A PHARMACIST-MEDIATED, MEDICATION RECONCILIATION PROGRAMME AT A PRIVATE HOSPITAL, GAUTENG, SOUTH AFRICA

A mini-dissertation submitted by

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2016
DECLARATION

I, Delyne Subrayen, declare that the mini-dissertation hereby submitted to the Sefako Makgatho Health Science University, for the degree of Master of Pharmacy, in the Faculty of Health Sciences, School of Health Care Sciences, has not previously been submitted by me for a degree at this or any other University; that this is my work in design and execution, and that all material contained herein has been duly acknowledged.

____________________________________
Mrs Delyne Subrayen

____________________________________
Date
DEDICATION

I dedicate this work to my loving husband, Yogesh Naidoo for his unwavering support during these past few years. To my parents Kugan and Shirley Subrayen whose passion and love for education were inspirational and pivotal in the completion of this dissertation. Finally, to my late grandfather Mr Munsamy Subrayen, whose love for the English language, inspired my scientific writing.
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### ABBREVIATIONS AND ACRONYMS

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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADE</td>
<td>Adverse drug event</td>
</tr>
<tr>
<td>ASHSP</td>
<td>American Society of Health Systems Pharmacists</td>
</tr>
<tr>
<td>BPMH</td>
<td>Best Possible Medication History</td>
</tr>
<tr>
<td>BPMP</td>
<td>Best Possible Medication Plan</td>
</tr>
<tr>
<td>NCCMERP</td>
<td>National Coordinating Council for Medication Error Reporting and Prevention</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>U.S.</td>
<td>United States of America</td>
</tr>
</tbody>
</table>
LIST OF DEFINITIONS

**Adverse Drug Events** - An injury resulting from medication intervention related to a drug (NCCMERP, 2015)

**Adverse Drug Reaction** - any response to a drug which is noxious and unintended which occurs at doses normally used in man for prophylaxis, diagnosis, or therapy of disease, or from the modifications of physiological function (NCCMERP, 2015).

**Medication discrepancies** - any unexplained change in the patients' medication lists between sites (Sinvani, Beizer, Akerman, Pekmezaris, Nouryan, Lutsky, Cal, Dlugacz, Masick and Wolf-Klein, 2013).

**Medication errors** - any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient or consumer (NCCMERP, 2015).

**Medication Reconciliation** - is the comprehensive evaluation of a patient’s medication regimen any time there is a change in therapy in an effort to avoid medication errors such as omissions, duplications, dosing errors, or drug interactions, as well as to observe compliance and adherence patterns (ASHSP, 2012).

**High Five's** - a World Health organisation project aimed at significantly reducing the frequency of 5 challenging patient safety problems in 5 countries over 5 years (WHO, 2007).

**Transition of care** - movement of a patient from one healthcare setting to another (hospital, long-term care facility, between wards, rehabilitation, home care) (WHO, 2007)

**Unintentional discrepancies** - any omission, duplication, or failure to change back to the original regimen when indicated (Sinvani, Beizer, Akerman, Pekmezaris, Nouryan, Lutsky, Cal, Dlugacz, Masick and Wolf-Klein, 2013).
ABSTRACT

**Introduction:** Medication reconciliation is a strategy to reduce medication errors and thereby decrease Adverse Drug Events (ADEs). Intensive participation from a pharmacist performing medication reconciliation at admission and discharge resulted in a 47% decrease in emergency department visits and an 80% decrease in drug related readmissions in the 12 months following discharge. ADEs have been found to be a major cause of morbidity and mortality in healthcare systems around the world. More than 50% of ADEs are preventable. The main aim of the study was to determine the need for pharmacist-mediated medication reconciliation on admission and discharge in a private hospital medical ward to avoid ADEs which are becoming prevalent patient safety issues.

**Method:** The study was conducted at a 214 bed multi-disciplinary private hospital facility in Gauteng, South Africa. The study followed a prospective quantitative, cross-sectional interventional design and was carried out in a 36 bed medical ward. There was no control group for the purposes of the study and the study was performed over a period of six months.

**Results:** Two hundred patients (female = 71%; male = 29%) were included in the study during the six month study period. One thousand and one interventions were made during the study period with 677 interventions occurring on admission and 324 at discharge. Twenty seven percent of study subjects had prescription discrepancies on admission and twelve percent of study subjects had medication discrepancies on discharge. A total of eighty four medicine related interventions were made on admission and twenty five medicine related interventions were made on discharge. The average time taken for medication reconciliation on admission and discharge was 29.31 minutes per patient and cost R112.20 (7.06USD) per patient. The total cost for the provision of this service was R22 439.01 (1405.95USD) for the entire study period. The cost savings generated by this service for the study period were R3 229 554.

**Conclusion:** The multi-disciplinary (physician, pharmacist and nurse) management of a patient during their hospital stay could help to reduce adverse drug events as demonstrated in this study. The findings of this study are in agreement with the available literature which demonstrates the benefits of a pharmacist performing medication reconciliation at admission and discharge. In addition, the cost-savings demonstrated by this study justifies the time invested in providing this service and illustrates that medication reconciliation is a fruitful investment in patient safety.
Chapter 1: Introduction

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

In this chapter the background and rationale for this study are discussed. This is followed by the research question, aim and objectives of the study. The importance and significance of this study are also described. The chapter ends with a short overview of the outline of the dissertation.

1.2 BACKGROUND AND RATIONALE FOR THE STUDY

Medication reconciliation is a strategy to reduce medication discrepancies, and thereby decrease adverse drug events (ADEs) and medication errors (Meuller, Sponsler, Kripalani, Schnipper, 2012; Mekonnen, McLachlan & Brien, 2016).

Adverse drug events from medicine use have been shown to be a significant cause of hospital re-admissions, increased cost of hospitalisation and increased morbidity for patients (Bishop, Cohen, Billings & Thomas, 2015; Harris, Hu, Lee, Mistry, York & Johnson 2015).

