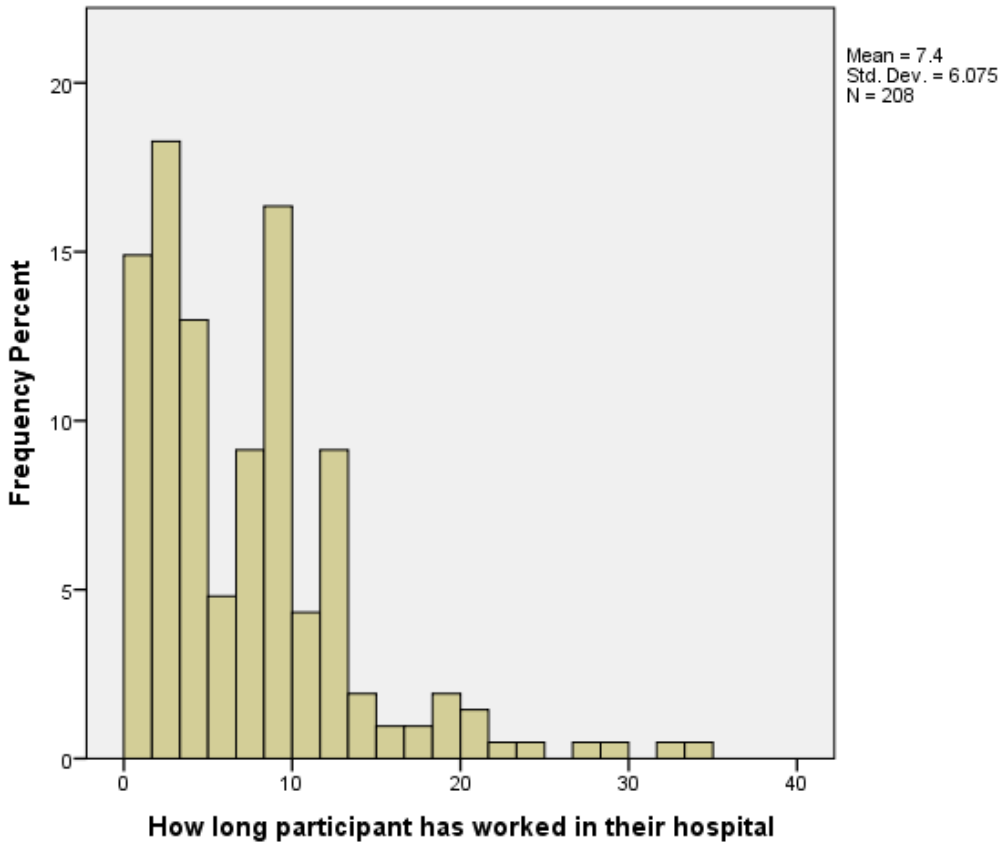

Figure 4.2 Period of time worked in respective hospitals.

4.3 THE EFFECTS OF INFORMATION TECHNOLOGY ON THE DELIVERY OF NURSING CARE AS EXPERIENCED BY REGISTERED AND ENROLLED NURSES

The delivery of nursing care was measured by the quality of nursing documentation, the amount of time nurses had to spend on hands-on patient care and the reduction of medication errors. The quality of nursing documentation was measured by the appropriateness of nursing care plans, the compliance of nursing documentation with the legal requirements of recordkeeping, and the accuracy and completeness of the record of patient care. The statements in the research instrument were structured using a four-point Likert scale. Participants were required to indicate their experiences with the delivery of nursing care in their respective hospitals by responding whether they strongly agreed, agreed, disagreed or strongly disagreed with the statements.

Independent samples *t*-tests were performed to determine whether there were statistical differences in the experiences of registered and enrolled nurses with the delivery of nursing care between those who worked in the hospital with a paper-based documentation system, and those who worked in the hospital with a computer-based documentation system. The independent samples *t*-test is used to compare two independent samples; in other words, two separate groups of subjects. It is used to determine whether there is a difference between the means with the standard error, the standard error being the standard deviation of the sampling distribution of the mean (Leech, Barrett and Morgan 2015: 88; 100-102; 332-334.

The independent samples test has two parts. The first is Levene's test for the assumption of equal variances and the second part is the *t*-test for equality of means (Leech, Barrett and Morgan 2015: 101).

Where Levene's test was greater than 0.05, the indication is that the variances are not significantly different. In other words the variances (the standard deviation squared) of the two groups (the nurses in the hospital with a computer-based documentation system and the nurses in the hospital with a paper-based system) were approximately equal. The 'equal variances assumed' line was used to interpret and report the *t*-test. On the other hand, when Levene's test was less than 0.05, the indication is that the variances were significantly different. As the variances (the standard deviation squared) of the two groups were not approximately equal, the 'equal variances not assumed' line was used (Leech, Barrett and Morgan 2015: 101; 203).

The *p*-value or probability level is used to interpret the results of statistical tests. If the probability is less than the pre-set alpha level, usually 0.05, the results are said to be statistically significant and the null hypothesis of no difference or relationship is rejected (Leech, Barrett and Morgan 2015: 101; 203). In this study, if the *p*-value of the *t*-test was less than 0.05, the null hypothesis that the delivery of nursing care is not affected by IT can be rejected. If the *p*-value of the *t*-test is more than 0.05, however, the null hypothesis can be accepted.

4.3.1 Nursing care plans

The experiences of nurses with nursing care plans was measured by whether nurses experienced nursing care plans as being appropriate, adequate, updated when the patient's condition changes and whether

patient risks, for example a high risk of developing decubitus ulcers, was always appropriately planned for.

The results in Table 4.5 illustrate that Levene's test was 0.00 for all four statements related to the appropriateness of nursing care plans. This indicates that the variances of the two groups were not approximately equal. The 'equal variances not assumed' line was thus used for the interpretation and reporting of the *t*-test.

Since the *p*-value for all four statements related to the appropriateness of nursing care plans was 0.00, the null hypothesis that the delivery of nursing care is not affected by IT was rejected for these statements. There was thus a statistical difference between the experiences of nurses with the appropriateness of nursing care plans between those who worked in a hospital with a paper-based documentation system, and those who worked on a hospital with a computer-based documentation system, at a 95% confidence interval.

Table 4.5 Independent samples test: Nursing care plans.

Statements describing nurses' experiences with nursing care plans		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	Lower	Upper
Planned nursing care is appropriate.	Equal variances assumed	30.272	.000	10.049	206	.000	.702	.070	.564	.840
	Equal variances not assumed			10.049	156.196	000	.702	.070	.564	.840
Planned nursing care is adequate.	Equal variances assumed	13.395	.000	13.733	204	.000	1.000	.073	.856	1.144
	Equal variances not assumed			13.733	176.477	.000	1.000	.073	.856	1.144
The nursing care plan of a patient is always updated when the patient's condition has changed.	Equal variances assumed	105.292	.000	12.981	203	.000	1.276	.098	1.082	1.470
	Equal variances not assumed			12.934	131.094	.000	1.276	.099	1.081	1.471
Patient risks for example a high risk for developing pressure sores is always appropriately planned for.	Equal variances assumed	19.598	.000	9.275	203	.000	.758	.082	.597	.919
	Equal variances not assumed			9.204	155.910	.000	.758	.082	.595	.920

Table 4.6 shows that the nurses in the hospital with a paper-based documentation system had average scores between 1.83 and 2.43, while the nurses working in the hospital with a computer-based documentation system had average scores ranging from 1.13 to 1.17 for their experiences with nursing care plans. These scores indicate that the nurses in the hospital with a computer-based documentation system agreed more strongly that nursing care plans were appropriate, adequate, and updated when the patient's condition changes. Further, they agreed more strongly than the nurses in the hospital with a paper-based

documentation system that patient risks, for example a high risk of developing decubitus ulcers, were always appropriately planned for. The nurses in the hospital with a computer-based documentation system thus had more positive experiences with nursing care plans than those in the hospital with a paper-based documentation system.

Table 4.6 Group Statistics: Nursing care plans.

Statements describing nurses' experiences with nursing care plans	Type of documentation system	N	Mean	Std. Deviation	Std. Error Mean
Planned nursing care is appropriate.	Paper-based	104	1.83	.630	.062
	Computer-based	104	1.13	.332	.033
Planned nursing care is adequate.	Paper-based	104	2.17	.617	.061
	Computer-based	104	1.17	.406	.040
The nursing care plan of a patient is always updated when the patient's condition has changed.	Paper-based	104	2.43	.928	.092
	Computer-based	104	1.16	.364	.036
Patient risks for example a high risk for developing pressure sores is always appropriately planned for.	Paper-based	104	1.93	.725	.072
	Computer-based	104	1.17	.405	.040

4.3.2 The compliance of nursing documentation with the legal requirements of recordkeeping

The experiences of nurses with the compliance of nursing documentation with the legal requirements of recordkeeping was measured through various elements. These elements included unauthorised abbreviations; whether documentation reflects the date and time; whether errors were corrected in the prescribed manner; whether documentation was legible

and whether entries in nursing documentation were always signed. Further elements included whether signatures were legible and accompanied by nurses' designations.

As shown in Table 4.7, Levene's test was 0.00 to 0.01 for all the statements related to the experiences of nurses with the compliance of nursing documentation with the legal requirements of recordkeeping, except for the statement related to whether nursing documentation always reflects the time nursing care was rendered. The Levene's test for this statement was 0.269. These results indicate that the variances of the two groups were approximately equal for this statement but not for the other statements. The 'equal variances not assumed' line was thus used for the interpretation and reporting of the *t*-test for all the statements related to the experiences of nurses with the compliance of nursing documentation with the legal requirements of recordkeeping. It was not used, however, for the statement related to whether nursing documentation always reflects the time nursing care was rendered, where the 'equal variances assumed' line was used.

