THE IMPACT OF A WARD PHARMACIST IN A SURGICAL WARD OF A PRIVATE HOSPITAL IN THE EASTERN CAPE

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2014

THE IMPACT OF A WARD PHARMACIST IN A SURGICAL WARD OF A PRIVATE HOSPITAL IN THE EASTERN CAPE

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Research dissertation submitted in fulfilment of the requirements for the degree of

MAGISTER PHARMACIAE

in the

FACULTY OF HEALTH SCIENCES

at the

NELSON MANDELA METROPOLITAN UNIVERSITY

November 2014

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DECLARATION

I, Leanne Stone (205000576), hereby declare that the work on which this dissertation is based is my own work and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree at this or any other university.

LEANNE STONE

November 2014

ACKNOWLEDGEMENTS

I would like to convey my sincere gratitude to the following people and organisations for their contribution to this dissertation:

- My supervisors, Miss Lia Kritiotis and Dr Susan Burton for their support, advice and guidance throughout the study. Your contribution is immeasurable and greatly appreciated.

- Dr Danie Venter from the Department of Statistics at the Nelson Mandela Metropolitan University for the statistical assistance.

- The private hospital group who provided funding for the research to be conducted at the institution.

- The hospital manager at the private hospital institution who permitted the research to be conducted at the hospital.

- The pharmacy managers for providing encouragement and support throughout the study.

- The unit manager of the study ward for your support, co-operation and assistance.

- The medical practitioners and nursing staff working in the study ward for showing interest and participating in the study.

- My husband for encouraging me to pursue a post-graduate degree and for all your support and patience throughout the study. Thank you for being understanding and allowing me to pursue my dreams.

- My family for their support, understanding and encouragement throughout the study.

- My friends and colleagues for their enthusiasm and encouragement.

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ABBREVIATIONS

ART	Assessment of Risk Tool
ASHP	American Society of Health-System Pharmacists
CCU	Cardiac Care Unit
CDC	Centres for Disease Control and Prevention
CDSS	Clinical Decision Support System
COPD	Chronic Obstructive Pulmonary Disease
CPD	Continuing Professional Development
CPOE	Computerised Physician Order Entry System
CSSD	Central Sterile Supply Department
EAHP	European Association of Hospital Pharmacists
eMAR	Electronic Medication Administration System
FIP	International Pharmaceutical Federation
FRTI	Faculty of Research and Technology Innovation
GPP	Good Pharmacy Practice
HIT	Healthcare Information Technology
ICU	Intensive Care Unit
IMWP	Imperial Model of Ward Pharmacy
ISMP	Institute for Safe Medication practices
NHS	National Health Service
NICU	Neonatal Intensive Care Unit
NSAID	Non-Steroidal Anti-Inflammatory Drug
PMB	Prescribed Minimum Benefit
PONV	Postoperative Nausea and Vomiting
PPMI	Pharmacy Practice Model Initiative
REC-H	Research Ethics Committee-Human
RPSGB	Royal Pharmaceutical Society of Great Britain
SAPC	South African Pharmacy Council
SASOCP	South African Society of Clinical Pharmacy
SSI	Surgical Site Infection
UAE	United Arab Emirates
UK	United Kingdom

US	United States
WHO	World Health Organisation

Abstract

Medication errors are becoming problematic in both hospital and outpatient settings worldwide. Inappropriate use of medication can cause harm to the patient and maintaining high levels of quality patient care is essential to protect all patients. Clinical pharmacy practice contributes to improved patient care by optimising medication therapy; and promoting health, wellness and disease prevention. The involvement of a pharmacist at a ward level has been shown to improve patient care; reduce mortality and morbidity rates; decrease healthcare costs; minimise medication errors; and improve outcomes of drug therapy. However, clinical pharmacy is a fairly new practice in South Africa and there are limited studies available.

This study aimed to evaluate the perceived benefits of a ward-based pharmacist on the provision of pharmaceutical care to patients in a hospital setting and to consequently implement a ward-based pharmacy service. The objectives of the study were: (1) to assess, via a questionnaire, the perceptions and attitudes of medical practitioners and nurses to ward-based pharmacy prior to and after implementation of a ward-based pharmacy service, (2) to implement a ward-based pharmacy service in a selected hospital ward; (3) to document and analyse the nature of the work and activities that a ward pharmacist undertakes, and (4) to document and analyse the frequency and nature of ward pharmacist interventions.

The study was conducted in a surgical ward of a private hospital in the Eastern Cape. The study design was an intervention study, using a mixed-methods design, with a convergent approach. A convenience sample of 106 patients was obtained over the eight week study period. Participation was voluntary and confidentiality was maintained at all times. Four data collection tools were used during the study and a pilot study was conducted to ensure their validity and reliability. The quantitative data was analysed statistically while the qualitative questions were analysed through coding the various responses.

The results of the study showed that medical practitioners and nurses of a surgical ward had a positive attitude towards ward pharmacy both prior to and

after the implementation of a ward pharmacy service. There were ward pharmacist interventions made in 50% (n=106) of the patients who participated in the study. A large percentage (57%; 50; n=87) of the ward pharmacist interventions were pharmacist-initiated interventions to optimise patient care while prescribing errors (51%; 19; n=37) were the most commonly occurring medication error. The majority of the medication items involved in the interventions (34%; 34; n=101) were related to the anti-microbial medication class. Overall, there was a 73% (36; n=49) acceptance rate of the ward pharmacist interventions that were made to both the medical practitioners and nurses.

There were a number of factors that had a significant relationship with a ward pharmacist intervention being required which included: (1) number of medication items ($p=0.001$; Chi^2 test; $p<0.0005$ Student's t-test), (2) length of hospital stay ($p<0.0005$; Chi^2 test), (3) presence of one or more chronic disease states ($p=0.003$; Chi^2 test) and (4) presence of one or more allergies ($p=0.028$; Chi^2 test). The ward pharmacist interventions were shown to be of clinical significance and to have a positive impact on the patients concerned. It can be concluded that the ward pharmacy service was beneficial to the patients, medical practitioners and nursing staff.

Keywords

Clinical Pharmacy Practice, Ward-based Pharmacy, Hospital Pharmacy, Intervention Study, Pharmaceutical Care

CHAPTER 1
BACKGROUND TO THE STUDY

1.1. Introduction

The term clinical pharmacy is used internationally; however, it is understood differently around the world (Franklin & van Mil, 2005). For the purpose of this study, the term clinical pharmacy will be defined as "a health science discipline in which pharmacists provide patient care that optimises medication therapy and promotes health, wellness and disease prevention" (American College of Clinical Pharmacy, 2008, p. 816). The terms clinical pharmacy practice, clinical pharmacy services and ward-based clinical pharmacy will be used interchangeably to refer to clinical pharmacy and will be used throughout the discussion. Ward-based clinical pharmacy practice was first developed and implemented in the United States in the mid-1960s, followed by Canada, Europe, Australia and more recently, Asia (Schumock, Butler, Meek *et al.*, 2003, p. 120). For example, clinical pharmacy recently emerged in Iran (in 2010), however, there is limited data available on the clinical activities being performed (Vessal, 2010, p. 60).

The role of a ward pharmacist has expanded over the years with the availability of clinical pharmacy training programmes. Initially in the mid-1960s there was an awareness of medication errors; and ward-based prescription charts were being implemented, which resulted in pharmacists visiting the wards - this was described as "ward pharmacy" (Child, Cooke, & Hey, 2011, p. 140). During the 1970s and 1980s ward pharmacy services expanded and pharmacists were interacting with the patients and other healthcare professionals (Child *et al.*, 2011, p. 140). The pharmacist was now seen as being directly involved in the care of the patient and the service was now known as "clinical pharmacy" which was described in the 1986 Nuffield Report (Child *et al.*, 2011, p. 140). Therefore, the terms "ward pharmacist" and "clinical pharmacist" overlap depending on the services being provided and also the level of clinical training

that each individual pharmacist has undergone (Stone & Curtis, 2002, pp. 169-170).

The involvement of a pharmacist at a ward level has been shown to improve patient care; reduce mortality and morbidity rates; decrease healthcare costs; minimise medication errors; and improve outcomes of drug therapy (Pickette, Muncey, & Wham, 2010, p. 751). According to Matsoso (2009, p. 1), a United Kingdom (UK) Gillie report showed that high rates of drug administration errors in a hospital were resolved by ward-based pharmacy practice. More specifically, a recent study confirmed that the participation of clinical pharmacists in the wards of a US hospital reduced preventable medication errors by 78%-80% (Khalili, Karimzadeh, Mirzabeigi, & Dashti-Khavidaki, 2013, p. 1).

The incorrect use of medication, resulting in errors, is widely recognised as being problematic in both hospital and outpatient settings worldwide (Klopotowska, Wierenga, de Rooij *et al.*, 2011, p. 2). A medication error can be defined as "any preventable event that may cause or lead to inappropriate medication use or patient harm, while the medication is in the control of the healthcare professional or patient" (Klopotowska *et al.*, 2011, p. 5). In 2006, the American Institute of Medicine reported that medication errors affected 1.5 million Americans each year and occurred in 4-14% of hospital patients admitted worldwide (Khalili *et al.*, 2013, p. 1). The Department of Health in the UK reported, in 2004, that medication errors accounted for 10-20% of all adverse events occurring in the National Health Service (NHS) hospitals (Agyemang & While, 2010, p. 380). Furthermore, medication related errors are responsible for approximately 7000 deaths per year in the US (Glavin, 2010, p. 76). According to Welzel (2012, p. 406), currently there is no conclusive data of medication related error rates in South Africa.

The pharmacist plays an integral role in the healthcare team. Therefore, pharmacist participation at a ward level is beneficial. A clinical ward-based pharmacist contributes to improved patient safety and thus, it is important that clinical pharmacy is practiced in all hospital settings. However, a challenge for pharmacy as a profession is the switch from theoretical education to the practical bedside management of patients' medications. Clinical pharmacy

programmes need to be established in teaching hospitals to enable pharmacists to have a clinical environment while undergoing training. (Fahimi, 2010, p. 301)

1.2. Motivation for the Study

Patient safety is defined by the World Health Organisation (WHO) as “the prevention of errors and adverse effects to patients associated with healthcare”. (Welzel, 2012, p. 406). Maintaining high levels of quality patient care is necessary to protect all patients. Every country should have dedicated resources and personnel who are responsible for implementing patient safety programmes (Welzel, 2012, p. 406).

According to Schellack and Gous (2011, p. 29), ward-based clinical pharmacy is a fairly new practice in South Africa. However, the importance of pharmacists in ward medication monitoring was first explored in South Africa in 1991, when it was noted that pharmacists need to be more involved with patients in a ward and communicate with other members of the healthcare team (Schellack & Gous, 2011, p. 29). A study done by Schellack and Gous (2011, p. 33) in a neonatal intensive care unit (NICU) in South Africa showed that the presence of a pharmacist in the ward contributed to improved patient care. Furthermore the study also demonstrated that both the medical practitioners and nurses felt that there was a need for a ward-based pharmacist (Schellack & Gous, 2011, p. 33).

A 2002 report, from the UK Audit Commission on Medicines Management in hospitals, found that a key factor in clinical ward pharmacy was for the pharmacist to spend minimal time involved in supply and dispensing of medication from a central pharmacy. It has been estimated that pharmacists worldwide spend one quarter of their time on the supply and dispensing of medication (Gray, 2008, p. 36). Minimising the duration of time spent on the aforementioned activities will allow pharmacists to spend more time in the wards to influence prescribing decisions. Currently in the US, clinical pharmacy services, which include interventions made by pharmacists, have been shown to be cost-effective (Khalili *et al.*, 2013, p. 6).

The ward pharmacist needs to work with other healthcare professionals to achieve optimal therapeutic outcomes for the patient. The medical and nursing staff's perception and acceptance of clinical ward pharmacy is thus important to ensure successful establishment. (Khalili *et al.*, 2013, p. 6) A ward pharmacist fulfils an important role in improving medication safety and patient pharmaceutical care (de Boer, Ramrattan, Kiewiet *et al.*, 2011, p. 2). The motivation for the study is thus to assess the perception of medical practitioners and nurses towards ward-based pharmacy and to measure the impact of a ward pharmacist on the provision of clinical pharmacy services.

1.3. Problem Statement and Hypothesis

Currently, ward-based clinical pharmacy is not being widely practiced in South Africa (Schellack & Gous, 2011, p. 29). On the other hand, in other countries, clinical ward-based pharmacy is presently being practiced and has been proven to reduce the frequency of medication errors and healthcare costs; and to improve patient outcomes (Khalili, Farsaei, Rezaee, & Dashti-Khavidaki, 2011, p. 284). Ward-based pharmacists can intervene, owing to their pharmacological knowledge of all medication classes. Therefore, the hypothesis was that a ward-based pharmacist can improve pharmaceutical care provision to patients in a private hospital setting.

1.4. Primary Aim

The primary aim of the study was to evaluate the impact of a ward-based pharmacist on the provision of pharmaceutical care to patients in a surgical ward, within a South African private hospital setting.

1.5. Objectives

Based on the primary aim, the objectives can be outlined as follows:

- assess the perceptions and attitudes of medical practitioners and nurses to ward-based pharmacy prior to and after implementation of a ward-based pharmacy service;
- implement a ward-based pharmacy service in a selected hospital ward;

- document and analyse the nature of the work and activities that a ward pharmacist undertakes; and
- document and analyse the frequency and nature of ward pharmacist interventions.

CHAPTER 2
CLINICAL PHARMACY PRACTICE

2.1. The Emergence of Clinical Pharmacy

Clinical pharmacy practice was first introduced in the US in the mid-1960s (Hepler & Strand, 1990, p. 534). The introduction of clinical pharmacy practice gave rise to the philosophy of pharmaceutical care in the early 1990s (Franklin & van Mil, 2005, p. 137). The term pharmaceutical care is interpreted differently around the world (Franklin & van Mil, 2005, p. 137). For the purpose of this study, pharmaceutical care will be defined as "the responsible provision of drug therapy for the purpose of achieving definite outcomes which improve the patient quality of life" (Hepler & Strand, 1990, p. 539). Pharmaceutical care involves a pharmacist co-operating with a patient and other professionals in designing, implementing and monitoring a therapeutic plan (Calvert, 1999, p. 234). Clinical pharmacy practice, together with the philosophy of pharmaceutical care, has changed the way in which pharmacy is practiced, by ensuring that the focus is on the interaction between a patient and his/her medication, as opposed to looking at the medication in isolation (Vessal, 2010, p. 61).

The goal of clinical pharmacy practice is to optimise therapy; and promote health, wellness and disease prevention. Clinical pharmacy combines elements of patient care with therapeutic knowledge to ensure optimal patient outcomes. The pharmacist assumes the role of a drug therapy expert and can practice both independently or in collaboration with other healthcare professionals. Clinical pharmacy practice strives to apply new knowledge that can improve patient health and quality of life. (American College of Clinical Pharmacy, 2008, pp. 816-817)

2.2. The Role and Benefits of a Clinical Pharmacist

Clinical pharmacists should be responsible and accountable for the management of medication therapy in patient care settings (American College of Clinical Pharmacy, 2008, p. 816). The services that are provided by the

pharmacist can include: medication chart review; therapeutic drug level monitoring; documenting and reporting adverse drug reactions; managing drug therapy; and medication counselling (Poh, Nigro, Avent, & Doecke, 2009, p. 176). A ward-based pharmacist should review each patient's acute and chronic medications on admission (de Boer *et al.*, 2011, p. 4).

It is important to ensure that there is effective communication between the pharmacist, medical practitioners and nurses to minimise the potential for medication errors (Schellack & Gous, 2011, p. 29). Ward-based pharmacists need to make themselves readily available for any queries from medical practitioners or nurses (Vessal, 2010, p. 61). Similarly, medical practitioners need to recognise and fully utilise the knowledge that pharmacists have regarding medication (Vessal, 2010, p. 61).

Ward-based pharmacists should be involved in the whole medication process from the dispensing stage to the medication administration at a ward level (Khalili *et al.*, 2011, p. 283). A ward-based pharmacist can improve patient safety by recommending optimal treatment regimens to medical practitioners, which include, amongst other things, medication choices and appropriate dosage recommendations (Vessal, 2010, p. 61). In addition, a ward-based pharmacist can also improve compliance with formulary requirements to ensure cost-effective use of medication for the patient (Gray, 2008, p. 36).

The participation of a ward-based pharmacist on physician ward rounds can also reduce medication errors and improve patient outcomes (Poh *et al.*, 2009, p. 176). A study done in the UK found that pharmacists attending physician ward rounds made significantly more physician-accepted interventions relative to those not attending (Miller, Franklin, & Jacklin, 2011, p. 312&315).

Pharmacist interventions should be made as soon as possible after prescribing, thus, it is advantageous for a pharmacist to be based in a ward where he/she has direct contact with prescribers and nursing staff (Miller *et al.*, 2011, p. 312). Direct face-to-face communication has been shown to have a higher intervention acceptance rate, 69-89%, compared with written communication which has an acceptance rate of 39-70% (Nielsen, Andersen, Rasmussen, &

Honore, 2013, pp. 1138-1141). Querying and resolving medication errors from a central pharmacy can be time consuming as the prescriber or nursing staff may not be available (Gray, 2008, p. 36). Furthermore, a ward-based pharmacist has direct contact with the patient, as well as access to information on the clinical status of the patient, which is not available when dispensing from a central pharmacy (de Boer *et al.*, 2011, p. 2). A record should be maintained of all ward queries and interventions, together with their outcomes (Stone & Curtis, 2002, p. 171).

At the stage of hospital discharge, the ward-based pharmacist can assist the patient with a medication list, containing the following information: drug names, doses, time of dosing, indications for the medications and any other specific instructions on how to take them correctly. The pharmacist can also assist by transferring any relevant information to the patient's general practitioner or regular community pharmacist, if necessary. (Poh *et al.*, 2009, p. 176) It is evident that the pharmacist plays an important role in counselling a patient about his/her medication at the stage of hospital discharge (Poh *et al.*, 2009, p. 176). Encouraging patients to take their medication correctly is an important aspect of clinical pharmacy practice (Calvert, 1999, p. 236). It has been shown that discharge medication counselling improved a patient's medication knowledge and reduced both hospital re-admission rates and the potential for polypharmacy (Donihi, Weber, Sirio, Mark, & Meyer, 2009, p. 1).

Franklin, Rosa, Miller, and Jacklin (2012, p. 518) suggested that a clinical pharmacy service in the UK should involve pharmacists visiting hospital wards once or twice daily on weekdays. However, according to the South African Good Pharmacy Practice (GPP) Guidelines, the frequency of ward visits must be determined by the needs of the patients within each hospital ward (Gray, 2008, p. 35) (South African Pharmacy Council, 2010, pp. 79-80).

During ward visits, the pharmacist must review patient medication charts together with laboratory results (de Boer *et al.*, 2011, p. 4). The daily practice of the ward pharmacist should involve regular conversations with the patients and healthcare professionals regarding medication therapy evaluations and recommendations (American College of Clinical Pharmacy, 2008, p. 817).

2.3. The need for Ward-based Clinical Pharmacy

The majority of hospitalised patients receive medication as part of their treatment. A large number of medication items and doses are administered daily in hospitals worldwide. For example, an average of 7000 doses of medication is administered daily to patients in an average NHS hospital in the UK. (Agyemang & While, 2010, p. 380) In 2006, the American Institute of Medicine reported that medication errors occurred in 4-14% of hospitalised patients worldwide (Khalili *et al.*, 2013, p. 1). In South Africa, there is no data on medical error rate available even with patient safety being of utmost importance (Bruwer, 2012, p. 42). However, a recent estimation of the medical error rates in developing countries was 8.2% of patients admitted (Welzel, 2012, p. 406). Patient safety should be a focus area and can be influenced by the hospital standards and training of healthcare workers (Bruwer, 2012, p. 40).

Medication errors can occur due to human and system factors and can result in accidental harm to the patient. (Agyemang & While, 2010, p. 380) Studies have shown that approximately 28% of medication errors are preventable (Picone, Titler, Dochterman *et al.*, 2008, p. 116). Preventable medication errors can result in increased mortality and morbidity rates and increased healthcare costs (Vessal, 2010, p. 60). For example, data from 2004 showed that the cost of medication errors in an average NHS hospital in the UK was over £1.6 million per year (Agyemang & While, 2010, p. 380). Increased healthcare costs are mainly due to increased length of hospital stay and possible complications depending on the type of medication error. Additionally in the UK, clinical negligence claims from the NHS contribute to the cost of medication errors. (Agyemang & While, 2010, p. 380)

Studies have demonstrated that clinical pharmacists play an important role in terms of assisting with the safe use of medications to minimise medication errors in the wards (Khalili *et al.*, 2013, p. 1). Medication errors can have different outcomes, ranging from causing no harm to the patient; to having potentially life threatening consequences (Vessal, 2010, p. 59). A pharmacist has a very important role to play in surgical patients in particular because of the notion that due to the fact that surgeons spend a large amount of their time in

operating theatres, this may leave them with limited time to focus on each patient's drug therapy requirements. The pharmacist therefore plays an important role in surgical wards to assist in identifying medication errors and adverse drug events. (Neville, Chevalier, Daley *et al.*, 2014, p. 217)

Within the hospital environment there are several stages in the medication use process and ward-based pharmacists should be involved in each one of these stages. The different stages are outlined below and include: prescribing, transcribing, dispensing and administration. Medication errors can occur at any one of these stages. (Vessal, 2010, pp. 59-60) However, studies have demonstrated that the most common errors occur at the stage where prescribing and drug administration take place (Keers, Williams, Cooke, & Ashcroft, 2013, p. 1046). A study done by Leape, Bates, Cullen *et al.* (1995, p. 35) showed that 39% of medication errors occurred during the prescribing stage, while 38% occurred at the medication administration stage.

2.3.1. Types of Medication Errors

2.3.1.1. Prescribing Errors

A prescribing error is defined as "incorrect drug selection, dose, dosage form, frequency, route or instructions" (Vessal, 2010, p. 59). The overall incidence for prescribing errors is approximately 0.4% (Agyemang & While, 2010, p. 381).

Common medication errors are due to poor legibility of prescriptions and due to prescriptions not written in a language understood by the healthcare professionals concerned (Davids, 2013, p. 52). Prescribing errors may also be due to the prescriber having inadequate knowledge of the drug, calculation errors, confusion of the drug name, dosage formulations, use of abbreviations, use of zero and decimal points, unusual routes of administration, uncommon or complicated dosage regimens and poor history taking (Agyemang & While, 2010, p. 381). In addition, nursing staff can prescribe certain medications, if it is within their scope of practice; however, this is sometimes done without consultation with the attending doctor. Standard protocols used by doctors need to be reviewed every six months. The use of old protocols can lead to patients receiving incorrect medication. (Davids, 2013, p. 52)

2.3.1.2. Transcribing Errors

The regulations governing the use of medication in South Africa do not provide clarity about the transcribing of medication by nursing staff (Davids, 2013, p. 52). However, a number of studies suggest that it is best practice for nursing staff not to transcribe medication to reduce potential errors associated with transcribing. Hospital institutions that do allow transcribing to occur need to ensure that policies adhering to legal requirements are in place. The transcribing of medication can lead to items being transcribed incorrectly which can result in medication errors. (Davids, 2013, p. 52)

2.3.1.3. Dispensing Errors

A dispensing error occurs when one or more of the following takes place: the patient receives the incorrect drug, the wrong strength or dose, incorrect directions, or when the wrong medication is given to the wrong patient (Peterson, Wu, & Bergin, 1999, p. 58). Dispensing errors can be fatal, resulting in patient morbidity and mortality, increased healthcare costs and the pharmacist being placed at an increased risk for personal liability (Peterson *et al.*, 1999, p. 57). There is limited information on dispensing error rates worldwide which could be due to pharmacists not reporting errors unless there are serious outcomes (Peterson *et al.*, 1999, p. 58).

Dispensing errors could occur due to confusion of a drug name or products that look or sound alike (Agyemang & While, 2010, p. 381). Furthermore, there are other possible causative factors which may include: high prescription volume, pharmacist fatigue due to workload and interruptions while dispensing. Pharmacists should take regular breaks to minimise fatigue and disruptions should be kept to a minimum, which can be done by assigning one person to answer the telephone and to handle queries (Peterson *et al.*, 1999, p. 61). All pharmacists need to attend regular Continuous Professional Development (CPD) talks or lectures to ensure that they maintain an up-to-date knowledge of the medication items available (Peterson *et al.*, 1999, p. 65).

Pharmacists need to ensure that the patient is not allergic to the medication before dispensing each item. When dispensing generic medications, it is

important for pharmacists to indicate the name of the generic item to the nursing staff to prevent the wrong medication being administered to the patient. (Davids, 2013, p. 53)

The dispensing procedure, workflow and layout within a pharmacy must be optimal to prevent unnecessary confusion which can lead to errors when dispensing (Peterson *et al.*, 1999, p. 63). Dispensing errors can also be minimised by implementing a system that allows for each prescription to be checked by a second pharmacist before leaving the pharmacy (Agyemang & While, 2010, p. 381). Furthermore, dispensing errors can also be reduced through the use of an electronic prescribing system and an automated dispensing system which can assist with improving workflow and minimising errors (Beso, Franklin, & Barber, 2005, p. 189).

2.3.1.4. Administration Errors

Medication administration is the responsibility of nursing staff, however, the process also involves other healthcare professionals. The doctor needs to prescribe the correct items, then the correct medication needs to be dispensed by the pharmacist and the final checking of the medication, together with the correct administration process, is the responsibility of the nursing staff. (Agyemang & While, 2010, p. 383) Medication errors could be due to nursing staff working out of their scope of practice or not adhering to hospital standards (Davids, 2013, p. 52). Approximately 70% of prescribing errors are detected and corrected by pharmacists and nursing staff prior to medication administration (Agyemang & While, 2010, p. 383). Administration errors occur in approximately 5% of all medication doses being administered in hospital settings. Furthermore, medication error rates in the UK showed that medication errors related to intravenous medications were significantly higher than those for oral medication items (Agyemang & While, 2010, p. 380).

Common causes for administration errors may include: (1) prescriptions being illegible, (2) verbal orders being taken incorrectly, (3) transcribing errors, and (4) items being labelled inadequately (Agyemang & While, 2010, p. 381). Additionally, administration errors can also be due to personal factors or

organisational factors. Personal factors may include: (1) lack of knowledge, (2) not adhering to policies and procedures, (3) distractions, (4) fatigue, (5) illness, and (6) stress (Agyemang & While, 2010, p. 381). Distractions which commonly occur are mostly due to conversations, including phone calls. Other distractions could include dealing with sick patients, emergency cases or newly admitted patients. In all hospital institutions it is important to ensure that procedures are put in place to avoid preventable interruptions as far as possible. Organisational factors can often be an underlying cause which may include: (1) a shortage of staff, (2) storing similar drugs in the same place, (2) the clinic room being crowded when preparing medications or a medication trolley that has too many items on it, (3) equipment failure, and (4) delay or unavailability of medications. (Agyemang & While, 2010, p. 381)

Nursing staff need to ensure that they take adequate breaks during their shift, particularly when working long hours (Keers *et al.*, 2013, p. 1064). Increased working hours and on-call duties are often required by nursing staff working in specialised units. In most countries, there are no regulations restricting the number of hours worked, which results in nurses working extended hours per shift and per week. (Rogers, Hwang, Scott, Aiken, & Dinges, 2004, pp. 202-203) A study done by Rogers *et al.* (2004, pp. 206-207) in the US during 2002 showed that there was a direct relationship between error rate and the amount of overtime, shift duration and hours worked per week. The results showed that nurses working a 12.5 hour shift or more were three times more likely to make an error. Furthermore, nurses working more than forty or fifty hours per week were more likely to make an error. Hospital institutions can minimise these errors by implementing a work schedule that limits the overtime and number of hours worked by nursing staff (Rogers *et al.*, 2004, p. 207).

Nursing staff need to have a good knowledge of the medication items they administer, including high-risk drugs, in terms of therapeutic indication, dosage, side effects and precautions or contraindications (Agyemang & While, 2010, p. 384). Calculation errors by the nursing staff can result in the incorrect dose being administered to the patient (Davids, 2013, p. 53). Complex calculations should be double-checked by another registered nurse prior to medication administration (Agyemang & While, 2010, p. 384). Prior to the administration of

any medication, the nursing staff need to firstly ensure that the patient is not allergic to any medication that they will be administering. All the patient's allergies and risk factors are recorded on the hospital medication chart. Nursing staff need to pay careful attention to detail; medication labels need to be carefully read in order to ensure that the correct directions for administration are understood, particularly the dose and route of administration. In addition, the time of administration is very important, particularly when dealing with intravenous medications. It is also very important that nursing staff check the patient's details on the medication label to ensure that the correct patient receives the correct medication. (Davids, 2013, p. 53)

Record keeping is of vital importance when administering any medication item. Nursing staff therefore need to ensure that they have another nurse who checks the medication items prior to administration. In addition, both nurses need to sign for the doses administered only once they have been administered. Missed doses can occur if a dose is signed for in advance and then the medication is not administered. (Davids, 2013, p. 53)

2.3.2. Reducing Medication Errors through the use of Technology

Advancements in Healthcare Information Technology (HIT) can assist in reducing preventable medication errors (Poon, Keohane, Yoon *et al.*, 2010, p. 1699). The use of HIT and automation to improve pharmacy practice systems was first introduced in the 1970s, however, in 2008 only 10.4% of hospitals in the US had a fully electronic and integrated medication reconciliation system. The goal of such a system is to optimise the role of the pharmacist to improve patient care provided to hospital patients. (Siska & Tribble, 2011, p. 1118) Furthermore, the implementation of HIT systems have been shown to have cost saving benefits with reports estimating up to $88 billion over a 10 year period in the USA (Agrawal, 2009, p. 681).

The use of a computerised physician-order entry (CPOE) system with a clinical decision support system (CDSS) and a bar-code verification system are examples of systems that have been shown to reduce medication error rates (Poon *et al.*, 2010, p. 1699). The systems have different functions; however,

when both are implemented, they have complementary roles to reduce medication errors (Poon *et al.*, 2010, p. 1704). In spite of this, the use of technology does have several barriers and challenges which has resulted in the slow implementation of HIT worldwide (Siska & Tribble, 2011, p. 1118). The seven most common challenges encountered are outlined below:

(1) Financial Challenges

Implementing HIT systems is expensive and the cost varies between institutions depending on the size, complexity and type of system implemented. Furthermore, the maintenance of such a system is costly, thus, the implementation needs to be seen as a long-term financial investment. However, there are limited studies available which investigate the total cost of implementing such a system and the subsequent return on investment. (Siska & Tribble, 2011, p. 1118)

(2) Work-Force Challenges

Personnel trained in information technology, healthcare and informatics are required when implementing a HIT system. However, there is a shortage of HIT personnel due to the limited number of training and education programmes available. (Siska & Tribble, 2011, p. 1118)

(3) Strategic Challenges

An HIT system needs to integrate information from all hospital departments and there cannot be a fragmented approach. In order to successfully implement an integrated HIT system, there needs to be an overall vision for the institution's requirements which considers all hospital departments. The system requirements should therefore be carefully considered prior to implementing any HIT in a hospital institution. (Siska & Tribble, 2011, pp. 1118-1119)

(4) Cultural Challenges

Implementing a HIT system requires changes to the workflow within each department which is often disruptive and challenging. Often personnel are resistant to change in the workplace which may be related to their cultural

heritage is an additional challenge to implementing HIT. (Siska & Tribble, 2011, p. 1119)

(5) Structural Challenges

Most institutions have their data within each department which results in a challenge when implementing a HIT system that requires data interoperability. The necessary changes need to be made in the hospital institution to ensure that each department doesn't function in isolation but rather as part of the hospital team to ensure that the HIT system functions optimally. (Siska & Tribble, 2011, p. 1119)

(6) Technical Challenges

The HIT systems are often developed without taking the needs of the end users into account which could be as a result of the software developers not having sufficient healthcare knowledge. Therefore it is important for hospital management to establish their requirements for the system prior to its implementation to ensure that the system meets the requirements of the institution. Once the system has been designed, it should first be implemented during a trial period. Following the trial period, any necessary changes should be made before final implementation of the system. (Siska & Tribble, 2011, p. 1119)

(7) Privacy and Security Concerns

Patient confidentiality becomes a concern when implementing a system that stores patient information and has many users across the different departments within an institution. Procedures need to be put into place to ensure that users who have access to the information are authorised to do so. (Siska & Tribble, 2011, p. 1119)

Figure 2.1 outlines the medication use process and the effect of information technology on each key stage (Poon *et al.*, 2010, p. 1706).

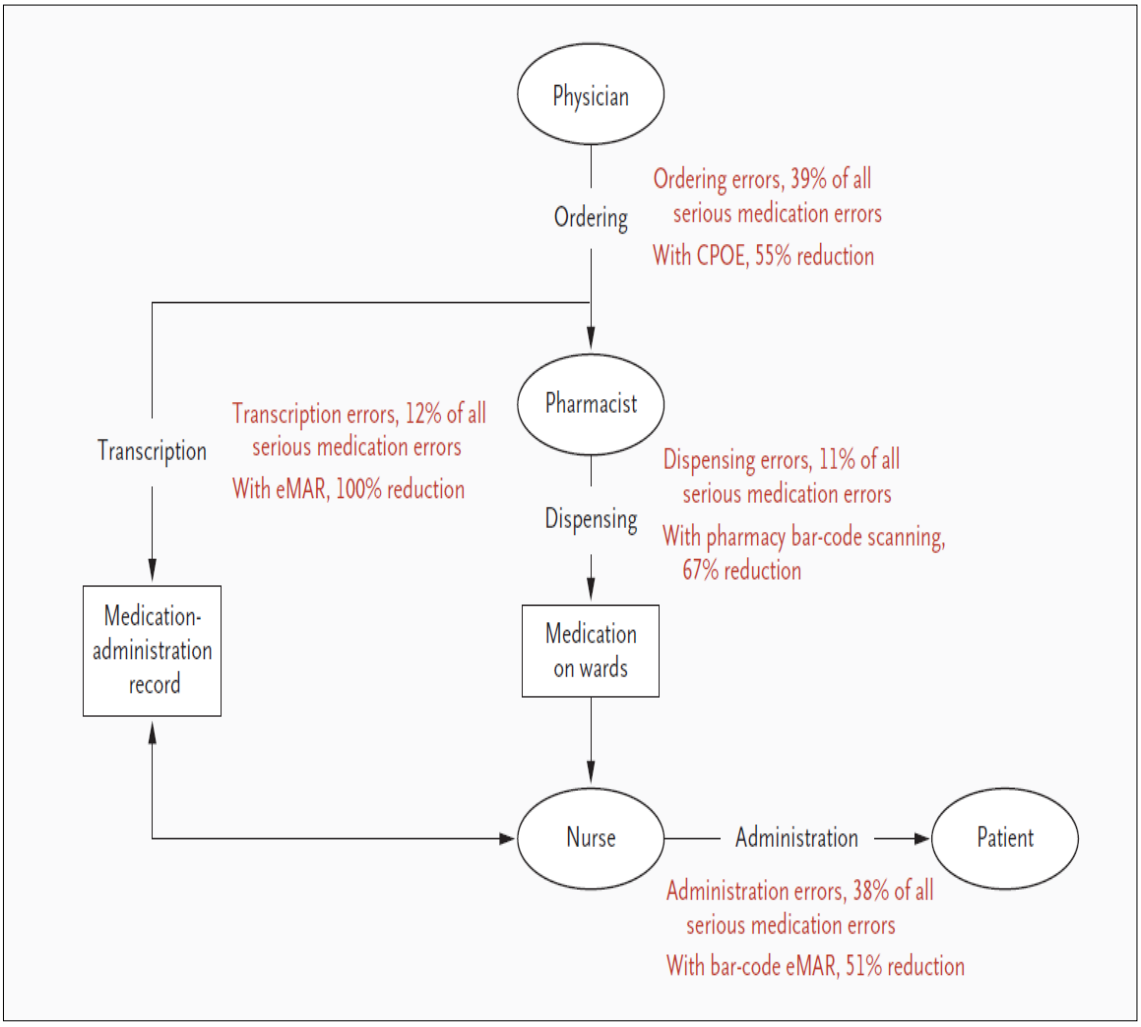

Figure 2.1: Effect of health information technology at key stages in the process of medication use (adapted from (Poon *et al.*, 2010, p. 1706)) (eMAR – Electronic Medication Administration System; CPOE – Computerised Physician-order Entry System)

2.3.2.1. Computerised Physician-order Entry System

The CPOE is a system that enables physicians to write medication orders online (Bates, 2000, p. 789). The CPOE can assist in reducing medication errors that can occur during the medication use process (Bates, Leape, Cullen *et al.*, 1998, p. 1315). For example, the use of a CPOE can reduce prescribing and dispensing errors that occur due to illegible handwriting (Agyemang & While, 2010, p. 384). The first CPOE system was introduced into clinical practice in the US during the 1970s and the system has been shown to be successful at reducing medication errors (van Doormaal, van den Bemt, Zaal *et al.*, 2009, p. 816).

The incorporation of a CDSS into the CPOE can assist the prescriber to check medication doses and also alerts the prescriber to any related allergies, drug interactions and any abnormal laboratory results (van Doormaal *et al.*, 2009, p. 816). Prescribers can sometimes forget about patient allergies and drug interactions at the time of prescribing, therefore the CDSS can be a useful tool to provide alerts where relevant (Agrawal, 2009, pp. 681-682). The CDSS must have the appropriate drug alerts for the clinical setting to prevent unnecessary alerts. Furthermore, it is important that all users are trained on how to use the system correctly to achieve optimal results. (van Doormaal *et al.*, 2009, p. 822)

Two studies were carried out to assess the impact of a CPOE at Brigham and Women's Hospital, which is a tertiary care hospital in Boston with 726 beds. The first study was carried out by Bates *et al.* (1998, p. 1312) and the intervention phase of the study was conducted between October 1994 and July 1995. The results showed that there was a 55% reduction in non-intercepted serious medication errors when the CPOE system was implemented. Conversely, the second study carried out by Bates, Teich, Lee *et al.* (1999, p. 314&320) which included data from 1997, once system improvements had been made, showed a 86% reduction in non-intercepted serious medication errors. The first study also showed that the rate of non-intercepted potential adverse drug events decreased by 84% and intercepted potential adverse drug events decreased by 58% (Bates *et al.*, 1998, p. 1313). Furthermore, there was a 19% reduction in ordering errors, transcribing errors decreased by 84%, dispensing errors were reduced by 68% and administration errors decreased by 59%. The use of the CPOE in this institution resulted in an overall decrease in errors that occur from the ordering to administration phase. (Bates *et al.*, 1998, p. 1314)

A more recent study done by van Doormaal *et al.* (2009, pp. 817-822) was carried out from July 2005 to May 2008 at two teaching hospitals in the Netherlands which evaluated the impact of CPOE with CDSS. The study was performed in two medical wards at each institution. The results obtained were similar to those observed in the study done by Bates *et al.* (1998) and Bates *et al.* (1999), however, in this study the CPOE with CDSS had the largest impact on reducing the number of administration errors. Similarly to the

abovementioned studies, the incidence of dosing and transcribing errors was also reduced.

The CPOE system with CDSS can assist in reducing medication errors that occur in all stages of the medication process. The system contributes to improved patient safety and further reductions in medication error rates could be expected with further advancements. (Bates *et al.*, 1998, p. 1315) Overall, the advantages of the system include: (1) medication orders are structured and no information is omitted, (2) scripts are legible, (3) prescribers are updated with the latest drug information and any new warnings or side effects, and (4) allergies, inappropriate doses, drug-interactions and drug-laboratory problems are identified at the point of prescribing (Bates, 2000, p. 789). In addition, the pharmacist's work efficiency is improved and less time is spent on routine checks, allowing more time to focus on patient care (Calvert, 1999, pp. 234-235). The involvement of prescribers is essential for the successful implementation of an electronic prescribing system in a hospital institution (Tully, 2000, p. 245).