It has been established that 6.5% of hospital admissions are due to ADEs and their estimated cost in the United Kingdom is £466 million annually (WHO, 2007; NHS, 2014). It is also estimated that in the UK, 16% of medication incidents led to actual patient harm with 0.9% causing death.

In 2013, Megeurditchian, Krotneva, Reidel & Huang demonstrated that in the United States (US), ADEs are the sixth leading cause of death and on average, cost each hospital 5.6 million US dollars per year. Fifty eight percent of these ADEs are preventable.

Research has indicated that the ADE rate in hospitalised patients in South Africa ranges from 2.7 to 6.3 per 100 admissions. (Muller, Gous & Schellack, 2016; Mehta et al., 2007).

Mekonnen et al. (2016) showed that over half of all medication errors can be attributed to unintended medication discrepancies, during the patients hospital stay.

In addition, various authors have concurred that identifying medication discrepancies and strategies to prevent them are important for improving patient safety and lowering
healthcare costs that result from ADEs (Bishop et. al, 2015; Cornu, Steurbaut, leysen, De Baere, Ligneel, Mets & Du Pont, 2012)

1.3    PROBLEM STATEMENT

During admission/discharge, poor communication and unintentional information loss puts patients at an increased risk for medication discrepancies. According to Kwan, Lo, Sampson & Shoijania (2013), these medication discrepancies can result in medication errors and adverse drug events and persist following discharge.

In addition, Varkey, Cunningham & O'Meara (2007), demonstrated that 23% of hospitalized internal medicine patients discharged from a teaching hospital experienced an adverse event and that 72% of these were ADEs.

Medication errors have been shown to be one of the leading causes of injury to hospitalized patients and over half of all medication errors occur at the interfaces of care (van der Schrieck-de Loos & van Groenestijn, 2011; Varkey, Cunningham & O'Meara, 2007).

According to various studies on medication reconciliation, the percentage variance between medications patients' were taking prior to admission and in hospital ranged from 30 to 70%. Intensive participation from a pharmacist performing medication reconciliation at admission and discharge resulted in a 47% decrease in emergency department visits and an 80% decrease in drug related readmissions in the 12 months following discharge (Greenwald, Halasyamani & Greene, 2010; Kwan et.al 2013).

Therefore, the aim of the study was to determine the effect of a pharmacist-mediated medication reconciliation on admission and discharge in a private hospital medical ward to avoid ADEs which are becoming a prevalent patient safety issue.

1.4    RESEARCH QUESTION

What were the discrepancies identified when pharmacist-mediated medication reconciliation was performed on admission and discharge in a Private Hospital medical ward?
1.5 PURPOSE OF THE STUDY

1.5.1 Aim

To evaluate a pharmacist initiated medication reconciliation at admission and discharge in a private hospital medical ward.

1.5.2 Objectives

The objectives of the study were:

1. To determine the number of interventions that the pharmacist can make when performing medication reconciliation at the point of admission and discharge

2. To describe the interventions made by a pharmacist when performing medication reconciliation at the point of admission and discharge

3. To compare admission and discharge prescriptions of medical ward patients in order to identify prescription discrepancies

4. To document, quantify and resolve medication prescription discrepancies identified during the study period

5. To describe the outcome of a pharmacist-mediated medication reconciliation at the point of discharge in a Private Hospital in South Africa.

1.6 IMPORTANCE OR SIGNIFICANCE OF THE STUDY

In 2011, the National Department of Health (NDoH) of South Africa established the core standards which comprise seven domains/standards that are to be maintained by all healthcare facilities in South Africa. The domain of patient safety, clinical governance and clinical care, provides guidance on how to ensure quality nursing and clinical care and ethical practice; how to reduce unforeseen harm to health care users or patients in identified cases of greater clinical risk; how to prevent or manage problems or adverse events; and support any affected patients or staff (NDoH, 2011). It is the responsibility of the health care provider to ensure that the risk of ADEs are minimised during a patients hospital stay.

The average hospitalised patient is subject to at least one medication error per day (ASHSP, 2012). Fifty-percent of all hospital-related medication errors have been attributed to poor communication at the transitions and interfaces of care (ASHSP, 2012).
Medication reconciliation is a strategy to improve patient safety and reduce ADEs. Implementation of medication reconciliation has led to a 50% reduction in medication discrepancies for in-hospital patients. (Van der Schrieck-de Loos et al., 2011).

The role of the pharmacist in South Africa, up to this point, has largely focussed on antibiotic stewardship, ward rounds and interventions made thereupon (Gous & Schellack 2014). Medication reconciliation is not currently part of the practice of pharmacists in private or public sector hospitals in South Africa.

Therefore, there are no studies published on a pharmacist initiated medication reconciliation service in South African Hospitals and/or the potential benefits.

The results of this study could be used to demonstrate the impact that a pharmacist can have in a medical ward whilst performing medication reconciliation as this can improve patient safety by reducing medication errors.

1.7 OUTLINE OF THE DISSERTATION

This dissertation consists of five chapters. Chapter 1 serves as an introduction to the dissertation which includes the background and rationale of the study, together with the stated research questions, aim and objectives of the study. It also includes an overview of the importance of the study. Chapter 2 focuses on the review of literature relating to definition and process of medication reconciliation. The role of a pharmacist in preventing medication discrepancies is also discussed in this chapter. Chapter 3 discusses the methodology related to this study. This includes the study design, study site, study population and the sample selection. It further elaborates on the study period, the process of data collection, the analysis of data, the reliability and validity of the study. Ethical principles of the study are also discussed. Chapter 4 presents the manuscript containing the results of the study followed by the discussion of the results. Chapter 5 concludes the dissertation with a summary of the limitations of the study, recommendations for future studies and a conclusion. Figure 1.1 provides a short illustration of the outline of this dissertation.
There is no data available to evaluate medication reconciliation performed by a pharmacist in South African Hospitals. Implementing medication reconciliation would assist in identifying prescription discrepancies and resolving them to prevent adverse drug events.

The study examined the interventions made during the process as well as the time taken to perform medication reconciliation.