The *p*-value for all the questions related to the experiences of nurses with the compliance of nursing documentation with the legal requirements of recordkeeping, except the statements related to the use of unauthorised abbreviations and whether nursing documentation always reflects the time nursing care was rendered, was 0.00. Thus, the null hypothesis that the delivery of nursing care is not affected by IT was rejected for these questions. The *p*-values for the statements related to the use of unauthorised abbreviations and whether nursing documentation always reflects the time nursing care was rendered was 0.807 and 0.761 respectively. The null hypothesis that the delivery of nursing care is not

affected by IT for these two statements was thus accepted. Therefore a statistical difference exists between the experiences of nurses with the compliance of nursing documentation with the legal requirements of recordkeeping between those who worked in a hospital with a paper-based documentation system, and those who worked on a hospital with a computer-based documentation system. This was at a 95% confidence interval for all the experiences of nurses with the compliance of nursing documentation with the legal requirements of recordkeeping, except the use of unauthorised abbreviations and whether nursing documentation always reflects the time nursing care was rendered.

Table 4.7 Independent samples test: Compliance of nursing documentation with the legal requirements of record keeping.

Statements describing nurses' experiences with the compliance of nursing documentation with the legal requirements of record keeping		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Unauthorized abbreviations are never used in nursing documentation.	Equal variances assumed	10.509	.001	.244	206	.807	.029	.118	-.204	.262
	Equal variances not assumed			.244	193.734	.807	.029	.118	-.204	.262
Nursing documentation always reflects the date on which nursing care was rendered.	Equal variances assumed	70.849	.000	7.464	206	.000	.567	.076	.417	.717
	Equal variances not assumed			7.464	158.992	.000	.567	.076	.417	.717
Nursing documentation always reflects the time nursing care was rendered.	Equal variances assumed	1.229	.269	.304	206	.761	.029	.095	-.158	.216
	Equal variances not assumed			.304	204.329	.761	.029	.095	-.158	.216
Errors are always corrected in the prescribed manner.	Equal variances assumed	16.669	.000	7.848	202	.000	.843	.107	.631	1.055
	Equal variances not assumed			7.848	189.702	000	.843	.107	.631	1.055
Nursing documentation is always legible.	Equal variances assumed	73.725	.000	12.763	199	.000	1.131	.089	.956	1.306
	Equal variances not assumed			12.720	137.170	.000	1.131	.089	.955	1.307
Entries are always signed by the nurse who made the entry.	Equal variances assumed	30.212	.000	6.700	206	.000	.587	.088	.414	.759
	Equal variances not assumed			6.700	173.688	.000	.587	.088	.414	.759
Nurses' signatures are always legible.	Equal variances assumed	87.307	.000	13.625	203	.000	1.286	.094	1.100	1.472
	Equal variances not assumed			13.583	144.945	.000	1.286	.095	1.099	1.473
Nurses' signatures are always accompanied by their designation.	Equal variances assumed	125.430	.000	13.005	206	.000	1.240	.095	1.052	1.428
	Equal variances not assumed			13.005	138.839	.000	1.240	.095	1.052	1.429

The findings in Table 4.8 reveal that the average scores for their experiences with the compliance of nursing documentation with the legal requirements of recordkeeping of the nurses in the hospital with a paper-based documentation system ranged from 1.70 to 2.44, while those of the nurses in the hospital with a computer-based documentation system was

1.13 to 1.89. The nurses in the hospital with a computer-based documentation system agreed more strongly that unauthorised abbreviations were not used; that documentation reflects the date and time; that errors were corrected in the prescribed manner; and that documentation was legible. They further agreed more strongly that entries in nursing documentation were always signed with signatures being legible and accompanied by nurses' designations, than nurses in the hospital with a paper-based documentation system. The experiences of nurses with nursing documentation complying with the legal requirements of recordkeeping in the hospital with a computer-based documentation system were thus better than those in the hospital with a paper-based documentation system. Exceptions were the experiences of nurses with the use of unauthorised abbreviations and whether nursing documentation always reflects the time nursing care was rendered. Here there was no statistical difference between the experiences of nurses in the hospital with a computer-based documentation system and those in the hospital with a paper-based documentation system.

Table 4.8 Group Statistics: Compliance of nursing documentation with the legal requirements of record keeping.

Statements describing nurses' experiences with compliance of nursing documentation with the legal requirements of record keeping	Type of documentation system	N	Mean	Std. Deviation	Std. Error Mean
Unauthorized abbreviations are never used in nursing documentation.	Paper-based	104	1.92	.952	.093
	Computer-based	104	1.89	.736	.072
Nursing documentation always reflects the date on which nursing care was rendered.	Paper-based	104	1.70	.681	.067
	Computer-based	104	1.13	.370	.036
Nursing documentation always reflects the time nursing care was rendered.	Paper-based	104	1.73	.714	.070
	Computer-based	104	1.70	.652	.064
Errors are always corrected in the prescribed manner.	Paper-based	104	2.12	.859	.085
	Computer-based	104	1.27	.662	.066
Nursing documentation is always legible.	Paper-based	104	2.26	.812	.081
	Computer-based	104	1.13	.365	.036
Entries are always signed by the nurse who made the entry.	Paper-based	104	1.80	.755	.074
	Computer-based	104	1.21	.476	.047
Nurses' signatures are always legible.	Paper-based	104	2.44	.863	.085
	Computer-based	104	1.16	.414	.041
Nurses' signatures are always accompanied by their designation.	Paper-based	104	2.38	.896	.088
	Computer-based	104	1.14	.380	.037

4.3.3 The accuracy and completeness of the record of nursing care

The experiences of nurses with the accuracy and completeness of the record of nursing care was measured by whether documented nursing care was always adequate, clear, complete, free from errors and whether a patient's documentation was ever lost. The data in Table 4.9 illustrates that Levene's test was 0.00 to 0.02 for all the statements related to the accuracy and completeness of the record of nursing care, except for the statement related to whether patient information is attached to the incorrect patient's record. The Levene's test for this statement was 0.205, indicating that the variances of the two groups were approximately equal

for this statement but not for the other statements. The ‘equal variances not assumed’ line was thus used for the interpretation and reporting of the *t*-test for all the statements related to the experiences of nurses with the accuracy and completeness of the record of nursing care, except the statement related to whether patient information is attached to the incorrect patient’s record, where the ‘equal variances assumed’ line was used.

The result of the *p*-value for all the statements related to the experiences of nurses with the accuracy and completeness of the record of nursing care, except the statement related to the whether errors are made when entering patient data from, for example, cardiac monitors, intravenous pumps or results to investigates into the patient’s record, was 0.00. The null hypothesis that the delivery of nursing care is not affected by IT was rejected for these statements. The null hypothesis for the question related to whether errors were made when entering patient data from, for example, cardiac monitors, intravenous pumps or results to investigations was accepted because the *p*-value for this question was 0.317. The *t*-test thus indicates that there is a statistical difference between the experiences of nurses with the accuracy and completeness of the record of nursing care between those who worked in a hospital with a paper-based documentation system, and nurses who worked in a hospital with a computer-based documentation system. This was at a 95% confidence interval for all the experiences of nurses with the record of nursing care, except for whether errors are made when entering patient data from, for example, cardiac monitors, intravenous pumps or results to investigations into the patient’s record.

Table 4.9 Independent samples test: Accuracy and completeness of the record of nursing care.

Statements describing nurses' experiences with the accuracy and completeness of the record of nursing care		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Documented nursing care is always inadequate.	Equal variances assumed	48.381	.000	-4.805	204	.000	-.665	.138	-.937	-.392
	Equal variances not assumed			-4.828	164.946	.000	-.665	.138	-.936	-.393
The documentation of nursing tasks is always clear.	Equal variances assumed	59.913	.000	14.519	205	.000	1.239	.085	1.071	1.407
	Equal variances not assumed			14.556	161.770	.000	1.239	.085	1.071	1.407
Documented nursing care is always complete.	Equal variances assumed	9.589	.002	10.269	204	.000	.919	.090	.743	1.096
	Equal variances not assumed			10.241	187.102	.000	.919	.090	.742	1.096
Errors are not made when entering patient data from for example cardiac monitors, intravenous pumps or results to investigations into the patient's record.	Equal variances assumed	24.749	.000	1.005	203	.316	.122	.122	-.118	.362
	Equal variances not assumed			1.003	178.669	.317	.122	.122	-.118	.363
Patient information (such as findings) is often attached to the incorrect patient's record.	Equal variances assumed	1.617	.205	-7.314	205	.000	-.695	.095	-.882	-.508
	Equal variances not assumed			-7.304	190.589	.000	-.695	.095	-.883	-.507
Patient's documentation is never lost.	Equal variances assumed	23.125	.000	-13.278	203	.000	-1.139	.086	-1.309	-.970
	Equal variances not assumed			-13.259	186.132	.000	-1.139	.086	-1.309	-.970

Table 4.10 shows that the mean scores of the nurses in the hospital with a paper-based documentation system were 2.44 to 2.73, whereas the mean scores for the nurses working in the hospital with a computer-based documentation system were between 3.11 and 3.79 for the statements related to whether documented nursing care was inadequate, whether patient information (such as findings) is often attached to the incorrect patient's record and whether patient's documentation is often lost. These results show that the nurses in the hospital with a paper-based

documentation system agreed more strongly with these statements than the nurses in the hospital with a computer-based documentation system. The questions related to whether the documentation of nursing tasks is always clear and whether documented nursing care is always complete for the nurses in the hospital with a paper-based documentation system had average scores ranging between 2.30 and 2.40. The average scores to these questions for the nurses in the hospital with a computer-based documentation system ranged from 1.17 to 1.38. The nurses in the hospital with a computer-based documentation system thus had more positive experiences with the accuracy and completeness of the record of nursing care than those in the hospital with a paper-based documentation system. The exception was for whether errors are made when entering patient data from, for example, cardiac monitors, intravenous pumps or results to investigations into the patient's record. Here, there was no statistical difference between the experiences of nurses in the hospital with a computer-based documentation system and those in the hospital with a paper-based documentation system.