2.3.2.2. Bar-Code Verification System

Technological advancements have allowed for the development of a bar-code verification system which can assist in reducing dispensing and administration errors. Pharmacists can use the system in the dispensing process to ensure that the medication scanned is the correct item and that the dose and formulation are correct. Furthermore, nursing staff can use the device at the bedside to verify the patient's identity and the medication that the patient needs to receive. (Poon, Cina, Churchill *et al.*, 2006, p. 426)

The bar-coding system requires that all medication items entering the pharmacy needs to be bar-coded before being stored on the shelves. During the dispensing process, the medication will be scanned to ensure that the correct medication has been selected. (Poon *et al.*, 2006, pp. 427-428) In an automated dispensing process, the scanned items will be placed into the appropriate compartment of the semi-automated medication cabinets which will be used in the ward. The nursing staff will use the bar-coded scanning system to

administer medication from this cabinet to each patient. (Poon *et al.*, 2006, p. 429)

A study done by Poon *et al.* (2006, p. 427&433) over a 20 month period in 2003 at a 735 bed tertiary academic medical centre, measured the effect of the bar-coding system on dispensing errors. The results showed that the system reduced the dispensing error rate by 67%.

The bar-coding system is usually used together with an electronic medication administration system (eMAR) on a ward level, which documents doses administered as the nurse scans the bar-code of the item. The eMAR system receives medication orders electronically from the prescriber or pharmacy, which assists in reducing transcribing errors. The pharmacist needs to review each prescription and approve the items electronically prior to the nurse administering the medication. (Poon *et al.*, 2010, p. 1699)

At the bedside, the nursing staff will scan the patient's wristband and then the medication item that needs to be administered. The eMAR system will issue a warning if the patient's dose is not due or the item is not prescribed for the patient. In addition, the nursing staff can only administer a dose once the prescription has been clinically reviewed by a pharmacist. Once the system has verified the item and dose, the administration will then be documented electronically. The system also has the benefit of storing a list of all the medication items that need to be administered to each patient and the nursing staff will be alerted when a dose is overdue. (Poon *et al.*, 2010, p. 1699)

A second study done by Poon *et al.* (2010, p. 1699) over a 9 month period in 2009 measured the benefits of the bar-code verification system in the same 735 bed tertiary academic medical centre. The results showed that there was a 41.4% reduction in non-timing medication administration errors and the adverse drug events due to these errors was reduced by 50.8%. Furthermore, medication errors due to the incorrect timing of medication administration improved by 27.3% and no transcription errors occurred with the use of the eMAR system. (Poon *et al.*, 2010, p. 1701)

Overall, studies have demonstrated that the bar-code verification system has proven to be successful, thus, it is recommended that it is implemented in hospital institutions as an additional safety measure to prevent medication administration errors. (Poon *et al.*, 2010, p. 1702)

2.3.3. Patients at Increased Risk for Medication Errors

Patients who are particularly at an increased risk for medication errors include: the elderly; those undergoing surgical procedures; and patients in an intensive care unit (ICU). In addition, if a patient is on four or more medication items, he/she is at an increased risk for drug-related morbidity. (Fahimi, 2010, p. 301) The reason/s for these patient groups being at increased risk is/are outlined below:

(1) Elderly Patients

Patients who are 70 years or older, are at an increased risk for medication errors (Falconer, Nand, Liow, Jackson, & Seddon, 2014, p. 312). Polypharmacy is one of the main reasons that elderly patients are at an increased risk for medication errors. Studies have shown that 30% of all medications prescribed are consumed by patients over the age of 65 years and the majority of these patients take approximately five different medications per day. (Picone *et al.*, 2008, p. 116) In addition, a number of other factors may contribute to these patients being at an increased risk for medication errors, including: (1) renal insufficiency, (2) multi-morbidity and disabilities, (3) changes in physiological and cognitive functioning (Klopotowska *et al.*, 2011, p. 2). Furthermore, studies have also shown that recent hospitalisation can also contribute to elderly patients being at an increased risk for medication errors (Falconer *et al.*, 2014, p. 312).

(2) Patients undergoing Surgery

Patients undergoing surgical procedures are at an increased risk for medication errors due to changes in their medication treatment both prior to and after surgery (de Boer *et al.*, 2011, p. 2). Studies have shown that the majority of adverse events occurring in patients undergoing anaesthesia were due to medication errors. During surgery, the most commonly occurring medication error is due to incorrect identification of the medication

and also medication being drawn into unlabelled syringes. However, the bar-code verification system mentioned above (Section 2.3.2.2) could be implemented to reduce such medication errors. (Glavin, 2010, pp. 76-78) Furthermore, the frequent use of analgesics, anticoagulants and antibiotics post-operatively in surgical patients also places them at an increased risk for medication errors (de Boer *et al.*, 2011, p. 2).

(3) Intensive Care Unit Patients

Patients in an ICU are at high risk for medication errors due to the nature of their illnesses, polypharmacy, use of high-risk drugs and a high frequency in the changes to pharmacotherapy (Klopotowska, Kuiper, van Kan *et al.*, 2010, p. 2). Studies have shown that ICU patients are on double the amount of medication items compared to other hospitalised patients and in addition, the majority of these medications are infusions that require complex calculations which are based on the patients weight and can often lead to medication errors (Moyen, Camire, & Stelfox, 2008, p. 3). The technology used in an ICU to administer the medications are often more complex than those used in general hospital wards which places the patient at risk for medication errors due to system failures. Medication errors account for approximately 78% of all the adverse events occurring in an ICU, of which 19% are life-threatening and an additional 42% are of clinical significance and could have led to patient harm. (Moyen *et al.*, 2008, p. 2) Studies have also shown that an average of 1.7 medication errors occur per patient in an ICU each day, however the use of CPOE with CDSS and a bar-code verification system can greatly assist in reducing medication errors in these patients (Moyen *et al.*, 2008, p. 1&3).

(4) Polypharmacy and High Risk Medication Items

Polypharmacy can result in an enhanced risk of adverse drug reactions. A patient on between five to eight items or more is considered a high risk patient. High risk medication items place a patient at increased risk for medication errors and adverse drug events. (Falconer *et al.*, 2014, p. 312) According to the Institute for Safe Medication Practices (ISMP), high risk medication items can cause severe harm to a patient when a medication error occurs. Medication error rates, however, are not necessarily higher in

these classes of drugs. High risk items should be universally recognised and carefully handled by all medical professionals. It is essential that all the necessary procedures are adhered to when administering these medication classes, which include: (1) opioids/narcotics, (2) anti-epileptics, (3) anti-psychotics, (4) anti-coagulants, (5) hypoglycaemic agents, (6) chemotherapy, (7) cardiovascular agents, (8) antimicrobials, and (9) potassium supplements. (Institute for Healthcare Improvement, 2012)

2.3.4. Studies Investigating the Potential Benefit of Ward-based Clinical Pharmacy

A number of studies which investigate the impact of a ward-based pharmacist in various hospital institutions have been conducted to date. The majority of the studies carried out were based in an ICU or general medicine unit. A few of the larger studies are discussed below.

One of the first studies conducted was a controlled clinical trial evaluating the efficacy of pharmacist participation on physician rounds, which was carried out by Leape, Cullen, Clapp *et al.* (1999, p. 269) in two medical ICUs at Massachusetts General Hospital in Boston from 1993 to 1995. The ICU was the study unit and consisted of 17 beds while the Cardiac Care Unit (CCU) was the control unit which consisted of 15 beds. The pharmacist did daily ward rounds in the ICU with the physicians and nurses and was in the unit for consultation and assistance to the nursing staff for the duration of the morning on weekdays. The pharmacist was available on call throughout the day if the nursing staff required any assistance. In the control unit CCU, a pharmacist was available in the unit but did not attend physician ward rounds. The results showed that preventable medication errors per 1000 patient-days were reduced by 66% when a clinical pharmacist intervened at the prescribing phase in the ICU, compared to the CCU where the error rate remained the same. After the intervention period, the preventable medication errors in the ICU was 72% lower than in the CCU. A total of 398 pharmacist interventions were recorded, 366 of which were related to prescribing. Of these 366 prescribing-related interventions, 362 (99%) were accepted by the physicians. Nearly half, 178 (46%) of the interventions were due to incomplete orders, wrong dose, wrong frequency, inappropriate choice and duplicate therapy. The remaining interventions involved the following:

providing drug information (100 cases); recommending alternative therapies which were either safer and/or cheaper (47 cases); identifying drug interactions or allergies (22 cases); using non-formulary drugs (14 cases); identifying previously unrecognised adverse drug events (6 cases); recognising errors in the pharmacy dispensing system (12 cases); and a pharmacy dispensing error (1 case). Overall, this study proved that the involvement of a pharmacist at a ward level had positive outcomes.

A second study, similar to the one done by Leape *et al.* (1999) was carried out by Kukukarslan, Peters, Mlynarek, and Nafziger (2003, p. 2015&2016) at the Henry Ford Hospital in Detroit during 2000. The results obtained from this study were similar to those found in the study done by Leape *et al.,* with the rate of preventable adverse drug events being reduced by 78% in a general medicine unit. A total of 150 interventions were made, of which 147 (98%) were accepted. The intervention categories used by Leape *et al.* were adopted for this study and the percentages of each type of intervention made were classified as follows: dosage or frequency adjustments (35%); addition of drugs to therapy (21%); identification of potential problems with continuing medication after discharge (8%); deletion of drugs from therapy (7%) and recommendation of laboratory monitoring (6%).

However, the successful intervention programmes shown in the study done by Leape *et al.* (1999) cannot be applied to all hospital settings due to differences between countries. For example, pharmacists in the Netherlands are scarce compared to in the US and UK, with an average of 0.75 hospital pharmacists per 100 patient beds. Furthermore, there are no clinical positions in hospital institutions in the Netherlands and thus, they do not have a pharmacy practice model that allows for ward pharmacy services to be extensively provided. A study was done by Klopotowska *et al.* (2010, pp. 1-10) in 2005 at the Academic Medical Centre in Amsterdam, which evaluated the impact of a ward-based clinical pharmacist. The study was carried out in a 28 bed ICU from 3 October 2005 to 30 June 2006. On average, the pharmacists spent three days a week and two-and-a-half hours a day in the ICU. The study consisted of a baseline period of three weeks and an intervention phase of eight months. During the baseline period, the pharmacist monitored all medications prescribed in the ICU

and classified all prescribing errors. During the intervention phase, the prescribers and nursing staff were informed about the study and were aware of the pharmacist being present in the unit. All of the pharmacist recommendations were discussed with the prescribers during the multidisciplinary rounds. A total of 504 patients' medication items were reviewed during the baseline period and 5901 during the intervention period. The pharmacist made a total of 659 recommendations to the prescribers with an acceptance rate of 74%. The results showed a decrease in the incidence of prescribing errors from 190.5 per 1000 monitored patient-days during the baseline to 62.5 during the intervention phase. Preventable adverse drug events that could result in patient harm decreased from four per 1000 monitored patient-days during the baseline period to one during the intervention phase. The study showed that on-ward participation of a pharmacist can result in a decrease in prescribing errors and incidence of adverse drug events, as well as having a cost-saving benefit. The results obtained from this study were slightly different to those obtained in the previous two studies discussed, thus, the benefit of ward-based pharmacy practice cannot be generalised.

Clinical pharmacy only recently commenced in Iran, therefore, there are limited studies available on the efficacy of ward-based pharmacy practice. However, a recent prospective, interventional study was done by Khalili *et al.* (2013, pp. 1-6) from September 2010 to September 2011, in a 60 bed infectious diseases ward of Imam, Iran. Preventable medication errors were monitored and the nursing staff assessed the ward-based service provided by means of completing a questionnaire. A total number of 956 patients were admitted to the ward during the study period with the number of medication items totalling 6250. The clinical pharmacist made a total of 3016 interventions of which 2420 (80%) were accepted. The total number of medication errors was 231 (24%); this rate was higher than those observed in two similar studies conducted in Iran. The first being a study done by Khalili *et al.* (2011, p. 283), which showed a medication error rate of 13.01% in an infectious diseases unit and in the second study, carried out by Vessal (2010, p. 63), the medication error rate was reported to be 10.5% in a nephrology ward. The nursing staff satisfaction questionnaire received the highest rates for education on the correct storage,

preparation and administration of drugs. Therefore, pharmacists at a ward level may play an important role in educating the nursing staff.

Overall, all of the abovementioned studies have demonstrated that ward-based pharmacy practice has positive outcomes for the patient and other healthcare professionals; however, the impact of the service varies between countries and also between various institutions.

2.4. The Economic Effects of Clinical Pharmacy Practice

On a global level, healthcare costs are escalating and available resources are limited (De Rijdt, Willems, & Simoens, 2008, p. 1162). There is an increasing need for healthcare costs to be minimised; while at the same time ensuring optimal therapeutic benefit for the patient (Saddique, 2012, p. 276).

The cost-effectiveness of clinical pharmacy is not always easy to measure due to the fact that the criteria for research have not been standardised (de Boer *et al.*, 2011, p. 6). Clinical outcomes, which lead to improved patient care, such as: preventing adverse drug events, reducing length of hospital stay, preventing re-admission to hospital and medication counselling at discharge, may be difficult to quantify (Kaboli, 2008, p. 1123). On the other hand, certain interventions have a direct cost saving effect and are easier to quantify. These may include: discontinuing unnecessary drugs, recommending an oral drug formulation, switching to a less expensive agent, and decreasing a drug's dosage (De Rijdt *et al.*, 2008, p. 1163). Studies have shown a median benefit to cost ratio of 4.89:1 for clinical pharmacy services being provided in hospitals (Neville *et al.*, 2014, p. 216).

From the cost saving point of view, clinical pharmacy practice benefits may be used to improve other high priority healthcare services and primary care services (Matsoso, 2009, p. S11). For example, the use of a medication bar-coding verification system and CPOE with CDSS can further assist in reducing costs due to adverse drug events (de Boer *et al.*, 2011, p. 2).

2.4.1. Studies Investigating the Economic Effect of Clinical Pharmacy Practice

Studies have demonstrated the cost saving benefits resulting from clinical pharmacy being practiced in hospitals in the US, Australia, Canada, Northern Ireland and a few other countries (Matsoso, 2009, p. S10). The first cost benefit analysis study was published in 1979 (Schumock *et al.*, 2003, p. 113). The majority (85%) of the cost benefit studies conducted from 1979-2000 have been shown to have a cost saving impact. However, the outcomes measured in each study are not necessarily the same and may include: (1) cost to benefit ratio, (2) cost per preventable adverse drug events, (3) annual cost saving benefit, and (4) length of hospital stay. (Schumock *et al.*, 2003, p. 117) The next few paragraphs will summarise some of the studies (conducted between 1992 and 2012 in different countries) which investigated the economic effect of clinical pharmacy practice in various clinical settings.

One of the earlier studies conducted across 1016 hospitals in the US, during 1992, evaluated the impact of the pharmacist providing 14 clinical pharmacy services and assessed the number of pharmacists located in the wards and in the central pharmacy (Bond, Raehl, & Franke, 2000, p. 610). The results showed cost-saving benefits for nine of the clinical pharmacy services provided, while only two of the services showed a statistical increase in cost of care. Furthermore, the results also showed that an increase in the number of pharmacy administrators and clinical pharmacists per occupied patient bed resulted in a decrease in the total cost of patient care by up to 48%. An increase in the number of clinical pharmacists from 0.34 per 100 beds to 1.11 or 3.23 per 100 beds, respectively, both resulted in reduced cost of patient care, thus, it is suggested that the number of clinical pharmacists for each institution should be optimal. Conversely, an increase in the number of dispensing pharmacists from a central pharmacy, per occupied bed, resulted in an increase in the total cost of care. (Bond *et al.*, 2000, p. 615)

A study done around a similar time by Leape *et al.* (1999, p. 270) in two medical ICUs from 1993 to 1995 at Massachusetts General Hospital in Boston, showed that approximately 58 preventable adverse drug events were actually prevented. The estimated cost of an adverse drug event due to an error was

$4685 in 1995, which would have resulted in a cost saving of $270 000 per year in a single unit. The impact of CPOE with CDSS was also measured in this study and an additional $480 000 per year would have been saved by implementing the CPOE system. Conversely, a more recent study conducted by Weant, Armitstead, Ladha *et al.* (2009, pp. 946-950) from 1999 to 2002, in a neurosurgery ward at a university teaching hospital in America showed that the provision of clinical pharmacy services had an annual cost saving of $859,130 for the unit. Furthermore, the average length of hospital stay was reduced by 1.32 days per patient. Similar cost saving results were also observed in a study done by Mialon, Williams, and Wiebe (2004, pp. 121-124) from 2002 to 2003 in a paediatric emergency department in Texas. The clinical pharmacy services showed an 80% reduction in medication errors with an annual cost saving of $800 000 per year for the unit.

Similar results to the study done by Weant *et al.* (2009) were obtained in a study carried out by Kukukarslan *et al.* (2003, p. 2017) at the Henry Ford Hospital in Detroit in 2000, which showed that preventing adverse drug events resulted in a reduced length of stay by 1.4 days which amounted to a cost of $923 per admission. However, a more recent study done in 2008 by Neville *et al.* (2014, pp. 219-220) in a surgical ward in Canada also demonstrated similar cost-savings. The study was carried out in two surgical wards and each pharmacist intervention had an estimated cost saving of $617-1239 and there was an average reduction of length of stay by 3.4 days per patient. The average reduction in length of hospital stay in this study was higher than that observed in the study done by Kukukarslan *et al.* (2003), however, the study done by Weant *et al.* (2009) reported a 1.32 day reduction. The study also assessed the benefit –to-cost ratio based on a top salary for a clinical pharmacist at the institution. The results showed that the benefit outweighed the cost with the ratio being between 3:1 and 7:1 in the favour of benefits, depending on the type of intervention made. (Neville *et al.*, 2014, pp. 219-220). A more recent study done by Gallagher, Byrne, Woods, Lynch, and McCarthy (2014, p. 178) at the Cork University Hospital in Ireland during 2012 demonstrated a slightly higher benefit to cost ratio of 8.64:1. This study also demonstrated a €166 cost saving per adverse event avoided with an annual cost saving benefit of €626 279. The cost saving per adverse event in this study was higher than that observed in an

earlier study done by Klopotowska *et al.* (2010, p. 8&9) in 2005, in an ICU setting at the Academic Medical Centre in Amsterdam, which showed that each intervention cost €3 per monitored patient-day but resulted in a saving of €26 to €40 by preventing an adverse drug event. Furthermore, in this study it was estimated that a pharmacist monitoring prescribing in an ICU would result in a nine to thirteen fold return on investment, depending on the number of medical and surgical patients in the unit.

The abovementioned studies all demonstrate a cost saving benefit with the provision of clinical pharmacy services. However, cost saving amounts can vary amongst hospitals depending on the size of the institution and the nature of the clinical pharmacy services provided (De Rijdt *et al.*, 2008, p. 1170).

2.5. Clinical Pharmacy Practice in South Africa

Currently, clinical pharmacy is not a fairly common practice in South African hospitals. The attendance of medical ward rounds is time consuming, and in South Africa, a shortage of pharmacists; sub-optimal use of technical support staff; and the lack of training of pharmacists, has resulted in the limited involvement of pharmacists in the wards. (Schellack & Gous, 2011, p. 29) At present, in South Africa, patient numbers are increasing, however, the resources are diminishing or staying the same (Welzel, 2012, p. 408). Patient safety has been made a priority in many countries. South Africa, however, does not have dedicated personnel to research and implement patient safety programmes. Therefore, there needs to be greater emphasis placed on patient safety in South Africa. (Welzel, 2012, p. 406)

There are limited South African studies in the area of clinical pharmacy services. However, a study done by Schellack and Gous (2011, p. 33) during 2007 in a NICU in the Gauteng province of South Africa, showed that prior to introducing a clinical service in the unit, medical practitioners and nurses felt that there was a need for a clinical pharmacist prior to introducing a clinical service in the unit. Once the service was introduced in the NICU, both the doctors and nurses felt that the service was essential.

In South Africa, there are a number of pharmacists interested in clinical pharmacy and thus, the South African Society of Clinical Pharmacy (SASOCP) was established in South Africa during 2011. The society was the initiative of the pharmacy department at the University of Limpopo and was started by pharmacists with an interest in promoting clinical pharmacy. The objectives of SASOCP include the following: (1) promoting the practice of clinical pharmacy, (2) continuing education and research, (3) providing clinical practice guidelines and a platform for clinical pharmacists' viewpoints and networking. A conference is held annually which allows pharmacists from around South Africa, to present their research. In addition, Continuing Professional Development (CPD) activities are organised by the local branch within each province. Provinces which have established branches with committee members, include: (1) Limpopo, (2) Gauteng, (3) Western Cape, (4) Eastern Cape, and (4) North West. (South African Society of Clinical Pharmacy, 2011)

One of the challenges currently faced is that the South African Pharmacy Council (SAPC) does not have a specialist category for clinical pharmacists. The first proposal for a specialist category was submitted to the National Department of Health in March 2009 (Gray & Suleman, 2012, p. 39). However, the registrar from the SAPC, provided feedback on the progress of the registration at the 2014 annual SASOCP conference which was held in Cape Town from 19 to 21 June. The feedback provided by Masango (2014, pp. 7-9) outlined the proposed scope of practice for a clinical pharmacist in South Africa. Furthermore, it was mentioned that the curriculum for the qualification is currently being drafted by a consultant, which was commenced in 2012. The consultant will consider both local and international universities' curricula for a clinical pharmacist before drafting the South African curriculum. However, the proposed duration of the qualification is two years with the minimum requirement being a BPharm degree.

Many of the developed countries providing clinical pharmacy services have pharmacy technicians as part of their clinical pharmacy practice model (Tisdale & Hall, 2012, p. 346). Pharmacy technicians can assume some of the pharmacists' responsibilities, such as the preparation and distribution of medicines, which allows the pharmacist to have more time to provide ward-

based services (Mabasa, Malyuk, Tung *et al.*, 2010, p. 41). Furthermore, the development of clinical pharmacy has resulted in the activities of pharmacy technicians becoming increasingly clinical in nature (Child *et al.*, 2011, p. 154). Pharmacy technicians therefore play an important role in a clinical pharmacy practice model; however, South Africa only recently had a registration category for pharmacy technicians. The first accredited course in South Africa for pharmacist technicians became available in 2013. (South African Pharmacy Council, 2013)

To date, there has been limited involvement of South African pharmacists in the hospital wards, due to a number of challenges previously outlined. However, the implementation of clinical pharmacy practice models should soon be possible in both public and private hospitals, with the pharmacy technician registration category being approved and that of the clinical pharmacist being underway.

2.6. Clinical Pharmacy Practice in Developing Countries

Ward-based clinical pharmacy practice was first developed and practiced in the US in the mid-1960s. Following the implementation in the US, the practice has been fairly recently adopted in a few developing countries. (Schumock *et al.*, 2003, p. 120) The implementation of clinical pharmacy practice in these developing countries is outlined below, however, there are limited studies that have been performed in many of these countries (Vessal, 2010, p. 60).

Clinical pharmacy practice was first introduced in China in 1989 with the development of the first Bachelor of Science degree in clinical pharmacy. The programme was established by the West China School of Pharmacy at the Sichuan University. In 1998, the programme was stopped due to the country's development and was later re-commenced in 2006. The number of clinical training programmes in China has increased from 15 in 2006 to 25 in 2011. The curriculum and duration of the programmes is not consistent between colleges. (Jiang, Liu, Deng, & Li, 2012, pp. 1-3) The activities performed by the pharmacist are ward-based and include: (1) ward rounds, (2) case discussions, and (3) consultations. The primary aims of the clinical pharmacist in China are to ensure optimal therapeutic treatment; ensuring that treatment is economical;

and providing patient education. However, clinical pharmacy services are still being developed in China and a number of challenges are being faced, one of the largest being the attitudes and perceptions of the prescribers. (Li, Huo, Kong, Li, & Wang, 2014, p. 444) However, China's Ministry of Health firmly supports the implementation of clinical pharmacy services which limits any challenges regarding government funding and policies (Penm, Moles, Wang, Li, & Chaar, 2014, p. 346&350).

During 1993, clinical pharmacy practice was started in Brazil and the concept of pharmaceutical care was later introduced in 2001. A Clinical Pharmacy Specialization Course was developed in 1993 by the Faculty of Pharmaceutical Sciences at the University of Sãn Paulo. Converse to the ward-based activities performed by a clinical pharmacist in China, the role of a clinical pharmacist in Brazil includes activities that take place more within the central hospital pharmacy. The Brazilian clinical pharmacist's responsibilities, include: (1) reviewing and implementing the clinical and medication use policy, (2) reviewing all medication orders, (3) checking doses very closely, (4) ensuring that all prescriptions are dispensed correctly, and (5) teaching and training other clinical pharmacists. (Martinez-Sanchez, Ribeiro, & Storpirtis, 2005, pp. 421-422)

The first clinical pharmacy programme in India began in 1996, with the introduction of a Master of Pharmacy programme. The programme was developed in collaboration with Australian institutions and was held at the JSS College of Pharmacy in Mysore. By 2003, there were six additional colleges offering a clinical Master of Pharmacy programme. A clinical pharmacist in India performs the following ward-based activities: (1) attending medical ward rounds, (2) medication review and counselling, (3) monitoring drug therapy, (4) supplying drug information, (5) reporting adverse drug reactions, (6) conducting drug-use evaluations, (7) medication formulary review, and (8) providing poison control services. Similarly to China, clinical pharmacy practice development in India still faces a number of challenges, for example: the acceptance of the practice by medical professionals and the community. Furthermore, providing clinical pharmacy services to a very large, mostly uneducated population is also one of the challenges faced. (Lal & Rao, 2005, pp. 1510-1511)

Most Middle Eastern countries only offer a Bachelor of Pharmacy Degree, with few countries offering a clinical post-graduate programme, therefore, clinical pharmacy services are limited in these countries (Kheir, Zaidan, Younes *et al.*, 2008, p. 6). However, certain countries offer clinical post-graduate programmes which range from a Masters in Clinical Pharmacy to a PharmD qualification. A few of these countries are: (1) Egypt, (2) Iraq, (3) Jordan, (4) Lebanon, (5) Palestine, (6) Qatar, (7) Saudi Arabia, (8) Syria, and (9) Yemen. (Kheir *et al.*, 2008, p. 3) Lebanon offers the only US accredited PharmD programme outside of the US and it is offered by the Lebanese American University. Despite the PharmD programme being available in Lebanon, clinical pharmacy services are not widely practiced in the country. (Kheir *et al.*, 2008, p. 9) The clinical pharmacy services provided by each country vary depending on the economic situation and stability of the country (Kheir *et al.*, 2008, p. 11). Middle Eastern countries that don't offer a clinical pharmacy programme, such as United Arab Emirates, recruit clinical pharmacists from other countries to work in the public sector hospitals (Abu-Gharbieh, Fahmy, Rasool, Abduelkarem, & Basheti, 2010, pp. 422-423).

Clinical pharmacy is currently not being widely practiced in all developing countries. However, there are a number of challenges being faced in these countries and it is also apparent that the practice is not standardised between countries with varying clinical pharmacy activities evident. (Vessal, 2010, p. 60)

2.7. Clinical Pharmacy Practice in Developed Countries

According to Matsoso (2009, pp. S10-S11), pharmacists comprise the third largest healthcare professional group in the world. Therefore, they are in an ideal position to be able to make a significant impact in terms of achieving good health outcomes for all patients, at all levels of care. However, the implementation of clinical pharmacy practice requires changes in the health system and an enhancement of a pharmacist's knowledge base. There needs to be a change in the approach of service delivery by pharmacists in both primary and hospital care settings. Many countries have had to critically assess the size, skills and competencies of the health work force before implementing clinical pharmacy practice. Ward pharmacists are fairly common in the US and

in the UK and the next few paragraphs will discuss the clinical pharmacy practice in these countries (Franklin et al., 2012, p. 312&315).

There are many differences between the healthcare systems in the US and UK together with the type of clinical pharmacy services being offered (Franklin et al., 2012, p. 312&315). A recent survey conducted by the European Association of Hospital Pharmacists (EAHP) showed that pharmacists in the US worked in the wards for eight hours a day in 34% of the hospitals. Similarly, in the UK and Ireland specifically, pharmacists traditionally conducted visits to the wards daily on weekdays and attended physician ward rounds (Frontini, Miharija-Gala, & Sykora, 2013, p. 69&73). Having mentioned this, pharmacists in the UK only spend between 30% and 70% of their time providing clinical pharmacy services (Child *et al.*, 2011, p. 141). The EAHP survey also noted that clinical ward-based pharmacy is not being widely practiced in many of the other European countries (Frontini *et al.*, 2013, p. 69&73). Furthermore, the survey also showed that only 6% of hospitals in Europe have hospital pharmacists spending at least 50% of their time working in the wards and that daily ward visits was not common practice (Frontini *et al.*, 2013, p. 69&73). However, a survey done in the early 1990s showed that clinical pharmacy services were being provided in the majority of the National Health Service (NHS) hospitals in the UK, but the type of activities varied vastly between the institutions (Child *et al.*, 2011, p. 141). Activities performed by ward pharmacists in the US, also differs from other countries. For example, only 71% of US hospitals have pharmacists reviewing the medication prior to the first dose being administered versus pharmacists in Europe who do not appear to be as involved in medication review, based on the available data of their clinical activities (Frontini *et al.*, 2013, p. 73). Currently, one of the challenges faced at an international level is the lack of direction provided by the government and pharmacy profession regarding standardised clinical pharmacy services (Child *et al.*, 2011, p. 141).

The clinical pharmacist intervention acceptance rates reported by physicians and nursing staff vary between Europe and the US. European studies report an acceptance rate of 73-89%, whilst the US reports 85-99%. The difference could be due to clinical pharmacy training programmes and services being more developed in the US. (Khalili *et al.*, 2013, p. 5) The US has a clinical degree

called the PharmD, whilst European countries have an undergraduate masters degree (MPharm), which is not a clinically focused degree. (Anderson & Futter, 2009, p. 1)

The ratio of the number of hospital pharmacists performing clinical activities according to the number of hospital beds also differs in each country. There appear to be very few countries that have implemented a set standard ratio. (Matsoso, 2009, p. S10) For example, in Europe, there is an average of 0.93 hospital pharmacists per 100 beds (Langebrake & Hilgarth, 2010, p. 194). Belgium is one of the countries in Europe which has a set standard ratio of one full-time pharmacist per 150 patient beds (0.67 pharmacists per 100 beds) (Matsoso, 2009, p. S10). In contrast, Germany has the lowest ratio in Europe with 0.31 pharmacists per 100 beds (Langebrake & Hilgarth, 2010, p. 194). In the US, there are no standardised ratios, however, the ratio is largely dependent on the size of the hospital. For example, a survey study done by Bond and Raehl (2006, pp. 735-738) in the US showed that in 1998, the average ratio varied from 0.93 ± 0.77 to 5.16 ± 4.11 per 100 beds which are higher than the ratios reported for Europe.

The health policies and resources of each country may differ, and thus, clinical pharmacy practice cannot be generalised. Available resources in a hospital may be limited. For this reason, ensuring optimal use of available resources; together with task shifting, may assist in the implementation of an institution-specific clinical pharmacy practice model. (Matsoso, 2009, pp. S9-10) Therefore, hospital specific models may not only vary internationally but also locally among different hospitals within the same region. Although clinical pharmacy is practiced differently in each country and hospital setting, it may be useful to learn from the clinical pharmacy practice models that have been successfully implemented by other countries. (Matsoso, 2009, pp. S9-10)

2.8. Implementation of a Clinical Ward-based Pharmacy Service

The implementation of a clinical pharmacy practice model requires a transformation from focusing on order entry and distribution to drug therapy management (Pickette *et al.*, 2010, p. 752). In a healthcare system, the

pharmacist should be part of a multidisciplinary care team that focuses on patient care (Pickette *et al.*, 2010, p. 751).

For the successful implementation of a ward-based pharmacy service there needs to be a team of pharmacy technicians and hospital pharmacists in place (de Boer *et al.*, 2011, p. 4). Studies have demonstrated that dispensing pharmacists in a central pharmacy should be kept to a minimum, preferably lower than 5.11 pharmacists per 100 patient beds. Conversely, the number of clinical pharmacists must be maximised and should not be less than 1.11 pharmacists per 100 occupied patient beds. (Bond *et al.*, 2000, p. 609) All pharmacists performing clinical activities should receive adequate training in therapeutic monitoring, pharmacokinetics, documentation and disease management. However, globally there appear to be no standardised training programmes available. Furthermore, training and competency assessments should be performed on an on-going basis to ensure the delivery of a consistently high standard of clinical pharmacy services. (Pickette *et al.*, 2010, p. 753)

The use of pharmacy technicians in the preparation and distribution of medicines allows pharmacists more time to provide ward-based services (Mabasa *et al.*, 2010, p. 41). Section 2.5 highlighted and discussed the role of a pharmacy technician in the clinical pharmacy practice model. Pharmacy technicians should also receive training in monitoring and documenting ward-based pharmacy interventions. (de Boer *et al.*, 2011, p. 4) Hospitals are moving towards implementing clinical pharmacy practice models where the goal is a technician-managed, technology-assisted drug distribution system (Tisdale & Hall, 2012, p. 346).

2.8.1. Clinical Pharmacy Practice Models

There are a number of clinical pharmacy practice models that have been implemented across various countries; however, as discussed in the aforementioned paragraphs, there is a lack of uniformity between these models (Matsoso, 2009, pp. S9-10). A hospital pharmacy practice model was defined in 2010 by the University Health System Consortium for academic medical centers in the US as: “the manner in which a pharmacy department’s human resources

are distributed to fulfill (a) the departmental mission of ensuring that patients achieve optimal outcomes from the use of medicines and (b) the departmental responsibility for leading improvements in the medication-use process. The model takes into account how pharmacists, pharmacy technicians, and other pharmacy staff spend their time and how they interface with patients, health professionals outside of pharmacy, hospital executives, information systems, devices, and vendors".

In 2008, the American Society of Health-System Pharmacists (ASHP) established a Pharmacy Practice Model Initiative (PPMI). The goal of PPMI was to advance the health and well-being of patients in hospitals in the US by developing and implementing standardised clinical pharmacy practice models. The aim was to identify optimal practice models which use pharmacists effectively as direct patient care providers in order to improve patient outcomes. (Tisdale & Hall, 2012, p. 345) Four clinical pharmacy practice models were described, namely: (1) drug distribution-centered model, (2) clinical pharmacist-centered model, (3) patient-centered integrated model, and a (4) comprehensive model (Haas, Eckel, Arif *et al.*, 2012, p. e36).

A clinical pharmacy practice model must be based on a set of values, principles and philosophies which strive to achieve optimal patient outcomes (Haas *et al.*, 2012, p. e37). The following paragraph will review the four practice models as described by the ASHP. The first model is the drug distribution-centered model which focuses on medication distribution tasks rather than the medication use process. In this practice model, the pharmacist has limited interaction with other healthcare professionals in developing a therapeutic care plan for the patient. Conversely, in the clinical pharmacist-centered model the pharmacist is engaged in clinical activities and has limited involvement in the distribution of medications. The pharmacist actively interacts with other healthcare professionals and is involved in the medication use process. The third model is the patient-centered integrated system which is where both of the aforementioned models are combined and the pharmacist assumes both clinical and distributive functions. However, in this practice model, the pharmacy technicians manage the majority of the medication distribution functions which are overseen by the pharmacist. The last model is the comprehensive model

which requires pharmacists to perform and be accountable for a number of activities, including medication distribution and clinical activities. Furthermore, this model requires the presence of a clinical specialist that is involved in advancing practice, education and research. (University Health System Consortium, 2010, p. 3)

The four clinical pharmacy practice models have been implemented in a number of hospitals in the US. However, prior to implementing one of the abovementioned models, it is essential to critically assess the requirements of the institution together with the available resources. (University Health System Consortium, 2010, p. 11)

There are no standardised clinical pharmacy practice models in the UK or any of the other European countries. However, many studies have evaluated the impact of different pharmacy practice models within a particular institution. (Yee & Haas, 2014, p. 769) One example of a clinical pharmacy practice model implemented in the UK was the Imperial Model of Ward Pharmacy (IMWP) which was implemented during 2001. The model was implemented at Hammersmith and Charing Cross Hospitals in the UK and was later also implemented in St Mary's teaching hospital in 2010. The traditional ward pharmacy service was offered until 2001 and included reviewing each patient's medication daily on weekdays. The ward pharmacists had non-ward based responsibilities and therefore minimal emphasis was placed on the following activities: medication review on admission and discharge; patient monitoring and education. The IMWP was implemented as a more patient-focused service. The model was not based on pharmacists reviewing every patient's medication daily, since medication regimens for most patients did not alter much on a day-to-day basis. The IMWP involved two types of ward visits, chart-focused and patient-focused visits. Chart-focused visits involved reviewing all medication items on prescription charts and took place on Mondays, Wednesdays and Fridays. On the other hand, patient-focused visits took place on Tuesdays and Thursdays and involved: medication reconciliation, drug-related problems, laboratory result monitoring and discharge counselling. An evaluation of this practice model took place in 2010 in eight medical wards and the results showed that pharmacists screened prescription charts more thoroughly on

chart-focused days and likewise had more time to spend on patient education, monitoring and follow-up on patient-focused days. The IMWP model allows for a more patient-focused service without requiring more resources. (Franklin *et al.*, 2012, pp. 519-521)

Despite attempts to implement clinical pharmacy practice models in the US and certain European countries, there is a lack of international clinical pharmacy practice guidelines which has resulted in various different practice models being developed and implemented (Yee & Haas, 2014, p. 769).

2.8.2. Challenges for Hospital Pharmacy and Clinical Practice

The practice of hospital pharmacy differs between countries which could be due to the lack of international practice guidelines, poor communication between countries and differences in pharmacy training programmes (Matsoso, 2009, p. S11). Furthermore, the concept of clinical pharmacy and pharmaceutical care is interpreted differently around the world, which poses challenges for healthcare professionals (Franklin & van Mil, 2005, p. 137). However, the WHO, in collaboration with the International Pharmaceutical Federation (FIP) has set certain standard practice guidelines which include: (1) good pharmacy practice, (2) good distribution and trade practice, and (3) good manufacturing practices. The development of good hospital practice standards, by the WHO and FIP, could provide a platform for global standards to be implemented. The Good Pharmacy Practice guidelines could therefore be adopted internationally; however, they have not been updated recently. (Matsoso, 2009, p. S12)

Many countries have developed hospital pharmacy societies to support hospital pharmacy practice. However, there is no society representing hospital pharmacy on an international level. As part of the FIP, there is a hospital pharmacy section that aims to build relationships and share experiences between pharmacists globally. (Le Blanc & Dasta, 2005, p. 184) Hospital pharmacy societies in certain countries of the US, UK and Australia, have taken the initiative to implement their own hospital practice models, but, there is a need for international collaboration to ensure that patients receive the same level of care globally (Doloresco & Vermeulen, 2009, p. S19).

Another challenge faced is the global shortage of pharmacists (Doloresco & Vermeulen, 2009, p. S17). A survey of hospital pharmacy practice was conducted across 85 countries in 2008 and the results showed that over 50% of countries had a shortage of pharmacists (Doloresco & Vermeulen, 2009, p. S17). The shortage of pharmacists was first noticed in 1998 and has been thought to be due to the following factors: (1) increase in prescription drug use, (2) expansion in the role of a pharmacist, (3) limited use of pharmacy technicians and technology, (4) inefficiencies in the workplace, and (5) a greater number of female pharmacists who generally tend to work fewer hours than male pharmacists (Cooksey, Knapp, Walton, & Cultice, 2002, p. 183). Pharmacy schools in the US and Canada have made provision to enrol larger numbers of students, however, this is not usually possible in developing countries due to the cost of education and the facilities required. A shortage of pharmacists poses a challenge to the provision of clinical pharmacy services, which has resulted in many countries needing to reduce their clinical services offered. (Le Blanc & Dasta, 2005, p. 187) However, the use of an electronic patient prioritization tool, which has been developed in certain countries, could be used to assist hospital pharmacists to identify patients that are at a high risk for medication errors (Falconer *et al.*, 2014, p. 311).

The undergraduate education and training programmes to register as a pharmacist differ between countries and this poses another challenge in terms of standardising clinical pharmacy services on a global level. There are three main qualifications for pharmacy which are outlined below and include: (1) PharmD, (2) MPharm, and (3) BPharm degrees. (Doloresco & Vermeulen, 2009, p. S17)

(1) <u>PharmD</u>

The US has a doctor of pharmacy degree, or PharmD degree. The PharmD degree is an undergraduate degree which includes four years of pharmacy education that is more clinically focused. Additionally, post-graduate degrees can be completed to specialise in certain care settings such as ICU, oncology and transplant centres. (Cooksey *et al.*, 2002, p. 186) The PharmD has also been adopted in certain developing countries such as India, Korea, Pakistan, Bangladesh and Iran (Jamshed, Babar, & Masood, 2007, p. 1). However, there

is debate about the level of education and training that these facilities provide during the PharmD programme, due to the fact that most of these counties do not have the appropriate infrastructure and economic resources to deliver an efficient PharmD programme (Anderson & Futter, 2009, p. 2).