Chapter 1 discussed the background and rationale for this study. It also stated the aim of the study, which investigated the number and type of interventions made by the pharmacist whilst performing medication reconciliation. The objectives of the study were also set out. This chapter concluded with the significance of the study and the outline of the dissertation. Chapter 2 will focus on a literature review pertaining to the study.
CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

This chapter deals with an overview of the literature on medication reconciliation and previous research that has been conducted in the particular field. The chapter starts with an introduction to medication reconciliation processes and people involved in the process. Thereafter, drug utilisation studies and aspects of ADE’s are discussed. The chapter concludes with a discussion on high risk patients and high risk medications.

2.2 MEDICATION RECONCILIATION

Medication reconciliation is the comprehensive evaluation of a patient’s prescriptions any time there are changes made to their regimen (ASHSP, 2012; Kwan et al., 2013). This is performed in order to prevent medication errors such as omissions, duplications, dosing errors, or drug interactions. The process also provides the pharmacist the opportunity to assess compliance and adherence patterns (ASHSP, 2012).

During medication reconciliation, the pharmacist compares the existing (in-hospital prescription) with previous medication regimens (chronic medications) and this should occur at each transition of care, when existing orders are modified or rewritten and if the patient has added non-prescription medications to the regimen during their hospital stay (ASHSP, 2012).

This results in a complete list of medications which should be accurately communicated to the next provider of care (Kwan et al., 2013; Campbell et al., 2009).

2.2.1 The medication reconciliation process

The pharmacist compares the medication reflected on the pre-admission medication list with the medication list reflected on the in-patient medication chart and the discharge prescription.

The prescriptions should be evaluated for the following:

- New medications
- Discontinued medications
- Adjusted medications
Chapter 3: Method

- Unchanged medications to be continued
- Medications held in hospital
- New medications started on discharge
- Additional comments as appropriate (Kwan et al., 2013; Walker, Bernstein, Tucker Jones, Piersma, Kim, Regal, Kuhn & Flanders, 2009).

Medication discrepancies are defined as any unexplained change in the patients' medication lists between sites and unintentional discrepancies are defined as any omission, duplication, or failure to change back to the original regimen when indicated (Sinvani, Beizer, Akerman, Pekmezaris, Nouryan, Lutsky, Cal, Dlugacz, Masick & Wolf-Klein, 2013).

Upon resolution of discrepancies, the corrected version of the patient's prescription is known as a best-possible medication plan (BPMP) and should be communicated to the patient and their primary care physician (Kwan et al., 2013).

Factors affecting medication reconciliation include but are not limited to: staffing models, financial constraints, time constraints, inability of patients to communicate during their hospital stay and the degree of the pharmacist's medication knowledge (Kwan et al., 2013; Walker et al., 2009).

2.2.2 Who should be involved in medication reconciliation

It has been documented that hospital pharmacists are uniquely suited to perform medication reconciliation when their education and expertise are considered, and that their involvement may result in more accurate reconciliations. In addition, it has been demonstrated that a pharmacist-led medication reconciliation service has yielded the largest benefits whilst being the most cost effective, when the quality-adjusted life year value is considered (Fernandes & Shojania, 2012).

2.2.3 The pharmacist and medication reconciliation

When medication reconciliation is performed by pharmacists, the frequency and severity of hospital medication errors were reduced (ASHP, 2013).

It has been demonstrated that when physicians obtained medication histories there were 6.4 times more discrepancies than when histories are taken by pharmacists (Rheeder, 2008).
In addition, pharmacists involved in medication reconciliation have led to high rates of patient intervention, large numbers of interventions per patient and improved documentation of medication discrepancies and medication-related admissions (ASHSP, 2013)

Myrka (2012) demonstrated that intensive participation from a pharmacist performing medication reconciliation at admission and discharge resulted in the following:

1. A 47% decrease in emergency department visits and
2. An 80% decrease in drug related readmissions in the 12 months following discharge

### 2.2.4 Medication reconciliation at admission

![Diagram of Medication Reconciliation Process at admission]

**Figure 2.1: Overview of the Medication Reconciliation Process at admission**

A Best Possible Medication History (BPMH) is a medication history obtained by the healthcare professional which includes all prescription and non-prescription medicines that may be obtained from a variety of sources (Kwan *et al.*, 2013; WHO, 2007).
The BMPH should reflect all of the following types of medication:

A. All prescribed medicines

B. All non-prescribed medicines (including over-the-counter medicines, herbal, traditional medicines)

C. All recreational or when-necessary medicines taken by the patient

2.3 HOW TO OBTAIN THE BEST POSSIBLE MEDICATION HISTORY (BPMH)

The World Health Organisation and Kwan et al. (2013) agree that the BPMH is different from a routine medication history in that it is complete and takes into account all information that is available. According to the WHO (2007), the BPMH may be obtained using the following sources:

A. Patient/family interviews

B. Medication Vials/Lists

C. Government medication database if available

D. Community Pharmacy Profile

E. Family Physician records

F. Patient Medication List

G. Previous healthcare records.

2.3.1 When should BPMH be taken?

Ideally, the BPMH should be taken within 24 hours of admission as recommended by the WHO (2007), however if this is not possible, it should be noted that formal medication reconciliation is still of benefit even if performed after the 24 hour window period.

2.3.2 Medication reconciliation at internal transfer

The WHO, in 2007 stated that it is imperative that medication reconciliation is performed at the interfaces of care as this is where orders are often changed:
Chapter 3: Method

The interfaces of care are defined as:

A. Change in responsible medical service
B. Change in the level of care (ICU to ward or vice versa)
C. Post-operative transfer
D. Internal transfer between units/wards

The aim of performing medication reconciliation at internal transfer is to ensure that the patients’ medications are appropriate for the new status of the patient (WHO, 2007).