Table 4.10 Group Statistics: Accuracy and completeness of the record of nursing care.

Statements describing nurses' experiences with the accuracy and completeness of the record of nursing care	Type of documentation system	N	Mean	Std. Deviation	Std. Error Mean
Documented nursing care is always inadequate.	Paper-based	104	2.44	.698	.069
	Computer-based	104	3.11	1.214	.119
The documentation of nursing tasks is always clear.	Paper-based	104	2.40	.757	.074
	Computer-based	104	1.17	.422	.042
Documented nursing care is always complete.	Paper-based	104	2.30	.728	.072
	Computer-based	104	1.38	.545	.053
Errors are not made when entering patient data from for example cardiac monitors, intravenous pumps or results to investigations into the patient's record.	Paper-based	104	2.52	.698	.069
	Computer-based	102	2.40	1.017	.101
Patient information (such as findings) is often attached to the incorrect patient's record.	Paper-based	104	2.73	.769	.076
	Computer-based	104	3.42	.586	.057
Patient's documentation is often lost.	Paper-based	104	2.65	.699	.069
	Computer-based	104	3.79	.517	.051

4.3.4 The time nurses have available for patient care

The experiences of nurses with the time they have available for patient care was measured by the accessibility of patient information of earlier admissions; laboratory and radiology results; nursing care plans; patient's documentation and the patient's prescription chart. It was also measured by how quick and easy it was to complete a patient admission, discharge, and to create and update a nursing care plan. Further measurements were how much time nurses had to document nursing care rendered, whether it was necessary to copy data when creating and updating a nursing care plan or documenting nursing care, and whether it was necessary to contact the doctor because the order was unclear or incomplete.

Levene's test was 0.00 to 0.022 for all the statements related to the experiences of nurses with the time they have available for patient care, except for the statements related to whether it is quick and easy to complete the documentation for a patient admission; whether it is quick to update a nursing care plan; whether nurses have adequate time for hands-on nursing care and whether it is easy to complete the documentation for a patient discharge. The Levene's test for these statements was 0.495 to 0.972, indicating that the variances of the two groups were approximately equal for these questions but not for the other statements. The 'equal variances not assumed' line was thus used for the interpretation and reporting of the t-test for all the statements related to the experiences of nurses with the time they have available for patient care. The exceptions were statements related to whether it is quick and easy to complete the documentation for a patient admission; whether it is quick to update a nursing care plan; whether nurses have adequate time for hands-on nursing care and whether it is easy to complete the documentation for a patient discharge, where the 'equal variances assumed' line was used.

The null hypothesis that the delivery of nursing care is not affected by IT was rejected for all the statements related to the experiences of nurses with the time they have available for patient care, since the p-value for these statements was 0.00 to 0.033. There was a statistical difference between the experiences of nurses with the time they have available for patient care between those who worked in the hospital with a paper-based documentation system and those who worked on the hospital with a computer-based documentation system, at a 95% confidence interval. This is indicated in Table 4.11 below.

Table 4.11 Independent samples test: Time nurses have available for patient care.

Statements describing nurses' experiences with the time available for patient care		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	Lower	Upper
Patient information of earlier admissions is easily accessible.	Equal variances assumed	94.370	.000	14.290	206	.000	1.317	.092	1.136	1.499
	Equal variances not assumed			14.290	143.205	.000	1.317	.092	1.135	1.500
It is quick to complete the documentation for a patient admission.	Equal variances assumed	.115	.734	8.238	206	.000	.846	.103	.644	1.049
	Equal variances not assumed			8.238	205.914	.000	.846	.103	.644	1.049
It is easy to complete the documentation for a patient admission.	Equal variances assumed	.249	.618	9.627	205	.000	.819	.085	.651	.986
	Equal variances not assumed			9.618	197.077	.000	.819	.085	.651	.987
Laboratory results are easily accessible.	Equal variances assumed	42.929	.000	14.104	205	.000	1.095	.078	.942	1.248
	Equal variances not assumed			14.145	151.425	.000	1.095	.077	.942	1.248
Radiology results are easily accessible.	Equal variances assumed	15.056	.000	2.155	204	.032	.240	.111	.020	.460
	Equal variances not assumed			2.149	183.959	.033	.240	.112	.020	.461
Nursing care plans are easily accessible.	Equal variances assumed	7.565	.006	11.139	205	.000	.885	.079	.728	1.042
	Equal variances not assumed			11.117	175.594	.000	.885	.080	.728	1.042
Nursing documentation is easily accessible.	Equal variances assumed	18.063	.000	13.252	202	.000	.963	.073	.819	1.106
	Equal variances not assumed			13.168	140.728	.000	.963	.073	.818	1.107
The patient's prescription chart is always accessible.	Equal variances assumed	11.632	.001	12.124	206	.000	.865	.071	.725	1.006
	Equal variances not assumed			12.124	150.002	.000	.865	.071	.724	1.006
It is quick to create a nursing care plan.	Equal variances assumed	12.120	.001	10.862	204	.000	.918	.085	.752	1.085
	Equal variances not assumed			10.908	173.595	.000	.918	.084	.752	1.085
It is quick to update a nursing care plan.	Equal variances assumed	.245	.621	9.441	205	.000	.781	.083	.618	.944
	Equal variances not assumed			9.434	199.974	.000	.781	.083	.617	.944
Nurses have adequate time for hands-on nursing care.	Equal variances assumed	.468	.495	14.483	203	.000	1.353	.093	1.169	1.537
	Equal variances not assumed			14.435	190.625	.000	1.353	.094	1.168	1.538

Table 4.11 Independent samples test: Time nurses have available for patient care (continued).

Statements describing nurses' experiences with the time available for patient care		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Nurses have adequate time to document nursing care rendered.	Equal variances assumed	5.292	.022	10.503	204	.000	1.136	.108	.923	1.349
	Equal variances not assumed			10.503	203.403	.000	1.136	.108	.923	1.349
It is easy to obtain an overview on the nursing tasks that have already been done for a patient.	Equal variances assumed	65.117	.000	18.105	201	.000	1.284	.071	1.144	1.424
	Equal variances not assumed			17.988	165.676	.000	1.284	.071	1.143	1.425
It is easy to reuse available information e.g. vital signs for nursing documentation.	Equal variances assumed	10.772	.001	11.422	204	.000	1.044	.091	.864	1.224
	Equal variances not assumed			11.404	197.203	.000	1.044	.092	.863	1.224
It is easy to complete the documentation for a patient discharge.	Equal variances assumed	.001	.972	10.952	204	.000	.845	.077	.693	.997
	Equal variances not assumed			10.952	197.710	.000	.845	.077	.693	.997
There is an effective system in place for detecting incomplete procedure during patient discharge.	Equal variances assumed	5.643	.018	4.308	202	.000	.450	.105	.244	.657
	Equal variances not assumed			4.321	199.406	.000	.450	.104	.245	.656
The patient's documentation is always accessible.	Equal variances assumed	10.226	.002	13.938	201	.000	1.076	.077	.924	1.228
	Equal variances not assumed			13.952	193.052	.000	1.076	.077	.924	1.228
It is often necessary to copy the same data when creating a nursing care plan.	Equal variances assumed	23.910	.000	6.017	203	.000	.495	.082	.333	.657
	Equal variances not assumed			6.021	200.549	.000	.495	.082	.333	.657
It is often necessary to copy the same data when updating a nursing care plan.	Equal variances assumed	23.054	.000	5.271	205	.000	.428	.081	.268	.588
	Equal variances not assumed			5.268	200.471	.000	.428	.081	.268	.588
It is often necessary to copy the same data when documenting nursing care.	Equal variances assumed	20.451	.000	5.476	203	.000	.452	.082	.289	.614
	Equal variances not assumed			5.473	199.724	.000	.452	.083	.289	.614
It is often necessary to contact the doctor because their order is unclear.	Equal variances assumed	18.555	.000	-10.528	205	.000	-1.278	.121	-1.517	-1.039
	Equal variances not assumed			-10.541	193.723	.000	-1.278	.121	-1.517	-1.039
It is often necessary to contact the doctor because their order is incomplete.	Equal variances assumed	8.960	.003	-10.934	205	.000	-1.326	.121	-1.565	-1.087
	Equal variances not assumed			-10.947	193.754	.000	-1.326	.121	-1.564	-1.087

The information in Table 4.12 shows that the mean scores for the nurses working in the hospital with a paper-based documentation system ranged between 2.51 and 2.54 for the statements related to whether it is often necessary to copy the same data when creating and updating a nursing care plan and documenting nursing care. For the same statements, the average scores for the nurses in the hospital with a computer-based documentation system ranged between 2.05 and 2.09. The nurses in the hospital with a computer-based documentation system therefore agreed more strongly with these statements than those in the hospital with a paper-based documentation system.

The nurses in the hospital with a paper-based documentation system had mean scores of 2.09 and 2.14 respectively for the questions related to whether it is often necessary to contact the doctor because the order is unclear and incomplete, while the nurses in the hospital with a computer-based documentation system had mean scores of 3.37 to 3.46 respectively.