(2) MPharm

In Europe, the entry-level pharmacy qualification is an undergraduate master's degree, or MPharm degree. The curriculum is based on the European required syllabus and has a large clinical component. The programme duration differs within Europe, with the shortest being four years in the United Kingdom. Following the degree, a one-year internship training and a national registration examination, need to be completed. On successful completion, a candidate can register with the Royal Pharmaceutical Society of Great Britain (RPSGB) as a pharmacist. (Sosabowski & Gard, 2008, p. 1&3)

(3) BPharm

Australia, New Zealand and South Africa have a four year undergraduate degree which is a bachelor of pharmacy degree, or BPharm degree. In all three countries, the four year degree is followed by a one-year internship period and an examination. (Anderson & Futter, 2009, p. 1) Additionally, in South Africa, the one-year internship is followed by a one-year community service period, where the candidate is required to work for a state institution. The BPharm degree is not a clinically-based programme and the syllabus is largely based on each country's requirements. These countries do not offer an undergraduate clinical degree, however, they all offer some form of a post-graduate clinical qualification. The increased importance of clinical practice worldwide has resulted in the re-assessment of the BPharm curricula in these countries. (Marriott, Nation, Roller *et al.*, 2008, p. 2&8)

Pharmacy schools worldwide have started to change the undergraduate pharmacy curriculum from being laboratory-based to being more clinically focused (Le Blanc & Dasta, 2005, p. 189). One of the limitations is that developing countries often have a lack of funds and infrastructure available, which poses challenges when considering such changes (Le Blanc & Dasta, 2005, p. 189). However, the practice of clinical pharmacy has led to the

development of various clinical postgraduate programmes internationally. The curricula may vary between the programmes and may include just coursework, or coursework and a research component or a full research project. A doctoral programme traditionally involves full research with the goal of producing independent researchers; however, the practical component is not a focus area in such programmes. Doctoral programmes in Australia, the UK and the Asia-Pacific region are research-based with either limited or no practical component. There are a few doctoral programmes which include both research and a practical component, for example: (1) the DPharm at the University of Auckland in New Zealand, (2) the doctor of clinical pharmacy at the University of South Australia, and (3) the doctor of clinical pharmacy at University Sains, Malaysia. However, there are several limitations to programmes that offer research and coursework which could include: (1) longer course duration, (2) additional course costs, (3) shortage of skilled practicing academicians, and (4) additional workload for faculty staff members. (Hadi & Awaisu, 2010, p. 1&2)

Internationally, there are a number of challenges which make it difficult to implement one universal set of standards for clinical pharmacy practice, which include: (1) the differences in the graduate training programmes, (2) responsibilities and activities of pharmacists, (3) infrastructures, and (4) philosophies of clinical pharmacy and pharmaceutical care (Le Blanc & Dasta, 2005, p. 188). However, despite the challenges faced, hospital pharmacists worldwide have a common goal to advance the pharmacy profession to being more involved in patient care (Le Blanc & Dasta, 2005, p. 189).

2.8.3. Technology Advancements for Ward-based Clinical Pharmacy

Studies have shown that optimising the use of technology can enable pharmacists to perform more clinical activities, particularly where resources are limited (Pickette *et al.*, 2010, p. 753). The following paragraphs will discuss the advantages of implementing an electronic patient prioritization tool and the importance of web-based documentation.

2.8.3.1. Electronic Patient Prioritisation Tool

The shortage of pharmacists worldwide poses a challenge to providing clinical pharmacy services to every hospital in-patient. With limited pharmacists available, the prioritisation of patients for medication chart review can become difficult and time consuming. (Falconer *et al.*, 2014, p. 313) The use of an electronic patient prioritization tool can be used to identify patients that are at a high risk for medication errors (Falconer *et al.*, 2014, p. 311). The use of such a tool enables clinical pharmacy services to be offered to selected patients in institutions where pharmacists are limited (Falconer *et al.*, 2014, p. 311).

The Assessment of Risk Tool (ART) is an example of an electronic prioritization tool which was developed and implemented in October 2011 by the clinical pharmacy department at Middlemore Public Hospital in Auckland, New Zealand. The ART was the first complex electronic prioritisation tool developed to be used in a large hospital. The Middlemore Hospital has 900 patient beds and has approximately 6000 admissions per month. The ART enabled the workflow of the clinical pharmacists to be improved. Clinical pharmacists were able to intervene early and the number of pharmacist interventions increased significantly. (Falconer *et al.*, 2014, pp. 312-319)

In South Africa, Bluebird Medical Data Exchange is a system currently available to allow for clinical data exchange. The system was developed by Intelligent Medical Systems (Pty) Ltd over two decades ago and it integrates all of the information pertaining to a patient, including: (1) laboratory results from all laboratories within South Africa, (2) radiology reports, (3) discharge summaries, (4) referral notes, and (5) consultations. The system also allows for medical practitioners to send and receive clinical documents. Bluebird is web-based and has applications specifically for Windows, Apple, iPhone and iPad. (Intelligent Medical Systems, 2014) Private hospital groups within South Africa have started to subscribe to Bluebird, which will enable all healthcare professionals, including pharmacists, to access clinical information. Pharmacists can use Bluebird to identify patients that are at high risk for medication errors. Furthermore, Bluebird also has the capacity to allow for electronic prescribing. (Vine, 2007, p. 31)

2.8.3.2. Web-based Documentation

All clinical interventions need to be documented in order to measure the value of care provided by a clinical pharmacy service (Fahimi, 2010, p. 297). A web-based clinical documentation tool can be used to assist with documenting and tracking clinical interventions, as well as calculating cost savings (Pickette *et al.*, 2010, p. 752). All hospital institutions providing clinical pharmacy services should therefore ensure that a web-based documentation tool is implemented (Fahimi, 2010, p. 297).

A web-based intervention documentation programme called Quantifi®, was implemented in Providence Sacred Heart Medical Centre and Children's Hospital in Washington during 2005. The programme was integrated into the daily workflow of the ward-based clinical pharmacists, allowing for all interventions and follow-ups to be recorded. Quantifi® also measures the financial impact of pharmacist interventions, taking the pharmacist's time into consideration. (Pickette *et al.*, 2010, p. 752)

2.8.4. Establishment of Hospital Committees

The establishment of certain hospital committees is essential, particularly at institutions that provide clinical ward-based pharmacy services. The following committees should be established and will be outlined below: (1) drug and therapeutics committee, (2) infection control committee, and (3) antimicrobial stewardship committee. The ward-based clinical pharmacist plays an important role in each of the abovementioned committees and thus, there should be active involvement from the pharmacist. (Stone & Curtis, 2002, p. 174)

2.8.4.1. Drug and Therapeutics Committee

The inappropriate use of drugs to treat infectious diseases can result in increased mortality and morbidity rates, increased healthcare costs and antimicrobial resistance (Green, Beith, & Chalker, 2003, p. 11). Developing countries in particular have challenges with the rational use of drugs. The establishment of a Drug and Therapeutics Committee has been successfully implemented in hospitals of developing countries such as the US, Australia and certain European countries, including the UK, and has been shown to promote

the appropriate use of drugs. Certain countries may name their Drug and Therapeutics Committees slightly differently, for example, a Pharmacy and Therapeutics Committee, a Formulary Committee, or a Rational Drug Use Committee. (Green *et al.*, 2003, p. 11)

A Drug and Therapeutics Committee is a multidisciplinary team of healthcare professionals from the institution and should include the following members: (1) ward-based clinical pharmacist or a drug information pharmacist, (2) pharmacy managers, (3) nursing managers, (4) prescribers from different specialities, and (5) infection control nurse (Stone & Curtis, 2002, p. 174).

The activities of the Drug and Therapeutics Committee should include: (1) establish and maintain formulary requirements, (2) evaluate and approve treatment guidelines, (3) control any new medication items, (4) monitor and evaluate drug use, (5) promote good prescribing practice, and (6) promote and monitor infection control practices (Pacey & Li Wan Po, 1998, p. 172) (Green *et al.*, 2003, p. 11). The establishment of a medication formulary can assist in promoting cost-effective prescribing within the institution (Stone & Curtis, 2002, p. 174). Additional activities that can be addressed by the Drug and Therapeutics Committee may include managing adverse drug reactions and medication errors (Green *et al.*, 2003, p. 11). For the successful establishment of a Drug and Therapeutics committee, it is essential that the hospital authorises and supports the committee to perform the necessary changes that may be required with regard to drug selection (Green *et al.*, 2003, p. 11).

Studies done in developed countries have shown that Drug and Therapeutics Committees have been successful in promoting rational drug use, reducing costs through implementing formularies and improving the management of drugs (Green *et al.*, 2003, p. 11). Furthermore, the World Health Organization promotes the establishment of a Drug and Therapeutics Committee within each hospital institution and published guidelines on the implementation and role of such a committee in 2003 (Green *et al.*, 2003, p. 11).

2.8.4.2. Infection Control Committee

Infection control is important in all settings providing healthcare to prevent the risk of nosocomial infections for the patients and hospital staff (World Health Organization, 2002, p. 9). Infection control programmes therefore need to be established and maintained in all hospital institutions (World Health Organization, 2002, p. 9).

All healthcare facilities should have an Infection Control Committee which consists of a multidisciplinary team of healthcare professionals, including: (1) infection control nurses, (2) occupational health nurses, (3) hospital pharmacists, (4) pharmacy managers, (5) nursing managers, (6) central sterile supply department (CSSD) manager, (7) housekeeping services, (8) laundry services, and (9) food services (Stone & Curtis, 2002, pp. 174-175) (World Health Organization, 2002, p. 9). Each hospital should create awareness about its Infection Control Committee and all the tasks, policies and activities need to be communicated to all the administration and medical staff at the institution (World Health Organization, 2002, p. 9). In addition, hospital management needs to support the infection control programme at their institution and review all the policies implemented by the committee (World Health Organization, 2002, p. 9).

The activities performed by an Infection Control Committee should include: (1) assessing and promoting improved levels of practice in the facility, (2) appropriately training staff in infection control and safety, (3) reviewing and approving a yearly programme of activity for surveillance and prevention, (4) reviewing epidemiological surveillance data and identifying areas for intervention, (5) reviewing the risks associated with using new devices or technologies in the institution, (6) reviewing and providing input into the investigation of epidemics, and (7) communicating and co-operating with other hospital committees, such as the Drug and Therapeutics Committee and Antimicrobial Stewardship Committee (World Health Organization, 2002, p. 9). It is essential that infection control policies, specific to each institution, are established, implemented and kept updated (Stone & Curtis, 2002, pp. 174-175).

Ward-based clinical pharmacists need to work in collaboration with infection prevention practitioners, in order to minimise the spread of resistant pathogens (Matsoso, 2009, p. S12). The role of the ward-based clinical pharmacist as part of the Infection Control Committee includes: (1) ensuring that medications are received, stored and distributed in a manner to prevent potential transmission of organisms, (2) providing information and assisting with the development of guidelines on the use of antiseptics and disinfectants, and (3) monitoring and keeping a record of all antimicrobial agents issued to the patients (World Health Organization, 2002, p. 9). Ward-based pharmacists should therefore be actively involved in the Infection Control Committee at their institution (Matsoso, 2009, p. S12).

2.8.4.3. Antimicrobial Stewardship Committee

Antimicrobial resistance occurs when micro-organisms, including bacteria, viruses, fungi and parasites, have mutated which results in antimicrobial agents no longer being effective to destroy them (World Health Organization, 2014). The development of such resistant micro-organisms is caused by the overuse and misuse of antimicrobial drugs (World Health Organization, 2014). Antimicrobial drug resistance is an increasing concern worldwide and could result in public health disasters due to the emergence of resistant pathogens (Matsoso, 2009, p. S12). Furthermore, there are limited new antimicrobial agents being developed due to the large costs associated with the research and development of these agents (World Health Organization, 2014). Thus, there is an increasing need to safeguard and prevent the emergence of resistance to the antimicrobial agents that are currently available (World Health Organization, 2014).

The establishment of an Antimicrobial Stewardship Committee should therefore be an essential requirement for all hospital institutions (Child *et al.*, 2011, p. 155). An Antimicrobial Stewardship Committee is a multidisciplinary team that should consist of the following healthcare professionals: (1) ward-based clinical pharmacist, (2) clinical microbiologist, (3) infection control practitioners, (4) infection prevention practitioners, (5) infectious diseases physician, and (6) an epidemiologist (Ohl & Luther, 2011, p. S6).

The goal of the Antimicrobial Stewardship Committee should be to promote the rational use of antimicrobial drugs and to minimise the development of resistant micro-organisms (Child *et al.*, 2011, p. 155). The Antimicrobial Stewardship Committee should therefore closely monitor the following: (1) antimicrobial usage, (2) prescribing habits, and (3) causative micro-organisms within their institution (Kopp, Mrsan, Erstad, & Duby, 2007, p. 2484). The role of the ward-based clinical pharmacist particularly, as part of an antimicrobial stewardship committee, should include: (1) development of antimicrobial guidelines, (2) implementation and management of an antimicrobial formulary, (3) advice about intravenous to oral switches, (4) streamlining empirical treatment, (5) attendance of antimicrobial ward rounds, and (6) reviewing the treatment of complex patient cases (Langebrake & Hilgarth, 2010, p. 195). It is essential that all members of the Antimicrobial Stewardship Committee work in collaboration to achieve effective antimicrobial stewardship within their institution (Child *et al.*, 2011, p. 155).

CHAPTER 3
RESEARCH METHODOLOGY

3.1. Introduction

The aim of the study was to assess the impact of a ward-based pharmacist providing pharmaceutical care to hospital patients. Figure 3.1 outlines; and the following sections (3.2-3.6) discuss the steps involved in the research process, in order to achieve the aim of the study.

3.2. Study Design

The study was an intervention study, using a mixed methods design. The intervention study included a pre-intervention phase, an intervention phase and a post-intervention phase. An intervention study is used to assess the impact of a change or the provision of a new service in a department, which was assessed (Smith, 2005, pp. 31-32).

The study had a mixed methods design due to the fact that the research was both qualitative and quantitative in nature (Creswell & Plano Clark, 2011, p. 54). The use of open-ended questions was employed to obtain qualitative data from the questionnaires. The qualitative and quantitative components of the study were carried out independently during the research period (Creswell & Plano Clark, 2011, p. 70). In addition to the intervention and mixed methods design, the study also had a parallel convergent approach, given that all of the data was collected concurrently and the results, after independent analysis, were combined in order to obtain an overall interpretation (Creswell & Plano Clark, 2011, pp. 70-71).

3.3. Sample and Setting

The setting selected for the study was a surgical ward in a 340-bed private hospital situated in Port Elizabeth, Eastern Cape, South Africa. A surgical ward was selected as the study site in view of the fact that patients undergoing surgical procedures have been shown to be more likely to be at risk for medication errors (Klopotowska *et al.*, 2011, p. 2).

Convenience sampling is a non-probability sampling procedure where the researcher selects patients that are accessible and willing to participate in the research. The disadvantage of convenience sampling is that the data collected may not be representative of a wider population, however, the use of convenience sampling caused the least disruption for the patients and nursing staff working in the selected hospital ward. (Smith, 2005, pp. 43-44) Convenience sampling was therefore employed in the study and there were two distinct sample groups. The first group being the hospital patients admitted to the surgical ward where the study was conducted; and the second group consisted of the healthcare professionals working in the selected ward. The hospital patients in the first group were the focus in the intervention phase of the study and included all adult patients (aged 18 years or older) who were admitted to the surgical ward during the intervention phase of the study. Pregnant patients were excluded from the study. The researcher looked at all classes of medications that were prescribed for each patient, excluding anaesthetics and dietary supplements.

The healthcare professionals in the second group included medical practitioners and nurses, who participated in the pre- and post-intervention phases. The sample included all prescribers and nurses who were working in the selected ward at the time of the study.

3.4. Data Collection

3.4.1. Data Collection Tools

The development of data collection tools by the researcher allows for the researcher to determine the appropriate variables and level of detail that is required (Smith, 2005, p. 11). Additionally, this method prevents any unnecessary data from being collected, which is inefficient. Purpose-designed data collection tools were therefore used in the study. There were four data collection tools developed by the researcher, namely:

1. Medical Practitioner and Nurse Pre-intervention Questionnaire (Appendix 3 & 4)
2. Audit and Intervention Form (Appendix 5)

3. Pharmacist Suggestion Form (Appendix 6)
4. Medical practitioner and Nurse Post-intervention Questionnaire (Appendix 7 & 8)

The four data collection tools were piloted in the ICU during November 2013. The pilot study was used to assess the validity and reliability of the data collection tools and amendments were made where necessary. The data collected during the pilot study was not used in the final study data.

3.4.1.1. Medical practitioner and Nurse Pre-intervention Questionnaire

Development of the Questionnaire

Questionnaires are useful tools to collect information for pharmacy practice research and the quality of clinical pharmacy services can be measured by surveying the main consumers of the service, which include medical practitioners and nurses (Chevalier & Neville, 2011, p. 61). Furthermore, nursing staff comprise the largest healthcare professional group with whom the pharmacists interact (Chevalier & Neville, 2011, p. 62). The development of the questionnaires allows the researcher to determine the appropriate variables, level of detail required and the feasibility of data collection. The content of the questionnaire is important to ensure reliability and validity of the data collected. (Smith, 2005, pp. 63-34) The researcher made use of questionnaire design guides by Leung (2001, pp. 187-189) and Eiselen and Uys (2005, pp. 1-22) during the development of the questionnaires to ensure that they were easy to use and collected the information in a manner that was easy to code, capture and analyse. Furthermore, the researcher ensured that only relevant information was recorded to prevent any unnecessary data collection, which can lead to the questionnaires becoming too lengthy to complete.

The researcher developed two questionnaires to collect all the relevant information: a Medical Practitioner and Nurse Pre-intervention Questionnaire (see Appendix 3 & 4). The questionnaires were designed to determine the awareness of medical practitioners and nurses regarding ward-based pharmacy practice. Additionally, their perceptions and attitudes towards a ward-based pharmacy service were also assessed. The two questionnaires contain three sections, namely: (1) personal information, (2) awareness and understanding of

clinical ward-based pharmacy, and (3) opinions and expectations of a clinical ward-based pharmacy service.

The use of both open- and closed-ended questions was incorporated into the questionnaires. Closed-ended questions allow for a limited response which enables participants to answer or complete the questionnaires quicker and with less difficulty. On the other hand, open-ended questions enable the participant to express his/her opinion. The majority of the questions included were closed-ended which allowed for the data to be analysed quantitatively. A few open-ended questions were included at the end of the questionnaires to allow the medical practitioners and nurses to provide their opinions and to express any concerns that they may have had.

Distribution of the Questionnaire

A self-completion method of distribution is preferred for closed-ended questions, while a structured interview is preferred for open-ended questions because this allows the researcher to get any clarification or further details from the participant. (Smith, 2005, pp. 64-65) Despite the fact that the majority of the questions were close-ended, the researcher decided to initially use the structured interview method for the questionnaire administration to enable elucidation of responses.

Piloting of the Questionnaire

The Medical Practitioner and Nurse Pre-intervention Questionnaires were piloted in the ICU during a structured interview with the nursing staff. A total of four Medical Practitioner and Nurse Pre-intervention Questionnaires were completed during structured interviews. The results of the pilot study showed that a structured interview was not the most appropriate way to collect the data from the questionnaires. The researcher initially decided to administer the questionnaires via a structured interview because this method allows the researcher to get a better indication of the participants perception and it also allows for follow up on any ambiguous or interesting responses (Smith, 2005, p. 70). However, the researcher encountered numerous challenges with this method of administration. Firstly, the participants were very busy and thus, it was challenging to find a convenient time for both parties to meet and perform

the interview. The nursing staff also found it difficult to give answers immediately and looked to the researcher to guide them with the most appropriate answer. The majority of the questions were closed-ended questions, therefore, the questionnaire could alternatively be distributed as a self-completion questionnaire (Smith, 2005, p. 64). Based on the feedback from the first pilot study, the researcher decided to carry out a second pilot study whereby the questionnaire was distributed for self-completion.

A second pilot study was carried out, whereby, the questionnaires were given to medical practitioners and nursing staff to complete and return to the researcher. A cover letter describing the purpose of the study was attached to each Medical Practitioner and Nurse Questionnaire to provide the participants with information about the study (refer to Appendix 11). A total of eight questionnaires were piloted on the ICU medical practitioners and nursing staff. In addition to completing the questionnaire, the participants were asked to complete a short feedback questionnaire which would be used to assess the questions in terms of understanding, level of difficulty, clarity and time taken to complete. Appendix 12 contains the feedback and suggestions form that was attached to each pilot questionnaire. The researcher found that the questionnaires were completed and returned within one day and the answers obtained would result in more accurate data being collected. The second pilot study proved that this was a better method for completion of the questionnaires, thus, it was decided to rather use the self-completion method of distribution for all the questionnaires used in the study.

The feedback from the medical practitioners and nursing staff showed that the questionnaire was easy to follow and took an average of ten minutes to complete. The comments provided also indicated that the questions were clear and easy to understand. The researcher therefore made no amendments to any of the questions.

3.4.1.2. Audit and Intervention Form

Development of the Audit and Intervention Form

An Audit and Intervention Form (see Appendix 5) was designed for the researcher to review patient medication treatment and record any intervention

made. The researcher designed the majority of the form based on previous experience, working as a ward pharmacist. In addition, the researcher adopted certain criteria from a template used in a study done by (Saddique, 2012, p. 275) and the pharmacy intervention form of the NHS in England (National Health Service, 2013). The pharmacist medication intervention categories were adopted from the 15 categories described in a study done by Leape *et al.* (1995, pp. 35-43).

The medication review contained two sections, namely: (1) patient demographic information, and (2) medication Information. The medication items were classified according to acute or chronic treatment. Furthermore, patient chronic disease states, allergies and any surgical procedure performed were also recorded. The intervention form was only completed for patients where the pharmacist made an intervention. The intervention form contained a further two sections, namely: (1) details of the intervention, and (2) medication intervention category. The intervention form allowed for any prescribing, transcribing, dispensing and administration errors to be recorded. The severity of the intervention was categorised and any cost-saving benefit was also documented. The form also allowed for the method of the intervention, together with the time taken, to be recorded.

Distribution of the Audit and Intervention Form

The Audit and Intervention Form was designed for the researcher to record patient medication information. The forms were taken daily with the researcher to the study ward and one audit form was completed by the researcher per patient. Additionally, an intervention form was completed for patients where an intervention was made.

Piloting of the Audit and Intervention Form

The Audit and Intervention Form was piloted on five patients in the ICU. The forms were completed by the researcher and the results of the pilot study showed that the Audit and Intervention Form required minimal amendments. The researcher found that the audit section of the form required a section for laboratory results together with a section for follow-up notes to be made. After

the pilot study, the necessary amendments were made to the data collection tool prior to the commencement of data collection.

3.4.1.3. Pharmacist Suggestion Form

Development of the Pharmacist Suggestion Form

A Pharmacist Suggestion Form (see Appendix 6) was designed to communicate any medication recommendations or queries that were not urgent, to the medical practitioners. The form was designed by the researcher based on previous experience as a ward pharmacist. The patient information was documented at the top of the form followed by a section where the pharmacist could make any suggestions. The form also contained a space below the pharmacist's suggestion, where the medical practitioner could provide any feedback to the pharmacist. The suggestion form provided a useful tool for the researcher to communicate with the medical practitioner concerned.

Distribution of the Pharmacist Suggestion Form

The Pharmacist Suggestion Form was taken to the ward daily with the researcher. The researcher would complete the form with any suggestions and leave it in the front of the patient's hospital file. The feedback or response from the medical practitioners would be followed up by the researcher on the next ward visit. All interventions made through the use of the pharmacist suggestion form were documented on the intervention form.

Piloting of the Pharmacist Suggestion Form

The Pharmacist Suggestion Form was piloted on five patients in the ICU. The forms were completed by the researcher and feedback/suggestions were provided by the attending physicians. The form was easy to use for both the researcher and the physicians involved. No amendments to the pharmacist suggestion form were required prior to the data collection phase.

3.4.1.4. Medical Practitioner and Nurse Post-intervention Questionnaire

Development of the Questionnaire

Two questionnaires were designed, namely: a Medical Practitioner and Nurse Post-intervention Questionnaire (see Appendix 7 & 8). Similarly to the approach for the pre-intervention phase, the researcher designed the questionnaires to

ensure that they questionnaires were reliable and that the necessary information was recorded. The questionnaires were designed to determine whether the medical practitioners' and nurses' attitudes towards a ward-based pharmacy service had changed after the implementation of the service. Furthermore, their views and expectations of the service were assessed.

The two questionnaires contain three sections, namely: (1) personal information, (2) assessment of clinical ward-based pharmacy service, and (3) views and expectations of the ward-based pharmacy service. The questionnaire design was similar to that of the Medical Practitioner and Nurse Pre-intervention Questionnaire with the use of both open- and closed-ended questions. The use of similar questions to the ones in the pre-intervention questionnaire allowed the researcher to determine whether their opinions and attitudes had changed once the ward-based pharmacy service had been implemented.

Distribution of the Questionnaire

The questionnaires were distributed for self-completion, based on the challenges experienced with regards to semi-structured interviews during the pilot study of the pre-intervention questionnaires.

Piloting of the Questionnaire

There were a total of eight Medical Practitioner and Nurse Post-intervention Questionnaires piloted in the ICU during November 2013. The participants were asked to complete a few questions (see Appendix 12) to provide feedback on the questionnaires. The questionnaires were completed by the participants and returned to the researcher after one to two days. Overall, the researcher experienced no problems with the questionnaires during the pilot study. Furthermore, the participants indicated that the questionnaire was easy to follow and no suggestions were made. There were no amendments made to the questionnaire following the pilot study.

3.4.2. Data Collection Process

Data collection took place during three phases, namely: (1) the pre-intervention phase, (2) the intervention phase, and (3) the post-intervention phase.

The researcher was introduced by the unit manager to all medical practitioners and nursing staff who worked in the selected ward, prior to the commencement of the pre-intervention phase, which was the first phase of the data collection process. The aim and objectives of the research, as well as the importance of the pharmacist participating as an integral part of the healthcare team to improve patient outcomes, was explained by the researcher. Sections 3.4.2.1 to 3.4.2.3 discuss the pre-intervention, intervention and post-intervention phases, respectively.

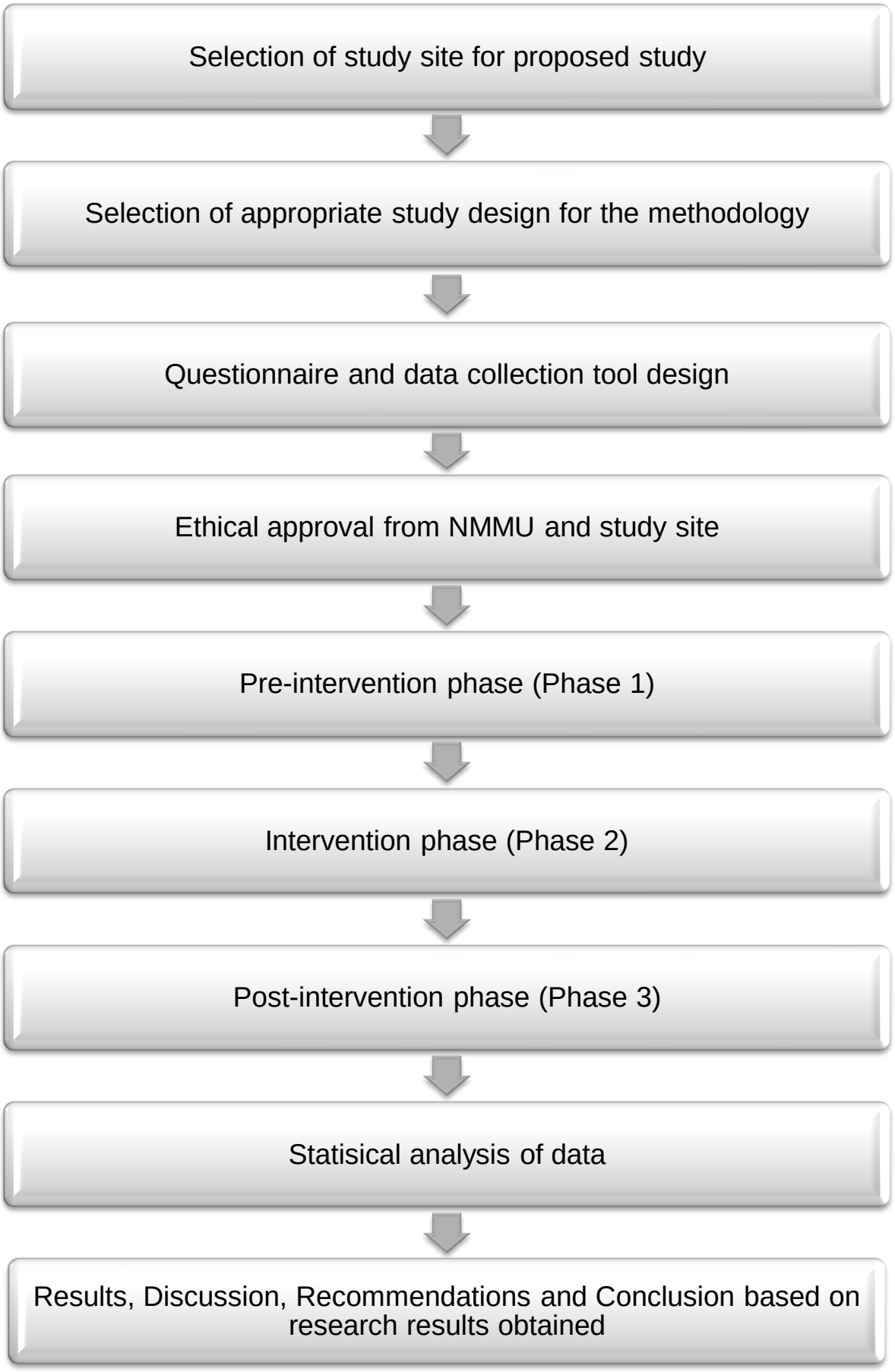

Figure 3.1: Steps involved in the research methodology process

3.4.2.1. Pre-intervention Phase

During the pre-intervention phase (Phase 1), the researcher outlined the purpose of the research to the medical practitioners and nurses who were working in the selected surgical ward. Appendix 1.2 contains the cover letter that was administered to the participants during this phase of the study. Questionnaires were distributed to medical practitioners and nursing staff. Once completed, they were returned to the researcher. Each questionnaire was numbered to ensure that the confidentiality of all participants was maintained. However, this method allowed the researcher to follow up with a particular medical practitioner or nurse should the questionnaire not be returned or if the researcher needed to clarify a particular answer or response. Phase 1 took place over two weeks (30 January 2014 to 13 February 2014) prior to the commencement of the intervention phase (Phase 2).

Clinical ward-based pharmacy practice will have a different meaning and significance to various categories of healthcare professionals. Two different questionnaires were therefore distributed to medical practitioners and nurses, in order to ensure that reliable data was collected. The questionnaires (refer to Appendix 3 for the Pre-intervention Questionnaire for medical practitioners and refer to Appendix 4 for the Pre-intervention Questionnaire for nurses) were completed by the participants during this phase of the study. The two questionnaires contain three sections, namely: (1) personal information, (2) awareness and understanding of clinical ward-based pharmacy, and (3) opinions and expectations of a clinical ward-based pharmacy service. The purpose of the questionnaires was to assess whether the abovementioned healthcare professionals were aware of ward-based clinical pharmacy and to assess their perceptions and attitudes towards the service being implemented in the ward.

3.4.2.2. Intervention Phase

The researcher, working as a ward-based pharmacist, reviewed patient medication files and dispensed medication to all patients admitted to the surgical ward during the study period. A patient consent form (refer to Appendix 1.1) was given to each patient in the surgical ward during the study. The consent form explained the purpose of the research and a signature from the

patient served as consent to access the patient file. The researcher ensured that consent was obtained from each patient before accessing his/her patient file. The researcher conducted the data collection process in the selected surgical ward over eight weeks (03 March 2014 to 25 April 2014) on weekdays between 08h00 and 12h00. A medication audit form was completed daily for each patient in the ward (see Appendix 5). The medication audit form allowed the pharmacist to assess the patients' medications and to document any prescribing, transcribing, dispensing and administration medication errors. Furthermore, pharmacist-initiated interventions to optimise patient care, together with any cost-saving benefit, were also documented. The estimated time to make each intervention was also recorded. In this study, an intervention is defined as any change made to a patient's pharmacotherapeutic treatment plan due to advice from the researcher (de Boer *et al.*, 2011, p. 4). Detected medication errors were classified according to their severity and potential harm caused to the patient. The classification of these interventions, according to their clinical significance, was determined by two independent reviewers. The perceived benefit of the intervention to the patient was also assessed.

All medication prescribed for each patient was reviewed, excluding anaesthetics and dietary supplements. Medication-related queries which needed to be resolved without delay, were discussed in person if the medical practitioner was present in the ward or via telephone, if the medical practitioner was not present in the ward at the time. Medication recommendations, or queries that were not urgent, were made through the use of a Pharmacist Suggestion Form, which was placed in the patient's medication file (see Appendix 6). The recommendation form had a section for pharmacist comments and suggestions followed by a section below which allowed for feedback from the medical practitioner. The medical practitioner would leave the suggestion form with his/her feedback in the patient's medication file. The researcher checked each patient's medication file on a daily basis, weekdays between 08h00 and 12h00, and followed up on any feedback made through the use of the suggestion form.

3.4.2.3. Post-intervention Phase

The post-intervention phase (Phase 3) commenced immediately on completion of the intervention phase and took place over 2 weeks (28 April 2014 to 9 May 2014).

Phase 3 involved the administration of the post-intervention questionnaires to the medical practitioners (see Appendix 7) and the nurses (see Appendix 8). Appendix 1.3 contains the cover letter that was administered to the participants during this phase of the study. These questionnaires were completed by the participants during this phase of the study. The two questionnaires contain three sections, namely: (1) personal information, (2) assessment of clinical ward-based pharmacy service, and (3) views and expectations of the ward-based pharmacy service. The purpose of this phase of the study was to determine whether there were changes in the medical practitioners' and nurses' opinions and attitudes towards ward-based clinical pharmacy once the service had been implemented in the ward. The findings were compared with those from the pre-intervention questionnaires in order to identify any differences or similarities.

3.5. Data Analysis

The qualitative data obtained from the open-ended questions was captured into Microsoft Excel®. The researcher then familiarised herself with the responses that were obtained from the various questions and then a coding frame was developed. The content of the coding frame was derived from the participants' responses and the researcher ensured that it covered all of the opinions that were provided. Principle themes were identified for the coding frame and a separate coding frame was developed for responses related to each principle theme. All the responses were then coded using the same coding frame to ensure consistency and reliability of the results. Once all of the responses were coded, the researcher compared the responses and was able to identify similarities, differences and any inconsistencies. The researcher was able to compare the opinions, views and expectations of the participants. The same method was used in both the pre-intervention phase and the post-intervention phase which allowed the researcher to identify whether the responses of the participants had changed during the course of the study.

Once the quantitative data was collected, it was all coded and captured in Microsoft Excel®. Coding assists in the processing of the data, particularly for quantitative data (Smith, 2005, p. 60). The quantitative data was analysed statistically using Microsoft Excel® and an in-house programme developed by the consultant in the unit for statistical consultation at the Nelson Mandela Metropolitan University. Descriptive statistics were used to organise, summarise and present the data in such a way that the results of the study could be clearly interpreted. The data was analysed using graphical techniques and numerical descriptive measures to summarise the data. Where appropriate, the results were presented as mean ± standard deviation. The mean is a measure of central location and is also known as the average. The mean is calculated by summing all of the observations and dividing this value by the total number of observations. (Keller & Warrack, 2003, p. 93) The standard deviation is a measure of variability and is used when comparing two sets of data (Keller & Warrack, 2003, p. 103&105).

Inferential statistics were employed to analyse the results of the sample and to draw conclusions across the population (Keller & Warrack, 2003, p. 3) The inferential statistical tests that were used included the Student's t-test and the Chi-squared test. The Student's t-test is used to compare two samples and to assess whether the means of two groups are statistically different from each other (Harris & Taylor, 2009, p. 29). The Chi-squared test is used to measure the difference between actual and expected frequencies (Harris & Taylor, 2009, p. 34). The Student's t-test and Chi-squared tests were used to calculate a probability (p) value which is used to determine whether a hypothesis is true or not (Harris & Taylor, 2009, p. 24). A p-value therefore gives the probability of any observed difference having happened by chance (Harris & Taylor, 2009, p. 24). The p-values were calculated at a 95% probability level and a p-value of <0.05 was considered to be statistically significant.

3.6. Ethical Considerations

Ethical approval was sought and granted from the Faculty of Research and Technology Innovation (FRTI) and the Research Ethics Committee-Human (REC-H) at the Nelson Mandela Metropolitan University (see Appendix 9). In

addition, ethical approval was also requested and granted from the Research Ethics Committee of the selected private hospital group. Permission to undertake the study was also requested from the general hospital manager.

Medical practitioners and nurses participating in the pre- and post-intervention phases were informed about the purpose of the study, and agreeing to complete the questionnaire served as consent. The medical practitioners and nurses were not obligated to complete the questionnaires and could withdraw from participating.

The patients in the surgical ward were informed about the purpose of the study and written informed consent was requested from all patients willing to participate in the study (see Appendix 1.1). Patient medication therapy was not altered by the researcher. The researcher presented any medication recommendations to the medical practitioner, who then decided whether or not to implement the change. The ward pharmacy service was not withdrawn from the surgical ward after the data collection period.

All information obtained remained confidential at all times during the study. The names of the patients, medical practitioners and nurses were kept confidential. The use of a hospital admission number was used to identify patients. A number was allocated to each medical practitioner and nurse participating in the pre- and post-intervention questionnaires. The researcher used this system of tracking, in the case of any follow up information being required. The study was undertaken according to the recommendations of the Helsinki Agreement, which is a set of ethical principles aiming to protect human subjects and their information during the course of medical research (World Medical Association Declaration of Helsinki, 2001, p. 373).

CHAPTER 4
RESULTS AND DISCUSSION

4.1. Introduction

The results and discussion of the study are outlined in chapter 4. Sections 4.3 to 4.5 discuss the results from the pre-intervention phase; the intervention phase; and the post-intervention phase, respectively.

4.2. Ethical Approval

A research proposal was submitted and ethical approval was obtained (H13-HEA-PHA-007) from the Faculty of Research and Technology Innovation (FRTI) and the Research Ethics Committee-Human (REC-H) at the Nelson Mandela Metropolitan University (see Appendix 9 & 10). Permission to undertake the study in a surgical ward was obtained (UNIV-2013-0025) from the Research Ethics Committee of the selected private hospital group and permission was also obtained from the hospital manager.

The researcher ensured that written informed consent was obtained from the patient before accessing each patient file (see Appendix 1.1). Patient consent was voluntary and confidentiality was maintained at all times with no names being linked to any of the data. There were no changes made to the patients' medical records or medication treatment during the study. The study was undertaken according to the recommendations of the Helsinki Agreement (World Medical Association Declaration of Helsinki, 2001, p. 373).

4.3. Pre-Intervention Phase

4.3.1. Sample and Setting

The pre-intervention phase of the study took place in a 40-bed surgical ward of a private hospital in the Eastern Cape Province of South Africa. The sample included all medical practitioners and nurses working in the ward during the time of the study. Medical practitioners and nurses were not obliged to participate in the study and agreement to complete the questionnaire served as voluntary consent.

4.3.2. Questionnaire Distribution and Response Rate

A total of 13 medical practitioner and 35 nursing pre-intervention questionnaires were distributed for self-completion over a period of two weeks. There were 11 (85%; n=13) medical practitioners' questionnaires returned to the researcher while only 21 (60%; n=35) nursing questionnaires were returned. The lower questionnaire return rate among the nursing staff could be due to the number of agency staff members in the ward during the study period. Agency staff members are non-permanent staff members who work occasionally when required by the hospital.