Figure 2.2: Medication reconciliation process at internal transfer

2.3.3 Medication reconciliation at discharge

A report by the American Society of Health Systems Pharmacists in 2012 revealed, that the implementation of medication reconciliation at discharge has demonstrated reductions in the adverse drug event rate from 90%-47% in a surgical ward and 57%-33% in a medical ward of a large academic medical facility.
2.4 COMMON BARRIERS TO IMPLEMENTATION OF MEDICATION RECONCILIATION

The lack of established best practices and clear ownership for medication reconciliation is a significant barrier to its implementation. This is further compounded by the lack of a standardised methodology of noting a patient's medication record and reduced access to the required data when patients are seen by more than one healthcare professional. Patients are required to present a standardised medication list on admission; however the barriers to the adoption of a medication list are usability, perceived value and portability (ASHSP, 2012; Myrka, 2012). The use of non-formulary medication and communication failures between healthcare professionals has been found to be an additional barrier as revealed by Myrka et al. in 2012.

2.5 IMPROVEMENTS DUE TO MEDICATION RECONCILIATION

In Canada, the implementation of the International Standard Operating Procedure for Medication Reconciliation led to a 50% reduction in medication discrepancies (Van der Schrieck-de Loos et al., 2011). In the United States, implementation of medication reconciliation at three hospitals in Massachusetts, yielded an 85% reduction in medication errors over a 10-month period (WHO, 2007).

2.6 DRUG UTILISATION STUDIES

Drug utilisation has been extensively studied since the 1960s, and in 1969, the WHO acknowledged the need for an internationally accepted drug classification system for use in drug utilisation studies (WHO, 2013). In 1981, the WHO recommended the use of the ATC/DDD classification system when international utilisation studies were performed. The purpose of the ATC/DDD tool was for drug utilisation research to improve the quality of drug use.

Medication reconciliation studies are at the very basic level an enquiry into drug utilisation of a patient to ensure the highest levels of medication safety are maintained. The ATC is therefore employed to evaluate drug utilisation of a patient when performing medication reconciliation.
2.7 ANATOMICAL THERAPEUTIC CHEMICAL CLASSIFICATION (ATC)

The ATC system, as defined by the World Health Organisation in 2013, is a classification methodology whereby the main active ingredient of a medicine is classified according to its main therapeutic use. The same active ingredient with formulations that have different strengths or routes of administration will have different ATC codes.

2.8 INTERNATIONAL STATISTICAL CLASSIFICATION OF DISEASES AND HEALTH RELATED PROBLEMS (ICD-10)

According to the WHO, the ICD-10 system is the standard diagnostic tool for health management and epidemiological purposes that is used to assess and monitor the prevalence of diseases and provides a general health picture of the population in a country.

The classification system is used by healthcare professionals and funders alike, to classify diseases on patient health records and death certificates. The ICD-10 system is continuously revised as disease pathologies change and new diseases are discovered (WHO, 2010).

The ICD-10 codes are a classification system where morbid entities are assigned according to established criteria. The purpose of this classification system is to allow for the systematic recording analysis, interpretation, and comparison of mortality and morbidity data (WHO, 2010).

2.9 ADVERSE DRUG EVENTS

An adverse drug event is defined as an injury resulting from medication intervention that is drug related (Myrka, 2012). In healthcare systems around the world, ADEs have been found to be a major cause of morbidity and mortality (WHO, 2007). Large proportions of ADEs have been attributed to poor communication between healthcare professionals and occur most often at interfaces of care i.e. when patients are transferred between wards or being discharged (Kwan et al., 2013; WHO, 2007; van der Shriek loos et al., 2010). It is estimated that 46-56% of all medication errors occur at admission, transfer within or discharge from the hospital (Wong, Bajcar, Wong, Alibhai, Huh, Cesta, Pond & Fernandes, 2008; Chabra, Rattinger, Hare & Zuckerman, 2012).

More than 50% of ADEs are preventable and have been demonstrated to be a result of incomplete medication histories, prescribing errors, dispensing errors and overuse/underuse of prescribed pharmacotherapy (Megeurditchian et al, 2013).
Chapter 3: Method

It is estimated that in the US, the average hospitalised patient is subject to at least one medication error every day (ASHSP, 2012). A systematic review of medication reconciliation studies revealed between 12-17% of patients experience ADEs following discharge from hospital (Meuller, Sponsler, Kripalani & Schnipper, 2012).

2.10 CATEGORIZING MEDICATION ERRORS

The National Coordinating Council for Medication Error reporting and Prevention (NCCMERP), introduced the medication error index that classifies medication errors based on the severity of their outcome. Table 2.1 below details the different categories for defining medication errors as per NCCMERP.

Table 2.1: Types of Medication errors as classified by the harm caused

<table>
<thead>
<tr>
<th>NO ERROR</th>
<th>NO HARM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A</td>
<td>Circumstances or events that have the capacity to cause harm</td>
</tr>
<tr>
<td>ERROR</td>
<td>NO HARM</td>
</tr>
<tr>
<td>Category B</td>
<td>Error occurred but did not reach the patient</td>
</tr>
<tr>
<td>Category C</td>
<td>Error occurred and reached the patient but did not cause harm</td>
</tr>
<tr>
<td>Category D</td>
<td>Error occurred and reached the patient; required monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm</td>
</tr>
<tr>
<td>ERROR</td>
<td>HARM</td>
</tr>
<tr>
<td>Category E</td>
<td>Error occurred; need for treatment or intervention; temporary harm to patient</td>
</tr>
<tr>
<td>Category F</td>
<td>Error occurred; need for prolonged hospitalisation; temporary harm to patient</td>
</tr>
<tr>
<td>Category G</td>
<td>Error occurred that contributed to permanent patient harm</td>
</tr>
<tr>
<td>Category H</td>
<td>Error occurred that required intervention necessary to sustain life</td>
</tr>
<tr>
<td>ERROR</td>
<td>DEATH</td>
</tr>
<tr>
<td>Category I</td>
<td>Error occurred that resulted in patient death</td>
</tr>
</tbody>
</table>

2.11 IMPACT OF ADVERSE DRUG EVENTS

Adverse drug events are the most common type of adverse event experienced by in-hospital patients (Klopotoskwa, Wierienga, Smorenborg, Stuitj, Arisz, Kuks, Dijkgraaf, Lie-A-Huen & de Rooij, 2013).
It has been established that between 3-19% of admissions are due to ADEs (WHO, 2007) and their estimated cost in the US alone ranges from 3.5-7 billion US dollars annually (Myrka, 2012). Whilst in the UK, the annual cost of ADEs are estimated at £466 million per annum (NHS, 2014).