The average scores for the nurses in the hospital with a paper-based documentation system ranged between 1.98 to 2.9 for all the remaining questions related to the time nurses have available to spend on hands-on patient care, whereas the average scores for the nurses in the hospital with a computer-based documentation system ranged between 1.1 and 2.27. These scores indicate that the nurses in the hospital with a computer-based documentation system therefore agreed more strongly with these statements that than those in the hospital with a paper-based documentation system.

The experiences of nurses in the hospital with a computer-based documentation system were more positive than those in the hospital with a paper-based documentation system with regard to the time nurses have available to spend on patient care. The exception was for the necessity to copy the same data when creating and updating a nursing care plan and documenting nursing care, where the experiences of nurses in the hospital with a paper-based documentation system were more positive.

Table 4.12 Group Statistics: Time nurses have available for patient care.

Statements describing nurses' experiences with the time available for patient care	Type of documentation system	N	Mean	Std. Deviation	Std. Error Mean
Patient information of earlier admissions is easily accessible.	Paper-based	104	2.44	.857	.084
	Computer-based	104	1.13	.386	.038
It is quick to complete the documentation for a patient admission.	Paper-based	104	2.29	.733	.072
	Computer-based	104	1.44	.748	.073
It is easy to complete the documentation for a patient admission.	Paper-based	104	2.16	.668	.066
	Computer-based	104	1.34	.551	.054
Laboratory results are easily accessible.	Paper-based	104	2.21	.706	.069
	Computer-based	104	1.12	.351	.035
Radiology results are easily accessible.	Paper-based	104	2.25	.665	.065
	Computer-based	104	2.01	.917	.091
Nursing care plans are easily accessible.	Paper-based	104	2.05	.677	.067
	Computer-based	104	1.16	.443	.043
Nursing documentation is easily accessible.	Paper-based	104	2.07	.667	.066
	Computer-based	104	1.11	.310	.031
The patient's prescription chart is always accessible.	Paper-based	104	1.98	.653	.064
	Computer-based	104	1.12	.321	.031
It is quick to create a nursing care plan.	Paper-based	104	2.16	.726	.071
	Computer-based	104	1.25	.455	.045
It is quick to update a nursing care plan.	Paper-based	104	2.18	.638	.063
	Computer-based	104	1.40	.549	.054
Nurses have adequate time for hands-on nursing care.	Paper-based	104	2.90	.742	.074
	Computer-based	104	1.55	.589	.058
Nurses have adequate time to document nursing care rendered.	Paper-based	104	2.81	.755	.074
	Computer-based	104	1.67	.797	.079
It is easy to obtain an overview on the nursing tasks that have already been done for a patient.	Paper-based	104	2.43	.607	.061
	Computer-based	104	1.15	.381	.038
It is easy to reuse available information e.g. vital signs for nursing documentation.	Paper-based	104	2.28	.709	.070
	Computer-based	104	1.24	.599	.059
It is easy to complete the documentation for a patient discharge.	Paper-based	104	2.15	.601	.059
	Computer-based	104	1.30	.502	.049

Table 4.12 Group Statistics: Time nurses have available for patient care (continued).

Statements describing nurses' experiences with the time available for patient care	Type of documentation system	N	Mean	Std. Deviation	Std. Error Mean
There is an effective system in place for detecting incomplete procedure during patient discharge.	Paper-based	104	2.71	.686	.069
	Computer-based	104	2.26	.800	.078
The patient's documentation is always accessible.	Paper-based	104	2.34	.605	.060
	Computer-based	104	1.27	.488	.049
It is often necessary to copy the same data when creating a nursing care plan.	Paper-based	104	2.54	.623	.061
	Computer-based	104	2.05	.552	.055
It is often necessary to copy the same data when updating a nursing care plan.	Paper-based	104	2.51	.624	.061
	Computer-based	104	2.09	.542	.053
It is often necessary to copy the same data when documenting nursing care.	Paper-based	104	2.53	.625	.062
	Computer-based	104	2.08	.555	.055
It is often necessary to contact the doctor because their order is unclear.	Paper-based	104	2.09	.755	.074
	Computer-based	104	3.37	.976	.096
It is often necessary to contact the doctor because their order is incomplete.	Paper-based	104	2.14	.755	.074
	Computer-based	104	3.46	.975	.096

4.3.5 The reduction in medication errors

The reduction of medication errors was measured by how well the patient's prescription record supported the prevention of medication errors, in other words whether the doctor's prescription met the requirements of a legal script; whether it was necessary to transcribe orders or take telephonic orders; whether errors were made when taking a telephonic order; whether the prescription record alerted the medication nurse if any of the "five rights" (i.e. the right patient, medication, dose, frequency, route) were incorrect and whether the prescription record alerted the medication nurse to drug interactions, contra-indications or patient allergies.

As seen by the data in Table 4.13, Levene's test was 0.00 to 0.046 for all the statements related to the experiences of nurses with the patient's prescription record, except for the statements related to whether the patient's prescription record supports the prevention of medication errors; whether the patient's prescription record alerts the medication nurse to drug interactions; whether errors are made when taking down a telephonic order from the doctor and whether the doctor's medication prescription is always easy to read. The Levene's test for these statements was 0.176 to 0.575, indicating that the variances of the two groups were approximately equal for these statements but not for the other statements. The 'equal variances not assumed' line was thus used for the interpretation and reporting of the *t*-test for all the statements related to the experiences of nurses with the patient's prescription record, with exceptions. The exceptions were the statements related to whether the patient's prescription record supports the prevention of medication errors; whether the patient's prescription record alerts the medication nurse to drug interactions; whether errors are made when taking down a telephonic order from the doctor and whether the doctor's medication prescription is always easy to read, where the 'equal variances assumed' line was used.

The p-value for all the statements related to the experiences of nurses with the patient's prescription record, except the statements related to whether the patient's prescription record alerts the medication nurse to drug interactions and to contra-indications of prescribed medications, was 0.00. The null hypothesis that the delivery of nursing care is not affected by IT was hence rejected for these statements. The null hypothesis that the delivery of nursing care is not affected by IT for the questions related to whether the patient's prescription record alerts the medication nurse to

drug interactions and to contra-indications of prescribed medications was accepted, because the p-values for these two questions were 0.352 and 0.914 respectively. There was thus a statistical difference between the experiences of nurses with the patient's prescription record between those who worked in a hospital with a paper-based documentation system and those who worked in a hospital with a computer-based documentation system, at a 95% confidence interval. This was for all the experiences of nurses with the patient's prescription record, except whether the patient's prescription record alerts the medication nurse to drug interactions and to contra-indications of prescribed medications.

Table 4.13 Independent samples test: Reduction in medication errors.

Statements describing nurses' experiences with medication errors		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	Lower	Upper
The patient's prescription record supports the prevention of medication errors.	Equal variances assumed	1.842	.176	6.056	203	.000	.514	.085	.347	.681
	Equal variances not assumed			6.052	201.722	.000	.514	.085	.346	.681
The patient's prescription record alerts the medication nurse if any of the 'five rights' are incorrect.	Equal variances assumed	21.680	.000	3.741	204	.000	.394	.105	.186	.601
	Equal variances not assumed			3.752	190.260	.000	.394	.105	.187	.601
The patient's prescription record alerts the medication nurse to drug interactions.	Equal variances assumed	.315	.575	.934	202	.352	.105	.113	-.117	.328
	Equal variances not assumed			.935	199.757	.351	.105	.113	-.117	.328
The patient's prescription record alerts the medication nurse to contra-indications of prescribed medications.	Equal variances assumed	20.298	.000	-.108	203	.914	-.013	.122	-.254	.227
	Equal variances not assumed			-.108	186.339	.914	-.013	.121	-.253	.226
The patient's prescription record alerts the medication nurse to the patient's allergies.	Equal variances assumed	4.026	.046	7.836	203	.000	.680	.087	.509	.851
	Equal variances not assumed			7.834	202.288	.000	.680	.087	.509	.851
Errors are never made when taking down a telephonic order from the doctor.	Equal variances assumed	1.817	.179	-4.652	191	.000	-.503	.108	-.717	-.290
	Equal variances not assumed			-4.667	190.318	.000	-.503	.108	-.716	-.291
The doctor's medication prescription is always easy to read.	Equal variances assumed	.687	.408	21.644	201	.000	1.776	.082	1.614	1.938
	Equal variances not assumed			21.549	182.089	.000	1.776	.082	1.613	1.939
The doctor's medication prescription is always complete.	Equal variances assumed	23.879	.000	18.734	204	.000	1.602	.085	1.433	1.770
	Equal variances not assumed			18.643	161.129	.000	1.602	.086	1.432	1.771
The doctor's prescription is always signed by the doctor.	Equal variances assumed	51.682	.000	14.084	201	.000	1.150	.082	.989	1.311
	Equal variances not assumed			14.047	156.034	.000	1.150	.082	.988	1.312
Telephonic prescriptions are always signed by the doctor within 24 hours of the order been taken.	Equal variances assumed	15.001	.000	12.898	192	.000	1.203	.093	1.019	1.387
	Equal variances not assumed			12.757	174.858	.000	1.203	.094	1.017	1.389

Table 4.13 Independent samples test: Reduction in medication errors (continued).