4.3.3. Medical Practitioner and Nurse Participant Demographics

The demographic details of the participating medical practitioners and nurses were obtained from the closed-ended questions in Section A of the pre-intervention questionnaire (refer to Appendix 3 & 4). The following information was recorded for the medical practitioners: (1) gender, (2) number of years registered as a practitioner, (3) specialist category, and (4) number of years registered as a specialist. The nursing pre-intervention questionnaire recorded similar information and included: (1) gender, (2) number of years in practice and, (3) speciality.

The number of years in practice was categorised as follows: (1) 1-4 years, (2) 5-9 years, (3) 10-19 years, and (4) 20 years or more. The abovementioned year categories were used for the Medical Practitioner and Nurse Pre-intervention Questionnaire. The following sections present and discuss the results pertaining to the medical practitioners' (Section 4.3.3.1) and nurses' (Section 4.3.3.2) demographic information.

4.3.3.1. Medical Practitioner Demographic Information

Table 4.1 outlines the medical practitioner demographic information relating to the number of years registered as a practitioner. The "Year category" column depicts the number of years that the medical practitioner has been registered as a practitioner. It is evident that all of the medical practitioners (100%; n=11) were male and that all of them had been registered as practitioners for more than four years (see Table 4.1). The majority, 55% (6; n=11), of the medical practitioners had been registered as medical practitioners for more than twenty

years. However, only 27% (3; n=11) of the medical practitioners had been specialised for more than twenty years. The greatest number of specialist medical practitioners (4; n=11) had been registered for five to nine years and constituted 36% of the practitioners.

Table 4.1: Years of registration as a medical practitioner and specialist (n=11)

Years of registration	Practitioner registration	Specialist registration
	Percentage (%)	Percentage (%)
1-4	0%	9%
5-9	18%	36%
10-19	27%	27%
20+	55%	27%
Total	***100%***	***100%***

The 11 medical practitioners were categorised according to their speciality. Table 4.2 shows the distribution of the specialities. The majority of medical practitioners were physicians, 55% (6; n=11), with five other categories being represented.

Table 4.2: Medical practitioner specialist category (n=11)

Specialist Category	Percentage (%)
Anaesthetist	9%
Cardiothoracic Surgeon	9%
General Surgeon	9%
Gynaecology	9%
Neurosurgeon	9%
Physician	55%
Total	***100%***

4.3.3.2. Nurse Demographic Information

The majority, 95% (20; n=21), of the nursing staff were female. Table 4.3 shows the percentage of nurses who had been registered for a specified number of years (categorised as follows: 1-4 years, 5-9 years, 10-19 years or 20 years or more). More than half, 52% (11; n=21) of the nursing staff were newly qualified and had been registered as nurses for one to four years.

Table 4.3: Years of registration as a nurse (n=21)

Years of registration	Nurse registration
	Percentage (%)
1-4	52%
5-9	29%
10-19	0%
20+	19%
Total	***100%***

The nurses were categorised according to their registration status and there were a total of five different categories (see Table 4.4). The majority, 43% (9; n=21) of the nurses were qualified as registered nurses, followed by 24% (5; n=21) who were enrolled nurses.

Table 4.4: Nurse specialist category (n=21)

Specialist Category	Percentage (%)
Care Worker	4%
Enrolled Nurse	24%
Enrolled Nursing Assistant	19%
Registered Nurse	43%
Student Nurse	10%
Total	***100%***

4.3.4. Awareness and Understanding of Clinical Ward-Based Pharmacy

Participants' awareness and understanding of clinical ward-based pharmacy was assessed using open and closed-ended questions in section B of the questionnaires (refer to Appendix 3 & 4).

The medical practitioners and nurses were asked whether they were aware of clinical ward-based pharmacy. The results showed that 91% (10; n=11) of the medical practitioners were aware of clinical ward-based pharmacy, compared with only 57% (12; n=21) of the nurses (see Figure 4.1).

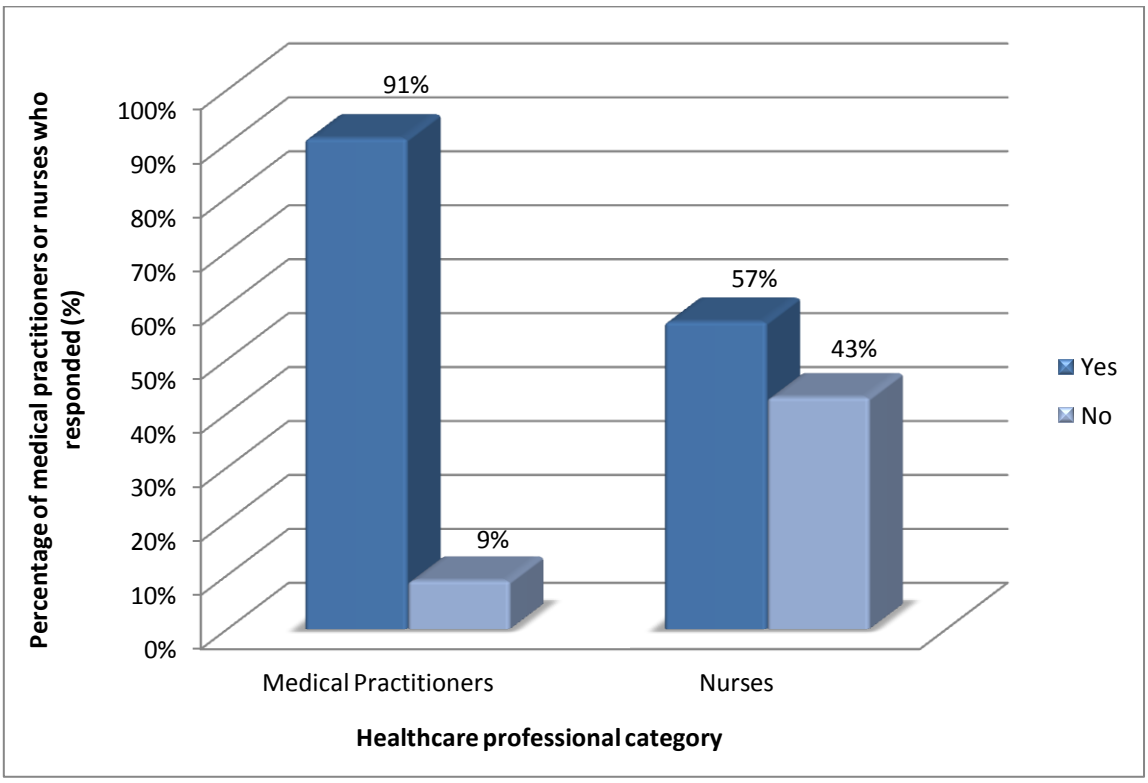

Figure 4.1: Awareness of medical practitioners (n=11) and nurses (n=21) of clinical ward-based pharmacy

The medical practitioners and nurses were then asked whether they had previously practiced at an institution, other than the study institution, where there was a ward or clinical pharmacist present. Forty-five percent (5; n=11) of the medical practitioners had previously practiced at an institution which offered clinical ward-based pharmacy services compared with only 24% (5; n=21) of the nurses (see Figure 4.2). Conversely, a similar study done by (Chevalier & Neville, 2011, p. 64) in Canada showed that 40% of the nurses had previously worked at an institution with a clinical pharmacist. The increased awareness of the medical practitioners towards clinical ward-based pharmacy could therefore be due to the fact that almost half of the practitioners had previously experienced this practice. Participants were also asked about the type of institution/s where they had experienced ward or clinical pharmacy being practiced. The institutions were categorised according to whether they were private hospitals, public hospitals or clinics. Additionally, the province was recorded if the institution was in South Africa and the country was documented if it was international.

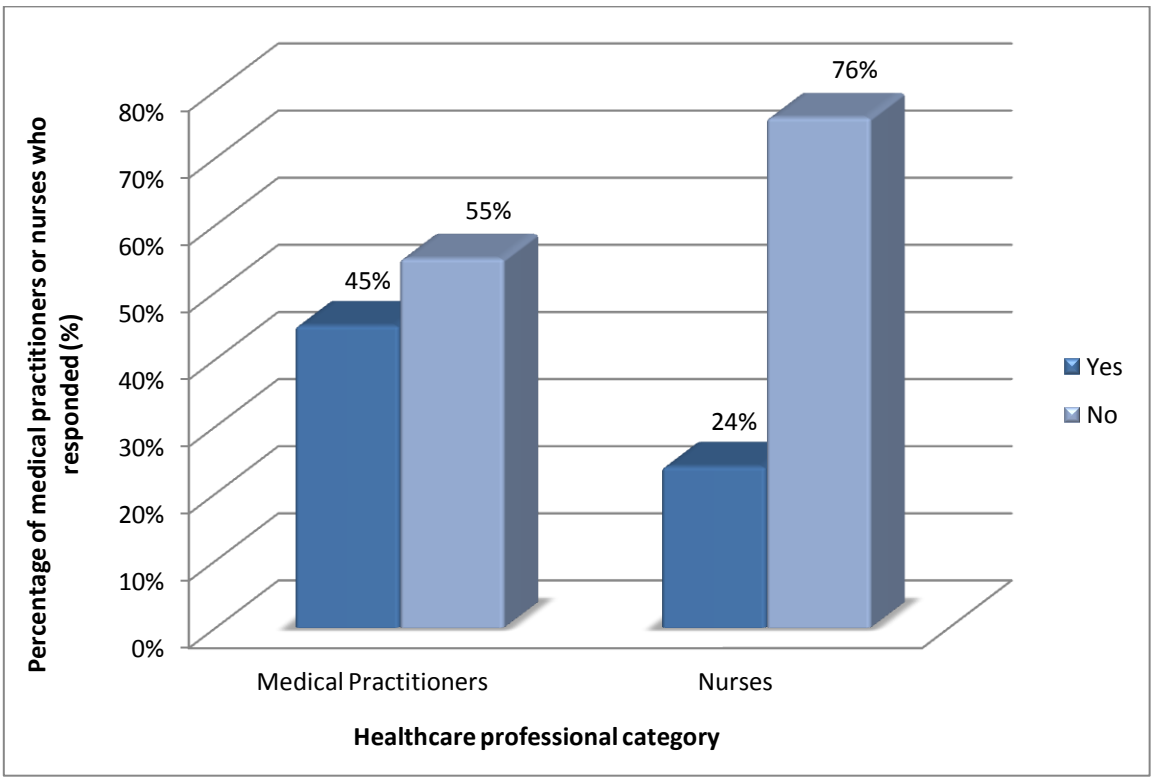

Figure 4.2: Medical practitioners (n=11) and nurses (n=21) who previously practiced at an institution with clinical ward-based pharmacy

Overall, the results showed that more than half, 60% (6; n=10), of the medical practitioners or nurses had experienced ward-based clinical pharmacy services at a public hospital. Four of these participants (67%; n=6) had experienced these services at a public hospital in the Eastern Cape Province while the other two participants (33%; n=6) had experienced these services in the Western Cape Province. Twenty percent (2; n=10) of the medical practitioners or nurses had previously experienced ward-based clinical pharmacy services at private hospitals, which were located in the Eastern Cape and the Western Cape Provinces. The remaining 20% (2; n=10) experienced this practice internationally in the UK, Australia and Canada.

The understanding of the term “clinical ward-based pharmacy” was assessed and the medical practitioners and nurses were asked to provide their understanding of this term. For the purpose of this study, the term clinical pharmacy was defined as “a health science discipline in which pharmacists provide patient care that optimises medication therapy and promotes health, wellness and disease prevention” (American College of Clinical Pharmacy, 2008, p. 816).

All of the medical practitioners understood the term correctly while 28.6% (6; n=21) of the nurses were uncertain of what the term meant. Additionally, one nurse understood the term incorrectly, while the remaining fourteen understood the term correctly. The understanding of the term by the medical practitioners highlighted that just under half of the practitioners felt that the term meant that the pharmacist played an important role in advising on prescribing, medication indications, drug interactions and adverse drug reactions. For example, one of the responses obtained from a medical practitioner as his understanding of the term was “where a pharmacist helps on the floor with prescribing and assists with the understanding, side effects, drug interactions of medications”. Conversely, about two-thirds of nurses felt that the term meant that the pharmacist had an important role to play in advising on general medication queries at a ward level. Similar definitions were obtained from these nurses and one example of a definition which was provided included “when a pharmacist is based in the ward to assist with medication queries”.

Prior to the implementation of the ward-based pharmacy service, the medical practitioners and nurses were also asked to explain, in their opinions, what the greatest benefit of a ward pharmacy service would be to their profession. Over two-thirds of the medical practitioners responded that a pharmacist reviewing prescribing, particularly medication doses, would be the greatest benefit to them. One of the responses obtained from a medical practitioner was “to detect prescription errors; in other words: dose, frequency, modification of prescriptions in disease states/renal failure etc.” On the other hand, the majority of the nurses felt that the pharmacist reviewing the medications would be the greatest benefit and that the incidence of medication errors would be reduced. For example, one of the responses obtained was “hopefully less medication errors and incidents, also less time away from patient care”. A large percentage of the medical practitioners and nurses thought that the ward pharmacy service would be beneficial to the patients and would particularly result in improved medication outcomes and also allow for medication information to be provided. A response obtained from a medical practitioner was “correct dose, correct medication, and optimal patient care” while one nurse provided the following

response “the pharmacist will be there to answer any questions that the patient may have regarding his/her treatment”.

4.3.5. Opinions and Attitudes Towards Clinical Ward-based Pharmacy

Section C of the Medical Practitioner and Nurse Questionnaires (refer to Appendix 3 & 4) was developed to establish the opinions and attitudes of the medical practitioners and nurses towards ward-based clinical pharmacy practice.

A Likert-type scale is a useful tool to use when investigating views and opinions and is commonly used in survey research (Smith, 2005, p. 102). A Likert-type scale was therefore adopted for question one, which consisted of a series of positive statements which was used to assess the views of the medical practitioners and nurses. The Likert-type scale contained the following five categories: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree and (5) strongly agree. The medical practitioners and nurses were asked to rate a total of 14 statements from one to five based on the extent to which they agreed or disagreed with them. The medical practitioner and nurse responses for each statement were calculated as a percentage for each category and are outlined in Tables 4.5 and 4.6. The highest percentage for each statement represents the most frequently occurring response category, which is also the mode. The mode is the most useful method to interpret Likert-type scale data due to the non-linearity of such a scale (Smith, 2005, p. 102).

Additionally, question four of Section C, looked specifically at whether the medical practitioners and nurses had any concerns about the participation of a ward pharmacist in the care of the patient. The question was structured as a closed-ended question with a place for comments if the medical practitioner or nurse had any concerns.

4.3.5.1. Medical Practitioner Opinions and Attitudes Towards Ward-based Clinical Pharmacy

The mode was used to assess the opinions and attitudes of the medical practitioners towards ward-based clinical pharmacy. Fifty percent (50%; 7; n=14) of the statements had category four being the largest percentage of

responses while the remaining 50% had category five being the largest (see Table 4.5). The results show that the majority of the medical practitioners either agreed or strongly agreed with the statements made, which suggests that they had a positive opinion and attitude towards ward-based clinical pharmacy. There were no strongly disagree responses for any of the statements, however, 18% (2; n=11) of the medical practitioners disagreed that they would prefer a pharmacist to be present when they prescribe medication.

The majority (64%; 7; n=11) of the medical practitioners agreed that it was necessary to have a pharmacist present in hospital wards, while 73% (8; n=11) agreed that pharmacists should be more available in the wards. All of the medical practitioners either agreed or strongly agreed that a ward pharmacy service will be beneficial to the medical practitioners, nurses and patients. Furthermore, the medical practitioners strongly agreed that the pharmacist plays an important role in improving medication safety and reducing medication errors. They also felt that it would be beneficial to have a ward pharmacist to handle medication-related queries. The medical practitioners all responded that they would be available for queries from a ward pharmacist and that they would incorporate appropriate recommendations into the patients' therapies. Overall, the responses to the 14 statements suggest that the medical practitioners felt positive towards the ward pharmacy service being implemented.

There were 10 medical practitioners (91%) who had no concerns about the participation of the ward pharmacist in the care of the patient. The single remaining (9%; n=11) medical practitioner was concerned that the final decision rests with the practitioner; however, this medical practitioner mentioned that advice and recommendations from a ward pharmacist would be appreciated.

Table 4.5: Medical practitioner response to ward-based clinical pharmacy (n=11)

Question	Statement	Percentage of Medical Practitioners who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	It is necessary to have a pharmacist in hospital wards	0%	0%	9%	64%	27%
2	Pharmacists should be more present in hospital wards	0%	0%	0%	73%	27%
3	I would prefer a pharmacist to be present when prescribing medication	0%	18%	27%	37%	18%
4	A ward-based pharmacy service will be beneficial to medical practitioners	0%	0%	0%	64%	36%
5	A ward-based pharmacy service will be beneficial to nursing staff	0%	0%	0%	36%	64%
6	A ward-based pharmacy service will be beneficial to patients	0%	0%	0%	36%	64%
7	Pharmacists play an important role in improving medication safety	0%	0%	0%	27%	73%
8	A ward-based pharmacist will reduce medication error rate	0%	0%	9%	27%	64%
9	It will be beneficial to have a ward pharmacist to handle medication-related queries	0%	0%	9%	36%	55%
10	The potential services offered by a ward pharmacist will assist me to optimise patient care in less time	0%	0%	18%	46%	36%
11	The pharmacist plays an important role in medication counselling at discharge	0%	9%	9%	46%	36%
12	I will be available for queries from a ward pharmacist	0%	0%	0%	45%	55%
13	I expect the pharmacist to inform me of any prescription errors	0%	0%	0%	18%	82%
14	I am willing to incorporate appropriate recommendations from a ward pharmacist into patient therapy	0%	0%	0%	55%	45%

4.3.5.2. Nurse Opinions and Attitudes Towards Ward-based Clinical Pharmacy

Similarly to Section 4.3.5.1, the mode was used to assess the opinions and attitudes of the nurses towards ward-based clinical pharmacy. Table 4.6 depicts the 14 statements together with the distribution of the percentages for each category. All of the statements have the largest percentage of responses for category 5, which suggests that the nurses strongly agreed with the statements and had a positive attitude towards ward-based clinical pharmacy. There were no nurses who strongly disagreed with any of the statements, however, 5% (1; n=21) of the nurses disagreed that the ward pharmacy service would be beneficial to medical practitioners. All of the statements received category three responses, which suggests that some of the nurses had a neutral opinion towards ward-based clinical pharmacy.

The majority (52%; 11; n=21) of the nurses strongly agreed that it was necessary to have a pharmacist present in the hospital wards and that pharmacists should be more available in the wards. Overall, the nurses felt that a ward pharmacy service would be beneficial to the medical practitioners, nurses and patients. The majority of the nurses agreed that pharmacists play an important role in improving medication safety and reducing medication errors. They also felt that it would be useful to have a pharmacist present in the ward to handle medication-related queries. The majority of the nurses responded that they would be available for queries from a ward pharmacist and that they would accept appropriate recommendations that were made.

The results from question four showed that none of the nurses had any concerns about the participation of the ward pharmacist in the care of the patient, prior to the implementation of a ward-based pharmacy service.

Table 4.6: Nurse response to ward-based clinical pharmacy (n=21)

Question	Statement	Percentage of Nurses who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	It is necessary to have a pharmacist in hospital wards	0%	0%	24%	24%	52%
2	Pharmacists should be more present in hospital wards	0%	0%	19%	29%	52%
3	When administering medication, it is useful to have a pharmacist present in the ward	0%	0%	38%	24%	38%
4	A ward-based pharmacy service will be beneficial to medical practitioners	0%	5%	10%	38%	47%
5	A ward-based pharmacy service will be beneficial to nursing staff	0%	0%	10%	33%	57%
6	A ward-based pharmacy service will be beneficial to patients	0%	0%	5%	38%	57%
7	Pharmacists play an important role in improving medication safety	0%	0%	19%	19%	62%
8	A ward-based pharmacist will reduce medication error rate	0%	0%	5%	28%	67%
9	It will be beneficial to have a ward pharmacist to handle medication-related queries	0%	0%	10%	19%	71%
10	The potential services offered by a ward pharmacist will assist me to optimise patient care in less time	0%	0%	19%	33%	48%
11	The pharmacist plays an important role in medication counselling at discharge	0%	0%	14%	24%	62%
12	I will be available for queries from a ward pharmacist	0%	0%	24%	19%	57%
13	I expect the pharmacist to inform me of any medication administration errors	0%	0%	19%	14%	67%
14	I am willing to accept appropriate recommendations from a ward pharmacist	0%	0%	14%	14%	72%

4.3.6. Opinions of Medical Practitioners and Nurses towards Clinical Pharmacy Services Provided by a Pharmacist

A second Likert-type scale was used in Section C of the Medical Practitioner and Nurse Questionnaires (refer to Appendix 3 & 4) to determine the views of the medical practitioners and nurses towards the pharmacist providing various clinical pharmacy services, prior to the implementation of a ward-based clinical pharmacy service. The Likert-type scale contained five categories according to the level of importance and included: (1) no importance, (2) slightly important, (3) neutral, (4) important and (5) high importance. A total of 11 clinical pharmacy services were listed and the medical practitioners and nurses were asked to rate to what extent they felt that it was important for the ward pharmacist to provide these services. The responses from the medical practitioners and nurses to the 11 clinical pharmacy services were calculated as a percentage for each category. Table 4.7 lists the clinical pharmacy services and depicts the percentage distribution across each category for both the medical practitioners and nurses.

The majority of the medical practitioners and nurses felt that all 11 clinical pharmacy services were important, with there being no category one responses which indicate no importance. However, 9% (1; n=11) of the medical practitioners responded that pharmacist participation in ward rounds and antibiotic stewardship was of slight importance while 5% (1; n=21) of the nurses felt that dispensing from the ward was of slight importance. There were a number of category three responses from both the medical practitioners and nurses which indicates that they had a neutral opinion towards the clinical pharmacy service.

A number of the clinical pharmacy services have the largest percentage in category five (see Table 4.7) which indicates that the service was viewed as being of high importance. The largest percentage of the nurse responses were category five for all of the 11 clinical pharmacy services. Conversely, the largest percentage of the medical practitioner responses were category five for only five of the services, with the remaining six services being category four. The clinical pharmacy services that both the medical practitioners and nurses felt were of high importance, prior to the implementation of a ward-based pharmacy service,

included: (1) medication chart review to ensure appropriate dose, (2) detecting medication errors, (3) detecting and reporting adverse drug reactions, (4) monitoring medication outcome, and (5) antibiotic stewardship.

The majority of the medical practitioners and nurses felt that all 11 clinical pharmacy services were important, with there being no category one responses which indicate no importance. However, 9% (1; n=11) of the medical practitioners responded that pharmacist participation in ward rounds and antibiotic stewardship was of slight importance while 5% (1; n=21) of the nurses felt that dispensing from the ward was of slight importance. There were a number of category three responses from both the medical practitioners and nurses which indicates that they had a neutral opinion towards the clinical pharmacy service.

A number of the clinical pharmacy services have the largest percentage in category five (see Table 4.7) which indicates that the service was viewed as being of high importance. The largest percentage of the nurse responses were category five for all of the 11 clinical pharmacy services. Conversely, the largest percentage of the medical practitioner responses were category five for only five of the services, with the remaining six services being category four. The clinical pharmacy services that both the medical practitioners and nurses felt were of high importance, prior to the implementation of a ward-based pharmacy service, included: (1) medication chart review to ensure appropriate dose, (2) detecting medication errors, (3) detecting and reporting adverse drug reactions, (4) monitoring medication outcome, and (5) antibiotic stewardship.

Table 4.7: Medical practitioner (n=11) and nurse (n=21) responses to clinical pharmacy services

Number	Clinical Pharmacy Service	Percentage of Medical Practitioners who Responded					Percentage of Nurses who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	Medication chart review to ensure optimal medication choice	0%	0%	9%	64%	27%	0%	0%	19%	33%	48%
2	Medication chart review to ensure cost-effective treatment	0%	0%	36%	36%	27%	0%	0%	19%	24%	57%
3	Medication chart review to ensure appropriate dose	0%	0%	0%	45%	55%	0%	0%	10%	29%	62%
4	Detecting medication errors	0%	0%	9%	0%	91%	0%	0%	10%	14%	76%
5	Medication counselling	0%	0%	18%	55%	27%	0%	0%	10%	29%	62%
6	Providing a drug information service	0%	0%	9%	64%	27%	0%	0%	5%	24%	71%
7	Dispensing from a computer in the ward instead of from a central pharmacy	0%	0%	36%	36%	27%	0%	5%	14%	24%	57%
8	Detecting and reporting adverse drug reactions	0%	0%	0%	27%	73%	0%	0%	10%	33%	57%
9	Monitoring medication outcome	0%	0%	27%	36%	36%	0%	0%	29%	14%	57%
10	Participation in ward rounds	0%	9%	18%	55%	18%	0%	0%	19%	29%	52%
11	Antibiotic stewardship	0%	9%	0%	36%	55%	0%	0%	5%	14%	81%

4.4. Intervention Phase

4.4.1. Sample and Setting

The intervention phase of the study took place in a 40-bed surgical ward of a private hospital in the Eastern Cape Province of South Africa. There were a total of 106 participants which comprised 34% of the total population (106; n=311) admitted to the surgical ward during the study period. Informed consent had to be obtained from each patient; therefore, a convenience sample was collected. Patients under the age of 18 years and pregnant patients were excluded from the study.

4.4.2. Demographic and Hospital Admission Information

The demographic and hospital admission information of the patient participants were obtained from the closed-ended questions from Section A of the audit form (refer to Appendix 5). The audit form recorded information on the patient's gender, age, allergies, chronic disease states, length of hospital stay, reason for admission and whether a surgical procedure was performed or not. Furthermore, the acute and chronic medication items, together with their doses, frequencies, routes of administration and start and stop dates were documented. Section 4.4.2 will discuss the demographic information of the patients, along with the abovementioned information that was also documented on the audit form.

4.4.2.1. Gender and Age

The ages of the participating patients were grouped according to seven age categories, which included: (1) 18-29 years, (2) 30-39 years, (3) 40-49 years, (4) 50-59 years, (5) 60-69 years, (6) 70-79 years, and (7) 80 or more years. The gender for each patient was also documented as being either female or male.

There were a total of 106 patients who participated in the study, 75% (79; n=106) of whom were female and the remaining 25% (27; n=106) were male. A similar study which was conducted by Bosma, Jansman, Franken, Harting, and Van den Bemt (2008, p. 35) showed a similar distribution of the participants, with 70% being female and 30% being male. Figure 4.3 shows the distribution of the age categories and the percentage of females and males within each category. The average age of all of the patients (n=106) was 47.1 ± 16.5 years

ranging from 18 years to over 80 years. The average age of the females (n=79) was 45 ± 15.9 years and ranged from 18 years to over 80 years, while the average age of the males (n=27) was 53.1 ± 16.9 years ranging from 18 to 76 years. In this study there was no significant difference (p=0.181; Chi^2 test) between the age distribution of the female and male patients.

The largest age group was the 40-49 year category with 26% (28; n=106) of the patients belonging to this group, of which 21% were females and 5% were males. Conversely, the smallest age group was the 80 year or older category with only 2% (2; n=106) of the patients belonging to this group and they were all female patients. The largest percentage of male patients, 8% (8; n=106) were between the ages of 60 and 69 years.

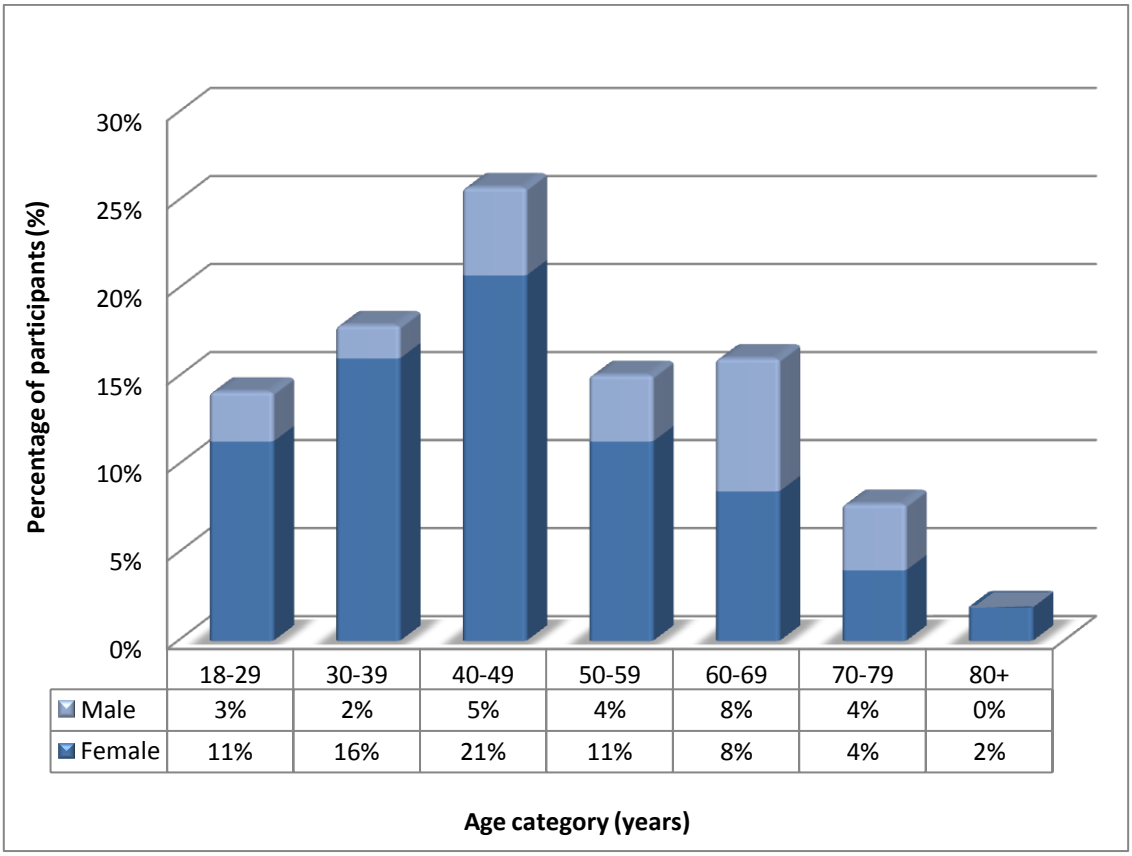

Figure 4.3: Age distribution of participants (n=106)

4.4.2.2. Allergies and Chronic Disease States

The researcher was able to identify patient allergies and chronic disease states through the use of the patients' medication files. Each patient medication file contains information about any patient allergies and chronic disease states

which is provided to the registered nurse by the patient, on admission to the ward. The researcher therefore verbally clarified any ambiguous information with the patient concerned.

The researcher documented the number of patients who had self-reported allergies and the nature of the allergy was also recorded in Section A of the audit form. There were four allergy categories which included: (1) penicillin, (2) opioid, (3) sulphur, and (4) aspirin. The researcher also documented any additional allergies that could not be classified into one of the four categories mentioned above. Table 4.8 outlines the percentage of patients who had zero or more allergies. There were a total of 31 allergies experienced by the 21 patients who reported medication allergies. The percentage of patients who had one or more allergies was 20% (21; n=106) and of these patients, 71% (15; n=21) had only one allergy. Penicillin was the most commonly experienced allergy (52%; 11; n=21) among the patients, followed by an opioid allergy which was found in 14% (3; n=21) of the patients. The allergy category that was least prevalent was an aspirin allergy which was only experienced in 5% (1; n=21) of the patients with allergies. Forty seven percent (47%; 10; n=21) of the patients had allergies that could not be classified into one of the four allergy categories.

Table 4.8: Distribution of patients with allergies (n=106)

Number of Allergies	Percentage of Patients
Zero	80%
One	14%
Two	4%
Three	1%
Four	0%
Five	1%
Total	***100%***

The researcher documented any chronic disease states on the patient's audit form and then the chronic diseases were categorised according to the South African 26 prescribed minimum benefit (PMB) chronic conditions. The Department of Health introduced the PMB conditions as a means of ensuring that patients receive medical treatment from state institutions and private medical insurers for the most prevalent chronic conditions (Board of Healthcare

Funders of Southern Africa, 2014). Table 4.9 represents the percentage of patients who had zero or more chronic diseases, while Figure 4.4 outlines the percentage of patients with chronic diseases according to their age category. More than half of the patients, 54% (57; n=106), had one or more chronic disease states present and 25% (14; n=57) of these patients also had one or more allergies. It was found that 26% (28; n=57) of the patients had been diagnosed with only one chronic disease state; with the maximum number of chronic diseases recorded per patient being four, which was found in 3% (3; n=57) of the patients. Furthermore, a larger percentage of male participants, 56% (15; n=27) had chronic disease state(s) present, in comparison with female participants where 53% (42; n=79) had present.

Table 4.9: Distribution of patients with chronic disease states (n=106)

Number of Chronic Diseases	Percentage of Patients
None	46%
One	26%
Two	15%
Three	9%
Four	3%
Total	***100%***

The number of patients within each age category who had one or more chronic disease states was calculated as a percentage of the total participants (n=106) and is represented in Figure 4.4. There is a direct correlation between the age of the patient and the presence of chronic disease state(s) ($p<0.0005$; Chi^2 test). Figure 4.4 shows that the percentage of participants with chronic disease state(s) increases with an increase in the age category and that all of the patients aged 70 years or older had at least one chronic disease state present.

There were a total of 102 chronic disease states documented for the 57 patients which were classified into 11 different chronic disease state categories (see Figure 4.5). The researcher included two additional chronic disease state categories, namely: depression and dementia, which were not listed in the South African PMB conditions list; however, these conditions are recognised as long term conditions which require chronic medication and lifestyle management.

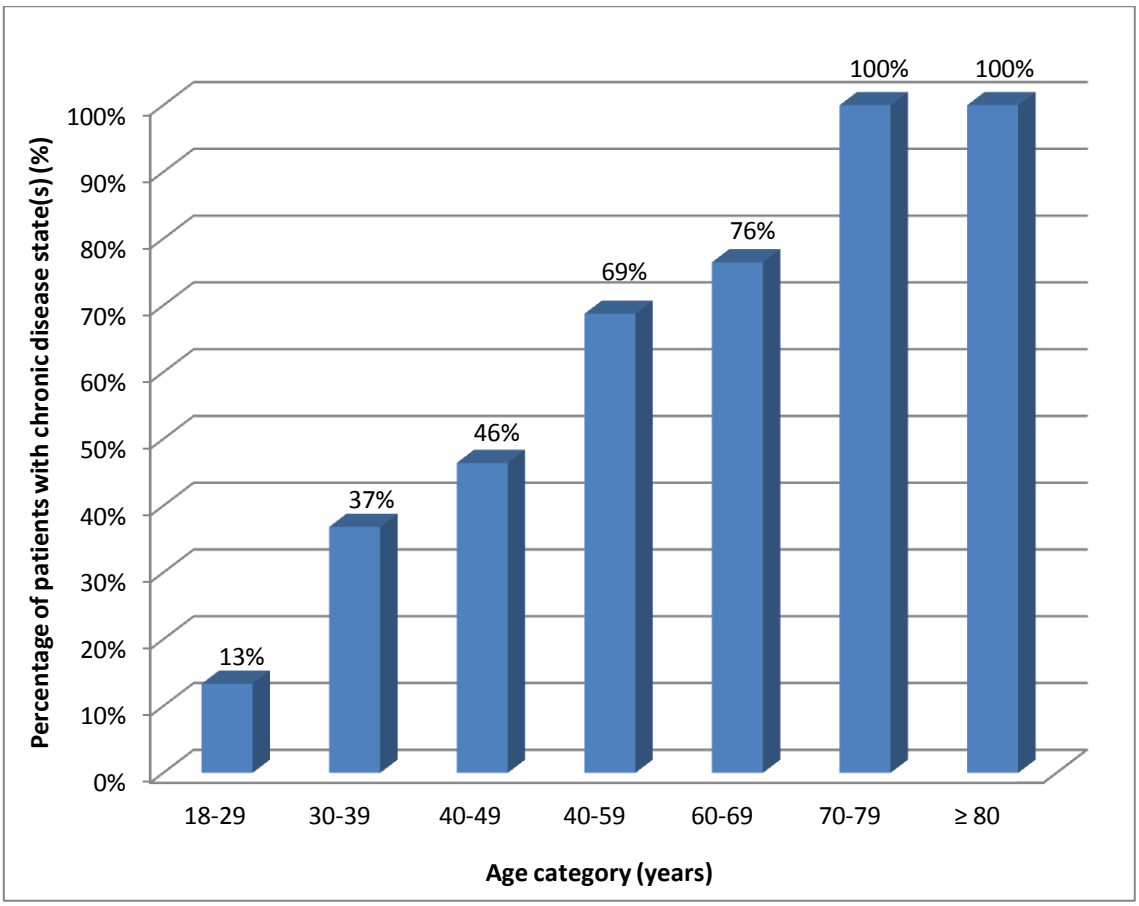

Figure 4.4: Age distribution of participants with chronic disease state(s) (n=106)

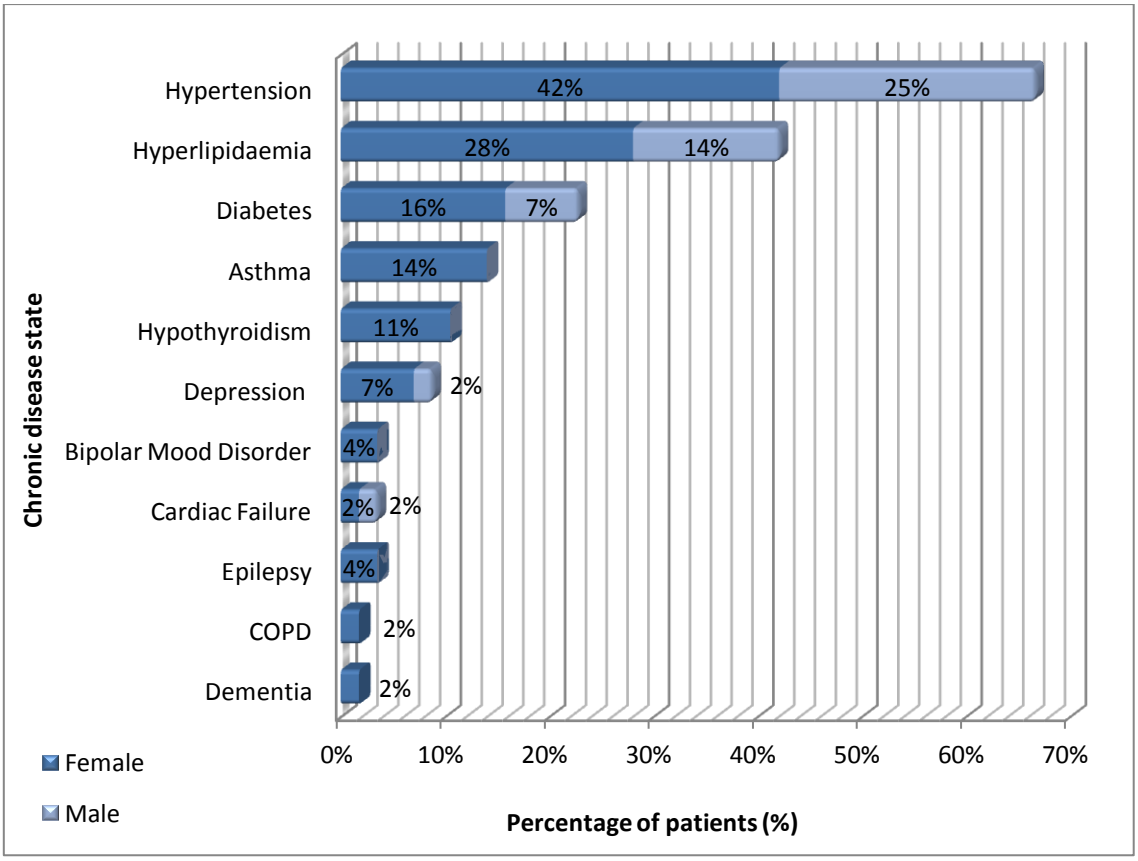

Figure 4.5: Percentage distribution of chronic disease states (n=57)

As depicted in Figure 4.5, hypertension was the most prevalent chronic disease state affecting 67% (38; n=57) of the patients, with the majority (42%; 24; n=57) of the patients being female. Furthermore, it can be seen from Table 4.10 that a large percentage of patients with hypertension were between 40 and 79 years of age. The second and third most prevalent chronic disease states were hyperlipidaemia and diabetes mellitus which were present in 42% (24; n=57) and 23% (13; n=57) of the patients, respectively. Sixty seven percent (16; n=24) of the patients with hyperlipidaemia were females and the majority of the patients with the condition were between the age of 50 and 79 years. A large percentage (69%; 9; n=13) of the patients with diabetes were female and the ages of the patients with the condition ranged from 18 to 79 years of age. Chronic obstructive pulmonary disease (COPD) and dementia were the least prevalent chronic disease states which were each observed in 2% (1; n=57) of the patients. In this study there was no significant relationship ($p=0.830$; Chi^2 test) between female and male patients with regards to the presence of chronic disease states.