It is estimated that in the US 180 000 fatal or life threatening ADEs occur annually in elderly patients, and greater than half of these are preventable. In ambulatory care, ADEs in the elderly costs the US health system in excess of 177 billion US dollars per annum (Myrka, 2012).

In addition, ADEs have been shown to increase the length of hospital stay by up to 4.6 days.

2.12 HIGH RISK GROUPS FOR ADVERSE DRUG EVENTS

It has been established that elderly patients (>65 years of age) are at higher risk for ADEs as a result of medication errors than any other age group. This has been attributed to multiple co-morbidities, polypharmacy, decreased organ function and cognitive impairment (Klopotoskwa et al, 2013; Yi, Shan & Hong, 2013).

Further research has confirmed the following to be risk factors for developing ADEs

1. >65 years of age
2. Renal impairment
3. Polypharmacy

(Zaal, van Doormaal, Lenderink, Mol, Kosterink, Egberts, Haaijer-Ruskamp & van den Bemt, 2010).

In addition, high-risk patients have been defined as those who have more than four prescription medicines, are hospitalised frequently, have chronic diseases requiring frequent therapy changes, and those who are prescribed large amounts of in-hospital medications. (Fernandes & Shojania, 2012).

2.13 HIGH RISK MEDICINES

The following classes of drugs have been identified as high-risk for potential medication errors and have been demonstrated to be the most frequently implicated in ADEs and should
therefore be focussed on when performing medication reconciliation (Klopotowska et. al, 2013; Myrka, 2012):

   a) Anticoagulants  
   b) Antiseizure drugs  
   c) Cardiovascular agents  
   d) Diuretics  
   e) Corticosteroids  
   f) Hypoglycaemics  
   g) Opioids  
   h) Psychoactive drugs

According to the Institute for Healthcare Improvement, ADEs occurring with anticoagulants (overdoses), opioids (excessive sedation as a result of multiple opioid agonists being used simultaneously) and antihyperglycaemics (overdoses), account for 50% of all ADEs (IHI, 2012).

A study in 2003 identified contributing factors to common adverse outcomes:

1. **Warfarin** - haemorrhage as a result of overdose and inappropriate monitoring;

2. **Opioids** - overdose and underdose were associated with respiratory depression or poor pain control (Kanjanarat, Winterstein, Johns, Hatton, Gonzales-Rothi & Segal, 2003).

The use of insulin to manage diabetes is a widespread practice globally, however ADEs are common and have been shown to increase the mortality of intensive care patients (IHI, 2012).

### 2.14 STRATEGIES TO REDUCE ADVERSE DRUG EVENTS

#### 2.14.1 WHO HIGH 5’s

In 2006, the World Health Organisation (WHO) launched a patient safety campaign known as the HIGH 5’s which consisted of five interventions:

1. Prevention of patient care handover errors;
2. Prevention of wrong site/wrong procedure/ surgical errors;

3. Prevention of high concentration drug errors;

4. Prevention of continuity of care medication errors via medication reconciliation;

5. Promotion of effective hand hygiene procedures;

All the above interventions serve to improve patient safety, with trials being performed around the world in various countries. Australia, Canada, Germany, the Netherlands, New Zealand, the United Kingdom, and the United States joined the campaign in 2007. France, Saudi Arabia, and Singapore have since joined the project. One of the interventions of the HIGH 5’s campaign is to improve the accuracy of medications at transitions of care through the use of medication reconciliation at various transitions in the healthcare system (Van der Schrieck-de Loos & van Groenestijn, 2011).

2.15 SUMMARY

This chapter described medication reconciliation, the importance thereof and processes involved. Current recommendations on who should be involved in medication reconciliation and the role of the pharmacist in this process were described.

Literature revealed that ADEs occur frequently in hospitalised patients and have the potential to cause severe patient harm. The impact that ADEs have, and strategies to prevent them were discussed. The implementation of medication reconciliation has been shown to reduce and prevent ADEs. The process of performing medication reconciliation at different parts of the hospital stay were discussed as well as high risk patients and high risk drugs.

Chapter 3 will detail the methodology used to perform medication reconciliation at the Netcare facility during the study period.
CHAPTER 3
METHOD

3.1 INTRODUCTION

This chapter describes the methodology used to evaluate a pharmacist initiated medication reconciliation at the point of discharge. The first section gives background information about the site where the study was conducted. The background is followed by the study design and a description of the sample selection. The data collection process, which includes the data collection instruments and pilot study are discussed. Measures used to ensure the reliability and validity of the data is outlined. The chapter ends with a discussion of the ethical considerations for this study.

3.2 STUDY DESIGN AND STUDY PERIOD

A quantitative, cross-sectional interventional study that was performed prospectively over a period of six month (1 July 2015 - 31 December 2015) period of study.

3.3 STUDY SITE

The study was conducted at a 214 bed multi-disciplinary private hospital facility in Gauteng, South Africa. The study was performed in a 36 bed medical ward that accepts admissions from general practitioners in the community together with those from specialist physicians and general practitioners from the Emergency Medicine Department. The hospital is part of a private healthcare group of 54 hospitals in South Africa, with 16 hospitals being part of the North East region into which this particular hospital falls.

The hospital serves as a base for three specialist physicians, a neurosurgeon, three general surgeons and three orthopaedic surgeons. The hospital has a fifteen bed medical/surgical intensive care unit, an eleven bed neonatal intensive care unit, a four bed paediatric intensive care unit and a fifteen bed high care unit. For the purpose of this research, the study was conducted in a thirty six bed medical ward.
Chapter 3: Method

3.4 STUDY POPULATION

The ward has an average occupancy rate of 89.15% and an average of 234 admissions per month (± 1400/6 months).

To be eligible, the study population included all males and females that are over the age of 18 and admitted to the medical ward during the study period.