Statements describing nurses' experiences with medication errors		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. 2-tailed	Mean Difference	Std. Error Difference	Lower	Upper
It is often necessary to take a telephonic prescription from the doctor.	Equal variances assumed	6.305	.013	-3.833	194	.000	-.373	.097	-.565	-.181
	Equal variances not assumed			-3.831	191.655	.000	-.373	.097	-.565	-.181
It is often necessary to transcribe the doctor's prescription.	Equal variances assumed	7.521	.007	-7.715	199	.000	-.886	.115	-1.112	-.659
	Equal variances not assumed			-7.657	183.898	.000	-.886	.116	-1.114	-.657

Table 4.14 shows that the nurses in the hospital with a paper-based documentation system had mean scores of 2.66 and 2.56 respectively for the questions related to whether it is often necessary to take a telephonic prescription from the doctor and whether it is often necessary to transcribe the doctor's prescription, whereas the nurses in the hospital with a computer-based documentation system had mean scores of 3.03 to 3.44 respectively. The nurses in the hospital with a computer-based documentation system agreed more strongly with these statements. The average scores for the nurses in the hospital with a paper-based documentation system ranged between 1.97 and 2.98 for all the remaining statements related to nurses experiences with the patient's prescription record, whereas the average scores for the nurses in the hospital with a computer-based documentation system ranged between 1.17 and 3.11. The nurses in the hospital with a computer-based documentation system more strongly agreed with all the remaining statements related to nurses' experiences with the patient's prescription record. The nurses working in the hospital with a computer-based

documentation system thus had more favourable experiences with the reduction in medication errors as measured by their experiences with the patient's prescription record than those in the hospital with a paper-based documentation system, with some exceptions. These exceptions were for whether the patient's prescription record alerts the medication nurse to drug interactions and to contra-indications of prescribed medications, where there was no statistical difference, as well as for whether errors are made when taking down a telephonic order from the doctor, where the nurses working in the hospital with a paper-based documentation system had a more positive experience.

Table 4.14 Group Statistics: Reduction in medication errors.

Statements describing nurses' experiences with medication errors	Type of documentation system	N	Mean	Std. Deviation	Std. Error Mean
The patient's prescription record supports the prevention of medication errors.	Paper-based	104	2.15	.623	.062
	Computer-based	104	1.63	.592	.058
The patient's prescription record alerts the medication nurse if any of the 'five rights' are incorrect.	Paper-based	104	1.97	.636	.063
	Computer-based	104	1.58	.856	.084
The patient's prescription record alerts the medication nurse to drug interactions.	Paper-based	104	2.43	.753	.075
	Computer-based	104	2.32	.854	.084
The patient's prescription record alerts the medication nurse to contra-indications of prescribed medications.	Paper-based	104	2.54	.714	.071
	Computer-based	104	2.56	1.003	.098
The patient's prescription record alerts the medication nurse to the patient's allergies.	Paper-based	104	2.03	.636	.063
	Computer-based	104	1.35	.606	.060
Errors are never made when taking down a telephonic order from the doctor.	Paper-based	104	2.60	.728	.076
	Computer-based	104	3.11	.770	.076
The doctor's medication prescription is always easy to read.	Paper-based	104	2.98	.666	.067
	Computer-based	104	1.20	.492	.049
The doctor's medication prescription is always complete.	Paper-based	104	2.78	.753	.075
	Computer-based	104	1.18	.435	.043
The doctor's prescription is always signed by the doctor.	Paper-based	104	2.32	.720	.072
	Computer-based	104	1.17	.400	.040
Telephonic prescriptions are always signed by the doctor within 24 hours of the order been taken.	Paper-based	104	2.47	.718	.075
	Computer-based	104	1.26	.579	.057
It is often necessary to take a telephonic prescription from the doctor.	Paper-based	104	2.66	.684	.071
	Computer-based	104	3.03	.678	.067
It is often necessary to transcribe the doctor's prescription.	Paper-based	104	2.56	.901	.091
	Computer-based	104	3.44	.722	.071

4.4 CONCLUSION

This chapter presented the findings of all the data that was collected and described the demographic characteristics of respondents to the questionnaire. It presented whether there was a statistically significant difference in the effects of IT on the delivery of nursing care as experienced by registered and enrolled nurses working in the hospital which uses a computer-based documentation system for patient care, when compared with a hospital which uses a paper-based documentation system. The next chapter will discuss the findings of the study.

CHAPTER 5

DISCUSSION OF THE RESULTS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The previous chapter focused on the presentation of the study findings. This chapter will focus on a discussion of the study findings. The discussion will be based on the objectives of the study as stated in chapter one. Stated objectives were to describe the effects of IT on the delivery of nursing care as measured by the quality of nursing documentation and the amount of time nurses have available to spend on hands-on patient care when IT is used in nursing, as opposed to when a paper-based documentation system is used, and the reduction of medication errors.

5.2 THE QUALITY OF NURSING DOCUMENTATION

The quality of nursing documentation was measured by the appropriateness of nursing care plans, the compliance of nursing documentation with the legal requirements of recordkeeping and the accuracy and completeness of the record of patient care.

5.2.1 appropriateness of nursing care plans

Nurses in the hospital with a computer-based documentation system had more positive experiences with nursing care plans than those in the hospital with a paper-based documentation system. Information technology therefore improved the experiences of nurses with nursing care plans being appropriate, adequate and being updated when the patient's condition changes. A study by Furukuwa, Raghu and Shao

(2010: 944) found that the electronic health record (EHR) improved the quality of nursing care through the use of standardised nursing care plans. Cox (2006: 554) discussed the importance of well organised care plans in providing adequate nursing care. The EHR also helps to ensure that patient risks are always appropriately planned for. Tremblay (2010: 42) outlined how the EHR alerts nurses of the patient's risks, facilitating appropriate care being planned. On the other hand, Mahler *et al*. (2007: 281) found that the standardised nursing care plans resulted in a lack of critical thinking and failure to plan appropriate care for patients.

5.2.2 The compliance of nursing documentation with the legal requirements of recordkeeping

The experiences of nurses in the hospital with a computer-based documentation system with the compliance of nursing documentation with the legal requirements of recordkeeping were better than those in the hospital with a paper-based documentation system. Exceptions were for the use of unauthorised abbreviations and whether nursing documentation always reflects the time nursing care was rendered, where there was no statistical difference.

Information technology thus improved the correction of errors in the prescribed manner, as well as helping to ensure that nursing documentation reflects the date. The use of information technology also improved the legibility of nursing entries and helped to ensure that entries in the nursing documentation were signed, with the signatures being legible and accompanied by nurses' designations. These findings are supported by Mahler *et al*. (2007: 281) who found that a computer-based documentation system improved the compliance of nursing documentation with the legal requirements for recordkeeping. Robles

(2009: 32) and Ammenwerth *et al*. (2010: 29) also found that the EHR increased the legibility of nursing documentation. Information technology failed, however, to decrease the use of unauthorised abbreviations or to help in ensuring that nursing entries reflect the time nursing care was rendered.

5.2.3 accuracy and completeness of the record of nursing care

Nurses in the hospital with a computer-based documentation system had more positive experiences with the record of nursing care than those in the hospital with a paper-based documentation system, with some exceptions. These exceptions were for whether errors were made when entering patient data from, for example, cardiac monitors, intravenous, pumps or results of investigations into the patient's record, where there was no statistical difference.

Hence IT facilitated documented nursing care being clear and complete. In support of this finding, Mahler *et al*. (2007: 281) reported that a computer-based documentation system enhances documented nursing care being complete. Information technology also prevented patients' documentation getting lost. This finding is contrary to a study by Holden (2010: 74), where it was found that sometimes old patient information and test results simply disappeared from the system. Information technology was unsuccessful, however, in ensuring that nursing documentation was free of errors. This is in opposition to Robles' (2009: 33) discussion that the EHR significantly reduces errors made in nursing documentation.

The quality of nursing documentation was therefore enhanced by IT. This is in keeping with a study by Robles (2009: 32) which also found that the EHR improved the quality of nursing documentation. Templates guide

documentation and thereby improve the clarity and comprehensiveness of documented nursing care (Noblin *et al*. 2013: 5). The quality of documented nursing care is also enhanced as a result of the EHR facilitating immediate documentation of nursing care rendered (Sweeny 2010: 534). Contrary to these results, the findings of a study by Mahler *et al*. (2007: 281) showed that IT did not always improve the quality of nursing documentation.

5.3 THE AMOUNT OF TIME NURSES HAVE AVAILABLE FOR PATIENT CARE

The experiences of nurses in the hospital with a computer-based documentation with the time they have available to spend on patient care system were more favourable than those in the hospital with a paper-based documentation system, with one exception. The exception is the necessity for copying the same data when creating and updating a nursing care plan and documenting nursing care, where nurses in the hospital with a paper-based documentation system had more positive experiences. This indicates that nurses have more time available for patient care as a result of IT.

Patient information of earlier admissions, laboratory and radiology results, nursing care plans, nursing documentation and the patient's prescription card were more accessible due to the use of IT. In support of these findings, Huston (2013: 2) also found that IT improves the accessibility of patient information. Holden (2010: 74) determined that a computer-based system makes the retrieval of patient information quicker and easier. Xue *et al.* (2012: 686) also reported that patient's clinical data, as well as laboratory and radiology results was more easily accessible through the use of IT. A CPOE system enables more than one healthcare provider to

view the prescription card at the same time (Niazkhani *et al*. 2009: 542). This is hugely beneficial, as nurses have access to the patient's prescription card at the same time as the doctor and the pharmacist. Consequently, time is saved trying to locate patient information or needing to wait for the patient's record while another member of the healthcare team is using it (Robles 2009:32). Furthermore, IT saves time as results of investigations are automatically available on the system (Fetter 2009: 345). Contrarily, Holden (2010: 74) found that patient information was not always easily accessible but difficult to access or find.

IT made the completion of patient admissions and discharges, as well as the creation and updating of nursing care plans, quicker and easier too. Similarly, Lee *et al.* (2013: 4-5) found that IT facilitated a quicker discharge process. The time required for nurses to document nursing care rendered and the necessity to contact the doctor because their order was unclear or incomplete, was reduced by the use of IT. This is in keeping with Robles' (2009: 34) discussion that IT saves nurses time by reducing the need for nurses to track down doctors. Furukawa, Raghu and Shao (2010: 944) also found that the EHR reduced the time nurses spent on documentation and that it enhanced communication between nurses and doctors. Lee *et al.* (2013: 5) stated that accurate communication and co-ordination of patient care saves time.