Overall, it can be seen from Table 4.10 that the majority of the patients with chronic conditions were aged between 40 and 79 years, with the largest percentage of patients being 40 to 49 years old and 60 to 69 years old. However, the incidence of chronic disease state(s) being present, increased with the age of the patient (see Figure 4.4) and the relationship between the patient's age and the presence of chronic disease states was found to be highly significant ($p<0.0005$; Chi^2 test).

Table 4.10: Distribution of chronic disease states according to patient age (n=57)

Chronic Disease State	**18-29 years**	**30-39 years**	**40-49 years**	**50-59 years**	**60-69 years**	**70-79 years**	**≥ 80 years**	***Total per Disease State***
Dementia	0%	0%	0%	0%	0%	0%	2%	***2%***
COPD	0%	0%	0%	0%	2%	0%	0%	***2%***
Epilepsy	0%	0%	4%	0%	0%	0%	0%	***4%***
Cardiac Failure	0%	2%	0%	0%	0%	2%	0%	***4%***
Bipolar Mood Disorder	0%	0%	2%	2%	0%	0%	0%	***4%***
Depression	0%	2%	2%	4%	2%	0%	0%	***9%***
Hypothyroidism	0%	0%	5%	2%	2%	0%	2%	***11%***
Asthma	4%	7%	4%	0%	0%	0%	0%	***14%***
Diabetes	2%	2%	4%	4%	5%	7%	0%	***23%***
Hyperlipidaemia	0%	2%	5%	11%	12%	11%	2%	***42%***
Hypertension	2%	0%	18%	11%	19%	14%	4%	***67%***
***Total per Age* Category**	***7%***	***14%***	***42%***	***32%***	***42%***	***33%***	***9%***	

4.4.2.3. Length of Hospital Stay and Reason for Admission

Section A of the audit form recorded the admission and discharge date for each patient. Additionally, it allowed the researcher to document the patient's reason for admission and whether a surgical procedure was performed. The average length of hospital stay for the participants was 5.10 ± 3.29 days (n=106), with the minimum length of stay being one day and the maximum being 21 days. The majority, 70% (74; n=106), of the patients had a hospital stay ranging from three to seven days. The average length of stay for patients undergoing surgical procedures was 5.21 ± 3.68 days, while for patient's not undergoing surgery it was 4.82 ± 1.85 days. The results therefore show that patients undergoing surgical procedures had a slightly longer average length of hospital stay in comparison to those who did not have a surgical procedure performed.

The reason for each patient's hospital admission, once documented, was categorised according to the twelve major systems in the human body (The Merck Manual of Medical Information, 2009). Table 4.11 represents the percentage of hospital admissions and surgical procedures related to each body system. The majority, 40% (40; n=106), of the hospital admissions were related

to the female reproductive system; however, females did comprise 75% (n=106) of the total number of patients. The second most prevalent reason for hospital admission were patients with a condition related to the digestive system which occurred in 24% (25; n=106) of the patients.

In total, there were surgical procedures performed in 74% (78; n=106) of the patients, with the majority (26%; 20; n=78) of these patients being between 40 and 49 years of age. The percentage of female and male participants who underwent surgery was very similar, being 73% (58; n=78) and 74% (20; n=27), respectively. The majority of the surgical procedures (41%; 32; n=78) were related to the female reproductive system, however, females did comprise 74% (58; n=78) of the patients who had surgery. Twenty-two percent (17; n=78) of surgical procedures were related to the digestive system. There were no admissions or surgical procedures which were related to the lymphatic, muscular or respiratory body systems.

Table 4.11: Distribution of hospital admissions (n=106) and surgical procedures (n=78) relative to the body systems

Body System	Percentage of Related Admissions	Percentage of Surgical Procedures
Female Reproductive System	40%	41%
Digestive	24%	22%
Skeletal	14%	17%
Integumentary	9%	9%
Urinary	7%	6%
Cardiovascular	3%	1%
Nervous	2%	1%
Endocrine	1%	1%
Male Reproductive System	1%	1%
Lymphatic	0%	0%
Muscular	0%	0%
Respiratory	0%	0%
Total	***100%***	***100%***

4.4.2.4. Acute and Chronic Medications

The acute and chronic medication items for each patient were recorded and the following information was documented by the researcher: (1) medication name, (2) prescribed dose, (3) route of administration, (4) frequency, (5) date that

treatment was commenced, and (6) date that treatment was discontinued. Table 4.12 shows the distribution of the number of acute and chronic medication items prescribed. The results showed that all of the patients (100%; n=106) received acute medication during their hospital stay with 776 medication items being prescribed in total. In addition, 54% (57; n=106) of the patients were also on chronic medication, however, 13 (23%; n=57) of these patients were uncertain of the names or classes of their chronic treatment(s). The researcher could therefore not document the chronic medication items for these 13 patients. There were a total of 147 medication items prescribed for the treatment of the chronic disease states in the 44 (77%; n=57) patients and the distribution is represented in Table 4.12.

Table 4.12: Distribution of the number of acute and chronic medication items prescribed (n=106)

Number of medication items prescribed	Acute medication: percentage of patients	Chronic medication: percentage of patients
0	0%	58%
1	1%	14%
2	8%	10%
3	5%	3%
4	8%	3%
5	10%	2%
6	11%	1%
7	6%	4%
8	16%	3%
9	8%	0%
10	9%	1%
11	8%	1%
12	2%	0%
13	4%	0%
14	2%	0%
15	2%	0%

The most commonly prescribed acute medication class was the analgesics, while the anti-hypertensives were the most commonly prescribed chronic medication class. The average number of acute medication items per patient was 7.32 ± 3.29 and the average number of chronic medication items per patient was 3.32 ± 2.80, with the maximum number of medication items per

patient being 15 and 11 for acute and chronic medications, respectively. However, the average number of items for patients on both acute and chronic medications was 8.71 ± 4.27 with one item being the minimum and 21 items being the maximum. The majority of patients (16%; 17; n=106) received a total of eight acute medication items during their hospital stay.

4.4.3. Pharmacist Interventions

The researcher, working as a ward pharmacist in the study ward, documented all interventions made during the study period. The interventions were recorded in Section C of the intervention form (see Appendix 5) and the following information was documented: (1) number of interventions, (2) intervention pertaining to acute or chronic medication, (3) who the intervention was directed at, (4) brief description of the intervention, (5) medication classes involved, (6) method via which the intervention was made, (6) whether the intervention was accepted or ignored, (7) approximate time taken to make the intervention, (8) cost-saving benefit, (9) level of the intervention, (10) perceived benefit of the intervention, and (11) medication intervention categories and sub-categories. The researcher made one or more interventions in 50% (53; n=106) of the participants who were admitted to the ward during the study with the average number of interventions per patient admitted being 0.82 ± 0.99. Furthermore, 66% (35; n=53) of these patients had undergone a surgical procedure. A similar study done by Neville *et al.* (2014, p. 218) in a surgical ward showed that there were clinical pharmacy interventions made in 66.4% of the patients.

4.4.3.1. Frequency and Distribution of Pharmacist Interventions

There were a total of 87 interventions made in the 53 patients during the study period and the researcher investigated whether certain patients were at an increased risk for an intervention. The average number of interventions made per patient requiring an intervention was 1.64 ± 0.79 with the maximum number of interventions per patient being four. The majority of these patients, 53% (46; n=87) had two interventions during their hospitalisation in the surgical ward. Furthermore, the majority (47%; 33; n=70) of patients who had interventions pertaining to acute medications had two interventions, while patients with chronic medication interventions mostly (47%; 8; n=17) had one intervention.

Figure 4.6 shows the distribution of the interventions pertaining to acute and chronic medications which is further categorised according to the number of interventions per patient. The average number of interventions per patient that pertained to acute medication was 1.28 ± 0.86 compared with chronic medications which had an average number of interventions of 0.32 ± 0.47. The majority (80%; 70; n=87) of the interventions were related to acute medications with the remaining 20% (17; n=87) applied to chronic medications. However, as reported in Section 4.4.2.4, the average number of acute medication items per patient was higher than the average number of chronic items. The relationship between the number of acute medication items and an intervention being required was found to be highly significant ($p=0.001$; Chi^2 test; $p<0.0005$ Student's t-test) and a similar relationship was seen with chronic medication items ($p=0.018$; Chi^2 test; $p=0.002$ Student's t-test). Overall, the relationship for the number of acute and chronic medication items was found to have a highly significant relationship ($p=0.001$; Chi^2 test; $p<0.0005$ Student's t-test) with an intervention being required. We can therefore conclude that an increase in acute or chronic medication items placed the patient at an increased risk for an intervention.

The average length of hospital stay for patients who required medication interventions was much longer than for the patients who did not require interventions, with the average length of stay being 6.75 ± 3.82 days and 3.45 ± 1.34 days, respectively. The relationship between the length of hospital stay and an intervention being required was found to be highly significant ($p<0.0005$; Chi^2 test and Student's t-test). Therefore, we can conclude that an increase in length of hospital stay increased the likelihood of a medication intervention being required.

A total of 66% (35; n=53) of the patients who required an intervention had undergone a surgical procedure. There was no significant ($p=0.078$; Chi^2 test) relationship between patients undergoing surgical procedures and an intervention being required. This finding contrasts with other studies which have demonstrated that patients undergoing a surgical procedure are at an increased

risk for medication errors (de Boer *et al.*, 2011, p. 2); however this was not a significant finding in this study.

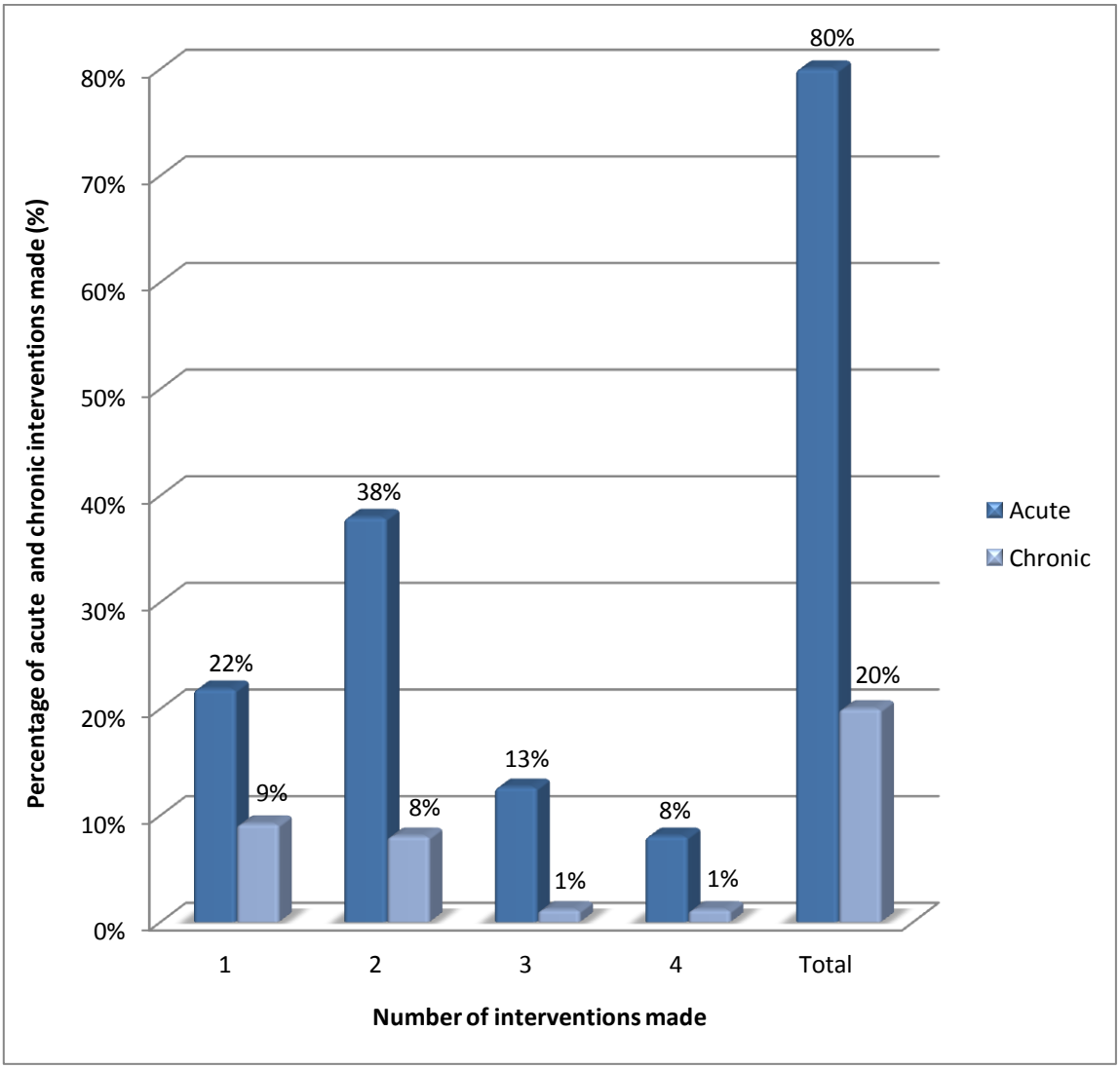

Figure 4.6: Distribution of interventions pertaining to acute and chronic medications (n=87)

The majority, 68% (36; n=53) of patients requiring an intervention had one or more chronic disease states present. There was a significant relationship (p=0.003; Chi² test) between the presence of chronic disease states and an intervention being required. We can therefore conclude that patients with chronic disease states were at an increased risk for an intervention. Twenty eight percent (28%; 15; n=53) of patients requiring an intervention had one or more allergies present. In this study there was a significant relationship (p=0.028; Chi² test) between patients with allergies and an intervention being required. There were 12 patients (23%; n=53) who required an intervention who

had both one or more allergies and at least one chronic disease state present. The relationship between allergies and chronic disease states and an intervention being required was found to be highly significant (p=0.001; Chi^2 test).

The researcher documented whether the intervention was directed at the medical practitioner, nurse or patient. A fourth category was included for any other person that the intervention may have been directed at, which included pharmacists or any other healthcare professionals. The percentage of interventions within each category was calculated and the results showed that overall, 93% (81; n=87) of the interventions were directed at the medical practitioners and nurses, with a comparable percentage of 48% (42; n=87) for the medical practitioners and 45% (39; n=87) for the nurses. The remaining 7% (6; n=87) of the interventions were directed at the patient and the "other" category. It was found that 2% (2; n=87) of the interventions in the "other" category were both directed at a pharmacist.

4.4.3.2. Medication Class Interventions

The medication items involved in the pharmacist interventions were classified according to 25 medication classes, which were based on the medication class classification used in a study done by Kannan, Janardhan, Rani *et al.* (2011, p. 1468). There were a total of 87 pharmacist interventions, involving 101 medication items that were each categorised into one of the appropriate medication classes. Figure 4.7 shows the percentage of interventions made within each medication class.

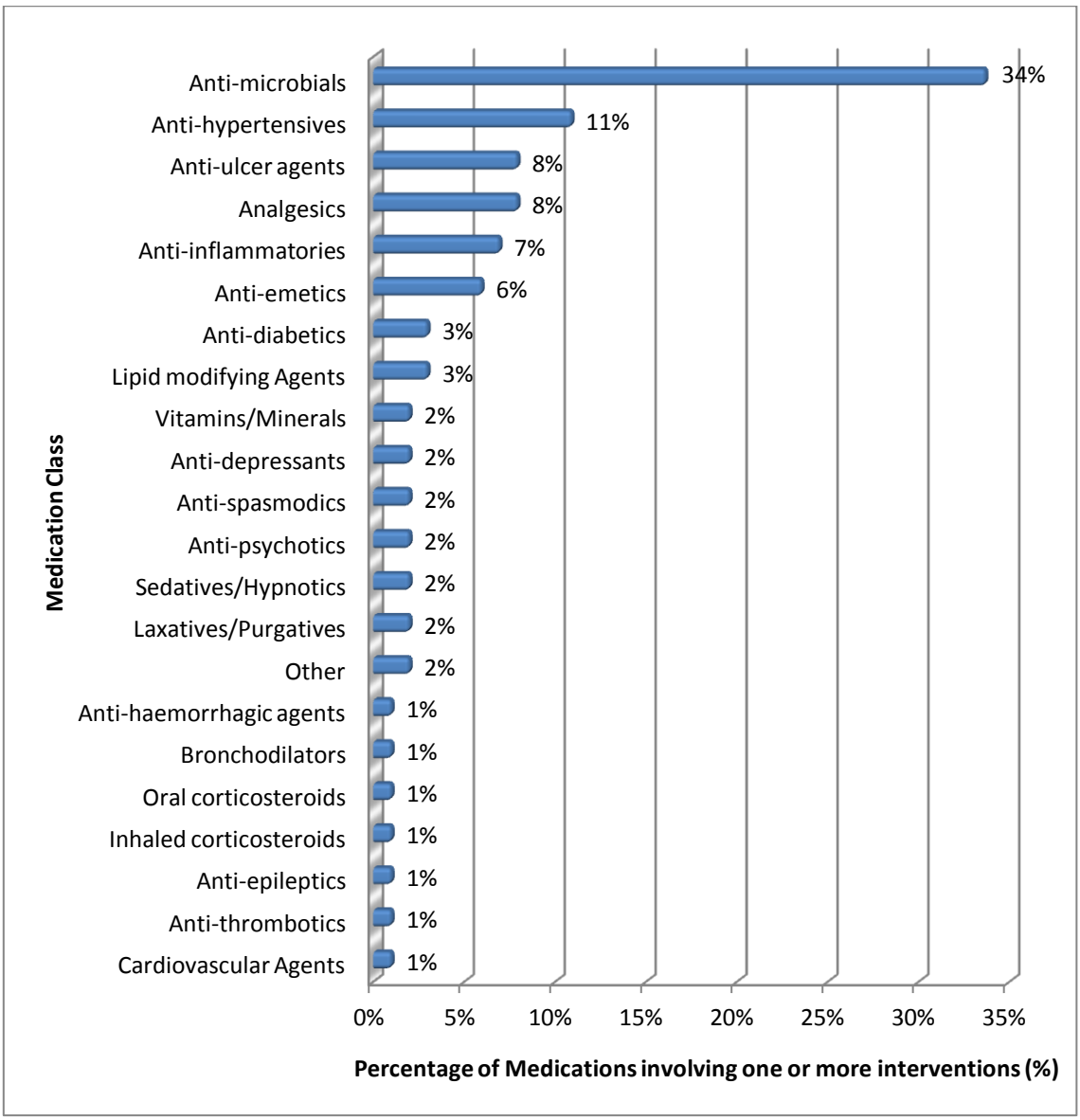

Figure 4.7: Percentage of interventions per medication class (n=101)

The greatest percentage, 34% (34; n=101) of the medication items involved in the interventions, were related to the anti-microbial drug class. A similar result was obtained in a study done by Vessal (2010, p. 63) in a nephrology ward where 38% of the pharmacist interventions were related to the anti-microbial medication class. The abovementioned results were expected in this study due to the fact that the majority of the patients (74%) had surgical procedures performed and anti-microbial agents are commonly prescribed for surgical patients, either as prophylaxis to prevent an infection or as empiric therapy to treat a surgical site infection (SSI). According to the Centres for Disease Control and Prevention (CDC) there are about 500 000 SSI's in the US annually. (Salkind & Rao, 2011, p. 585). Studies have shown that SSI's are responsible

for about 20% of all healthcare infections and occur in at least 5% of patients undergoing surgery (Child *et al.*, 2011, p. 156). A SSI can result in an increased length of hospital stay, increased healthcare costs and it also affects the patient's quality of life, therefore, surgeons are likely to prescribe anti-microbial agents for patients undergoing surgical procedures. (Salkind & Rao, 2011, p. 585)

The anti-hypertensive medication class was the second most commonly encountered class and accounted for 11% (11; n=101) of the medication items involved in the interventions. The number of interventions in this medication class could be due to 66% (35; n=53) of the intervention patients being on chronic medication(s) for one or more conditions. Furthermore, as mentioned previously, hypertension was identified as the most prevalent chronic disease state (see Figure 4.5) and the anti-hypertensive medication class was the most commonly prescribed chronic medication class (Section 4.4.2.4). A study done by Lucca, Ramesh, Narahari, and Minaz (2012, p. 245) in an ICU obtained a similar result whereby the anti-hypertensive medication class accounted for 14% of the medication classes involved in the pharmacist interventions.

Surgical patients are often on a number of medication items post-operatively. Non-steroidal anti-inflammatory drugs (NSAIDs) in particular are commonly prescribed post-operatively and these may place patients at an increased risk of gastric irritation or potentially peptic ulcer disease (Kalyanakrishnan & Salinas, 2007, pp. 1005-1006). This may explain why anti-ulcer agents were commonly prescribed and accounted for 8% (8; n=101) of the pharmacist interventions that were made.

Anti-inflammatory agents and analgesics are also widely used in a surgical ward for post-operative pain control and these medication classes accounted for 7% (7; n=101) and 8% (8; n=101) of the interventions, respectively. As mentioned in Section 4.4.2.4, the analgesics were the most commonly prescribed acute medication class for the participants. Studies have shown that post-operative pain control can increase recovery time, reduce length of hospital stay and decrease healthcare costs (James, 2013, pp. 1-2). Thus, anaesthetists are

likely to prescribe one or more pain medication items for each patient to ensure that there is adequate pain control.

The anti-emetic medication class accounted for 6% (6; n=101) of the interventions, which could be due to the fact that these agents are routinely prescribed in surgical patients for the treatment of post-operative nausea and vomiting (PONV). Post-operatively, the incidence of nausea and vomiting is about 50% and 30%, respectively. Studies have shown that prophylactic management with anti-emetics can reduce the length of hospital stay and decrease healthcare costs. (Gan, Diemunsch, Habib *et al.*, 2014, pp. 85-86)

There were 2% (2; n=101) of interventions that were related to the "other" medication class which included thyroid medication and hormonal replacement therapy. Furthermore, there were no interventions made in four of the medication classes which included: (1) anti-diarrhoeals, (2) anti-parkinsonian agents, (3) anti-histamines, and (4) anti-malarials.

Overall, the increased number of interventions in the abovementioned medication classes could be attributed to the fact that 66% (35; n=53) of the patients with interventions had undergone a surgical procedure during their hospitalisation.

4.4.3.3. Pharmacist Intervention Communication Methods

The method via which the ward pharmacist made each intervention was documented. Three different methods of communication were employed which included: (1) pharmacist suggestion form that was developed by the researcher (see Appendix 6), (2) telephonic conversation and (3) direct face-to-face conversation. The majority, 54% (47; n=87) of the interventions were made by means of direct face-to-face conversation. The researcher was present in the ward which enabled the majority of the interventions to be communicated via direct conversation with the person concerned. The second most commonly used method was the pharmacist suggestion form which accounted for 39% (34; n=87) of the interventions. The pharmacist suggestion form was only utilised for queries that were not urgent, such as recommending the discontinuation of a drug or requesting laboratory results. Any pharmacist

recommendations were also communicated via the pharmacist suggestion form. The researcher followed up daily, on weekdays, on all pharmacist suggestion forms that were placed in the patient's medication files. Telephonic conversation was the method least used, with 7% (6; n=87) of the interventions being communicated via this method. Telephonic conversation was used for all urgent queries where the person concerned was not available in the ward at the time. The pharmacist encountered a number of urgent queries during the study which included, for example, queries regarding the incorrect medication dose or frequency being prescribed or the initiation of medication being required.

4.4.3.4. Pharmacist Intervention Acceptance Rate

The acceptance rate of each pharmacist intervention was documented on the intervention form as being accepted, acknowledged or ignored. An intervention was considered to be accepted if the pharmacist made a suggestion and the change was implemented, however, if the change was not implemented then it was considered to be ignored. Certain medication errors occurred but they could not be corrected, however, measures could be put into place to prevent the re-occurrence of such errors. In these situations, the pharmacist informed the person concerned about the error and the intervention was considered acknowledged once the corrective measures were put into place.

There were a total of 41% (36; n=87) of the interventions that were accepted, 44% (38; n=87) were acknowledged and the remaining 15% (13; n=87) were ignored. However, overall, there was a 73% (36; n=49) acceptance rate for the suggestions that were made by the pharmacist. The acceptance rate for this study was slightly lower than that observed in a similar study done by Bosma *et al.* (2008, p. 36) in a surgical ward, which had an 82% acceptance rate. In the abovementioned study, the pharmacist had not undergone clinical pharmacy training, similarly to the researcher, and was practicing as a ward-based pharmacist. However, in studies where the pharmacists had undergone clinical pharmacy training, the acceptance rate appeared to be even greater. For example, a study done by Saddique (2012, p. 274) showed that the pharmacist's suggestions had an acceptance rate of 86% in a medical ward, which was similar to the 85.5% observed by Langebrake and Hilgarth (2010, p. 198) in a study conducted in an ICU and stem cell unit. Furthermore, a

systematic review, which was carried out by Graabaek and Kjeldsen (2013, p. 361) in 2011, evaluated studies from 1992-2011 which had investigated the impact of a pharmacist providing clinical pharmacy services. There were a total of 31 studies which were included in the review and the results showed that the acceptance rate of pharmacist interventions ranged from 39% to 100%, however, more than half of the studies reported an acceptance rate of 69% with four of these having 100% acceptance rates. Figure 4.8 shows the distribution of the interventions that were accepted, acknowledged or ignored, which have been classified according to the person who the intervention was directed at.

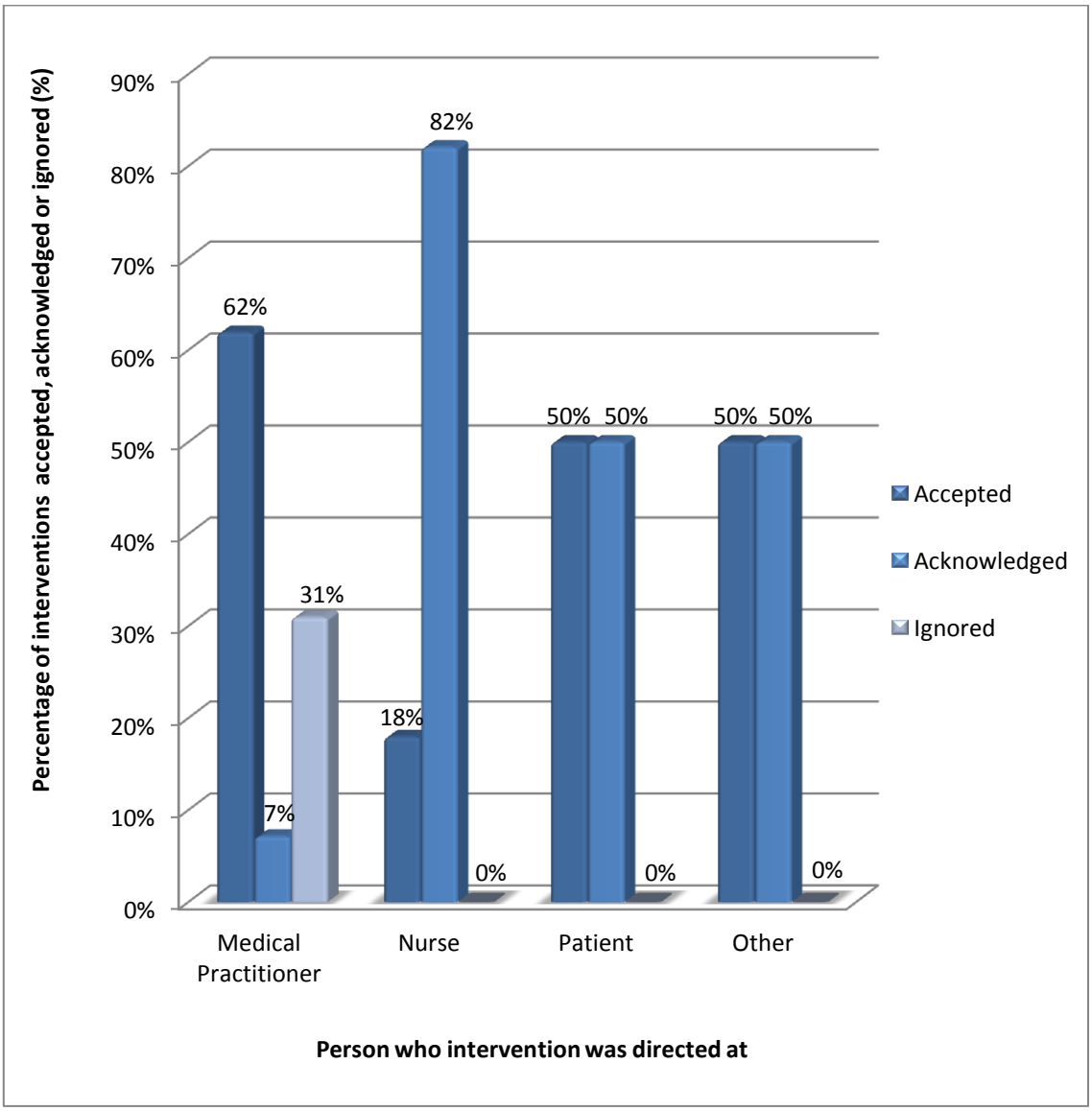

Figure 4.8: Distribution of interventions that were accepted, acknowledge or ignored (n=87)

Interventions made via telephonic conversation had the highest acceptance rate (83%; 5; n=6), followed by the pharmacist suggestion form (59%; 20; n=34). Overall, 48% (42; n=87) of the total interventions were directed at the medical practitioners, of which 62% (26; n=42) were accepted, 31% (13; n=42) were ignored and 7% (3; n=42) were acknowledged (see Figure 4.8). Therefore overall, the medical practitioners accepted 66% (26; n=39) of the pharmacist's suggestions, which was higher than that observed in a similar study done by Zaal, Jansen, Duisenberg-van Essenberg *et al.* (2013, p. 755) in a surgical ward, where there was a 56% acceptance rate by the physicians. On the other hand, the nursing interventions comprised 45% (39; n=87) of all of the interventions, of which 18% (7; n=39) were accepted, 82% (32; n=39) were acknowledged and there were no interventions that were ignored. Therefore, the nurses accepted all (100%; n=7) of the suggestions that were made by the researcher. The remaining 7% of the interventions were directed at the patient and "other" category and there was a 50% acceptance rate in both of these categories with the remaining 50% being acknowledged. There were no suggestions made by the ward pharmacist that were ignored, resulting in a 100% acceptance rate for the patient and "other" category.

4.4.3.5. Average Time Taken for Interventions

The approximate time taken to make the interventions pertaining to each patient was documented. The researcher would record the time from when the problem was identified to when the intervention was made. There were four time categories on the intervention form which were as follows: (1) 0-4 minutes, (2) 5-15 minutes, (3) 16-29 minutes, and (4) longer than 30 minutes.

The researcher documented the time taken per intervention and these amounts would be added if there was more than one intervention made per patient. Once all of the times were calculated, the researcher selected the appropriate time category for each patient. Figure 4.9 depicts the time categories and the percentage of patients whose interventions fell into each category. The majority, 72% (38; n=53) of the interventions took the ward pharmacist 5-15 minutes per patient, which is similar to the results shown in a similar study done by Saddique (2012, p. 274) where the average time was 9.59 minutes per patient. There were a total of 6% (3; n=53) in the 0-4 minute category and 23% (12;

n=53) fell in the 16-29 minute category. There were no recorded interventions that took longer than 30 minutes. Similar results were also observed in a study done by Lucca *et al.* (2012, p. 245) which showed that the average time was 14.17 minutes per intervention and the minimum time spent per intervention was four minutes with the maximum being 42 minutes.

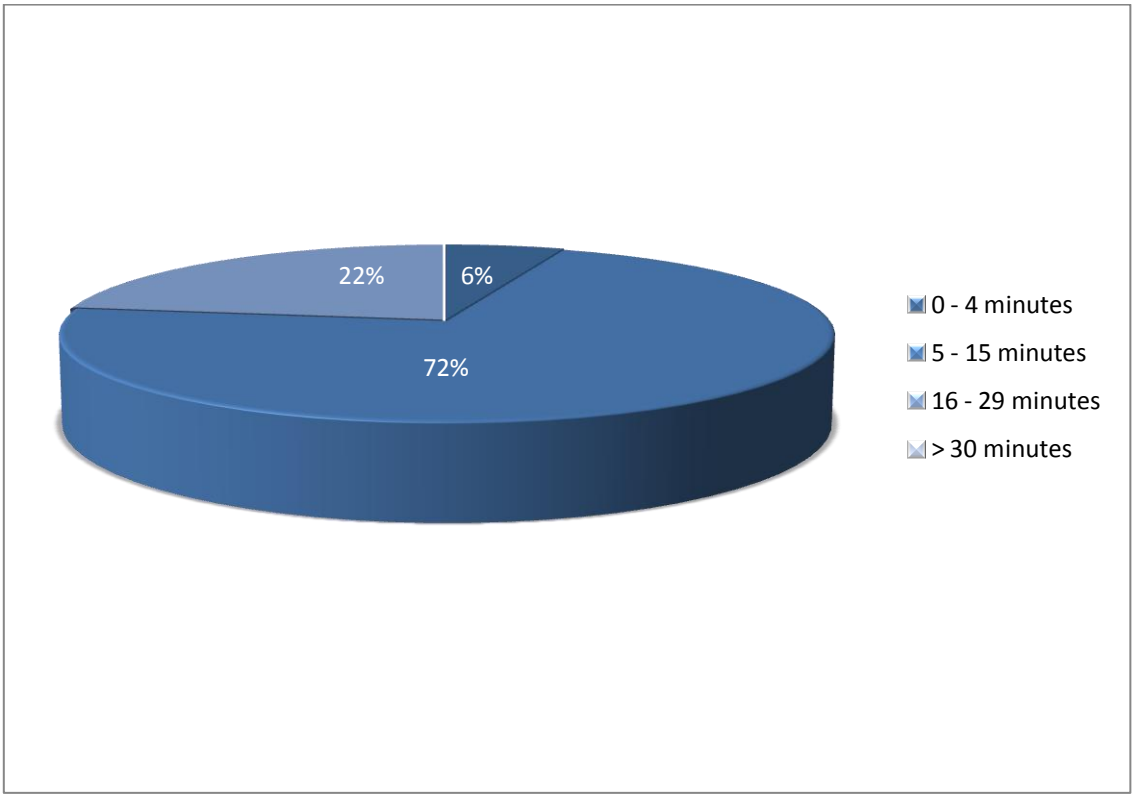

Figure 4.9: Approximate time taken to make interventions (n=53)

4.4.3.6. Cost-saving Benefit for Interventions

The researcher documented any cost-saving benefits for the interventions that were made, however, an in-depth cost-benefit analysis was not conducted. There are no standardised criteria for determining the cost-effectiveness of clinical pharmacy services which makes it complex to measure (de Boer *et al.*, 2011, p. 60). However, the benefits of a clinical pharmacist in reducing healthcare costs have been well documented using different methods and criteria. The intervention form was used to document whether the intervention had an impact on cost and whether it was a positive or negative effect. There were four categories on the form which could have attributed to the cost-saving benefit and these categories included: (1) medication discontinued, (2) intravenous to oral switch, (3) formulary compliance, and (4) generic

substitution. Any additional reason for the cost-saving was documented under a fifth category as “other”.

There were 21 interventions made by the ward pharmacist, involving 17 (32%; n=53) of the patients which showed a cost-saving benefit that was similar to the results shown in a study done by (Saddique, 2012, p. 274) which showed a cost-saving benefit in 23% of the patients. The most common reason for the cost-saving benefit was medication being discontinued, followed by intravenous to oral switch which accounted for 57% (12; n=21) and 29% (6; n=21), respectively.

4.4.4. Classification of Pharmacist Interventions

4.4.4.1. Pharmacist Intervention Categories

All of the interventions were pharmacist-initiated and once documented they were classified according to the type of intervention (see Appendix 5, Section D). The classification method described by Vessal (2010, pp. 59-60) was used to categorise the interventions that were caused by medication errors. These categories include: (1) prescribing errors, (2) transcribing errors, (3) dispensing errors and (4) administration errors. Furthermore, the researcher made a number of interventions that were not due to medication errors but rather pharmacist-initiated interventions which assisted in the optimisation of patient care. All of the interventions were therefore classified as either being a medication error intervention or an intervention to optimise patient care.

There were a total of 87 pharmacist interventions, the majority of which, namely: 57% (50; n=87), were to optimise patient care. The remaining 43% (37; n=87) were medication error interventions which were categorised into the appropriate medication error category. According to Keers *et al.* (2013, p. 1046), the most common errors occur at the stage where prescribing and drug administration take place. The results showed that prescribing errors accounted for 51% (19; n=37) of the medication error interventions, followed by administration errors which were found to be 35% (13; n=37). The remaining interventions were transcribing and dispensing errors which accounted for 8% (3; n=37) and 6% (2; n=37), respectively. The medication error category with the highest acceptance rate related to transcribing errors, followed by prescribing errors.

4.4.4.2. Pharmacist Intervention Sub-Categories

Interventions to optimise patient care and the four medication error categories were further classified into sub-categories, which described the type of intervention that was made within the category. Table 4.13 summarises the intervention categories and the distribution of interventions within each sub-category.

Table 4.13: Classification of pharmacist-initiated interventions (n=87)

Pharmacist-initiated Intervention Category and Sub-categories	Number of Interventions	Percentage (%)
Optimising Patient Care	**n=50**	
Advised on therapeutic drug level monitoring	0	0%
Adverse drug event noted and reported	0	0%
Drug-drug interaction identified	1	2%
Identification and resolution of medication-induced effects experienced or reported by the patient	0	0%
Switching to generic/cheaper alternative	0	0%
Switching from IV to oral medication	6	12%
Recommendation for medication to be initiated	2	4%
Recommendation for medication to be discontinued	3	6%
Counselling/provision of medicine information to a medical practitioner	1	2%
Counselling/provision of medicine information to nursing staff	3	6%
Counselling/provision of medicine information to a patient	0	0%
Assisting with patient adherence for chronic medication	12	24%
Identification of antibiotic hang time on day 1 of treatment (not administered within 60 minutes from prescribing)	18	36%
Laboratory results required	3	6%
Laboratory results requested	0	0%
Other (For example: double-antimicrobial cover)	1	2%

Pharmacist-initiated Intervention Category and Sub-categories	Number of Interventions	Percentage (%)
Prescribing Errors	**n=19**	
Incorrect drug prescribed for indication	1	5%
Sub-therapeutic dose prescribed	0	0%
Dosage too high	1	5%
Dosage adjustment required for renal failure or liver impairment	0	0%
Incorrect frequency prescribed	4	21%
Inappropriate dosage form	0	0%
Incorrect route of administration	0	0%
Unnecessary drug use	0	0%
Duplication of therapy	9	47%
Contraindication for the medication	0	0%
Patient allergic to medication	2	11%

Potential adverse drug-drug interaction between medications prescribed	0	0%
Other (For example: dosage omitted from prescription)	2	11%

Pharmacist-initiated Intervention Category and Sub-categories	Number of Interventions	Percentage (%)
Transcribing Errors	**n=3**	
Omission of medication	1	33%
Incorrectly transcribed from original prescription	0	0%
Telephonic order taken incorrectly	1	33%
Prescription not legal	1	33%
Other (For example: medication being accidentally stopped by nursing staff without prescribers instruction)	0	0%

Pharmacist-initiated Intervention Category and Sub-categories	Number of Interventions	Percentage (%)
Dispensing Errors	**n=2**	
Incorrect medication dispensed	1	50%
Medication charged to incorrect patient	1	50%
Incorrect directions for use on medication	0	0%
Incorrect or omitted storage/stability instructions on label	0	0%
Other (For example: Total parenteral nutrition or specialised feeds issued incorrectly)	0	0%

Pharmacist-initiated Intervention Category and Sub-categories	Number of Interventions	Percentage (%)
Administration Errors	**n=13**	
Incorrect time of administration	1	8%
Incorrect medication administered	0	0%
Incorrect administration technique	0	0%
Administered dose too high	0	0%
Administered dose too low	1	8%
Incorrect route of administration	0	0%
Missed dose	6	46%
Stability of medication affected when administered	0	0%
Duration of treatment longer than prescribed	3	23%
Duration of treatment shorter than prescribed	0	0%
Other (For example: delay in commencing with prescribed medication after admission)	2	15%

The most common intervention which assisted in optimising patient care was the identification of non-compliance regarding antibiotic hang time, which accounted for 36% (12; n=50) of the interventions in this category. At the time of the study, the private hospital group had rolled out an antibiotic stewardship program and selected antibiotic hang time as one of the focus areas. A study done by Kumar, Roberts, Wood *et al.* (2006, pp. 1593-1594) showed that early administration of anti-microbial treatment in a patient with septic shock can

result in a decreased mortality rate. The results from the study showed that a patient's mortality rate decreases by an average of 7.6% for each hour that anti-microbial treatment was delayed, starting from the onset of septic shock-related hypotension (Kumar *et al.*, 2006, pp. 1593-1594). International guidelines recommend that appropriate empirical broad-spectrum anti-microbial treatment is commenced within the first hour from the onset of severe sepsis or septic shock (Kumar *et al.*, 2006, pp. 1593-1594). The selected hospital had a number of hang time projects being carried out, both prior to and during the course of the study, however, these projects had not been implemented yet in the study ward. The researcher, working as a ward pharmacist, was involved with these projects and thus, antibiotic hang time was closely monitored in the selected ward during the study period.