3.5 SAMPLE SIZE

The study aimed to enrol 200 patients. This sample size was estimated based on the total number of adult patients seen at the medical ward during a 6 month period.

A sample size of 200 patients was estimated with the expected frequency of 60% at 5% confidence limit and 95% confidence interval. All estimations were performed on EpiInfo™ 7 StatCalc running under Microsoft Windows on a personal computer. The first 200 eligible subjects were included in the study provided that the inclusion criterion was met.

3.6 SAMPLE SELECTION

All patients who were admitted and discharged during the six month study period were eligible for participation in the study, provided the inclusion criteria was met and the study subject did not fall into any of the excluding criteria. Sampling was performed using purposive sampling methodology.

3.6.1 Inclusion criteria

The following inclusion criteria applied:

- Patients admitted to the medical ward who have taken chronic medicines prior to admission
- Patients that provided written consent
- All patients 18 years and older

3.6.2 Exclusion criteria

The following exclusion criteria applied:

- Patients who were admitted and discharged with no chronic medication prescribed
Patients transferred to high care and intensive care units were not included

Patients discharged after hours or when the researcher was not available to perform reconciliation

### 3.7 DATA COLLECTION INSTRUMENTS

The data collection was performed by the pharmacist/researcher who performed the medication reconciliation at the point of admission and at discharge using the medication reconciliation tool.

The data collection sheet (See Appendix 1) was adapted from the Queens University publication of Medication Reconciliation: A Learning guide that has been extensively used in Canada (Queens University, 2009). The process of data collection was carried out as per Figure 3.1 below.
Figure 3.1: Data collection process
3.8 DATA COLLECTION PROCESS

The pharmacist evaluated the patients’ chronic prescription before admission which is found on the admission record, as well as their chronic prescription on discharge. These two prescriptions were then compared to ascertain if any discrepancies were present.

For the purpose of this study discrepancies were defined as:

- Omissions
- Same class different drug
- Class duplication
- Drug duplication
- Incorrect dose
- Incorrect frequency
- Contra-indications
- Drug-interactions

The researcher then informed the prescriber of any discrepancies found, in an attempt to resolve them.

Once the discrepancy had been resolved, the researcher informed the patient of changes made and counselled the patients on their new prescription. The time taken for the researcher to perform medication reconciliation per patient was monitored and the cost thereof calculated.

English and Afrikaans were chosen as the languages in which the study information had been communicated to patients as the vast majority of patients admitted to the hospital are English and Afrikaans speaking.

3.9 DATA ENTRY AND ANALYSIS

Data were captured into and analysed using Microsoft Excel™ by the researcher. Data collection sheets (see Appendix A) were used to document the study subjects demographic details as well as information about their prescribed chronic medicines and classified according to the Anatomical Therapeutic Chemical (ATC) classification system. The data
collection sheets also include diagnosis using International Classification of Diseases (ICD 10) codes.

The types of prescriptions were summarised descriptively using frequency counts. The Chi square test was performed to check the difference between prescription on admission and at discharge. The average number of medicines per prescription was calculated. Frequency counts were performed on Omissions, Same class different drug, Class duplication, Drug duplication, incorrect dose, incorrect frequency, contra-indications and drug interactions. The number of interventions made will be used as a measure of the outcomes of the study.

All statistical analysis was performed on SAS Release 9.4 or IBM SPSS Statistics 22 running under Microsoft Windows on a personal computer.

3.10 COST SAVINGS AS A RESULT OF MEDICATION RECONCILIATION, AND THE POTENTIAL ADVERSE DRUG EVENTS PREVENTED

The cost saving calculation used for the purpose of this study is depicted below. This methodology is based on the MATCH Toolkit from the American Society of Health Systems Pharmacists as described by Steve Rough. The cost of managing an adverse drug event has been estimated at between 5000-10000USD (IHI, 2015). The calculation below has been performed using the 2500USD estimate. The Medication related events in South Africa that had the potential to cause significant harm (6.3), is based on the findings by Muller et al. (2016) and Mehtha et al. (2007).

<table>
<thead>
<tr>
<th>1.5 (discrepancies per patient admitted to hospital)</th>
<th>X</th>
<th>6000 patients (average of 20 minutes/patient to complete medication reconciliation)</th>
<th>X</th>
<th>0.01 (1% of Fairview admissions experience discrepancies that would result in an ADE)</th>
<th>X</th>
<th>0.85 (85% of discrepancies avoided through medication reconciliation process)</th>
<th>X</th>
<th>$2500 (conservative cost of an ADE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>= $191,250 annual gross savings</td>
<td>-</td>
<td>$45,000 (salary and benefits of an incremental pharmacy technician)</td>
<td>=</td>
<td>$146,250 annual net savings (325% return on investment in a new staff member)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(MATCH Toolkit, 2012)

3.11 RELIABILITY AND VALIDITY

Reliability is the extent to which a measuring instrument or tool is able to provide the same results when the entity being measured has not changed (Leedy & Ormrod, 2001). The use of
a pilot study has been shown to improve the reliability of a research study as it allows the researcher an opportunity familiarize him/herself with procedures, materials and data collection tools that will be used during the research study Neuman (2003).

In order to assure reliability and validity, a pilot study was performed prior to the commencement of the study and once ethical approval has been obtained.