Consequently, nurses have more time available for hands-on patient care as a result of the use of IT. The finding that IT saves nurses' time is supported by Xue *et al.* (2012: 686). Ammenwerth *et al*. (2010: 29) found that the EHR saved nurses time by reducing duplication when documenting nursing care. In contrast, Furukawa, Raghu and Shao (2010: 944) and Ammenwerth *et al*. (2010: 33) reported that the EHR

does not save nurses time due to there being increased computer-related tasks. Similarly, Niazkhani *et al*. (2009: 543) declared that IT resulted in an increase in administrative documentation time. Time is also wasted when nurses have difficulty finding items on the IT system (Noblin *et al*. 2013: 4). Finding the correct screen, having to choose from numerous options and having to respond to various alerts, also takes more time than performing the same task using a paper-based documentation system (Holden 2010: 74). Robles (2009: 33) also found that a well designed electronic documentation system takes more time than a paper-based documentation system, as it forces nurses to follow the correct processes and adhere to policies as well as preventing workarounds, shortcuts and the disregarding of rules. Time is also wasted when the system is slow, down, or when there are system failures and nurses need to wait until it is operational again before they can complete certain tasks (Noblin *et al*. 2013: 2).

The only exception to IT saving nurses time in this study is where IT resulted in the necessity to copy the same data when creating and updating a nursing care plan and documenting nursing care, thereby wasting time. Furst *et al*. (2013: 132), however, found that standardised nursing care plans saved nurses time. Ammenwerth *et al*. (2010: 30) reported that the pre-defined care plans in the EHR made care planning much quicker.

5.4 THE REDUCTION OF MEDICATION ERRORS

The reduction of medication errors was measured by how well the patient's prescription record supported the prevention of medication errors. In other words, whether the doctor's prescription met the requirements of a legal script; whether it was necessary to transcribe

orders or take telephonic orders; whether errors were made when taking a telephonic order; whether the prescription record alerted the medication nurse if any of the 'five rights' (i.e. the right patient, medication, dose, frequency, route) were incorrect and whether the prescription record alerted the medication nurse to drug interactions, contra-indications or patient allergies.

5.4.1 The compliance of the doctor's medication prescription with the requirements for a legal script

Nurses' experiences with the compliance of the doctor's medication prescription with the requirements for a legal script in the hospital with a computer-based documentation system were more favourable than those in the hospital with a paper-based documentation system. Information technology therefore improved the compliance of the doctor's medication prescription with the requirements for a legal script, in other words, that the doctor's medication script was legible, complete and signed by the doctor. In support of these findings, Fetter (2009: 345) expressed that medication errors are reduced by eliminating illegible prescriptions. A CPOE system has been found to reduce medication errors by standardising orders and ensuring that the order is complete (Tremblay 2010: 38). Niazkhani *et al*. (2009: 545) found that CPOE improved prescriptions being signed by the ordering doctor. Furthermore, a CPOE system was found to improve the legibility of the prescription, as well as to ensure that they are dated, timed and signed by the doctor (Prevent unintended consequences when rolling out computerised physician order entry 2009: 4). Adversely, Ammenwerth *et al*. (2010: 33) found that IT failed to improve the compliance of the doctor's medication prescription with the legal requirements of a script.

5.4.2 he need for transcriptions and telephonic orders Nurses in the hospital with a computer-based documentation system experienced a reduced need for transcribing orders and taking telephonic orders from the doctor. The need for nurses to transcribe orders and take telephonic orders was therefore reduced by the use of IT. Niazkhani *et al*. (2009: 542) explained that CPOE eliminated the need for transcriptions and significantly reduced the need for telephonic orders.

5.4.3 Reducing errors when taking telephonic orders

Nurses working in the hospital with a paper-based documentation system had better experiences with errors not being made when taking telephonic orders from the doctor. The experiences of nurses in the hospital with the computer-based documentation system showed that although there was a reduction in their need to transcribe orders or take telephonic orders, errors were made more often than when nurses in the hospital with a paper-based documentation system took telephonic orders. The reason for this may be that nurses in the hospital with a paper-based documentation system are often required to take telephonic orders, therefore they may have more proficiency in this skill than the nurses in the hospital with the computer-based documentation skills, who seldom need to take telephonic orders.

5.4.4 Alerting the nurse if any of the ‘five rights’ are incorrect

The study found that nurses in the hospital with a computer-based documentation system had more positive experiences with being alerted if any of the ‘five rights’ (the correct medication given to the correct patient at the correct time in the correct dose via the correct route) were incorrect, than those in the hospital with a paper-based documentation system. Hence IT reduced medication errors by alerting nurses if any of

the ‘five rights’ of medication administration were incorrect. This is in keeping with a study by Xue *et al.* (2012: 686), which also found that IT prevents medication errors by confirming that the correct medication is administered to the patient. Furst *et al*. (2013: 132) also found that the bar coding medication administration system reduces human error and gives alerts if any of the ‘five rights’ are incorrect.

5.4.5 Alerting the nurse of drug interactions, contra-indications and allergies

Nurses working in the hospital with a computer-based documentation system had more positive experiences with the patient’s prescription record alerting the medication nurse to patient allergies than those in the hospital with a paper-based documentation system. There was, however, no statistical difference in experiences of nurses with the patient’s prescription record alerting the medication nurse to drug interactions and to contra-indications of prescribed medications. The experiences of nurses with being alerted to patient allergies was therefore improved by IT, however IT failed to make a difference in the experiences of nurses with being alerted to drug interactions and to contra-indications. The finding of nurses being alerted to allergies is supported by Robles (2009: 33). The findings of this study related to IT failing to enhance nurses being alerted to drug interactions is in contrast with the findings of a study by Noblin *et al*. (2013: 4), who found that alerts to drug interactions were a positive feature of IT.

These results illustrate that medication errors are reduced by the use of IT. Huston (2013: 2-3) posited that CPOE and clinical decision support reduces medication errors. Bar-coding medication administration has also been shown to reduce medication errors (Tremblay 2010: 4).

Interestingly, the study by Stone et al. (2009: 961) showed no significant reduction in medication errors after CPOE introduction. Poon *et al*. (2010: 1699) highlighted that the bar-coding medication administration system may have unintended consequences, such as nurses bypassing this technology or relying on it too much, thereby resulting in the risk of new errors. Numerous previously unexplored medication errors caused by CPOE were identified by Koppel *et al*. (2005: 1200). Examples of these included medication discontinuation failures resulting in the patient receiving duplicative or conflicting medication, and selecting the incorrect patient's file resulting in the medication being administered to the incorrect patient.

Furukawa, Raghu and Shao (2010: 944) highlighted how automated alerts helped to prevent errors. Excessive reminders and alerts may, however, result in alert fatigue causing nurses to disregard these reminders and alerts (Cowen 2013: 29). Niazkhani *et al*. (2009: 543) found that the absence of direct communication with CPOE, such as the doctor ordering medication on a round or giving a telephonic order, resulted in delays in the ordered medication being administered by nurses as they were unaware that the medication was ordered. Some CPOE systems are not user-friendly, resulting in prescription and medication administration errors (Bey-Hwa *et al*. 2012: 3817- 3818).

5.5 SUMMARY

The effects of IT on the delivery of nursing care was measured by the quality of nursing documentation, the amount of time nurses have available for hands-on patient care and the reduction of medication errors. Nurses working in the hospital with a computer-based documentation system had more positive experiences with the effects of

IT on the delivery of nursing care than those in the hospital with a paper-based documentation system in most instances. The results of this study thus show that IT positively affected the experiences of nurses with the delivery of nursing care, with only a few exceptions. The null hypothesis that the delivery of nursing care is negatively affected by the use of IT in nursing was hence rejected for most the experiences of nurses with the delivery of nursing care.

IT failed to improve the experiences of nurses with the use of unauthorised abbreviations and whether nursing documentation always reflects the time nursing care was rendered. Errors being made when entering patient data from, for example, cardiac monitors, intravenous pumps or results to investigations into the patient's record, were not reduced by the use of IT. Information technology also made no difference to the experiences of nurses being alerted to drug interactions and to contra-indications of prescribed medications. Consequently no significant difference was found in these experiences.

There were a few instances where IT had a negative effect on the delivery of nursing care. The study revealed that IT increased the need to copy the same data when creating and updating a nursing care plan, as well as when documenting nursing care. Although the need for taking telephonic orders was reduced through the use of IT, it was found that when nurses in the hospital with a computer-based documentation system took telephonic orders, errors were made more often than when nurses in the hospital with a paper-based documentation system took telephonic orders. The null hypothesis was therefore accepted for these experiences. Literature also showed that poor implementation, ineffective integration and incompatible IT systems can result in errors being made

with the quality of nursing care being compromised. Information technology can also result in decreased interpersonal communication with the patient due to the need to concentrate on computer-related tasks.

5.6 RECOMMENDATIONS

The following recommendations are made with special reference to policy development and implementation, institutional management and practice, nursing education and further research. These factors were identified as having an influence on the successful implementation of IT in nursing.

5.6.1 Policy development and implementation

Information technology has been shown to positively influence the delivery of nursing care and hence needs to be introduced to healthcare institutions in South Africa which have not yet adopted a computerised-based documentation system. The use of IT in healthcare will help South Africa to meet the demands for quality nursing care and align its nursing care delivery to world-class quality and practices of first world countries. Policies related to the implementation of IT in healthcare therefore need to be developed. The policies will guide the implementation of IT and ensure standardisation across all healthcare institutions.