The second most common intervention which contributed to optimising patient care was assisting with adherence with regards chronic medication, which accounted for 24% (12; n=50) of the interventions. Interventions were made in 50% (53; n=106) of the patients in the study ward, of which 68% (36; n=53) had one or more chronic disease states and were on medication(s) to manage their condition/s. Studies have shown that pharmacists have an important role to play in medication management, particularly in assisting with adherence to chronic medication (Wood, 2012, p. 4). As part of the implemented ward pharmacy service, the researcher monitored whether patients were receiving their chronic medication(s) during their hospital stay. The researcher intervened, where appropriate, to improve compliance with chronic medication to prevent possible complications and increased healthcare costs. The interventions pertaining to non-compliance of chronic medication were mostly due to two reasons: (1) patient did not bring their chronic medication(s) to the hospital and these items were also not prescribed on admission, and (2) patients brought in chronic medication, but the items were not prescribed on the hospital medication charts.

Forty seven percent (9; n=19) of the prescribing errors were due to duplication of therapy, while the incorrect prescribed frequency was the second most common prescribing error which accounted for 21% (4; n=19) of the interventions in this category. The majority of the prescribing errors were related to the anti-emetic and anti-microbial medication classes which each accounted

for 26% (5; n=19) of these errors. The most frequent administration error was due to a missed medication dose, followed by the duration of treatment being longer than prescribed, which accounted for 46% (6; n=13) and 23% (3; n=13), respectively. There were three types of transcribing errors recorded which each occurred, once (33.3%; n=3) and included: (1) omission of medication, (2) telephonic order taken incorrectly, and (3) illegal prescription. There were two types of dispensing errors recorded once (50%; n=2) and included the incorrect medication being dispensed and medication charged to the incorrect patient.

4.4.5. Clinical Significance of Pharmacist Interventions

4.4.5.1. Level of Pharmacist Intervention

Pharmacist interventions can be evaluated by rating the interventions according to their clinical significance (Smith, 2000, p. 67). A review article by Smith (2000, p. 67) described a pharmaceutical intervention scoring classification and the implemention of such a system. A six-point scoring system, described by Smith (2000, p. 67) and used in previous studies conducted by ward pharmacists, was therefore employed to evaluate the clinical significance of the pharmacist-initiated interventions. The six categories included: (1) patient unaffected, (2) patient affected but no harm caused, (3) patient affected and could cause potential harm, (4) patient affected and temporary harm caused, (5) patient affected and permanent harm caused, and (6) life threatening.

Section C of the intervention form allowed the researcher to document a brief description of each pharmacist intervention that was made for each patient (n=53). The level of each pharmacist intervention was then determined by two independent reviewers who are both qualified pharmacists with a postgraduate qualification in pharmacology. A total of 87 pharmacist interventions were classified into one of the six categories according to the severity of the intervention and potential harm caused to the patient. However, there were no interventions which was life threatening or that caused permanent harm to the patient. Figure 4.10 outlines the classification of the pharmacist interventions according to their clinical significance.

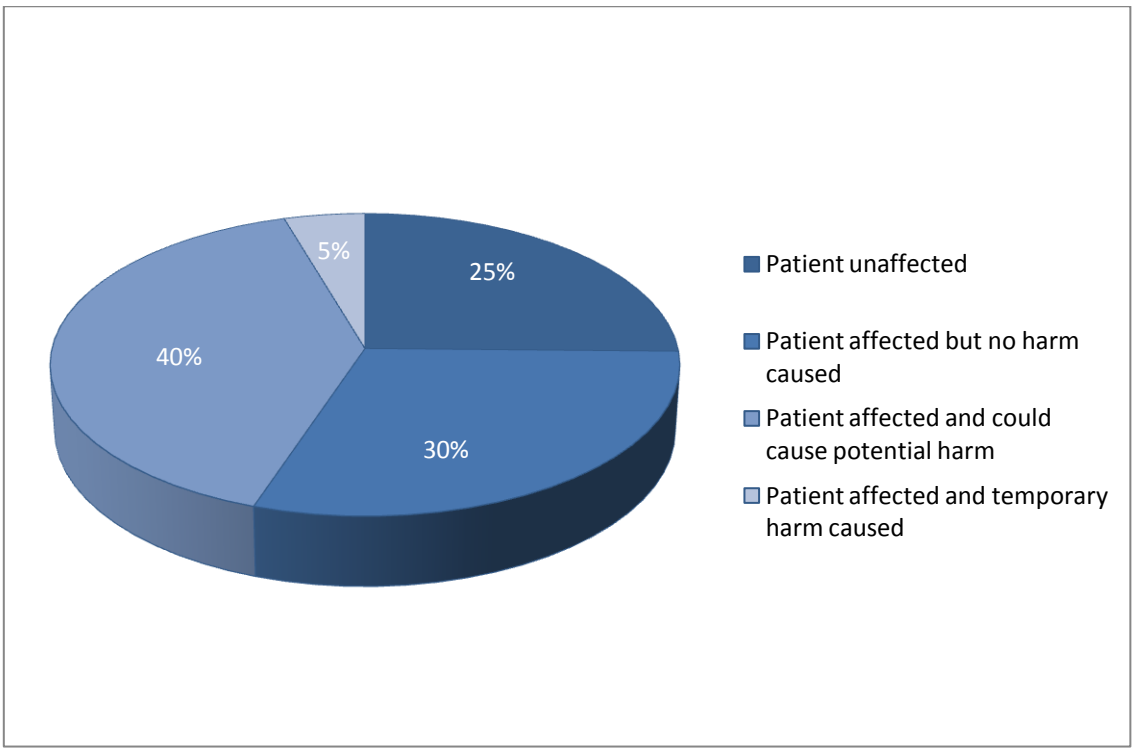

Figure 4.10: Level of pharmacist intervention according to clinical significance (n=87)

The majority of the interventions, 40% (35; n=87), resulted in the patient being affected and could have potentially caused harm. Patients were unaffected in 25% (22; n=87) of the interventions, while 30% (26; n=87) of the interventions resulted in the patients being affected but with no harm caused. In 5% (4; n=87) of the intervention cases the patient was affected and temporary harm was caused. Overall, 75% (65; n=87) of the interventions resulted in the patient being affected and thus, we can conclude that these interventions were of clinical significance. A similar result was obtained in a study done by Khalili *et al.* (2013, p. 5) where 76% of the pharmacist interventions made in an infectious diseases' ward, were found to be of clinical significance while the remaining 24% resulted in the patients being unaffected. Additionally, a study done by Bondesson, Holmdahl, Midlov *et al.* (2012, p. 275) showed similar results whereby 83% of the pharmacist interventions made in a medical ward, were of clinical significance.

4.4.5.2. Perceived Benefit of Pharmacist Intervention

The perceived benefit of the interventions made per patient was determined by the researcher. There were five categories, namely: (1) improved therapeutic

effectiveness, (2) improved monitoring of therapy, (3) improved compliance, (4) side effects or toxicity prevented, and (5) cost-saving benefit. There was a sixth category for any other perceived benefit to be included. The researcher classified each of the five categories on a scale of one to three according to the level of improvement resulting from all of the interventions pertaining to a patient. The level of improvement was classified as follows: (1) no improvement, (2) minor improvement, and (3) major improvement. Figure 4.11 summarises the level of improvement within each category.

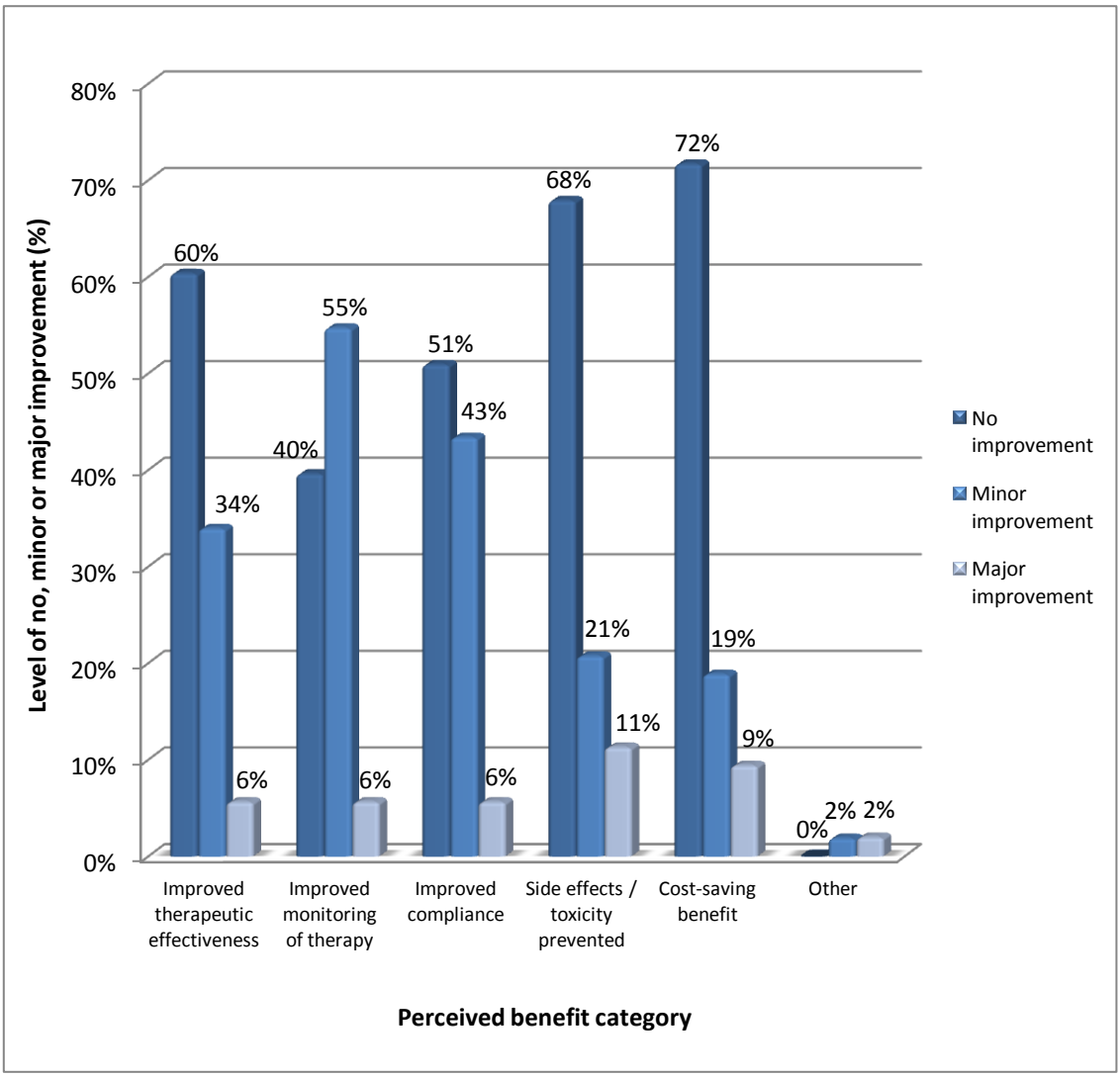

Figure 4.11: Perceived benefit of pharmacist intervention (n=53)

The category that showed the greatest improvement, involving 61% (32; n=53) of the patients, was improved monitoring of therapy which had 55% (29; n=53) of patients with minor improvement and 6% (3; n=53) with major improvement. The improved compliance category showed an overall improvement in 49% (26;

n=53) of patients, while the improved therapeutic effectiveness category showed an overall improvement in 40% (21; n=53) of the patients. The side effects and toxicity prevented category showed an overall improvement in 32% (17; n=53) of the patients, of which 11% (6; n=53) showed a major improvement. There was a small cost-saving benefit observed in interventions pertaining to 28% (15; n=53) of the patients. There were 4% (2; n=53) of the patients whose interventions were additionally classified in the “other” category. These interventions were due to allergic reactions being prevented and to medication safety.

4.5. Post-Intervention Phase

4.5.1. Sample and Setting

The post-intervention phase was structured in a similar way to the pre-intervention phase; however, it took place after the intervention phase. The sample included all medical practitioners and nurses working in the ward during the time of the study, as per the pre-intervention phase. The questionnaires were designed in a similar manner; however, the questions were worded slightly differently to those used in the pre-intervention phase. Once again, the medical practitioners and nurses were not obliged to participate in the study and agreement to complete the questionnaire served as consent.

4.5.2. Questionnaire Distribution and Response Rate

The post-intervention questionnaires were distributed over a period of two weeks to a total of 12 medical practitioners and 33 nurses. The questionnaires were distributed for self-completion and there were a total of 10 (83%; n=12) medical practitioners and 24 (73%; n=33) nurse questionnaires completed and returned to the researcher. The post-intervention questionnaire return rate in comparison with the pre-intervention phase remained fairly consistent for the medical practitioners while the nurse return rate increased by 13%. Conversely, a similar study carried out by (Chevalier & Neville, 2011, p. 64) showed that the nursing questionnaire return rate decreased from 75% in the pre-intervention phase to 67% in the post-intervention phase. The improved return rate for the nursing questionnaires during this phase could possibly be due to more permanent staff being in the ward during this period or due to the relationships that the researcher had developed with the staff during the study.

4.5.3. Medical Practitioner and Nurse Participant Demographics

The demographic detail of the medical practitioners and nurses was obtained from the closed-ended questions in Section A of the post-intervention questionnaires (see Appendix 7 & 8). The information recorded from Section A of the questionnaire was similar to that recorded during the pre-intervention phase. The medical practitioner questionnaire recorded the following information: (1) gender, (2) number of years registered as a practitioner, (3) specialist category and (4) number of years registered in specialist category. The nursing questionnaire recorded similar information which included: (1) gender, (2) number of years in practice and (3) specialist category.

The number of years in practice was categorised into four categories, namely: (1) 1-4 years, (2) 5-9 years, (3) 10-19 years and (4) 20 years or more. The abovementioned year categories were used for the medical practitioner and nurse post-intervention questionnaires. The following sections present and discuss the results pertaining to the medical practitioners' (Section 4.5.3.1) and nurses' (Section 4.5.3.2) demographic information.

4.5.3.1. Medical Practitioner Demographic Information

Table 4.14 outlines the medical practitioner demographic information relating to the number of years registered as a practitioner. It is evident that all of the medical practitioners (100%; n=10) were male and that there were no medical practitioners who were registered as practitioners in the one to four year category. Half of the medical practitioners (50%; 5; n=10) had been practicing as medical practitioners for between 10 and 19 years and 30% (3; n=10) had been registered for more than 20 years. Conversely, in the pre-intervention phase, the majority of the medical practitioners had been registered as practitioners for more than 20 years. However, there was a fairly even distribution of the number of years that these practitioners had been registered for in their speciality, which was similar to the trend observed in the pre-intervention phase.

Table 4.14: Years of registration as a medical practitioner and specialist (n=10)

Years of registration	Practitioner registration	Specialist registration
	Percentage (%)	Percentage (%)
1-4	0%	20%
5-9	20%	30%
10-19	50%	20%
20+	30%	30%
Total	***100%***	***100%***

The medical practitioners were categorised according to their speciality (see Table 4.15) and there were five different specialities in total. The distribution of the specialities in the post-intervention phase was comparable to that of the pre-intervention phase with the majority (50%; 5; n=10) of the specialists being physicians. In contrast to the pre-intervention phase, there were no anaesthetists or cardiothoracic surgeons in the post-intervention phase.

Table 4.15: Medical practitioner specialist category (n=10)

Specialist Category	Percentage (%)
Gastro-enterology	10%
General Surgeon	10%
Gynaecology	10%
Neurosurgeon	20%
Physician	50%
Total	***100%***

4.5.3.2. Nurse Demographic Information

All of the nursing staff (100%; n=24) were female and the largest percentage of the nurses (33%; 8; n=24) had 20 or more years of experience (see Table 4.16). Conversely, in the pre-intervention phase, more than half (52%; 11; n=21) of the nurses had between one to four years of experience, with only 19% (4; n=21) having 20 or more years of experience.

Table 4.16: Years of registration as a nurse (n=24)

Years of registration	Nurse registration
	Percentage (%)
1-4	25%
5-9	21%
10-19	21%
20+	33%
Total	***100%***

The nurses were categorised according to their registration status and there were a total of four categories. Table 4.17 depicts the distribution of the categories. The majority, 71% (17; n=24) of the nurses were registered nurses, relative to 43% (9; n=21) in the pre-intervention phase. However, in both phases, the registered nurse category was the largest. There were no care workers that participated in this phase of the study.

Table 4.17: Nurse specialist category (n=24)

Specialist Category	Percentage (%)
Enrolled Nurse	12.5%
Enrolled Nursing Assistant	12.5%
Registered Nurse	71%
Student Nurse	4%
Total	***100%***

4.5.4. Opinion of the Ward-based Pharmacy Service Offered

Section B of the Medical Practitioner and Nurse Post-intervention Questionnaires (refer to Appendix 7 & 8) was used to establish the opinions and attitudes of the medical practitioners and nurses towards ward-based clinical pharmacy following the implementation of a ward pharmacy service in the surgical ward. A Likert-type scale, similar to the one in Section C of the pre-intervention phase, was used to determine whether the opinions and attitudes of the medical practitioners and nurses had changed once the ward pharmacy service was implemented. The Likert-type scale contained 17 statements that were positive and related to ward-based clinical pharmacy and the service that was implemented. There were five Likert-type scale categories and the medical practitioners and nurses had to rate the statements according to the extent to

which they agreed or disagreed. The five categories for the Likert-type scale were as follows: (1) strongly disagree, (2) disagree, (3) neutral, (4) agree and (5) strongly agree. The medical practitioner and nurse responses for each statement were calculated as a percentage for each category and are outlined in Tables 4.18 and 4.19. The highest percentage for each statement represents the most frequently occurring response category, which is also the mode. The Likert-type scale data was analysed using the mode due to the non-linear nature of the scale.

Additionally, questions three and four of Section C looked specifically at whether the medical practitioners and nurses had any suggestions or concerns about the ward-based pharmacy service. The questions were structured as open-ended questions with a place for comments if the medical practitioner or nurse had any feedback.

4.5.4.1. Medical Practitioner Opinions and Attitudes Towards Ward-based Clinical Pharmacy Post-implementation of a Ward Pharmacy Service

The majority, 59% (10; n=17) of the statements had the largest percentage of responses being in category five (strongly agree) while the remaining statements (41%; 7; n=17) had category four (agree) being the largest (see Table 4.18). In the pre-intervention phase, only 50% of the statements had the largest percentage being category five responses (see Table 4.19). This suggests that the positive opinions and attitudes of the medical practitioners may have increased after the implementation of the ward pharmacy service.

Table 4.19 provides a comparison of the responses obtained from the medical practitioners to questions that were asked both in the pre-intervention and post-intervention phases. The results from the post-intervention phase show that the majority of the medical practitioners either agreed or strongly agreed with the statements made, which suggests that they had a positive opinion and attitude towards ward-based clinical pharmacy. Similarly to the pre-intervention phase, there were no responses in the strongly disagree category. However, the number of statements with responses in the disagree categories increased from the pre-intervention phase. Many of the medical practitioners working in the surgical ward had previously experienced ward pharmacy services at other

institutions which may have been different to the service that was implemented during the study. The results could be an indication that their perceived benefit of a ward pharmacy service was slightly different to the service that was implemented in the surgical ward. The type of ward-based pharmacy services provided are individualised according to the needs of each institution, therefore, the medical practitioners may have experienced ward pharmacy being practiced slightly differently. The requirements of the hospital institution and surgical ward were considered prior to the researcher implementing the ward-based pharmacy service.

Table 4.18: Medical practitioner response to ward-based clinical pharmacy (n=10)

Question	Statement	Percentage of Medical Practitioners who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	It is necessary to have a pharmacist in hospital wards	0%	10%	0%	30%	60%
2	It was beneficial having a pharmacist more present in the ward	0%	0%	30%	30%	40%
3	It was useful having the pharmacist in the ward when prescribing medication	0%	10%	20%	40%	30%
4	A ward-based pharmacy service was beneficial to medical practitioners	0%	0%	20%	40%	40%
5	A ward-based pharmacy service was beneficial to nursing staff	0%	0%	20%	30%	50%
6	A ward-based pharmacy service was beneficial to patients	0%	10%	10%	60%	20%
7	The pharmacist played an important role in improving medication safety	0%	0%	10%	40%	50%
8	Having a pharmacist in the ward reduced the risk for potential medication errors	0%	0%	10%	20%	70%
9	It was beneficial having a pharmacist to handle medication-related queries	0%	0%	10%	30%	60%
10	The services offered by a ward pharmacist assisted me to optimise patient care in less time	0%	0%	30%	60%	10%

11	The pharmacist played an important role in medication counselling at discharge	0%	0%	40%	40%	20%
12	I was comfortable with the pharmacist reviewing my prescribing	0%	0%	0%	50%	50%
13	Recommendations made by the pharmacist were useful	0%	0%	10%	50%	40%
14	The pharmacist was available to handle any queries	0%	10%	10%	40%	40%
15	The pharmacist provided useful information on any medication-related queries	0%	10%	20%	30%	40%
16	I found the pharmacist suggestion form to be useful	0%	0%	10%	70%	20%
17	My expectations of the ward/clinical pharmacy service have been met	0%	0%	40%	40%	20%

The majority (60%; 6; n=10) of the medical practitioners strongly agreed that it is necessary to have a pharmacist in hospital wards, while 40% (4; n=10) strongly agreed that it was beneficial having a pharmacist present in the ward. All of the medical practitioners either agreed or strongly agreed that a ward pharmacy service was beneficial to the medical practitioners and nurses. The majority of the medical practitioners agreed or strongly agreed that the service was also beneficial to patients, however, 10% (1; n=10) disagreed with the statement. Similarly to the pre-intervention phase, the majority of medical practitioners strongly agreed that the pharmacist played an important role in improving medication safety and reduced the risk for medication errors. Sixty percent (60%; 6; n=10) of the medical practitioners strongly agreed that it was beneficial having a pharmacist in the ward to handle medication-related queries.

The majority (70%; 7; n=10) of the medical practitioners either agreed or strongly agreed that the services provided by the ward pharmacist enabled them to optimise patient care in less time, while the remaining 30% (3; n=10) had a neutral response to the statement. All of the medical practitioners agreed that they were comfortable with the ward pharmacist reviewing their prescribing and 90% (9; n=10) either agreed or strongly agreed that they found the recommendations made by the ward pharmacist to be useful.

Table 4.19: Summary of medical practitioner responses to ward-based clinical pharmacy in pre-intervention (n=11) and post-intervention phase (n=10)

Question	Statement Pre- / Post-Intervention Phase	Pre-intervention phase: Percentage of Medical Practitioners who Responded					Post-intervention phase: Percentage of Medical Practitioners who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	It is necessary to have a pharmacist in hospital wards	0%	0%	0%	9%	64%	0%	10%	0%	30%	60%
2	Pharmacists should be more present in hospital wards / It was beneficial having a pharmacist more present in the ward	0%	0%	0%	0%	73%	0%	0%	30%	30%	40%
3	I would prefer a pharmacist to be present when prescribing medication / It was useful having the pharmacist in the ward when prescribing medication	0%	0%	18%	27%	37%	0%	10%	20%	40%	30%
4	A ward-based pharmacy service will be beneficial to medical practitioners / A ward-based pharmacy service was beneficial to medical practitioners	0%	0%	0%	0%	64%	0%	0%	20%	40%	40%
5	A ward-based pharmacy service will be beneficial to nursing	0%	0%	0%	0%	36%	0%	0%	20%	30%	50%

	staff / A ward-based pharmacy service was beneficial to nursing staff										
6	A ward-based pharmacy service will be beneficial to patients / A ward-based pharmacy service was beneficial to patients	0%	0%	0%	0%	36%	0%	10%	10%	60%	20%
7	Pharmacists play an important role in improving medication safety / The pharmacist played an important role in improving medication safety	0%	0%	0%	0%	27%	0%	0%	10%	40%	50%
8	A ward-based pharmacist will reduce medication error rate / Having a pharmacist in the ward reduced the risk for potential medication errors	0%	0%	0%	9%	27%	0%	0%	10%	20%	70%
9	It will be beneficial to have a ward pharmacist to handle medication-related queries / It was beneficial having a pharmacist to handle medication-related queries	0%	0%	0%	9%	36%	0%	0%	10%	30%	60%
10	The potential services offered by a ward pharmacist will assist me to optimise patient	0%	0%	0%	18%	46%	0%	0%	30%	60%	10%

	care in less time / The services offered by a ward pharmacist assisted me to optimise patient care in less time										
11	The pharmacist plays an important role in medication counselling at discharge / The pharmacist played an important role in medication counselling at discharge	0%	0%	9%	9%	46%	0%	0%	40%	40%	20%

The majority (80%; 8; n=10) of the medical practitioners found the ward pharmacist to be available to handle queries, however, 10% (1; n=10) had a neutral response and 10% disagreed. The ward pharmacist was not in the ward the whole day and the medical practitioners conduct their ward rounds at different times each day, which could have accounted for the 20% (2; n=10) who didn't agree that the pharmacist was available. However, the ward pharmacist was in the central hospital pharmacy during working hours on weekdays and was available for any queries.

Seventy percent (70%; 7; n=10) of the medical practitioners found the medication-related information provided by the ward pharmacist to be useful and 90% (9; n=10) agreed that the pharmacist suggestion form was useful. The majority (60%; 6; n=10) of the medical practitioners felt that their expectations of a ward pharmacy service had been met, with the remaining 40% having a neutral response. The expectations of the medical practitioners in the pre-intervention phase correlate closely with the results of the post-intervention phase. Overall, the medical practitioners were positive that their expectations of the ward pharmacy service had been met.

Following the implementation of the ward-based pharmacy service, the medical practitioners were once again asked to explain in their opinion what the greatest benefit of a ward pharmacy service was to their profession. In contrast to the pre-intervention phase, approximately two-thirds of the medical practitioners now felt that reviewing medication to monitor compliance and detect medication errors was the greatest benefit. Examples of two responses that were obtained included: "assisting with doses and administration compliance" and "allows for better medication safety and optimal dosing". Prior to the implementation of the ward based service, the majority of the medical practitioners felt that reviewing the prescription to ensure appropriate medication doses would be the greatest benefit.

There were 60% (6; n=10) of the medical practitioners who made suggestions on how the ward-based pharmacy service can be improved. Certain medical practitioners made the same suggestion(s). Overall, the suggestions included:

(1) electronic prescribing for practitioners, (2) ward pharmacists to be present at all ward rounds and not just the morning rounds, (3) ward pharmacists to be present in all hospital wards, and (4) ward pharmacist to be contactable via a speed-dial service to a cellular phone.

The results from question four showed that none of the medical practitioners had any concerns about the ward-based pharmacy service that was implemented. Conversely, in the pre-intervention phase there was one medical practitioner who had a concern about the participation of a ward pharmacist in the care of the patient. Any concerns that medical practitioners may have had prior to the implementation of the ward-based pharmacy service, were addressed once the service was implemented.

4.5.4.2. Nurse Opinions and Attitudes Towards Ward-based Clinical Pharmacy Post-implementation of a Ward Pharmacy Service

The majority, 94% (16; n=17) of the statements had the largest percentage of responses being in category five, with the remaining 6% (1; n=17) having category four as the largest percentage (see Table 4.20). A similar result was obtained in the pre-intervention phase (see Table 4.21), where all of the 14 statements had the largest percentage of responses in category five. The large category five response for the statements suggests that the nurses strongly agreed with the statements made and that they had a positive opinion and attitude towards the ward-based pharmacy service that was implemented.

Table 4.21 provides a comparison of the responses obtained from the nurses to questions that were asked both in the pre-intervention and post-intervention phases. The results show that the majority of the nurses either agreed or strongly agreed with the statements that were made. In the pre-intervention phase, there were no nurses who strongly disagreed with any of the statements; however, there were responses in this category in the post-intervention phase. Four percent (4%; 1; n=24) of the strongly disagreed statements were due to: (1) the nurses not being comfortable with the pharmacist monitoring medication administration, and (2) they did not feel that the ward pharmacy service enabled them to optimise patient care in less time. Furthermore, 13% (3; n=24) of the nurses felt that the pharmacist did not play an important role in medication

Table 4.20: Nurse response to ward-based clinical pharmacy (n=24)

Question	Statement	Percentage of Nurses who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	It is necessary to have a pharmacist in hospital wards	0%	0%	8%	13%	79%
2	It was beneficial having a pharmacist more present in the ward	0%	0%	0%	29%	71%
3	It was useful having the pharmacist in the ward when administering medication	0%	0%	17%	25%	58%
4	A ward-based pharmacy service was beneficial to medical practitioners	0%	0%	8%	33%	58%
5	A ward-based pharmacy service was beneficial to nursing staff	0%	0%	0%	29%	71%
6	A ward-based pharmacy service was beneficial to patients	0%	4%	0%	29%	67%
7	The pharmacist played an important role in improving medication safety	0%	0%	4%	25%	71%
8	Having a pharmacist in the ward reduced the risk for potential medication errors	0%	0%	4%	29%	67%
9	It was beneficial having a pharmacist to handle medication-related queries	0%	0%	0%	29%	71%
10	The services offered by a ward pharmacist assisted me to optimise patient care in less time	4%	0%	4%	25%	67%
11	The pharmacist played an important role in medication counselling at discharge	13%	4%	21%	33%	29%
12	I was comfortable with the pharmacist monitoring medication administration	4%	0%	8%	29%	58%
13	Recommendations made by the pharmacist were useful	0%	0%	8%	29%	63%
14	The pharmacist was available to handle any queries	0%	4%	13%	17%	67%
15	The pharmacist provided useful information on any medication-related queries	0%	4%	4%	25%	67%
16	I found the pharmacist suggestion form to be	0%	0%	25%	13%	63%

	useful					
17	My expectations of the ward/clinical pharmacy service have been met	0%	4%	17%	25%	54%

counselling at discharge. However, the researcher often performed the medication counselling from the central pharmacy in a private counselling area which would not be observed by the nursing staff. A large percentage of the statements received category three responses, which suggests that some of the nurses had a neutral opinion towards ward-based clinical pharmacy.

Seventy nine percent (79%; 19; n=24) of the nurses strongly agreed that it was necessary to have a pharmacist present in hospital wards and 71% (17; n=24) strongly agreed that it was beneficial having a pharmacist more present in the ward. Conversely, in the pre-intervention phase, only 52% (11; n=21) of the nurses strongly agreed with the two statements above.

The nurses strongly agreed that the ward pharmacy service would be beneficial to the medical practitioners, nurses and patients. Furthermore, in the pre-intervention phase, 57% (12; n=21) of the nurses strongly agreed that the service would be beneficial to nurses, while this result increased to 71% after implementation of the ward pharmacy service.

The response of the nursing staff towards the importance of the pharmacist in improving medication safety increased from 62% (13; n=21) having strongly agreed in the pre-intervention phase to 71% (17; n=24) after implementation of the service. However, the percentage of nurses who strongly agreed with the pharmacist assisting in reducing the risk for potential medication errors remained fairly consistent.

Seventy one percent of the nurses in both the pre-intervention and post-intervention phases strongly agreed that it was beneficial having a pharmacist in the ward to handle medication-related queries. Prior to the implementation of the ward pharmacy service, 81% (17; n=21) of the nurses either agreed or strongly agreed that the ward pharmacy service would enable them to optimise

patient care in less time, while in the post-intervention phase, 92% (22; n=24) either agreed or strongly agreed.

The majority (87%; 21; n=24) of the nurses either agreed or strongly agreed that they were comfortable with the ward pharmacist monitoring the medication administration. Eighty seven percent (87%; 21; n=24) of the nurses found the medication-related information provided by the ward pharmacist to be useful and 76% (18; n=24) found the pharmacist suggestion form to be useful. The majority, 84% (20; n=24), of the nurses found that the ward pharmacist was available to handle queries, while 8% (4; n=24) had a neutral response. Overall, 79% (19; n=24) of the nurses felt that their expectations of a ward pharmacy service had been met, while 4% (1; n=24) disagreed and 17% (4; n=24) had a neutral response. The results from the pre-intervention phase closely correlate with those in the post-intervention phase. The responses to a number of statements increased in the post-intervention phase which suggests that the ward pharmacy service had a positive impact on the nurses and that it met their expectations.

Following the implementation of the ward-based pharmacy service, the nurses were once again asked to explain, in their opinion, what the greatest benefit of a ward pharmacy service was to their profession. Two-thirds of the nurses now felt that the pharmacist providing advice was the greatest benefit of the ward pharmacy service, with the majority who were in agreement that general medication queries were handled without delay, which allowed them to spend more time on patient care. One of the responses obtained from a nurse was “more involvement and interaction in medication from nursing staff, medication errors minimised, medication queries were handled without delay to save time, quality nursing care could be provided”. Conversely, prior to the implementation of the service, the majority of the nurses felt that the pharmacist reviewing the medication items prescribed would be the greatest benefit.

Table 4.21: Summary of nurse responses to ward-based clinical pharmacy in pre-intervention (n=21) and post-intervention phase (n=24)

Question	Statement Pre- / Post-Intervention Phase	Pre-intervention phase: Percentage of Nurses who Responded					Post-intervention phase: Percentage of Nurses who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	It is necessary to have a pharmacist in hospital wards	0%	0%	24%	24%	52%	0%	0%	8%	13%	79%
2	Pharmacists should be more present in hospital wards / It was beneficial having a pharmacist more present in the ward	0%	0%	19%	29%	52%	0%	0%	0%	29%	71%
3	I would prefer a pharmacist to be present when administering medication / It was useful having the pharmacist in the ward when administering medication	0%	0%	38%	24%	38%	0%	0%	17%	25%	58%
4	A ward-based pharmacy service will be beneficial to medical practitioners / A ward-based pharmacy service was beneficial to medical practitioners	0%	5%	10%	38%	47%	0%	0%	8%	33%	58%
5	A ward-based pharmacy service will be beneficial to nursing	0%	0%	10%	33%	57%	0%	0%	0%	29%	71%

	staff / A ward-based pharmacy service was beneficial to nursing staff										
6	A ward-based pharmacy service will be beneficial to patients / A ward-based pharmacy service was beneficial to patients	0%	0%	5%	38%	57%	0%	4%	0%	29%	67%
7	Pharmacists play an important role in improving medication safety / The pharmacist played an important role in improving medication safety	0%	0%	19%	19%	62%	0%	0%	4%	25%	71%
8	A ward-based pharmacist will reduce medication error rate / Having a pharmacist in the ward reduced the risk for potential medication errors	0%	0%	5%	28%	67%	0%	0%	4%	29%	67%
9	It will be beneficial to have a ward pharmacist to handle medication-related queries / It was beneficial having a pharmacist to handle medication-related queries	0%	0%	10%	19%	71%	0%	0%	0%	29%	71%
10	The potential services offered by a ward pharmacist will assist me to optimise patient	0%	0%	19%	33%	48%	4%	0%	4%	25%	67%

	care in less time / The services offered by a ward pharmacist assisted me to optimise patient care in less time										
11	The pharmacist plays an important role in medication counselling at discharge / The pharmacist played an important role in medication counselling at discharge	0%	0%	14%	24%	62%	13%	4%	21%	33%	29%

The results from question three showed that 33% (8; n=24) of the nurses had made suggestions on how the ward-based pharmacy service can be improved. The majority of these nurses suggested that the ward pharmacist must be more present in the wards, including the afternoons and weekends. The nurses also suggested that the service should be provided to all the units, particularly the critical care units. In addition, a few of the nurses suggested that the ward pharmacist should focus more on providing in-service education to the nursing staff on relevant medication-related topics.

The results from question four in Section C showed similar findings to the pre-intervention phase in that none of the nurses had any concerns about the ward-based pharmacy service that was implemented in the ward.

4.5.5. Opinions of Medical Practitioners and Nurses towards the Clinical Pharmacy Services Provided by a Pharmacist

A Likert-type scale was used in section C of the medical practitioner and nurse post-intervention questionnaires (refer to Appendix 7 & 8) to determine whether the opinions of the medical practitioners and nurses towards the pharmacist providing various clinical pharmacy services had changed, following the implementation of a ward-based pharmacy service. The Likert-type scale contained five categories (see Table 4.22) according to the level of importance and included: (1) no importance, (2) slightly important, (3) neutral, (4) important and (5) high importance.

The 11 clinical pharmacy services that were provided by the ward pharmacist during the study were listed and the medical practitioners and nurses had to rate the extent to which they felt that the service was important. The responses from the medical practitioners and nurses to the 11 clinical pharmacy services were calculated as a percentage for each category. Table 4.22 lists the clinical pharmacy services and depicts the percentage distribution across each category for both the medical practitioners and nurses.

The majority of the medical practitioners and nurses felt that all 11 clinical pharmacy services were important, however there were a few category one responses 4% (1; n=24) from the nurses who felt that the following services

were of no importance: (1) dispensing from a computer in the ward, (2) detecting and reporting adverse drug reactions, (3) participating in ward rounds, and (4) antibiotic stewardship. In the pre-intervention phase there were no category one responses, however, 5% (1; n=21) of the nurses thought dispensing from a computer in the ward was of slight importance. Similarly to the pre-intervention phase, 10% (1; n=10) of the medical practitioners felt that pharmacist participation in ward rounds and antibiotic stewardship was of slight importance. Furthermore, 8% (2; n=24) of the nurses felt that detecting medication errors was of slight importance and 4% (1; n=24) felt that medication counselling was of slight importance. There were a number of category three responses from both the medical practitioners and the nurses which indicated a neutral opinion. A similar result was obtained in the pre-intervention phase.

A number of the clinical pharmacy services had the largest percentages in category five (see Table 4.22) which indicates that the services were viewed as being of high importance. The largest percentage of the nurse responses were category five for all 11 clinical pharmacy services, which is similar to what was found during the pre-intervention phase. On the contrary, the largest percentage of the medical practitioners' responses were category five for nine of the 11 services, compared to five in the pre-intervention phase. The remaining two services had the largest percentage in category four, which indicates that they were also important. The clinical pharmacy services that both the medical practitioners and nurses felt were of high importance, following the implementation of a ward-based pharmacy service were the same as those in the pre-intervention phase and included: (1) medication chart review to ensure optimal medication choice, (2) medication chart review to ensure cost-effective treatment, (3) provision of a drug information service, and (4) participation in ward rounds. The results show that both the medical practitioners' and nurses' perceptions of the importance of the pharmacist providing certain clinical pharmacy services, increased following the implementation of a ward-based pharmacy service in the ward.