**Table 3.2: Threats to external validity**

<table>
<thead>
<tr>
<th>Threats to External Validity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Validity: can the findings be generalized</td>
<td>The researcher acknowledges that the result from this study cannot be compared to the rest of the population as this study sample is very small, and will not be compared to larger populations.</td>
</tr>
<tr>
<td>Ecological Validity: The best testing environment is a familiar environment to the participant.</td>
<td>It is not possible for study subjects to be within a familiar environment as the setting for the study is the hospital.</td>
</tr>
<tr>
<td>Researcher Bias: Researcher influence results to portray a certain outcome</td>
<td>Quantities of interventions made will be used as a measure and is not likely to be influenced by the researcher.</td>
</tr>
<tr>
<td>Content Validity</td>
<td>The data collection sheet was adapted from the Queens University publication of Medication Reconciliation: A Learning guide that has been extensively used in Canada. (Queens University, 2009)</td>
</tr>
<tr>
<td>Study Design</td>
<td>There was no control group, and this is a threat to validity</td>
</tr>
</tbody>
</table>
Table 3.3  Threats to internal validity

<table>
<thead>
<tr>
<th>Threats to Internal Validity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>History: Influence of factors outside of the study, on the study</td>
<td>As patients were being cared for by a multi-disciplinary team, this was unavoidable.</td>
</tr>
<tr>
<td>Maturation: Factors in the participant that could change over time</td>
<td>This study was performed at one point in time and therefore this did not affect the study.</td>
</tr>
<tr>
<td>Hawthorne effect: Physicians may alter their behaviour because their prescriptions are being evaluated as part of this study.</td>
<td>The researcher acknowledges that this was unavoidable.</td>
</tr>
</tbody>
</table>

3.12  PILOT STUDY

A pilot study was conducted in the High Care Unit on ten patients, prior to the commencement of the data collection and once ethical approval had been obtained for the study.

The aim of the pilot study was to identify problems with the data collection instruments and to test the relevance for the study. Ten patients were included in the pilot study. The data collection tool was evaluated by a pharmacist, independent from the study to ensure bias was minimized. Amendments were made to the data collection tools if necessary once the pilot study and evaluation by the independent pharmacist had been completed.

3.13  BIAS

Selection bias in this research study was unavoidable and the researcher acknowledges this as a limitation of the study. As per the discussion in the section about validity and reliability, the researcher made every effort to minimize the effects thereof in this study.

3.14  ETHICAL CONSIDERATIONS

Informed consent was obtained from all subjects included in the study and the information obtained did not reveal the subject's or treating physician's details allowing for patient confidentiality/anonymity. The researcher was the only hospital staff member who had access to the information obtained during the study period. Permission has also been obtained from the hospital manager, Netcare Ethics and Research Committee, approval number UNIV-2015-0034 (Appendix 7), and Sefako Makgatho Health Sciences University Research and Ethics Committee (SMUREC), approval number: SMUREC/H/119/2015:PG. (Appendix 6)
All study material has been stored in a locked cupboard in the pharmacy department, that only the researcher had access to, in order to ensure the patients’ confidentiality was maintained throughout the study period.

3.15 SUMMARY

This prospective quantitative, cross-sectional interventional study was conducted at a multi-disciplinary private hospital facility in Gauteng. A total of 302 eligible subjects were included in the study provided that the inclusion criteria were met. The sample population of the study, inclusion and exclusion criteria including the study period were outlined. The data collection instruments were explained together with the data collection period and data collection procedure. The method of data capture and analysis were described. Steps taken to ensure data reliability and validity were explained as well as the steps taken to minimise bias. The chapter ended with an outline of the research ethics that were adhered to.

The results of the study will be presented and discussed in Chapter 4.
4.1 INTRODUCTION

The results and discussion will be presented as a journal article. This will be submitted to the European Journal of Clinical Pharmacy. This chapter will describe the results of the study, initially detailing the number of patients included and excluded and patient demographics. The age and length of stay of study subjects will be described thereafter, followed by the admission and discharge diagnoses per organ system. Finally the interventions and medicine related interventions will be described.

4.2 MANUSCRIPT FOR PUBLICATION

An investigation into medication reconciliation by a pharmacist at a private hospital in Gauteng Province South Africa-

Authors:

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Corresponding author: d.subrayen@gmail.com

Abstract

Introduction:

Medication reconciliation is a strategy to reduce medication errors and thereby decrease Adverse drug events (ADEs).
ADEs have been found to be a major cause of morbidity and mortality in healthcare systems around the world. More than 50% of ADEs are preventable.

Intensive participation from a pharmacist performing medication reconciliation at admission and discharge resulted in a 47% decrease in emergency department visits and an 80% decrease in drug related readmissions in the 12 months following discharge.

The main aim of the study was to describe the interventions and outcome of a pharmacist-mediated medication reconciliation on admission and discharge in a private hospital medical ward to avoid ADEs which are becoming prevalent patient safety issues.

**Method:** The study was conducted at a 214 bed multi-disciplinary private hospital facility in Gauteng, South Africa. The study followed a prospective quantitative, cross-sectional interventional design and was performed in a 36 bed medical ward. There was no control group for the purposes of the study and the study was performed over a period of six months.

**Results:** Two hundred patients (female = 71%; male = 29%) were included in the study during the six month study period. One thousand and one interventions were made during the study period with 677 interventions occurring on admission and 324 at discharge. A total of 84 medicine related interventions were made on admission and twenty five medicine related interventions were made on discharge. The average time taken for medication reconciliation service on admission and discharge was 29.31 minutes per patient and cost R112.20 (7.06U SD) per patient. The cost savings generated by this service for the study period were R3 229 554.

**Conclusion:** The findings of this study are in agreement with the available literature which demonstrates the benefits of a pharmacist performing medication reconciliation at admission and discharge. The cost-savings demonstrated by this study justifies the time invested in providing this service and illustrates that medication reconciliation is a fruitful investment in patient safety.
INTRODUCTION

Medication Reconciliation is the comprehensive evaluation of a patient's medication regimen any time there is a change in therapy in an effort to avoid medication errors such as omissions, duplications, dosing errors, or drug interactions, as well as to observe compliance and adherence patterns. Medication reconciliation was adopted by the World Health Organisation (HIGH FIVEs) as a strategy to reduce medication discrepancies, and thereby decreasing adverse drug events (ADEs).

Adverse drug events are the most common type of adverse event experienced by in-hospital patients. An ADE is defined as any response to a drug which is noxious and unintended which occurs at doses normally used in man for prophylaxis, diagnosis, or therapy of disease, or for the modifications of physiological function. In healthcare systems around the world, ADEs have been found to be a major cause of morbidity and mortality. It is estimated that in the UK 16% of medication incidents led to actual patient harm with 0.9% causing death. In addition, ADEs have been shown to increase the length of hospital stay by up to 4.6 days. More than 50% of ADEs are preventable and have been demonstrated to be a result of incomplete medication histories, prescribing errors, dispensing errors and overuse/underuse of prescribed pharmacotherapy.