5.6.2 tutional management and practice

Institutions need to review the resources available and the budget for the implementation of a computer-based documentation system as such implementation is very costly, especially at the start-up. The significant implementation costs of the EHR, CPOE and clinical decision support is a major challenge of these emerging technologies. Technical support needs to be available at all times after its implementation, particularly in the beginning, to assist users and deal with any problems which may arise.

For the implementation of a computer-based documentation system to be successful, technical support is vital.

5.6.3 education

Successful implementation of IT in nursing is dependent on effective training and skills development, concomitantly with commitment to ongoing learning and development. Training of all nursing staff who are required to use the computer-based documentation system will need to be done before commencement of its implementation. Ongoing training is also required for new staff and when changes are made to the system. It is also advocated that all educational institutions involved with training nurses incorporate the use of IT into their curricula.

5.6.4 her research

The current study was conducted in the public sector only, as there were no private hospitals in KZN which used only a computer-based system for patient care. It is recommended that further research be undertaken to determine the effects of IT on the delivery of nursing care in the private sector. This study reflected the findings of nurses' experiences of the effects of information on the delivery of nursing care. Further independent study measuring the outcomes is thus recommended. Since the required sample size was not obtained in the study, it is recommended that further research obtain a larger sample, hence being more representative of the population. It is recommended that further research uses probability sampling as this would enhance the robustness of the study.

5.7 CONCLUSION

This chapter discussed the study findings. Recommendations were made for policy development and implementation, institutional management and practice, nursing education and further research.

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APPENDIX A: UNIVERSITY ETHICAL CLEARANCE CERTIFICATE

DUT
DURBAN UNIVERSITY OF TECHNOLOGY

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: [illegible]
Fax: [illegible]
Email: [illegible]@dut.ac.za
[illegible]

www.dut.ac.za

14 March 2014

IREC Reference Number: **REC 11/14**

Mrs U A Smith
15 Wilanard
35 Brend Road
Durban
4001

Dear Mrs Smith

The effects of information technology on the delivery of nursing care: a comparative study

I am pleased to inform you that Full Approval has been granted to your proposal REC **11/14.**

The Proposal has been allocated the following Ethical Clearance number IREC **020/14**. Please use this number in all communication with this office.

Approval has been granted for a period of one year, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's

Please note that you may continue with validity testing and piloting of the questionnaire. Research on the proposed project may not proceed until IREC reviews and approves the final questionnaire. If there are no changes to the questionnaire kindly notify IREC in writing.

Yours Sincerely

[redacted]

Prof J K Adam
Chairperson: IREC

APPENDIX B: PERMISSION LETTER TO THE HOSPITAL MANAGERS

Hospital A/B
XXXXXXXX
XXXXXXXX
Durban
4001

Dear Sir/Madam

RE: REQUEST FOR PERMISSION TO CONDUCT STUDY

I am presently a Masters student at the Durban University of technology in the Department of Nursing. The proposed title of my research study is: "*The effects of information technology on the delivery of nursing care: A comparative study*."

During the past decades there has been an information explosion, which has resulted in a rapid advance in information technology (IT). Hospitals worldwide have integrated IT into their healthcare systems. Healthcare systems are also replacing paper-based documentation with electronic health records produced through computer-based documentation systems. Due to this, the use of IT in nursing is constantly increasing. The introduction of IT to nursing is aimed at improving the quality of patient care by facilitating the efficient delivery of nursing care as well as

resolving many of the difficulties experienced in nursing before the introduction of IT in the healthcare setting. Research has however shown that IT can negatively impact on the delivery of nursing care rather than improve it. The study will investigate the effects of IT on the delivery of nursing care as experienced by registered and enrolled nurses working in the hospital setting.

I hereby request your permission to conduct a research study at your hospital i.e. to use your hospital as one of my research settings, to distribute to and collect questionnaires from registered and enrolled nurses in your hospital who consent to participate and to use the responses of these participants. I have attached my research proposal for your perusal. I will greatly appreciate your permission to conduct the study in your hospital.

Yours sincerely

_____

Ursula Smith

DUT student number 21344448

_____

(Research supervisor: Dr. Petro Basson)

APPENDIX C: APPROVAL LETTER FROM PROVINCIAL DEPARTMENT OF HEALTH

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

Health Research & Knowledge Management sub-component
10 – 103 Natalia Building, 330 Langalibalele Street
Private Bag x9051
Pietermaritzburg
3200
Tel.: 033 – 3953189
Fax.: 033 – 394 3782
Email.: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Reference : HRKM 03/14
Enquiries : Mr X Xaba
Tel : 033 – 395 2805

Dear Mrs UA Smith

Subject: Approval of a Research Proposal

1. The research proposal titled **'The effects of information technology on the delivery of nursing care: A comparative study'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at RK Khan and Inkosi Albert Luthuli Central Hospital.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the icentified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mr X. Xaba on 033-395 2805.

Yours Sincerely

[redacted]

Dr E Lutge
Chairperson, Health Research Committee
Date: 03/03/14

APPENDIX D: APPROVAL LETTER FROM HOSPITAL A

health
Department:
Health
PROVINCE OF KWAZULU-NATAL

Inkosi Albert Luthuli Central Hospital
Ethekwini Health District
Office of the Medical Manager
Private Bag X 03, Mayville, 4058
800 Bellair Road, Mayville, 4058
Tel.: 031 240 1059.
Fax.: 031 240 1060
Email:cursclamun@ialch.co.za
www.kznhealth.gov.za

Reference: RE31/04
Enquiries: Medical Management

15 April 2014

Mrs U A Smith
Nursing

Dear Ms Smith

RE: PERMISSION TO CONDUCT RESEARCH AT IALCH

I have pleasure in informing you that permission has been granted to you by the Medical Manager to conduct research on: **The effects of information technology on the delivery of nursing care: a comparative study.**

Kindly take note of the following information before you continue:

1. Please ensure that you adhere to all the policies, procedures, protocols and guidelines of the Department of Health with regards to this research.
2. This research will only commence once this office has received confirmation from the Provincial Health Research Committee in the KZN Department of Health.
3. Kindly ensure that this office is informed before you commence your research.
4. The hospital will not provide any resources for this research.
5. You will be expected to provide feedback once your research is complete to the Medical Manager.

Yours faithfully

[redacted]
Dr K E Letebele Hartell
Medical Manager

APPENDIX E: APPROVAL LETTER FROM HOSPITAL B

health

Department:
Health
PROVINCE OF KWAZULU-NATAL

R.K.KHAN HOSPITAL/ETHEKWINI DISTRICT
OFFICE OF THE CEO
PRIVATE BAG X004
CHATSWORTH
4030

Tel.: 031-4596001
Fax. No. 031-4011247
Email: reena.ramcharan@kznhealth.gov.za
www.kznhealth.gov.za

ENQUIRIES: DR P.S. SUBBAN

29 MAY 2014

Ursula Smith
Clinical Training Specialist
Life Entabeni Hospital

Dear Madam

RE: PERMISSION TO CONDUCT RESEARCH STUDY: "THE EFFECTS OF INFORMATION TECHNOLOGY ON THE DELIVERY OF NURSING CARE."

Permission is granted to conduct your research at this institution.

Please note the following:

1. Please ensure that you adhere to all the policies, procedures, protocols and guidelines of the Institution with regards to this research.
2. Please ensure this office is informed before you commence your research.
3. You will be expected to provide feedback on your findings to this institution.
4. Kindly liaise with Mrs F. Ngidi, Nursing Services Manager on Tel. No. 031- 4596384.

Yours faithfully

[redacted]

HOSPITAL CEO

APPENDIX F: LETTER OF INFORMATION AND CONSENT

Title of the research study: "*The effects of information technology on the delivery of nursing care: A comparative study*."

Principle Researcher/s: Ursula Smith
Supervisor: Dr. Petro Basson

Brief introduction and purpose of the study:
During the past decades there has been an information explosion, which has resulted in a rapid advance in information technology (IT). Hospitals worldwide have integrated IT into their healthcare systems. Healthcare systems are also replacing paper-based documentation with electronic health records produced through computer-based documentation systems. Due to this, the use of IT in nursing is constantly increasing. The introduction of IT to nursing is aimed at improving the quality of patient care by facilitating the efficient delivery of nursing care as well as resolving many of the difficulties experienced in nursing before the introduction of IT in the healthcare setting. Research has however shown that IT can negatively impact on the delivery of nursing care rather than improve it. The aim of the study is to investigate the effects of IT on the delivery of nursing care as experienced by registered and enrolled nurses working in the hospital setting.

Risks to the participant: There are no known risks involved in this study.

Benefits:

The results of the study can be used to inform hospitals of the effects of IT on the delivery of nursing care and thereby enable hospitals to make informed decisions about the introduction of IT into the hospital setting.

Participation:

Your participation is voluntary; you are under no obligation to participate. If you agree to participate in the study, you will need to complete the attached questionnaire, which I will collect in person. You may withdraw from the study at any time without penalty or prejudice.

Any questions or queries you may have at any stage of the study will be answered by the researcher, who can be contacted on 031-2041468 or 0844420333 or via email at ursula.smith@lifehealthcare.co.za

Remuneration: None

Costs of the study: None

Confidentiality:

Confidentiality and privacy will be maintained.

Person to contact in the event of any problems:

Dr. Petro Basson (Research supervisor) on 031-3732687

Statement of agreement to participate in the research study:

I,_____(Full name), ID number_____, have read this document in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by Ursula Smith to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any penalty or prejudice. I hereby voluntarily agree to participate in this study.