Table 4.22: Medical practitioner (n=10) and nurse (n=24) responses to clinical pharmacy services

Number	Clinical Pharmacy Service	Percentage of Medical Practitioners who Responded					Percentage of Nurses who Responded				
		1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1	Medication chart review to ensure optimal medication choice	0%	0%	10%	30%	60%	0%	0%	4%	42%	54%
2	Medication chart review to ensure cost-effective treatment	0%	0%	40%	20%	40%	0%	0%	8%	38%	54%
3	Medication chart review to ensure appropriate dose	0%	0%	10%	20%	70%	0%	0%	4%	33%	63%
4	Detecting medication errors	0%	0%	10%	10%	80%	0%	8%	8%	13%	71%
5	Medication counselling	0%	0%	0%	60%	40%	0%	4%	13%	25%	58%
6	Providing a drug information service	0%	0%	10%	40%	50%	0%	0%	13%	21%	67%
7	Dispensing from a computer in the ward instead of from a central pharmacy	0%	0%	30%	40%	30%	4%	0%	8%	21%	67%
8	Detecting and reporting adverse drug reactions	0%	0%	10%	40%	50%	4%	0%	13%	25%	58%
9	Monitoring medication outcome	0%	0%	20%	40%	40%	0%	0%	8%	33%	58%
10	Participation in ward rounds	0%	10%	10%	40%	40%	4%	0%	4%	38%	54%
11	Antibiotic stewardship	0%	10%	0%	40%	50%	4%	0%	0%	29%	67%

4.6. Limitations of the Study

The study was only carried out in one surgical ward at a private hospital in Port Elizabeth, South Africa. The results obtained from the study cannot be compared to other wards within the same hospital or to other private or public hospitals in Port Elizabeth. The research was conducted in one hospital in the Eastern Cape Province and thus, the results cannot be extrapolated to the rest of the province or South Africa.

The success of the pharmacist intervention largely depends on inter-personal relationships. The personality and co-operativeness of the pharmacist and the medical staff are important in the successful establishment of a ward pharmacy service. However, the eight week study period limited the time available for the researcher to gain the trust of the medical practitioners and nurses in the study ward. Furthermore, the frequency and nature of the interventions which were recorded during the study may have been influenced by the level of professionalism, personal performance and individual social skills of the medical practitioner or nurse involved. Additionally, the pharmacist was not in the ward on a full-time basis and was not on-call after hours and on weekends which could have affected the nature and frequency of the pharmacist interventions.

There were no surgical wards used in the study as control wards. However, there was no previous or current involvement of a ward pharmacist in the other surgical ward at the study institution. It can therefore be assumed that the services offered by the ward pharmacist during the study had a positive impact on the patient in comparison with all of the other units in the hospital which received standard pharmaceutical care services from a general pharmacy. Standard pharmaceutical care is part of the daily service offered, whereby the pharmacist provides appropriate, safe and cost-effective medication to the patient, however, the pharmacist has no patient contact; no access to patient medication records; and there is no direct face-to-face contact with the medical practitioners or nurses.

The interventions were made based on the knowledge and at the discretion of the researcher. The researcher had a BPharm degree without any further clinical qualification but had previously practiced as a ward-pharmacist for two

years. The researcher completed a course in Antimicrobial Stewardship in 2012 through the University of Limpopo (Medunsa Campus). Furthermore, the private hospital group had rolled out Anti-microbial Stewardship during 2012 and the researcher received additionally training on anti-microbial agents. The majority (34%, 34, n=101) of the interventions made were related to the anti-microbial medication class which could be due to the focus on anti-microbial stewardship at the institution. The study institution did not make use of automated systems or hospital information technology such as CPOE with CDSS or bar-code verification technology. The use of an electronic system to alert the pharmacist of patients at high risk for medication errors was therefore not used; however, such systems could have assisted the researcher to identify patients.

The impact of the interventions on cost-saving, length of hospital stay and patient re-admission rate were not documented during the study. The use of anaesthetic medications and dietary supplements were also not assessed. Pregnant women and patients under 18 years of age were excluded from the study and thus, the impact of a ward-based clinical pharmacy service could not be determined in these patient groups.

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The primary aim of the study was to evaluate the impact of a ward-based pharmacist on the provision of pharmaceutical care to patients in a surgical ward, within a South African private hospital setting. Additionally, the opinions and attitudes of the medical practitioners and nurses working in the selected ward was assessed both prior to and following the implementation of the ward-based pharmacy service.

Prior to the implementation of the ward-based pharmacy service, the results from the questionnaires showed that the medical practitioners and nurses had a positive attitude towards the potential benefit of the service being offered. The medical practitioners and nurses also had no concerns about the role of the ward pharmacist in the care of the patient. Furthermore, there was a positive response towards the importance of the various clinical pharmacy services that are provided by a ward pharmacist. Following the implementation of the service, the attitudes of the medical practitioners and nurses remained positive and overall, they were satisfied that their expectations had been met.

The presence of a pharmacist in the ward resulted in improved communication between the pharmacy and the medical practitioners and nurses. The nurses encouraged more involvement of a ward pharmacist in the unit on a full-time basis. The medical practitioners and nurses working in the surgical ward found the ward-based pharmacy service to be of great value and thus, the expansion of the service to all units in the study institution could be beneficial, however, the results cannot be extrapolated to other units.

The ward pharmacist provided pharmaceutical care to 106 patients during the study. Pharmacist interventions were made in half (50%; 53; n=106) of the patients who participated in the study and a total of 87 interventions were made in these patients. A large number (57%; 50; n=87) of the interventions made by

the researcher were pharmacist-initiated interventions to assist in optimising patient care while the remaining interventions (43%; 37; n=87) were medication errors. Prescribing errors were the most commonly occurring type of medication error and accounted for 51% (19; n=37) of the medication errors. The majority of the interventions were related to acute medication items and the anti-microbial medication class specifically. There were a number of factors that were found to have a significant relationship with a ward pharmacist intervention being required, namely: (1) number of medication items ($p=0.001$; Chi^2 test; $p<0.0005$; Student's t-test), (2) length of hospital stay ($p<0.0005$; Chi^2 test; $p<0.0005$; Student's t-test), (3) presence of one or more chronic disease states ($p=0.003$; Chi^2 test) and the (4) presence of one or more allergies ($p=0.028$; Chi^2 test). An increase in the number of medication items and length of hospital stay resulted in these patients being at an increased risk for a pharmacist intervention being required. Furthermore, the presence of one or more chronic disease state(s) or allergies also resulted in these patients being at an increased risk for a pharmacist intervention being required.

The ward pharmacist interventions were of clinical significance and overall there was a high acceptance rate (73%; 36; n=49) of the interventions by both the medical practitioners and nurses. Moreover, the majority of the interventions had a perceived benefit to the patient, which included improved monitoring of drug therapy and improved compliance.

In conclusion, the results of this study have shown that the involvement of a pharmacist at a ward level can improve patient safety by reducing medication errors and assisting to optimise patient care. The differences in the results obtained in other studies may be due to limited studies being carried out in South Africa. Furthermore, clinical pharmacy qualifications and services differ between countries and thus, it is difficult to make conclusions based on results found in other studies.

5.2. Recommendations

5.2.1. Recommendations to Promote Pharmaceutical Care

The provision of a clinical pharmacy service by a ward pharmacist has been shown to be beneficial and thus, the provision of the service to all hospital patients on a full-time basis would have a positive impact on the level of pharmaceutical care provided. A future suggestion would be for the hospital to extend the service to all of the wards and to have ward pharmacists performing clinical pharmacy services in each unit on a full-time basis.

In future, the hospital could implement regular training sessions for each ward, which is performed by a ward pharmacist. The training will ensure that all of the nursing staff are educated on any new medications or pharmacy protocols that have been implemented.

5.2.2. Recommendations for Future Studies

Based on the findings of this study, future studies could explore the impact of a ward pharmacist in a surgical ward on a full-time basis. Furthermore, the study could be conducted in other specialised units and the inclusion of pregnant women could be considered. Additionally, the availability of the ward pharmacist after hours on weekdays and weekends could also be assessed.

There are limited studies available on the cost-effectiveness of clinical pharmacy services, particularly studies done in South Africa. Future studies could therefore focus on the cost-benefit of a ward pharmacist performing clinical pharmacy services in various wards or on a hospital level. Furthermore, the impact of clinical pharmacy services on the length of hospital stay and patient re-admission rates could also be assessed.

The use of health information technology by healthcare professionals to optimise patient care has not been well documented in South Africa. Therefore, future studies could measure the impact of technological advancements on the provision of clinical pharmacy services and pharmacist interventions made at a ward level.

REFERENCE LIST

Abu-Gharbieh, E., Fahmy, S., Rasool, B., Abduelkarem, A., & Basheti, I. (2010). Attitudes and Perceptions of Healthcare Providers and Medical Students Towards Clinical Pharmacy Services in United Arab Emirates. *Tropical Journal of Pharmaceutical Research, 9*(5), 421-430.

Agrawal, A. (2009). Medication errors: prevention using information technology systems. *British Journal of Clinical Pharmacology, 67*(6), 681-686.

Agyemang, R., & While, A. (2010). Medication errors: types, casues and impact on nursing practice. *British Journal of Nursing, 19*(6), 380-385.

American College of Clinical Pharmacy. (2008). The definition of clinical pharmacy. *Pharmacotherapy, 28*(6), 816-817. doi: 10.1592/phco.28.6.816

Anderson, C., & Futter, B. (2009). PharmD or Needs Based Education: Which Comes First? *American Journal if Pharmaceutical Education, 73*(5), 1-3.

Bates, D. W. (2000). Using information technology to reduce rates of medication errors in hospitals. *British Medical Journal, 320*, 788-791.

Bates, D. W., Leape, L. L., Cullen, D. J., Laird, N., Petersen, L. A., Teich, J. M., Burdick, E., Hickey, M., Kleefield, S., Shea, B., van der Vliet, M., & Seger, D. L. (1998). Effect of Computerized Physician Order Entry and a Team Intervention on Prevention of Serious Medication Errors. *The Journal of the American Medical Association, 280*(15), 1311-1316.

Bates, D. W., Teich, J. M., Lee, J., Seger, D., Kuperman, G. J., Ma'Luf, N., Boyle, D., & Leape, L. (1999). The Impact of Computerized Physician Order Entry on Medication Error Prevention. *Journal of the American Medical Informatics Association, 6*(4), 313-321.

Beso, A., Franklin, B. D., & Barber, N. (2005). The frequency and potential causes of dispensing errors in a hospital pharmacy. *Pharmacy World and Science Journal, 27*, 182-190.

Board of Healthcare Funders of Southern Africa. (2014). Prescribed Minimum Benefits Retrieved 17 August 2014, from http://www.bhfglobal.com/prescribed-minimum-benefits

Bond, C., & Raehl, C. (2006). Clinical Pharmacy Services, Pharmacy Staffing, and Adverse Drug Reactions in United States Hospitals. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 26*(6), 735-747.

Bond, C., Raehl, C., & Franke, T. (2000). Clinical Pharmacy Services, Pharmacy Staffing, and the Total Cost of Care in United States Hospitals. *Pharmacotherapy, 20*(6), 609-621.

Bondesson, A., Holmdahl, L., Midlov, P., Hoglund, P., Andersson, E., & Eriksson, T. (2012). Acceptance and importance of clinical pharmacists' LIMM-based recommendations. *International Journal of Clinical Pharmacy, 34*, 272-276.

Bosma, L., Jansman, F. G., Franken, A. M., Harting, J. W., & Van den Bemt, P. M. (2008). Evaluation of pharmacist clinical interventions in a Dutch hospital setting. *Pharmacy World and Science Journal, 30*, 31-38.

Bruwer, A. (2012). Medical Errors - a national epidemic? *Nursing Update*, 40-42.

Calvert, R. (1999). Clinical pharmacy - a hospital perspective. *British Journal of Clinical Pharmacology, 47*, 231-238.

Chevalier, B., & Neville, H. L. (2011). Evaluating clinical pharmacy services on a surgical patient-care area: a nurses' satisfaction survey. *International Journal of Pharmacy Practice, 19*, 61-69.

Child, D., Cooke, J., & Hey, R. (2011). Clinical Pharmacy. In M. Stephens (Ed.), *Hospital Pharmacy* (Second ed., pp. 139-161). United Kingdom.

Cooksey, J., Knapp, K., Walton, S., & Cultice, J. (2002). Challenges to the Pharmacist Profession from Escalating Pharmaceutical Demand. *Health Affairs, 21*(5), 182-188.

Creswell, J., & Plano Clark, V. (2011). Choosing a Mixed Methods Design *Designing and Conducting Mixed Methods Research* (pp. 53-106). Thousand Oaks, California: Sage Publications.

Davids, D. (2013). Medication Errors: what nurses should know. *Nursing Update*, 52-53.

de Boer, M., Ramrattan, M. A., Kiewiet, J. J., Boeker, E. B., Gombert-Handoko, K. B., van Lent-Evers, N. A., Kuks, P. F., Dijkgraaf, M. G., Boermeester, M. A., Lie, A. H. L., & group, S. s. (2011). Cost-effectiveness of ward-based pharmacy care in surgical patients: protocol of the SUREPILL (Surgery & Pharmacy In Liaison) study. [Multicenter Study Randomized Controlled Trial Research Support, Non-U.S. Gov't]. *British Medical Journal Health Services Research, 11*, 55-62. doi: 10.1186/1472-6963-11-55

De Rijdt, T., Willems, L., & Simoens, S. (2008). Economic effects of clinical pharmacy interventions: a literature review. [Review]. *American Journal of Health System Pharmacy, 65*(12), 1161-1172. doi: 10.2146/ajhp070506

Doloresco, F., & Vermeulen, L. C. (2009). Global survey of hospital pharmacy practice. [Research Support, Non-U.S. Gov't]. *Am J Health Syst Pharm, 66*(5 Suppl 3), S13-19. doi: 10.2146/ajhp080674

Donihi, A., Weber, R., Sirio, C., Mark, S., & Meyer, S. (2009). An Advanced Pharmacy Practice Experience in Inpatient Medication Education. *American Journal of Pharmaceutical Education, 73*(1), 1-6.

Eiselen, R. J., & Uys, T. (2005). *A Workbook: Questionnaire Design* University of Johannesburg.

Fahimi, F. (2010). Implementation of a Clinical Pharmacy Education Program in a Teaching Hospital: Resident Orientated Documentation and Intervention. *Iranian Journal of Pharmaceutical Research, 9*(3), 297-302.

Falconer, N., Nand, S., Liow, D., Jackson, A., & Seddon, M. (2014). Development of an electronic patient prioritization tool for clinical pharmacist interventions. *American Journal of Health System Pharmacy, 71*, 311-320.

Franklin, B. D., Rosa, M. B., Miller, G., & Jacklin, A. (2012). The evaluation of a novel model of providing ward pharmacy services. [Evaluation Studies Research Support, Non-U.S. Gov't]. *Int J Clin Pharm, 34*(4), 518-523. doi: 10.1007/s11096-012-9650-2

Franklin, B. D., & van Mil, J. W. (2005). Defining clinical pharmacy and pharmaceutical care. *Pharmacy World and Science Journal, 27*, 137.

Frontini, R., Miharija-Gala, T., & Sykora, J. (2013). EAHP survey 2010 on hospital pharmacy in Europe: parts 4 and 5. Clinical services and patient safety. *European Journal of Hospital Pharmacy, 20*, 69-73. doi: 10.1136/ejhpharm-2013-000285

Gallagher, J., Byrne, S., Woods, N., Lynch, D., & McCarthy, S. (2014). Cost-outcome description of clinical pharmacist interventions in a university teaching hospital. *BioMedCentral Health Services Research, 14*, 177-184.

Gan, T. J., Diemunsch, P., Habib, A. S., Kovac, A., Kranke, P., Meyer, T. A., Watcha, M., Chung, F., Angus, S., Apfel, C. C., Bergese, S. D., Candiotti, K. A., Chan, M. T., Davis, P. J., Hooper, V. D., Lagoo-Deenadayalan, S., Myles, P., Nezat, G., Philip, B. K., & Tramer, M. R. (2014). Consensus Guideline for the Management of Postoperative Nausea and Vomiting. *Society for Ambulatory Anaesthesiology 118*(1), 85-113.

Glavin, R. (2010). Drug errors: consequences, mechanisms, and avoidance. *British Journal of Anaesthesia, 105*(1), 76-82.

Graabaek, T., & Kjeldsen, L. (2013). Medication Reviews by Clinical Pharmacists at Hospitals Lead to Improved Patient Outcomes: A Systemactic Review. *Basic and Clinical Pharmacology and Toxicology, 112*, 359-373.

Gray, A. (2008). Good Pharmacy Practice and Safety - missing pieces of the jigsaw? *South African Pharmaceutical Journal*, 34-36.

Gray, A., & Suleman, F. (2012). Training for Clinical Pharmacists. [Journal]. *South African Pharmaceutical Journal, 79*(2), 38-40.

Green, T., Beith, A., & Chalker, J. (2003). Drug and therapeutics committees: vehicles for improving rational drug use. *Essential Drugs Monitor*(32), 1-24.

Haas, C., Eckel, S., Arif, S., Beringer, P., Blake, E., Lardieri, A., Lobo, B., Mercer, J., Moye, P., Orlando, P., & Wargo, K. (2012). Acute Care Clinical Pharmacy Practice: Unit- versus Service-based Models. *Pharmacotherapy, 32*(2), e35-e44.

Hadi, M. A., & Awaisu, A. (2010). Postgraduate Programs in Clinical Pharmacy and Pharmacy Practice: Are we Heading in the Right Direction? *American Journal if Pharmaceutical Education, 74*(4), 1-2.

Harris, M., & Taylor, G. (2009). *Medical and Helath Science Statistics Made Easy*. Massachusetts: Jones and Bartlett Publishers.

Hepler, C., & Strand, L. (1990). Opportunities and Responsibilities in Pharmaceutical Care. *American Journal of Hospital Pharmacy, 47*, 533-543.

Institute for Healthcare Improvement. (2012). How-to guide: Prevent harm from High-Alert medications Retrieved 24 May, 2014, from http://www.ihi.org/resources/Pages/Tools/HowtoGuidePreventHarmfromHighAlertMedications.aspx

Intelligent Medical Systems. (2014). Bluebird Clinical Web Service Retrieved 24 May, 2014, from http://www.intelms.com/index.html

James, D. N. (2013). Anaesthesia Services for Acute Pain ManagementGuidelines for the Provision of Anaesthetic Services (pp. 1-7): The Royal College of Anaesthetists.

Jamshed, S., Babar, Z., & Masood, I. (2007). The PharmD Degree in Developing Countries. *American Journal if Pharmaceutical Education, 71*(6), 1-2.

Jiang, J., Liu, Y., Deng, P., & Li, Q. (2012). Bachelor's Degree Programs in Clinical Pharmacy in China. *American Journal of Pharmaceutical Education, 76*(8), 1-4.

Kaboli, P. (2008). Realizing the pharmacoeconomic benefit of clinical pharmacy. *American Journal of Health System Pharmacists, 65*, 1123. doi: 10.2146/ajhp080191

Kalyanakrishnan, R., & Salinas, R. C. (2007). Peptic Ulcer Disease. *American Family Physician, 76*(7), 1005-1012.

Kannan, G., Janardhan, V., Rani, V., Thennarasu, P., Kumar, A., & Reddy, U. M. (2011). Pharmaceutial care in the general medicine ward of a tertiary care hospital in South India. *Journal of Pharmacy Research, 4*(5), 1467-1469.

Keers, R. N., Williams, S. D., Cooke, J., & Ashcroft, D. M. (2013). Causes of Medication Administration Errors in Hospitals: a Systematic Review of Quantitative and Qualitative Evidence. *Drug Safety Journal, 36*, 1045-1067.

Keller, G., & Warrack, B. (2003). *Statistics for Management and Economics* (6 ed.). United States of America: Thomson.

Khalili, H., Farsaei, S., Rezaee, H., & Dashti-Khavidaki, S. (2011). Role of clinical pharmacists' interventions in detection and prevention of medication errors in a medical ward. [Research Support, Non-U.S. Gov't]. *Int J Clin Pharm, 33*(2), 281-284. doi: 10.1007/s11096-011-9494-1

Khalili, H., Karimzadeh, I., Mirzabeigi, P., & Dashti-Khavidaki, S. (2013). Evaluation of clinical pharmacist's interventions in an infectious diseases ward and impact on patient's direct medication cost. *Eur J Intern Med, 24*(3), 227-233. doi: 10.1016/j.ejim.2012.11.014

Kheir, N., Zaidan, M., Younes, H., Hajj, M., Wilbur, K., & Jewesson, P. (2008). Pharmacy Education and Practice in 13 Middle Eastern Countries. *American Journal of Pharmaceutical Education, 72*(6), 1-13.

Klopotowska, J. E., Kuiper, R., van Kan, H. J., de Pont, A. C., Dijkgraaf, M. G., Lie, A. H. L., Vroom, M. B., & Smorenburg, S. M. (2010). On-ward participation of a hospital pharmacist in a Dutch intensive care unit reduces prescribing errors and related patient harm: an intervention study. [Clinical Trial Comparative Study Research Support, Non-U.S. Gov't]. *Crit Care, 14*(5), R174. doi: 10.1186/cc9278

Klopotowska, J. E., Wierenga, P. C., de Rooij, S. E., Stuijt, C. C., Arisz, L., Kuks, P. F., Dijkgraaf, M. G., Lie, A. H. L., & Smorenburg, S. M. (2011). The effect of an active on-ward participation of hospital pharmacists in Internal Medicine teams on preventable Adverse Drug Events in elderly inpatients: protocol of the WINGS study (Ward-oriented pharmacy in newly admitted geriatric seniors). [Multicenter Study]. *BMC Health Serv Res, 11*, 124. doi: 10.1186/1472-6963-11-124

Kopp, B., Mrsan, M., Erstad, B., & Duby, J. (2007). Cost Complications and Potential Adverse Events Prevented by Interventions of a Critical Care Pharmacist. *American Journal of Health System Pharmacists, 64*, 2483-2487.

Kukukarslan, S., Peters, M., Mlynarek, M., & Nafziger, D. (2003). Pharmacists on Rounding Teams Reduce Preventable Adverse Drug Events in Hospital General Medicine Units. *Archives of INternal Medicine, 163*(7), 2014-2018.

Kumar, A., Roberts, D., Wood, K., Light, B., Parrillo, J., Sharma, S., Suppes, R., Feinstein, D., Zanotti, S., Taiberg, L., Gurka, D., Kumar, A., & Cheang, M. (2006). Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in spetic shock. *Critical Care Medicine, 34*(6), 1589-1596.

Lal, L. S., & Rao, P. G. (2005). Clinical pharmacy education in India. *American Journal of Health System Pharmacists, 62*, 1510-1511.

Langebrake, C., & Hilgarth, H. (2010). Clinical pharmacists' interventions in a German university hospital. *Pharm World Sci, 32*(2), 194-199. doi: 10.1007/s11096-010-9367-z

Le Blanc, J. M., & Dasta, J. F. (2005). Scope of International Hospital Pharmacy Practice. *The Annals of Pharmacotherapy, 39*, 183-191.

Leape, L., Bates, D., Cullen, D., Cooper, J., Demonaco, H., Gallivan, T., Hallisey, R., Ives, J., Laird, N., Laffel, G., Nemeskal, R., Petersen, L., Porter, K., Servi, D., Shea, B., Small, S., Sweitzer, B., Thompson, T., Van der Vliet, M., Hojnowski-Diaz, P., Petrycki, S., Cotugno, M., Patterson, H., Hickey, M., Kleefield, S., Kinneally, E., Dempsey Clapp, M., Hackman, R., & Edmondson, A. (1995). Systems Analysis of Adverse Drug Events: ADE Prevention Study Group. *The Journal of the American Medical Association, 274*(1), 35-43.

Leape, L., Cullen, D., Clapp, M., Burdick, E., Demonaco, H., Erickson, J., & Bates, D. (1999). Pharmacist Participation on Physician Rounds and Adverse Drug Events in the Intensive Care Unit. *The Journal of the American Medical Association, 282*(3), 267-270.

Leung, W. (2001). How to design a questionnaire. *Student British Medical Journal, 9*, 187-189.

Li, X., Huo, H., Kong, W., Li, F., & Wang, J. (2014). Physicians' perceptions and attitudes toward clinical pharmacy services in urban general hospitals in China. *International Journal of Clinical Pharmacy, 36*, 443-450.

Lucca, J. M., Ramesh, M., Narahari, G. M., & Minaz, N. (2012). Impact of clinical pharmacist interventions on the cost of drug therapy in intensive care units of a tertiary care teaching hospital. *J Pharmacol Pharmacother, 3*(3), 242-247. doi: 10.4103/0976-500X.99422

Mabasa, V., Malyuk, D., Tung, A., Balen, R., Nicolls, T., & Rahiman, N. (2010). Using Clinical Pharmacy Support Technicians to Optimize Pharmaceutical Care in the Intensive Care Unit. *THe Canadian Journal of Hospital Pharmacy, 63*(1), 41-45.

Marriott, J., Nation, R., Roller, L., Costelloe, M., Galbraith, K., Stewart, P., & Charman, W. (2008). Pharmacy Education in the Context of Australian Practice. *American Journal of Health System Pharmacists, 72*(6), 1-12.

Martinez-Sanchez, A. M., Ribeiro, E., & Storpirtis, S. (2005). Clinical Pharmacy at the University Hospital from Sao Paulo, Brazil. *Pharmacy World and Science Journal, 27*, 421-422.

Masango, T. A. (2014). *Progress on the registration of clinical pharmacy as a speciality in South Africa*.
Paper presented at the South African Society of Clinical Pharmacy, Cape Town. http://www.mm3admin.co.za/documents/docmanager/b3960be6-cfef-e311-93fa-002590a85a77/00073451.pdf

Matsoso, M. P. (2009). Future vision and challenges for hospital pharmacy. *Am J Health Syst Pharm, 66*(5 Suppl 3), S9-12. doi: 10.2146/ajhp080628

Mialon, P., Williams, P., & Wiebe, R. (2004). Clinical Pharmacy Services in a Pediatric Emergency Room. *Pediatric Therapeutics, 39*(2), 121-124.

Miller, G., Franklin, B. D., & Jacklin, A. (2011). Including pharmacists on consultant-led ward rounds: a prospective non-randomised controlled trial. [Controlled Clinical Trial
Multicenter Study Research Support, Non-U.S. Gov't]. *Clin Med, 11*(4), 312-316.

Moyen, E., Camire, E., & Stelfox, H. (2008). Clinical review: Medication errors in critical care. *Critical Care, 12*(208), 7. Retrieved from http://ccforum.com/content/pdf/cc6813.pdf doi:10.1186/cc6813

National Health Service. (2013). Retrieved 21/04/2013, from http://www.medicinesresources.nhs.uk/upload/documents/Communities/SPS_E_SE_England/NEP_Pharmacy_intervention_form.pdf

Neville, H. L., Chevalier, B., Daley, C., Nodwell, L., Harding, C., Hiltz, A., MacDonald, T., Skedgel, C., MacKinnon, N. J., & Slayter, K. (2014). Clinical benefits and economic impact of post-surgical care provided by pharmacists in a Canadian hospital. *International Journal of Pharmacy Practice, 22*, 216-222.

Nielsen, T. R., Andersen, S. E., Rasmussen, M., & Honore, P. H. (2013). Clinical pharmacist service in the acute ward. *International Journal of Clinical Pharmacy, 35*, 1137-1151.

Ohl, C., & Luther, V. (2011). Antimicrobial Stewardship for Inpatient Facilities. *Journal of Hospital Medicine, 6*(1), S4-S15.

Pacey, S., & Li Wan Po, A. (1998). A Review of Methods of Drug Cost Management in Hospitals. *Journal of Clinical Pharmacy and Therapeutics, 23*, 171-177.

Penm, J., Moles, R., Wang, H., Li, Y., & Chaar, B. (2014). Factors Affecting the Implementation of Clinical Pharmacy Services in China. *Qualitative Health Research, 24*(3), 345-356.

Peterson, G. M., Wu, M. S. H., & Bergin, J. K. (1999). Pharmacists' attitudes towards dispensing errors: their causes and prevention. *Journal of Clinical Pharmacy and Therapeutics, 24*, 57-71.

Pickette, S. G., Muncey, L., & Wham, D. (2010). Implementation of a standard pharmacy clinical practice model in a multihospital system. *Am J Health Syst Pharm, 67*(9), 751-756. doi: 10.2146/ajhp090283

Picone, D., Titler, M., Dochterman, J., Shever, L., Kim, T., Abramowitz, P., Kanak, M., & Qin, R. (2008). Predictors of Medication Errors Among Elderly Hospitalized Patients. *American Journal of Medical Quality, 23*(2), 115-127.

Poh, E., Nigro, O., Avent, M., & Doecke, C. (2009). Pharmaceutical Reforms: Clinical Pharmacy Ward Services versus a Medical Team Model. *Journal of Pharmacy Practice and Research, 39*(3), 176-180.

Poon, E. G., Cina, J. L., Churchill, W., Patel, N., Featherstone, E., Rothschild, J. M., Keohane, C. A., Whittemore, A. D., Bates, D. W., & Gandhi, T. K. (2006). Medication Dispensing Errors and Potential Adverse Drug Events before and after Implementing Bar Code Technology in the Pharmacy. *Annals of Internal Medicine, 145*(6), 426-434.

Poon, E. G., Keohane, C. A., Yoon, C. S., Ditmore, M., Bane, A., Levtzion-Korach, O., Moniz, T., Rothschild, J. M., Kachalia, A. B., Hayes, J., Churchill, W. W., Lipsitz, S., Whittemore, A. D., Bates, D. W., & Gandhi, T. K. (2010). Effect of Bar-Code Technology on the Safety of Medication Administration. *The New England Journal of Medicine, 362*, 1698-1707.

Rogers, A. E., Hwang, W., Scott, L. D., Aiken, L. H., & Dinges, D. F. (2004). The Working Hours of Hospital Staff Nurses and Patient Safety. *Health Affairs, 23*(4), 202-212.

Saddique, A. (2012). Development of Clinical Pharmacy services at King Khalid University Hospital and its impact on the qaulity of healthcare provided. *Saudi Pharmaceutical Journal, 20*, 273-277.

Salkind, A. R., & Rao, K. C. (2011). Antibiotic Prophylaxis to Prevent Surgical Site Infections. *American Family Physician, 83*(5), 585-590.

Schellack, N., & Gous, A. (2011). An overview of the time needed to render critical ward services in a neonatal intensive care unit: documenting the activities of a clinical pharmacist. *South African Pharmaceutical Journal, 78*(10), 29-33.

Schumock, G., Butler, M., Meek, P., Vermeulen, L., Arondekar, B., & Bauman, J. (2003). Evidence of the Economic Benefit of Clinical Pharmacy Services: 1996-2000. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy, 23*(1), 113-132.

Siska, M. H., & Tribble, D. A. (2011). Opportunities and challenges related to technology in supporting optimal pharmacy practice models in hospitals and health systems. *American Journal of Health System Pharmacists, 68*, 1116-1126.

Smith, F. (2000). Evaluation of pharmaceutical services: Methods and measures. [Review]. *The International Journal of Pharmacy Practice, 8*, 60-76.

Smith, F. (2005). *Conducting your Pharmacy Practice Research Project*. London: Pharmaceutical Press.

Sosabowski, M., & Gard, P. (2008). Pharmacy Education in the United Kingdom. *American Journal of Health System Pharmacists, 72*(6), 1-7.

South African Pharmacy Council. (2010). Good Pharmacy Practice in South Africa. In O. o. t. Registrar (Ed.), (Fourth ed., pp. 1-243). Retrieved from http://www.pharmcouncil.co.za/G_PublicationsD.asp.

South African Pharmacy Council. (2013). Education: Accreditation of Courses.

South African Society of Clinical Pharmacy. (2011). Constitution of the South African Society of Clinical Pharmacy Retrieved 22 March 2013, from http://www.sasocp.co.za/downloads/SASOCP%20Constitution%2030%20th%20of%20June%202011.pdf

Stone, P., & Curtis, S. (2002). Pharmacy Practice *Pharmacy Practice* (3 ed., pp. 145-175). London: Pharmaceutical Press.

The Merck Manual of Medical Information. (2009). Major Organ Systems Retrieved 20 August, 2014, from http://www.merckmanuals.com/home/fundamentals/the_human_body/organ_systems.html

Tisdale, J., & Hall, K. (2012). Hospital Pharmacy in Canada: Ahead of the Curve. *Canadian Journal of Hospital Pharmacy, 65*(5), 345-346.

Tully, M. (2000). The impact of information technology on the performance of clinical pharmacy services. *Journal of Clinical Pharmacy and Therapeutics, 25*, 243-249.

University Health System Consortium. (2010). Pharmacy Practice Model for Academic Medical Centers Retrieved 5 October 2014, from http://www.ashp.org/DocLibrary/PPMI/PPMI-Academic-Medical-Centers-University.aspx

van Doormaal, J. E., van den Bemt, P. M., Zaal, R. J., Egberts, A. C., Lenderink, B. W., Kosterink, J. G., Haaijer-Ruskamp, F. M., & Mol, P. G. (2009). The Influence that Electronic Prescribing has on Medication Errors and Preventable Adverse Drug Events: an Interrupted Time-series Study. *Journal of the American Medical Informatics Association, 16*(6), 816-825.

Vessal, G. (2010). Detection of prescription errors by a unit-based clinical pharmacist in a nephrology ward. *Pharm World Sci, 32*(1), 59-65. doi: 10.1007/s11096-009-9341-9

Vine, D. G. (2007). More about...Practice Management. *Continuing Medical Education, 25*(1), 30-32.

Weant, K., Armitstead, J., Ladha, A., Sasaki-Adams, D., Hadar, E., & Ewend, M. (2009). Cost effectiveness of a clinical pharmacist on a neurosurgical team. *Neurosurgery, 65*(5), 946-950.

Welzel, T. (2012). Patient Safety: Minimising Medical Error. *CME, 30*(11), 406-409.

Wood, B. (2012). Medication Adherence: The Real Problem When Treating Chronic Conditions. *US Pharmacist, 37*(4), 3-6.

World Health Organization. (2002). Infection control programmes. In G. Ducel, J. Fabry & L. Nicolle (Eds.), *Prevention of hospital-acquired infections: A practical guide* (pp. 1-64): World Health Organization.

World Health Organization. (2014, April 2014). Antimicrobial resistance Retrieved 5 October, 2014, from http://www.who.int/mediacentre/factsheets/fs194/en/

World Medical Association Declaration of Helsinki. (2001). Ethical Principles for Medical Research Involving Human Subjects. *Bulletin of the World Health Organisation, 79*(4), 373-374.

Yee, G., & Haas, C. (2014). Standards of Practice for Clinical Pharmacists: The Time Has Come. *Pharmacotherapy, 34*(8), 769-770.

Zaal, R., Jansen, M., Duisenberg-van Essenberg, M., Tijssen, C., Roukema, J., & Van den Bemt, P. (2013). Identification of drug-related problems by a clinical pharmacist in addition to computerized alerts. *International Journal of Clinical Pharmacy, 35*, 753-762. doi: 10.1007/s11096-013-9798-4

APPENDIX 1.1: PATIENT CONSENT FORM

13 January 2014

Dear Patient,

Research is currently being conducted in this ward over a period of 3 months, from 01 April 2014 to 30 May 2014. The current practice in the ward will be monitored and recorded. The purpose of the research is to improve service delivery and patient care.

Participation in the research is voluntary. By signing this form you are voluntarily agreeing to participate in the research. Patient confidentiality will be maintained at all times during the research.

If you have any queries about the research, please feel free to contact:

Leanne Stone (MPharm candidate) 0843731995 / leannenicoleschmidt@gmail.com

Lia Kritiotis (Supervisor – NMMU) 0827538017 / lia.kritiotis@nmmu.ac.za

_____ _____

Patient signature Date

APPENDIX 1.2: COVER LETTER – MEDICAL PRACTITIONER AND NURSE PRE-INTERVENTION QUESTIONNAIRE

Pharmacy Department

Building 12

South Campus

Faculty of Health Sciences

Nelson Mandela Metropolitan University

13 January 2014

Attention: Medical practitioners and Nurses (Surgical Ward)

My name is Leanne Stone and I am presently a ward pharmacist. I am currently registered as a part time student for a Master's degree in pharmacy at the Nelson Mandela Metropolitan University (NMMU). The topic for the research is: 'The impact of a ward pharmacist in a surgical ward of a private hospital in the Eastern Cape'.

The research will be conducted at this hospital site over a period of twelve weeks. The aim of the study is to evaluate the perceived benefits of a ward-based pharmacist on the provision of pharmaceutical care to patients in a hospital setting and to consequently implement a ward-based pharmacy service. Clinical ward-based pharmacy is a fairly new practice in South Africa. The motivation for the study is due to the fact that a ward-based pharmacist fulfils an important role in improving medication safety and patient pharmaceutical care.

The first phase of the study requires your participation, by completing the attached questionnaire. The purpose of this phase of the study is to establish your understanding, views and expectations of a ward-based pharmacy service.

Your contribution during this phase of the study is appreciated. Thank you for your time and participation in the study.

Yours sincerely,

Leanne Stone	Miss Lia Kritiotis	Dr Susan Burton
Master's Student	Supervisor	Co-supervisor

APPENDIX 1.3: COVER LETTER – MEDICAL PRACTITIONER AND NURSE POST-INTERVENTION QUESTIONNAIRE

Pharmacy Department

Building 12

South Campus

Faculty of Health Sciences

Nelson Mandela Metropolitan University

13 January 2014

Attention: Medical practitioners and Nurses (Surgical Ward)

My name is Leanne Stone and I am presently a ward pharmacist. I am currently registered as a part time student for a Master's degree in pharmacy at the Nelson Mandela Metropolitan University (NMMU). The topic for the research is: 'The impact of a ward pharmacist in a surgical ward of a private hospital in the Eastern Cape'.

The research is being conducted at this hospital site over a period of twelve weeks. The aim of the study is to evaluate the perceived benefits of a ward-based pharmacist on the provision of pharmaceutical care to patients in a hospital setting and to consequently implement a ward-based pharmacy service. Clinical ward-based pharmacy is a fairly new practice in South Africa. The motivation for the study is due to the fact that a ward-based pharmacist fulfils an important role in improving medication safety and patient pharmaceutical care.

The third phase of the study requires your participation, by completing the following questionnaire. The purpose of this phase of the study is to determine whether there are changes in your opinions and attitudes towards ward-based clinical pharmacy and whether your expectations of the ward-based pharmacy service have been met.

Your contribution during this phase of the study is appreciated. Thank you for your time and participation in the study.

Yours sincerely,

_____	_____	_____
Leanne Stone	Miss Lia Kritiotis	Dr Susan Burton
Master's Student	Supervisor	Co-supervisor

APPENDIX 2: LETTER REQUESTING PERMISSION FROM PRIVATE HOSPITAL

Pharmacy Department

Building 12

South Campus

Faculty of Health Sciences

Nelson Mandela Metropolitan University

13 January 2014

Attention: Hospital Manager and Pharmacy Manager

My name is Leanne Stone and I am presently employed as a ward pharmacist. I am currently registered as a part time student for a Master's degree in pharmacy at the Nelson Mandela Metropolitan University (NMMU).

The topic for the research is: 'The impact of a ward pharmacist in a surgical ward of a private hospital in the Eastern Cape'. I would like to conduct the research in a surgical ward at this hospital site. In this regard, I would like to request permission from the hospital manager, pharmacy manager and the Netcare Research Ethics Committee. Currently, I engage with hospital patients in the wards, which forms part of my responsibility as ward pharmacist. In addition, I would like to request permission to interview nursing staff and doctors, both before and after implementing the service in the ward. The data will be collected over a period of 3 months. The ward pharmacy service will not be withdrawn from the ward after the data collection period. Confidentiality will be maintained at all times during the study. Ethical approval has been sought from the Faculty Research Committee (FRTI and REC-H) at NMMU.

Please contact me should you have any queries relating to the study. Email: leannenicoleschmidt@gmail.com

Yours sincerely,

Leanne Stone	Miss Lia Kritiotis	Dr Susan Burton
Master's Student	Supervisor	Co-supervisor

APPENDIX 3: MEDICAL PRACTITIONER PRE-INTERVENTION QUESTIONNAIRE

PHARMACY DEPARTMENT
Faculty of Health Sciences

Analysis of Ward-based Pharmacy

Medical Practitioner Pre-intervention Questionnaire Questionnaire Number: ☐

Please place an (X) in the appropriate box Date: _____

Section A: Personal Information	
1.	Gender: ☐ Female ☐ Male
2.	Number of years registered as a practitioner: ☐ 1-4 ☐ 5-9 ☐ 10-19 ☐ 20+
3.	Specialist Category: ☐ General Practitioner ☐ Orthopaedic ☐ Gynaecology ☐ Cardiology ☐ Physician ☐ Plastic Surgeon ☐ Ear, Nose & Throat ☐ Anaesthetist ☐ Urology ☐ Gastro-enterology ☐ Neurology If none of the above, please specify: _____
4.	Number of years in specialist category: ☐ 1-4 ☐ 5-9 ☐ 10-19 ☐ 20+
Section B: Awareness and Understanding of Clinical Ward-based Pharmacy	
1.	Are you aware of clinical (ward-based) pharmacy practice? ☐ Yes ☐ No
2.	Have you ever practised at a hospital (excluding Greenacres) where you were aware of ward/clinical pharmacist? ☐ Yes ☐ No If **Yes**, please state whether the institution was a: ☐ Private Hospital ☐ Public Hospital ☐ Clinic ☐ Other Was the institution in South Africa? ☐ Yes ☐ No If **Yes**, in which province: _____ If **No**, in which country: _____

3	In your opinion, what do you understand by the term 'clinical ward-based pharmacy'? _____ _____					
Section C: Opinions and Expectations of a Clinical Ward-based Pharmacy Service						
1.	On a scale of 1 to 5, where 1 is ***strongly disagree*** and 5 is ***strongly agree***, to what extent do you agree with the following statements: **1 = Strongly Disagree** **2 = Disagree** **3 = Neutral** **4 = Agree** **5 = Strongly Agree**					
1.1	It is necessary to have a pharmacist in hospital wards	1	2	3	4	5
1.2	Pharmacists should be more present in hospital wards	1	2	3	4	5
1.3	I would prefer a pharmacist to be present when prescribing medication	1	2	3	4	5
1.4	A ward-based pharmacy service will be beneficial to:					
a.	Medical Practitioners	1	2	3	4	5
b.	Nursing Staff	1	2	3	4	5
c.	Patients	1	2	3	4	5
1.5	Pharmacists play an important role in improving medication safety	1	2	3	4	5
1.6	A ward-based pharmacist will reduce medication error rate	1	2	3	4	5
1.7	It will be beneficial to have a ward pharmacist to handle medication-related queries	1	2	3	4	5
1.8	The potential services offered by a ward-pharmacist will assist me to optimise patient care in less time	1	2	3	4	5
1.9	The pharmacist plays an important role in medication counselling at discharge	1	2	3	4	5
1.10	I will be available for queries from a ward pharmacist	1	2	3	4	5
1.11	I expect the pharmacist to inform me of any prescription errors	1	2	3	4	5
1.12	I am willing to incorporate appropriate recommendations from a ward-pharmacist into patient therapy	1	2	3	4	5
2.	On a scale of 1 to 5, where 1 is ***no importance*** and 5 is ***high importance***, how would you rate the importance of a ward pharmacist providing the following services:					

	1 = No importance **2 = Slightly important** **3 = Neutral** **4 = Important** **5 = High importance**					
2.1	Medication chart review to ensure:					
a.	Optimal medication choice	1	2	3	4	5
b.	Ensuring cost-effective treatment	1	2	3	4	5
c.	Appropriate dose	1	2	3	4	5
2.2	Detecting medication errors	1	2	3	4	5
2.3	Medication counselling	1	2	3	4	5
2.4	Providing a drug information service	1	2	3	4	5
2.5	Dispensing from a computer in the ward instead of from a central pharmacy	1	2	3	4	5
2.6	Detecting and reporting adverse drug reactions	1	2	3	4	5
2.7	Monitoring medication outcome	1	2	3	4	5
2.8	Participation in ward rounds	1	2	3	4	5
2.9	Antibiotic Stewardship	1	2	3	4	5
2.10	Other: _____	1	2	3	4	5
3.	In your opinion, what will be the greatest benefit of a ward/clinical pharmacy service for the:					
3.1	Medical Practitioner? _____ _____ _____					
3.2	Nursing Staff? _____ _____ _____					

3.3	Patient? _____ _____ _____
4.	Do you have any concerns about the participation of a ward/clinical pharmacist in the care of the patient? Yes No If **Yes**, please provide concern/s:_____ _____ _____
5.	Other comments/recommendations: _____ _____ _____

APPENDIX 4: NURSE PRE-INTERVENTION QUESTIONNAIRE

PHARMACY DEPARTMENT
Faculty of Health Sciences

Analysis of Ward-based Pharmacy

Nurse Pre-intervention Questionnaire Questionnaire Number: ☐

Please place an (X) in the appropriate box Date: _____

Section A: Personal Information	
1.	Gender: ☐ Female ☐ Male
2.	Number of years in practice: ☐ 1-4 ☐ 5-9 ☐ 10-19 ☐ 20+
3.	Specialist Category: ☐ Registered Nurse ☐ Enrolled Nurse ☐ Enrolled Nursing Assistant ☐ Care Worker ☐ Student Nurse If none of the above, please specify: _____
Section B: Awareness and Understanding of Clinical Ward Pharmacy	
1.	Are you aware of clinical (ward-based) pharmacy practice? ☐ Yes ☐ No
2.	Have you ever practised at a hospital (excluding Greenacres) where there has been a ward/clinical pharmacist? ☐ Yes ☐ No ☐ Uncertain If **Yes**, please state whether the institution was a: ☐ Private Hospital ☐ Public Hospital ☐ Clinic ☐ Other Was the institution in South Africa? ☐ Yes ☐ No If **Yes**, in which province: _____ If **No**, in which country: _____
3.	In your opinion, what do you understand by the term 'clinical ward-based pharmacy'? _____ _____

	_____ _____					
Section C: Opinions and Expectations of a Clinical Ward-based Pharmacy Service						
1.	On a scale of 1 to 5, where 1 is ***strongly disagree*** and 5 is ***strongly agree***, to what extent do you agree with the following statements: **1 = Strongly Disagree** **2 = Disagree** **3 = Neutral** **4 = Agree** **5 = Strongly Agree**					
1.1	It is necessary to have a pharmacist in hospital wards	1	2	3	4	5
1.2	Pharmacists should be more present in hospital wards	1	2	3	4	5
1.3	When administering medication, it is useful to have a pharmacist present in the ward	1	2	3	4	5
1.4	A ward-based pharmacy service will be beneficial to:					
a.	Medical Practitioner	1	2	3	4	5
b.	Nursing Staff	1	2	3	4	5
c.	Patients	1	2	3	4	5
1.5	Pharmacists play an important role in improving medication safety	1	2	3	4	5
1.6	A ward-based pharmacist will reduce medication error rate	1	2	3	4	5
1.7	It will be beneficial to have a ward pharmacist to handle medication-related queries	1	2	3	4	5
1.8	The potential services offered by a ward-pharmacist will assist me to optimise patient care in less time	1	2	3	4	5
1.9	The pharmacist plays an important role in medication counselling at discharge	1	2	3	4	5
1.10	I will be available for queries from a ward pharmacist	1	2	3	4	5
1.11	I expect the pharmacist to inform me of any medication administration errors	1	2	3	4	5
1.12	I am willing to accept appropriate recommendations from a ward-pharmacist	1	2	3	4	5
2.	On a scale of 1 to 5, where 1 is ***no importance*** and 5 is ***high importance***, how would you rate the importance of a ward pharmacist providing the following services: **1 = No importance**					

	2 = Slightly important **3 = Neutral** **4 = Important** **5 = High importance**					
2.1	Medication chart review to ensure:					
a.	Optimal medication choice	1	2	3	4	5
b.	Ensuring cost-effective treatment	1	2	3	4	5
c.	Appropriate dose	1	2	3	4	5
2.2	Detecting medication errors	1	2	3	4	5
2.3	Medication counselling	1	2	3	4	5
2.4	Providing a drug information service	1	2	3	4	5
2.5	Dispensing from a computer in the ward instead of from a central pharmacy	1	2	3	4	5
2.6	Detecting and reporting adverse drug reactions	1	2	3	4	5
2.7	Monitoring medication outcome	1	2	3	4	5
2.8	Participation in ward rounds	1	2	3	4	5
2.9	Antibiotic Stewardship	1	2	3	4	5
2.10	Other: _____	1	2	3	4	5
3.	In your opinion, what will be the greatest benefit of a ward/clinical pharmacy service for the:					
3.1	Medical Practitioner? _____ _____ _____					
3.2	Nursing Staff? _____ _____ _____					

3.3	Patient? _____ _____ _____
4.	Do you have any concerns about the participation of a ward/clinical pharmacist in the care of the patient? Yes No If **Yes,** please provide concern/s_____ _____ _____
5.	Other comments/recommendations: _____ _____ _____

APPENDIX 5: AUDIT AND INTERVENTION FORM

PHARMACY DEPARTMENT
Faculty of Health Sciences

Analysis of Ward-based Pharmacy

Audit and Intervention Form Date: _____

Please place an (X) in the appropriate box

Section A: Demographic Information	
Admission Number:	Bed Number:
Admission Date: _____	Discharge Date: _____
Length of Hospital Stay (days): _____	Gender: F M
Age (years): 18-29 30-39 40-49 50-59 60-69 70-79 80 +	
Weight (kg): _____	Height (m): _____
Allergies: _____	
Chronic Diseases: 1.) _____ 2.) _____ 3.) _____ 4.) _____	
Reason for admission: _____	
Surgical Procedure been Performed? Y N If YES, type of surgical procedure: _____	
Date of Surgical Procedure: _____	
Surgeon:_____ Physician:_____ Anaethetist:_____ Other:_____	

Section B: Medication Information Acute Medication Items:			
#	**Item Name, Dose, Route, Frequency**	**Start Date**	**Stop Date**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
Chronic Medication Items:			
#	**Item Name, Dose, Route, Frequency**	**Start Date**	**Stop Date**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Lab Results:											
Date:											
CRP											
WBC											
PCT											
Platelets											
Fungitell											

Notes/Follow-up Required:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Intervention required? YES NO

If **YES**, continue to complete intervention sections (C and D)

Section C: Details of Intervention						
1.	Number of interventions made:					
2.	Interventions pertained to acute or chronic medication: Acute Chronic					
3.	Intervention(s) directed at: Prescriber Nurse Other Patient					
4.	Brief description of Intervention(s): _____ _____ _____ _____ _____ _____ _____ _____					
5.	Intervention/s involved the following medication class/es:					
	5.1	Anti-diarrhoeals	5.2	Anti-thrombotics	5.3	Cardiovascular agents
	5.4	Laxatives Purgatives	5.5	Anti-hypertensives	5.6	Anti-inflammatories
	5.7	Analgesics	5.8	Anti-emetics	5.9	Lipid modifying agents
	5.10	Anti-diabetics	5.11	Anti-epileptics	5.12	Sedative/Hypnotics
	5.13	Anti-psychotics	5.14	Anti-depressants	5.15	Anti-parkinsonian
	5.16	Inhaled Corticosteroids	5.17	Anti-ulcer agents	5.18	Anti-histamines
	5.19	Corticosteroids	5.20	Bronchodilators	5.21	Anti-malarials
	5.22	Vitamins/Minerals	5.23	Anti-haemorrhagic agents	5.24	Anti-microbials
	5.25	Other:				

6.	Intervention was made by means of: Pharmacist suggestion form / Telephonic Conversation / Direct Conversation
7.	Intervention was: Accepted / Ignored / Acknowledged
8.	Feedback/comments from medical practitioner: _____ _____ _____ _____
9.	Approximate time taken to make intervention: [0 – 4 minutes) / [5 - 15minutes) / [16 - 29 minutes) / > 30 minutes
10.	Cost saving per day (in Rands): _____
11.	Cost saving benefit due to: Medication Discontinued / IV to oral switch / Formulary Compliance / Generic Substitution
12.	Level of Intervention (to be determined by an independent reviewer):

12.1	Patient unaffected	**A**
12.2	Patient affected but no harm caused	**B**
12.3	Patient affected and could cause potential harm	**C**
12.4	Patient affected and temporary harm caused	**D**
12.5	Patient affected and permanent harm caused	**E**
12.6	Life threatening	**F**

13.	Perceived Benefit of Intervention(s) to Patient on a ***Scale of 1 to 3:*** ***1 = No Improvement*** ***2 = Minor Improvement*** ***3 = Major Improvement***			
13.1	Improved therapeutic effectiveness	1	2	3
13.2	Improved monitoring of therapy	1	2	3
13.3	Improved compliance	1	2	3
13.4	Side effects/toxicity prevented	1	2	3
13.5	Cost-saving benefit	1	2	3
13.6	Other: _____	1	2	3

Section D: Medication Intervention Categories 1. Prescribing errors:		
1.1	Incorrect drug prescribed for indication	
1.2	Sub therapeutic dose prescribed	
1.3	Dosage too high	
1.4	Dosage adjustment required for renal failure or liver impairment	
1.5	Incorrect frequency prescribed	
1.6	Inappropriate dosage form	
1.7	Incorrect route of administration	
1.8	Unnecessary drug use	
1.9	Duplication of therapy	
1.10	Contra-indication for the medication	
1.11	Patient allergic to medication	
1.12	Potential adverse drug-drug interaction between medications prescribed	
1.13	Other:	

	_____	
2. Transcribing errors:		
2.1	Omission of medication	
2.2	Incorrectly transcribed from original prescription	
2.3	Telephonic order taken incorrectly	
2.4	Prescription not legal	
2.5	Other: _____	
3. Dispensing errors:		
3.1	Incorrect medication dispensed	
3.2	Medication charged to incorrect patient	
3.3	Incorrect directions for use on medication	
3.4	Incorrect or omitted storage/stability instructions on label	
3.5	Other: _____	
4. Administration errors:		
4.1	Incorrect time of administration	
4.2	Incorrect medication administered	
4.3	Incorrect administration technique	
4.4	Administered dose too high	
4.5	Administered dose too low	
4.6	Incorrect route of administration	
4.7	Missed dose	
4.8	Stability of medication affected when administered	
4.9	Duration of treatment longer than prescribed	
4.10	Duration of treatment shorter than prescribed	
4.11	Other: _____	

5. Pharmacist initiated interventions to optimise patient care:		
5.1	Advised on therapeutic drug level monitoring	
5.2	Adverse drug event noted and reported	
5.3	Drug-drug interaction identified	
5.4	Identification and resolution of medication-induced effects experienced or reported by the patient	
5.5	Switching to generic/cheaper alternative	
5.6	Switching from IV to oral medication	
5.7	Recommendation for medication to be initiated	
5.8	Recommendation for medication to be discontinued	
5.9	Counselling/provision of medicine information to a medical practitioner	
5.10	Counselling/provision of medicine information to nursing staff	
5.11	Counselling/provision of medicine information to a patient	
5.12	Assisting with patient compliance for chronic medication	
5.13	Identification of antibiotic hang time on Day 1 of treatment (not administered within 60 minutes from prescribing)	
5.14	Laboratory results required	
5.15	Laboratory results requested	
5.16	Other: _____	

APPENDIX 6: PHARMACIST SUGGESTION FORM

Pharmacist Suggestion Form	
Date: _____	Time: _____
Hospital admission number: _____	
Pharmacist Name: _____	
Pharmacist contact number: _____	
Suggestion/Query: _____ _____ _____ _____ _____	
Pharmacist Signature: _____	
Medical Practitioner feedback: _____ _____ _____ _____	
Medical Practitioner Signature: _____	

APPENDIX 7: MEDICAL PRACTITIONER POST-INTERVENTION QUESTIONNAIRE

PHARMACY DEPARTMENT
Faculty of Health Sciences

Analysis of Ward-based Pharmacy

Medical Practitioner Post-intervention Questionnaire Questionnaire Number: ☐

Please place an (X) in the appropriate box Date: _____

Section A: Personal Information						
1.	Gender: ☐ Female ☐ Male					
2.	Number of years registered as a practitioner: ☐ 1-4 ☐ 5-9 ☐ 10-19 ☐ 20+					
3.	Specialist Category: ☐ General Practitioner ☐ Orthopaedic ☐ Gynaecology ☐ Cardiology ☐ Physician ☐ Plastic Surgeon ☐ Ear, Nose & Throat ☐ Anaesthetist ☐ Urology ☐ Gastro-enterology ☐ Neurology If none of the above, please specify: _____					
4.	Number of years in specialist category: ☐ 1-4 ☐ 5-9 ☐ 10-19 ☐ 20+					
Section B: Assessment of the Clinical Ward-based Pharmacy Service						
1.	On a scale of 1 to 5, where 1 is ***strongly disagree*** and 5 is ***strongly agree***, to what extent do you agree with the following statements: **1 = Strongly Disagree** **2 = Disagree** **3 = Neutral** **4 = Agree** **5 = Strongly Agree**					
1.1	It is necessary to have a pharmacist in hospital wards	1	2	3	4	5
1.2	It was beneficial having a pharmacist more present in the ward	1	2	3	4	5
1.3	It was useful having the pharmacist in the ward when prescribing medication	1	2	3	4	5
1.4	The ward pharmacy service was beneficial to:					

a.	Medical Practitioners	1	2	3	4	5
b.	Nursing Staff	1	2	3	4	5
c.	Patients	1	2	3	4	5
1.5	The pharmacist played an important role in improving medication safety	1	2	3	4	5
1.6	Having a pharmacist in the ward reduced the risk for potential medication errors	1	2	3	4	5
1.7	It was beneficial having a pharmacist to handle medication-related queries	1	2	3	4	5
1.8	The services offered by a ward pharmacist assisted me to optimise patient care in less time	1	2	3	4	5
1.9	The pharmacist played an important role in medication counselling at discharge	1	2	3	4	5
1.10	I was comfortable with the pharmacist reviewing my prescribing	1	2	3	4	5
1.11	Recommendations made by the pharmacist were useful	1	2	3	4	5
1.12	The pharmacist was available to handle any queries	1	2	3	4	5
1.13	The pharmacist provided useful information on any medication-related queries	1	2	3	4	5
1.14	I found the pharmacist suggestion form to be useful	1	2	3	4	5
1.15	My expectations of the ward/clinical pharmacy service have been met	1	2	3	4	5
Section C: Views and Expectations of the Ward-based Pharmacy Service						
1.	On a scale of 1 to 5, where 1 is ***no importance*** and 5 is ***high importance***, how would you rate the importance of a ward pharmacist providing the following services: **1 = No importance** **2 = Slightly important** **3 = Neutral** **4 = Important** **5 = High importance**					
1.1	Medication chart review to ensure:					
a.	Optimal medication choice	1	2	3	4	5
b.	Ensuring cost-effective treatment	1	2	3	4	5
c.	Appropriate dose	1	2	3	4	5
1.2	Detecting medication errors	1	2	3	4	5
1.3	Medication counselling	1	2	3	4	5
1.4	Providing a drug information service	1	2	3	4	5
1.5	Dispensing from a computer in the ward instead of from a central pharmacy	1	2	3	4	5

1.6	Detecting and reporting adverse drug reactions	1	2	3	4	5
1.7	Monitoring medication outcome	1	2	3	4	5
1.8	Participation in ward rounds	1	2	3	4	5
1.9	Antibiotic Stewardship	1	2	3	4	5
1.10	Other: _____	1	2	3	4	5
2.	In your opinion, what impact did the ward/clinical pharmacy service have on medical practitioners? _____ _____					
3.	Do you have any suggestions on how the ward/clinical pharmacy service can be improved? _____ _____					
4.	Do you still have any concerns about the ward/clinical pharmacy service, or have they been addressed? _____ _____					
5.	Other comments/recommendations: _____ _____ _____					

APPENDIX 8: NURSE POST-INTERVENTION QUESTIONNAIRE

PHARMACY DEPARTMENT
Faculty of Health Sciences

Analysis of Ward-based Pharmacy

Nurse Post-intervention Questionnaire Questionnaire Number: ☐

Please place an (X) in the appropriate box Date: _____

Section A: Personal Information						
1.	Gender: ☐ Female ☐ Male					
2.	Number of years in practice: ☐ 1-4 ☐ 5-9 ☐ 10-19 ☐ 20+					
3.	Specialist Category: ☐ Registered Nurse ☐ Enrolled Nurse ☐ Enrolled Nursing Assistant ☐ Care Worker ☐ Student Nurse If none of the above, please specify: _____					
Section B: Assessment of the Clinical Ward-based Pharmacy Service						
1.	On a scale of 1 to 5, where 1 is ***strongly disagree*** and 5 is ***strongly agree***, to what extent do you agree with the following statements: **1 = Strongly Disagree** **2 = Disagree** **3 = Neutral** **4 = Agree** **5 = Strongly Agree**					
1.1	It is necessary to have a pharmacist in hospital wards	1	2	3	4	5
1.2	It was beneficial having a pharmacist more present in the ward	1	2	3	4	5
1.3	It was useful having the pharmacist in the ward when administering medication	1	2	3	4	5
1.4	The ward pharmacy service was beneficial to:					
a.	Medical Practitioners	1	2	3	4	5
b.	Nursing Staff	1	2	3	4	5
c.	Patients	1	2	3	4	5

1.5	The pharmacist played an important role in improving medication safety	1	2	3	4	5
1.6	Having a pharmacist in the ward reduced the risk for potential medication errors	1	2	3	4	5
1.7	It was beneficial having a pharmacist to handle medication-related queries	1	2	3	4	5
1.8	The services offered by a ward pharmacist assisted me to optimise patient care in less time	1	2	3	4	5
1.9	The pharmacist played an important role in medication counselling at discharge	1	2	3	4	5
1.10	I was comfortable with the pharmacist monitoring medication administration	1	2	3	4	5
1.11	Recommendations made by the pharmacist were useful	1	2	3	4	5
1.12	The pharmacist was available to handle any queries	1	2	3	4	5
1.13	The pharmacist provided useful information on any medication-related queries	1	2	3	4	5
1.14	I found the pharmacist suggestion form to be useful	1	2	3	4	5
1.15	My expectations of the ward/clinical pharmacy service have been met	1	2	3	4	5

Section C: Views and Expectations of the Ward-based Pharmacy Service

1. On a scale of 1 to 5, where 1 is ***no importance*** and 5 is ***high importance***, how would you rate the importance of a ward pharmacist providing the following services:

1 = No importance
2 = Slightly important
3 = Neutral
4 = Important
5 = High importance

1.1	Medication chart review to ensure:					
a.	Optimal medication choice	1	2	3	4	5
b.	Ensuring cost-effective treatment	1	2	3	4	5
c.	Appropriate dose	1	2	3	4	5
1.2	Detecting medication errors	1	2	3	4	5
1.3	Medication counselling	1	2	3	4	5
1.4	Providing a drug information service	1	2	3	4	5
1.5	Dispensing from a computer in the ward instead of from a central pharmacy	1	2	3	4	5
1.6	Detecting and reporting adverse drug reactions	1	2	3	4	5
1.7	Monitoring medication outcome	1	2	3	4	5
1.8	Participation in ward rounds	1	2	3	4	5

1.9	Antibiotic Stewardship	1	2	3	4	5
1.10	Other: _____	1	2	3	4	5
2.	In your opinion, what impact did the ward/clinical pharmacy service have on nursing staff? _____ _____ _____					
3.	Do you have any suggestions on how the ward/clinical pharmacy service can be improved? _____ _____					
4.	Do you still have any concerns about the ward/clinical pharmacy service, or have they been addressed? _____ _____					
5.	Other comments/recommendations: _____ _____ _____					

APPENDIX 9: NMMU APPLICATION FOR ETHICAL APPROVAL

Nelson Mandela Metropolitan University
for tomorrow

D/496/05: APPLICATION FORM: ETHICS APPROVAL (HUMAN)

APPLICATION FOR APPROVAL
NMMU RESEARCH ETHICS COMMITTEE (HUMAN)

SECTION A: (To be filled in by a representative from the Faculty RTI Committee)					
Application reference code:	H HUMAN	..... YEAR	..... FACULTY	..... DEPARTMENT	..... NUMBER
Resolution of FRTI Committee:	☐ Ethics approval given (for noting by the REC-H) ☐ Referred to REC-H for consideration (if referred to REC-H, electronic copy of application documents to be emailed to Imtiaz.Khan@nmmu.ac.za)				
Resolution date:					
Faculty RTI representative signature:					

1. GENERAL PARTICULARS	
TITLE OF STUDY	
a) Concise descriptive title of study (must contain key words that best describe the study): **The Impact of a Ward Pharmacist in a Surgical Ward of a Private Hospital in the Eastern Cape**	
PRIMARY RESPONSIBLE PERSON (PRP)	
b) Name of PRP (must be member of permanent staff. Usually the supervisor in the case of students): **Miss L Kritiotis/Dr SF Burton 12/02/54**	
c) Contact number/s of PRP: **(041) 504 4334**	
d) Affiliation of PRP: Faculty **Health Sciences Specify here, if "other"** Department (or equivalent): Pharmacy	
PRINCIPLE INVESTIGATORS AND CO-WORKERS	
e) Name and affiliation of principal investigator (PI) / researcher (may be same as PRP): **Leanne Stone** Gender: **Female**	
f) Name(s) and affiliation(s) of all co workers (e.g. co-investigator/assistant researchers/supervisor/co-supervisor/promoter/co-promoter). If names are not yet known, state the affiliations of the groups they will be drawn from, e.g. Interns/M-students, etc. and the number of persons involved: **Leanne Stone (NMMU Master's Student) Miss L Kritiotis (Lecturer: Pharmacology; Supervisor) Dr SF Burton (Lecturer: Pharmacy Practice; Co-Supervisor)**	
STUDY DETAILS	
g) Scope of study: **Local**	h) If for degree purposes: **Master's**
i) Funding : **Other (specifics follow)** Additional information (e.g. source of funds or how combined funding is split) **Bursary from Employer**	
j) Are there any restrictions or conditions attached to publication and/or presentation of the study results? **No** If YES, elaborate (Any restrictions or conditions contained in contracts must be made available to the Committee): **Not applicable**	
k) Date of commencement of data collection: **2014/03/17**	

Anticipated date of completion of study: **2014**

l) Objectives of the study (the major objective(s) / Grand Tour questions are to be stated briefly and clearly):
To assess the perceptions and attitudes of prescribers and nursing staff to ward-based pharmacy; To evaluate the impact of a ward-based pharmacy service.

m) Rationale for this study: briefly (300 words or less) describe the background to this study i.e. why are you doing this particular piece of work. A few (no more than 5) key scientific references may be included:
Medication errors are becoming problematic in both hospital and outpatient settings worldwide. Inappropriate use of medication can cause harm to the patient and maintaining high levels of quality patient care is essential to protect all patients. Clinical pharmacy practice contributes to improved patient care by optimising medication therapy; and promoting health, wellness and disease prevention. The involvement of a pharmacist at a ward level has been shown to improve patient care; reduce mortality and morbidity rates; decrease healthcare costs; minimise medication errors; and improve outcomes of drug therapy. However, clinical pharmacy is a fairly new practice in South Africa and there are limited studies available. This study aims to evaluate the perceived benefits of a ward-based pharmacist on the provision of pharmaceutical care to patients in a hospital setting and to consequently implement a ward-based pharmacy service. The research will be in the form of an intervention study, using a mixed-methods design, with a convergent approach.

METHODOLOGY

n) Briefly state the methodology (specifically the procedure in which human subjects will be participating) (the full protocol is to be included as *Appendix 1*):
The study will be an intervention study, using a mixed methods design. The intervention study will include a pre-intervention interview phase, intervention phase and a post-intervention interview phase. The purpose of an intervention in this study is to assess the impact of a ward-based pharmacy service. Refer to Appendix 1, Section 5 for methodological details.

o) State the minimum and maximum number of participants involved (Minimum number should reflect the number of participants necessary to make the study viable)
Min: **100** Max: **300**

2. RISKS AND BENEFITS OF THIS STUDY

a) Is there any risk of harm, embarrassment or offence, however slight or temporary, to the participant, third parties or to the community at large? **No**
If YES, state each risk, and for each risk state i) whether the risk is reversible, ii) whether there are alternative procedures available and iii) whether there are remedial measures available.
Not applicable

b) Has the person administering the project previous experience with the particular risk factors involved? **No**
If YES, please specify: **Not applicable**

c) Are any benefits expected to accrue to the participant (e.g. improved health, mental state, financial etc.)? **Yes**
If YES, please specify the benefits: **Improved patient care and medication outcomes**

d) Will you be using equipment of any sort? **No**
If YES, please specify: **Not applicable**

e) Will any article of property, personal or cultural be collected in the course of the project? **No**
If YES, please specify: **Not applicable**

3. TARGET PARTICIPANT GROUP

a) If particular characteristics of any kind are required in the target group (e.g. age, cultural derivation, background, physical characteristics, disease status etc.) please specify: **All adult patients (over 18 years), excluding pregnant females, who are admitted to the selected hospital ward during the time of the study**

b) Are participants drawn from NMMU students? **No**

c) If participants are drawn from specific groups of NMMU students, please specify: **Not applicable**

d) Are participants drawn from a school population? **No**
If YES, please specify: **Not applicable**

e) If participants are drawn from an institutional population (e.g. hospital, prison, mental institution), please specify: **Private hospital**

f) If any records will be consulted for information, please specify the source of records: **Patient Files**

g) Will each individual participant know his/her records are being consulted? **Yes**
If YES, state how these records will be obtained: **The researcher, as employee of the hospital, will screen patient files in the selected ward as part of her job description, thus, informed consent is not required.**

h) Are all participants over 18 years of age? **Yes**
If NO, state justification for inclusion of minors in study: **Not applicable**

4. CONSENT OF PARTICIPANTS

a) Is consent to be given in writing? **No**
If YES, include the consent form with this application [Appendix 2].
If NO, state reasons why written consent is not appropriate in this study. **Two components of the study are relevant 1) audit of patient file and 2) prescriber and nursing staff questionnaires. 1) Audit of patient files: A patient consent form (see Appendix 2.1 attached) will be given to each patient admitted to the surgical ward. The consent form will explain the purpose of the study. A signature from the patient on the form will serve as consent to access the patient file. 2) Prescriber and nursing staff questionnaires: the researcher will explain the purpose of the study (verbally – by reading the letters attached as Appendices 2.2 and 2.3 for the pre- and post-intervention questionnaires, respectively) and will make an appointment with each prescriber and nurse, during the pre- and post-intervention phases. Agreeing to the appointment will serve as verbal consent from the participants. The prescribers and nurses are not obligated to complete the questionnaires and can withdraw from participating at anytime during the interview. Written consent is therefore not required.**

b) Are any participant(s) subject to legal restrictions preventing them from giving effective informed consent? **No**
If YES, please justify: **Not applicable**

c) Do any participant(s) operate in an institutional environment, which may cast doubt on the voluntary aspect of consent? **No**
If YES, state what special precautions will be taken to obtain a legally effective informed consent: **Not applicable**

d) Will participants receive remuneration for their participation? **No**
If YES, justify and state on what basis the remuneration is calculated, and how the veracity of the information can be guaranteed. **Not applicable**

e) Which gatekeeper will be approached for initial permission to gain access to the target group? (e.g. principal, nursing manager, chairperson of school governing body) **Hospital Manager and Pharmacy Manager – refer to Appendix 3 for letter requesting permission to conduct the study at the private hospital**

f) Do you require consent of an institutional authority for this study? (e.g. Department of Education, Department of Health) **No**
If YES, specify: **Not applicable**

5. INFORMATION TO PARTICIPANTS

a) What information will be offered to the participant before he/she consents to participate? (Attach written information given as [*Appendix 3*] and any oral information given as [*Appendix 4*])

b) Who will provide this information to the participant? (Give name and role)
This is only required for the prescriber and nursing staff questionnaires. As previously mentioned (in question 4a, the researcher will explain the purpose of the study (by verbally reading the letters attached as Appendices 2.1 and 2.2) to each prescriber and nursing staff member, prior to making an appointment during the pre- and post-intervention phases. Leanne Stone (Researcher)

c) Will the information provided be complete and accurate? **Yes**
If NO, describe the nature and extent of the deception involved and explain the rationale for the necessity of this deception: **Not applicable**

6. PRIVACY, ANONYMITY AND CONFIDENTIALITY OF DATA

a) Will the participant be identified by name in your research? **No**
If YES, justify: **Not applicable**

b) Are provisions made to protect participant's rights to privacy and anonymity and to preserve confidentiality with respect to data? **Yes**
If NO, justify. If YES, specify: **Not applicable**

c) If mechanical methods of observation be are to be used (e.g. one-way mirrors, recordings, videos etc.), will participant's consent to such methods be obtained? **No**
If NO, justify: **Not applicable**

d) Will data collected be stored in any way? **Yes**
If YES, please specify: (i) By whom? (ii) How many copies? (iii) For how long? (iv) For what reasons? (v) How will participant's anonymity be protected? **(i) By the supervisor (ii) One electronic copy and back-up (iii) Indefinitely (iv) For publication in an academic journal(s) (v) No patient or respondent identifiers will be linked to the data**

e) Will stored data be made available for re-use? **No**
If YES, how will participant's consent be obtained for such re-usage? **Not applicable**

f) Will any part of the project be conducted on private property (including shopping centres)? **Yes**
If YES, specify and state how consent of property owner is to be obtained: **Approval from the Hospital Manager and Pharmacy Manager – refer to Appendix 3.**

g) Are there any contractual secrecy or confidentiality constraints on this data? **No**
If YES, specify: **Not applicable**

7. FEEDBACK

a) Will feedback be given to participants? **No**
If YES, specify whether feedback will be written, oral or by other means and describe how this is to be given (e.g. to each individual immediately after participation, to each participant after the entire project is completed, to all participants in a group setting, etc.): **Not applicable**

b) If you are working in a school or other institutional setting, will you be providing teachers, school authorities or equivalent a copy of your results? **Yes**
If YES, specify, if NO, motivate: **Feedback will be given to the Hospital Manager, Pharmacy Manager, relevant Pharmacy Staff members and the participants, if she/he requests feedback.**

8. ETHICAL AND LEGAL ASPECTS

The Declaration of Helsinki (2000) or the Belmont Report will be included in the references: **Yes**
If NO, motivate: **Not applicable**
(A copy of the Belmont Report is available at the following link for reference purposes: http://www.nmmu.ac.za/documents/rcd/The%20Belmont%20Report.pdf)

a) I would like the REC-H to take note of the following additional information:
None

9. DECLARATION

If any changes are made to the above arrangements or procedures, I will bring these to the attention of the Research Ethics Committee (Human). I have read, understood and will comply with the *Guidelines for Ethical Conduct in Research and Education at the Nelson Mandela Metropolitan University* and have taken cognisance of the availability (on-line) of the Medical Research Council Guidelines on Ethics for Research (http://www.sahealthinfo.org/ethics/).
All participants are aware of any potential health hazards or risks associated with this study.
I am not aware of potential conflict(s) of interest which should be considered by the Committee.
If affirmative, specify: **Not applicable**

SIGNATURE: **Miss L Kritiotis** (Primary Responsible Person)	**31 August 2014** Date
SIGNATURE: **Leanne Stone** (Principal Investigator/Researcher)	**31 August 2014** Date

10. SCRUTINY BY FACULTY AND INTRA-FACULTY ACADEMIC UNIT

This study has been discussed, and is supported, at Faculty and Departmental (or equivalent) level. This is attested to by the signature below of a Faculty (e.g. RTI) and Departmental (e.g. HoD) representative, neither of whom may be a previous signator.

NAME and CAPACITY (e.g. HoD)	SIGNATURE	Date
NAME and CAPACITY (e.g. Chair:FacRTI)	SIGNATURE	Date

11. APPENDICES

In order to expedite the processing of this application, please ensure that all the required information, as specified below, is attached to your application. Examples of some of these documents can be found on the Research Ethics webpage (http://www.nmmu.ac.za/default.asp?id=4619&bhcp=1). You are not compelled to use the documents which have been provided as examples – they are made available as a convenience to those who do not already have them available.

APPENDIX 1: Research methodology

Attach the full protocol and methodology to this application, as "Appendix 1" and include the data collection instrument e.g. questionnaire if applicable.

APPENDIX 2: Informed consent form

If no written consent is required, motivate at 4a). The intention is that you make sure you have covered all the aspects of informed consent as applicable to your work.

APPENDIX 3: Written information given to participant prior to participation

Attach as "Appendix 3". The intention is that you make sure you have covered all the aspects of written information to be supplied to participants, as applicable to your work.

APPENDIX 4: Oral information given to participant prior to participation
If applicable, attach the required information to your application, as "Appendix 4".
APPENDIX 5, 6, 7: Institutional permissions
Attach any institutional permissions required to carry out the research e.g. Department of Education permission for research carried out in schools.

APPENDIX 10: ETHICAL APPROVAL FROM NMMU

Nelson Mandela Metropolitan University
for tomorrow

Copies to:
Supervisor: Ms L Kritiotis
Co-supervisor/s: Dr SF Burton

Summerstrand South
Faculty of Health Sciences
Tel. +27 (0)41 5042121 Fax. +27 (0)41 5042854
Nouwaal.Isaacs@nmmu.ac.za

Student number: 205000576

Contact person: Ms N Isaacs

15 August 2013

Mrs LN Stone
16 Burford Crescent
Linkside
Port Elizabeth
6001

FINAL RESEARCH/PROJECT PROPOSAL:
QUALIFICATION: **M PHARM**
TITLE: **THE IMPACT OF A WARD PHARMACIST IN A SURGICAL WARD OF A PRIVATE HOSPITAL IN THE EASTERN CAPE**

Please be advised that your final research project was approved by the Faculty Research, Technology and Innovation Committee, subject to the following amendments/recommendations being made to the satisfaction of your Supervisor/s:

COMMENTS/RECOMMENDATIONS

1. The proposal was well prepared.
2. Page 13
   Indicate within the primary aim that the research will be undertaken within a surgical ward.
3. Page 15
   The term convenient sample should be replaced with "convenience sampling".
4. Page 22
   The dissemination of results was not indicated.
5. There were minor referencing errors.

FRTI grants ethics approval. FRTI committee reference number: H13-HEA-PHA-007.

Please be informed that this is a summary of deliberations that you must discuss with your Supervisors.

Please e-mail an electronic copy of the final proposal, REC-H form and all appendices to the FRTI secretariat.

Kind regards

pp

Ms N Isaacs
Manager: Faculty Administration
Faculty of Health Sciences

APPENDIX 11: COVER LETTER – PILOT STUDY OF QUESTIONNAIRES

Pharmacy Department

Building 12

South Campus

Faculty of Health Sciences

Nelson Mandela Metropolitan University

12 November 2013

Attention: Medical Practitioners and Nursing Staff

Re: Pilot testing of Ward-based Pharmacy Project Questionnaires

My name is Leanne Stone and I am presently employed as a ward pharmacist. I am currently registered as a part time student for a Master's degree in pharmacy at the Nelson Mandela Metropolitan University (NMMU). The topic for the research is: 'The impact of a ward pharmacist in a surgical ward of a private hospital in the Eastern Cape'.

The research is being conducted at this hospital site over a period of twelve weeks. The aim of the study is to evaluate the perceived benefits of a ward-based pharmacist on the provision of pharmaceutical care to patients in a hospital setting and to consequently implement a ward-based pharmacy service. Clinical ward-based pharmacy is a fairly new practice in South Africa. The motivation for the study is due to the fact that a ward-based pharmacist fulfils an important role in improving medication safety and patient pharmaceutical care.

The pilot phase of the study requires your participation, through completing the following questionnaires. The questionnaires will be aimed at the medical practitioners and nursing staff in the ward where the study will be conducted. Please can you assess the questions in terms of understanding, level of difficulty, clarity and time taken to complete.

Your contribution during the pilot phase of the study is appreciated. Thank you for your time and participation in the study.

Yours sincerely,

_____

Leanne Stone

APPENDIX 12: FEEDBACK/SUGGESTIONS FORM – PILOT STUDY OF QUESTIONNAIRES

Please provide feedback on the questionnaire:

1. Was the questionnaire easy to follow?

   _____

   _____

2. Were the questions clear and easy to understand?

   _____

   _____

3. How long did the questionnaire take to complete?

   _____

   _____

4. Did you find the questions too long?

   _____

   _____

Any other comments or suggestions

_____

_____

_____

_____

_____

Thank you for your participation and feedback