Participant's signature: _ Date: _____

Witness's name: (print) _

Witness's signature:_____Date: _____

Researcher's name: Ursula Smith

Researcher's signature: _ Date: _____

Supervisor's name: Dr. Petro Basson

Supervisor's signature: _ Date: _____

APPENDIX G: QUESTIONNAIRE

Office use:

A	B

THE EFFECTS OF INFORMATION TECHNOLOGY
ON THE DELIVERY OF NURSING CARE

Section A

Please tick the appropriate box:

1. Please indicate what type of nursing documentation system the hospital in which you work uses:

	Code:
□ Paper-based	1
□ Computer-based	2

2. Please indicate the type of ward in which you work:	Code:
□ Medical	1
□ Surgical	2
□ Orthopaedic	3
□ High Care	4
□ Intensive Care	5
□ Other	6

3. Please indicate your gender	Code:
□ Female	1
□ Male	2

4. Please indicate your age in years:

5. Please indicate how long (in years) you have worked in this hospital:

_____

Section B

1. Please indicate your responses by ticking the block that best describes your experiences with nursing care plans:

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
1.1	Planned nursing care is appropriate.				
1.2	Planned nursing care is adequate.				
1.3	The nursing care plan of a patient is always updated when the patient's condition has changed.				
1.4	Patient risks for example a high risk for developing pressure sores is always appropriately planned for.				

2. Please indicate your responses by ticking the block that best describes your experiences with the compliance of nursing documentation with the legal requirements of recording keeping:

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
2.1	Unauthorized abbreviations are never used in nursing documentation.				
2.2	Nursing documentation always reflects the date on which nursing care was rendered.				
2.3	Nursing documentation always reflects the time nursing care was rendered.				
2.4	Errors are always corrected in the prescribed manner.				
2.5	Nursing documentation is always legible.				
2.6	Entries are always signed by the nurse who made the entry.				
2.7	Nurses' signatures are always legible.				

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
2.8	Nurses' signatures are always accompanied by their designation.				

3. Please indicate your responses by ticking the block that best describes your experiences with the record of patient care:

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
3.1	Documented nursing care is always adequate.				
3.2	The documentation of nursing tasks is always clear (in other words, who has done what, why, when).				
3.3	Documented nursing care is always complete.				
3.4	Errors are not made when entering patient data from for example cardiac monitors, intravenous pumps or results to investigations into the patient's record.				
3.5	Patient information (such as findings) is often attached to the incorrect patient's record.				
3.6	Patient's documentation is often lost.				

4. Please indicate your responses by ticking the block that best describes your experiences regarding the time you have available for patient care:

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
4.1	Patient information of earlier admissions is easily accessible.				

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
4.2	It is quick is it to complete the documentation for a patient admission.				
4.3	It is easy is it to complete the documentation for a patient admission.				
4.4	Laboratory results are easily accessible.				
4.5	Radiology results are easily accessible.				
4.6	Nursing care plans are easily accessible.				
4.7	Nursing documentation is easily accessible.				
4.8	The patient's prescription chart is always accessible.				
4.9	It is quick to create a nursing care plan.				
4.10	It is quick to update a nursing care plan.				
4.11	Nurses have adequate time for hands-on nursing care.				
4.12	Nurses have adequate time to document nursing care rendered.				
4.13	It is easy to obtain an overview on the nursing tasks that have already been done for a patient.				
4.14	It is easy to reuse patient information which is already available, such as vital signs, for nursing documentation.				
4.15	It is easy to complete the documentation for a patient discharge.				
4.16	There is an effective system in place for detecting incomplete procedure during patient discharge.				
4.17	The patient’s documentation is always accessible.				

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
4.18	It is often necessary to copy the same data when creating a nursing care plan.				
4.19	It is often necessary to copy the same data when updating a nursing care plan.				
4.20	It is often necessary to copy the same data when documentation nursing care.				
4.21	It is often necessary to contact the doctor because their order (for an investigation as an example) is unclear (due to for example the doctor's handwriting being illegible).				
4.22	It is often necessary to contact the doctor because their order (for an investigation as an example) is incomplete.				

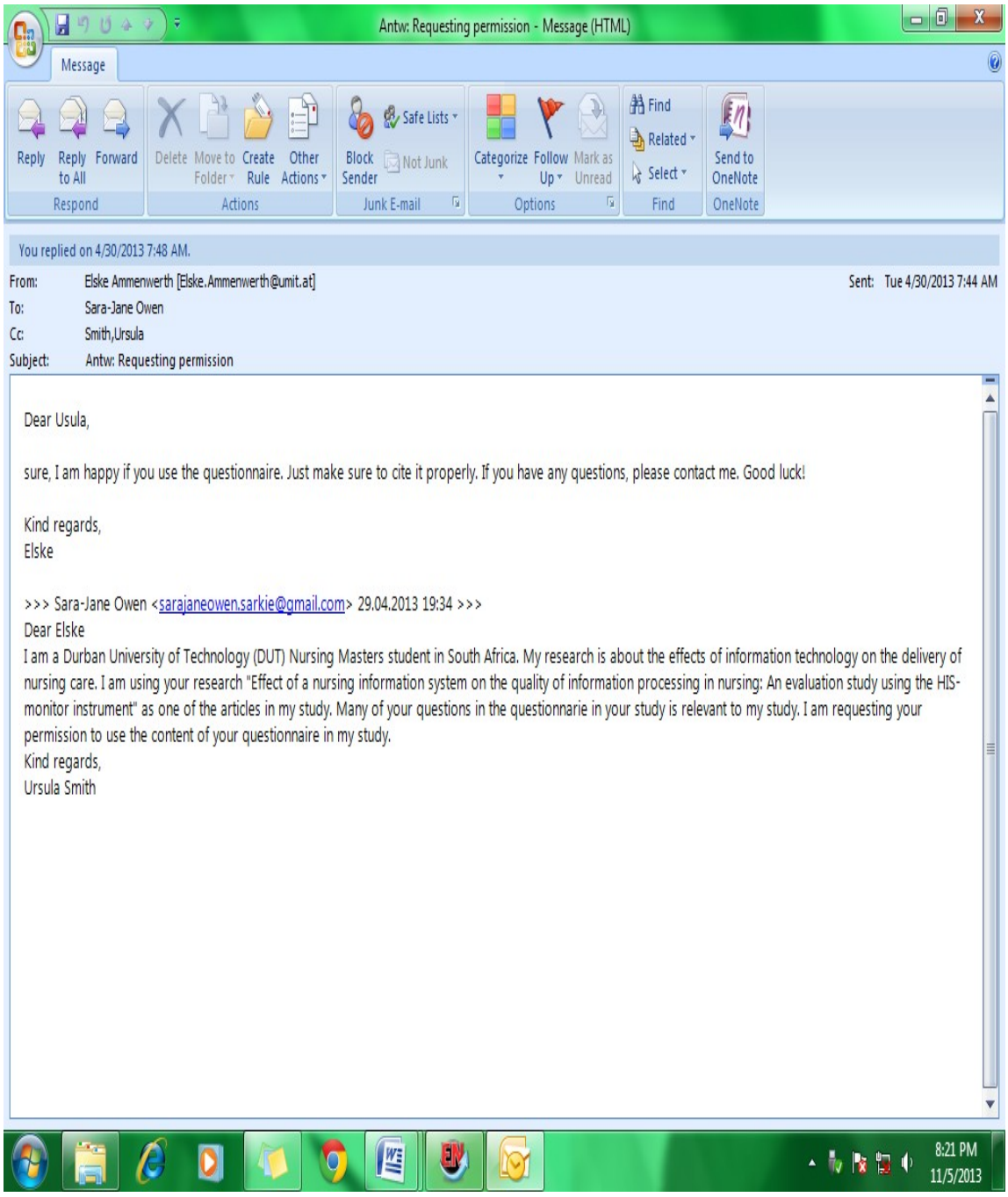
5. Please indicate your responses by ticking the block that best describes your experiences with the patient's prescription record:

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
5.1	The patient's prescription record supports the prevention of medication errors.				
5.2	The patient's prescription record alerts the medication nurse if any of the 'five rights' (i.e. the right patient, medication, dose, frequency, route) are incorrect.				
5.3	The patient's prescription record alerts the medication nurse to Dr.ug interactions.				
5.4	The patient's prescription record alerts the medication nurse to contra-indications of prescribed medications.				

		1 = Strongly agree	2 = Agree	3 = Disagree	4 = Strongly disagree
5.5	The patient's prescription record alerts the medication nurse to the patient's allergies.				
5.6	Errors are never made when taking down a telephonic order from the doctor.				
5.7	The doctor's medication prescription is always easy to read.				
5.8	The doctor's medication prescription is always complete (in other words, it reflects the date, dose, frequency or route of administration).				
5.9	The doctor's prescription is always signed by the doctor.				
5.10	Telephonic prescriptions are always signed by the doctor within 24 hours of the order been taken.				
5.11	It is often necessary to take a telephonic prescription from the doctor.				
5.12	Transcriptions are always signed by the doctor within 24 hours of the order been taken.				
5.13	It is often necessary to transcribe the doctor's prescription.				

Thank you very much for your participation!!!

APPENDIX H: PERMISSION FROM RESEARCHER WHO DEVISED THE HIS-MONITOR INSTRUMENT



APPENDIX I: LANGUAGE EDITING CERTIFICATE

Gillian Cruickshank
082-6601050
gilliancruickshank1@gmail.com

20th July 2015

To whom it may concern

Dear Sir/Madam

I confirm that I have proof-read and edited the Master's script of student **Ms Ursula Smith**. The student has been provided with a list of anomalies within the text that need to be amended by the student from her source material or similar.

Yours faithfully

[redacted].

Gillian Cruickshank (M.Ed: Higher Education)