Medication errors have been defined by NCCMERP (2015) 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 health care professional, patient or consumer. The average hospitalised patient is subject to at least one medication error per day. Fifty-percent of all hospital-related medication errors have been attributed to poor communication at the transitions and interfaces of care. Unintentional medication discrepancies have been identified as the cause of more than half of the medication errors that occur at transitions of care.

The large scale of the problem and its considerable cost implications make it imperative to identify and implement strategies such as medication reconciliation to reduce ADEs.

Key Focus

Medication reconciliation is a strategy to improve patient safety and reduce ADEs. The average hospitalised patient is subject to at least one medication error per day. Fifty-percent of all hospital-related medication errors have been attributed to poor communication at the transitions and interfaces of care. Implementation of medication reconciliation has led to a 50% reduction in medication discrepancies for in-hospital patients. When medication
reconciliation is performed by pharmacists, the frequency and severity of hospital medication errors were reduced. In addition, medication reconciliation by pharmacists proved to be more accurate than when performed by physicians. The involvement of pharmacists in medication reconciliation have led to high rates of patient intervention, large numbers of interventions per patient and improved documentation of medication discrepancies and medication-related admissions.

**Contribution to the field**

The role of the pharmacist in South Africa, up to this point, has largely focussed on dispensing, ward rounds and antibiotic stewardship. Medication reconciliation is not currently part of the routine practice of pharmacists in either private or public sector hospitals in South Africa.

To the best of the research team’s knowledge, there are no studies published on a pharmacist initiated medication reconciliation service in South African Private Hospitals and/or the potential benefits.

Therefore, this study was intended to evaluate the effect of pharmacist-mediated medication reconciliation at the point of admission and discharge in a private hospital medical ward.

**METHODS**

**STUDY DESIGN, SETTING AND POPULATION**

This quantitative, cross-sectional interventional study was performed prospectively during the study period of six months.

The study was conducted at a 214 bed multi-disciplinary private hospital facility in Gauteng, South Africa. The study has been performed in a medical ward that accepts admissions from general practitioners in the community together with those from specialist physicians and general practitioners from the Emergency Department (ED).

All patients who were admitted and discharged during the six month study period were eligible for participation in the study, provided the inclusion criteria listed below was met and they did not fall into any of the excluded criteria. A sample size of 200 patients was estimated with the expected frequency of 60% at 5% confidence limit and 95% confidence interval.
### Table 1: Ward Characteristics

<table>
<thead>
<tr>
<th>Unit</th>
<th>Number of beds</th>
<th>Number of admission per month</th>
<th>Occupancy Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>36 beds</td>
<td>234</td>
<td>89.15</td>
</tr>
</tbody>
</table>

### DEFINITIONS AND KEY CONCEPTS:

**Adverse Drug Events** - An injury resulting from medication intervention related to a drug

**Adverse Drug Reaction** - any response to a drug which is noxious and unintended which occurs at doses normally used in man for prophylaxis, diagnosis, or therapy of disease, or for the modifications of physiological function

**Medication discrepancies** - any unexplained change in the patients’ medication lists between sites

**Medication errors** - any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient or consumer

**High Five’s** - a World Health organisation project aimed at significantly reducing the frequency of 5 challenging patient safety problems in 5 countries over 5 years

**Transition of care** - movement of a patient from one healthcare setting to another (hospital, long-term care facility, between wards, rehabilitation, home care)

**Unintentional discrepancies** - any omission, duplication, or failure to change back to the original regimen when indicated

### Study Procedures and data collection instruments

The data collection was performed at the point of admission and discharge using the medication reconciliation data collection tool. A patients’ chronic prescription before admission which is found on the admission record, as well as their chronic prescription on discharge, were evaluated as part of performing medication reconciliation. These two prescriptions were then compared to ascertain if any discrepancies were present.
For the purpose of this study discrepancies were defined as:

- **Omissions** - a chronic medication was inadvertently left out during the hospital stay and the patient did not receive it as a result.

- **Same class different drug** - a patient received a drug from the same class during their hospital stay, whilst the drug from their chronic medication was omitted.

- **Class duplication** - a patient received two drugs from the same class.

- **Drug duplication** - the patient received the same drug twice as a result of a duplicate order on the prescription.

- **Incorrect dose** - a chronic medication was prescribed at the incorrect dose by the treating doctor when compared with the dose the patient was receiving prior to admission.

- **Incorrect frequency** - the frequency of a chronic medication was prescribed incorrectly by the treating doctor.

- **Contra-indications** - a medication prescribed during the hospital stay was contra-indicated in the patient's condition.

- **Drug-interactions** - a drug interaction was identified, after which the prescriber was informed of any discrepancies found, in an attempt to resolve them.

Once the discrepancy had been resolved, the patient was informed of changes made and counselling was done on any changes. The time taken for the researcher to perform medication reconciliation per patient was monitored and the cost thereof calculated.

The data collection tool was adapted from the Queens University publication of Medication Reconciliation: A Learning guide that has been extensively used in Canada. The data collection tool was piloted in a different ward of the hospital, no amendments were necessary.

**Cost savings as a result of medication reconciliation, and the potential adverse drug events prevented**

The cost saving calculation depicted below is based on the methodology by Steve Rough as published in the MATCH Toolkit from the American Society of Health Systems Pharmacists and the cost of managing an adverse drug event has been estimated at between 5000-10000USD. The calculation below has been performed using the 2500USD estimate. The Medication related events that had the potential to cause significant harm (6.3), is based on published literature.
Table 2: Cost savings from medication reconciliation during the study period

<table>
<thead>
<tr>
<th>Calculation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 (discrepancies per patient admitted to hospital)</td>
<td></td>
</tr>
<tr>
<td>X 6000 patients (average of 20 minutes/patient to complete medication reconciliation)</td>
<td></td>
</tr>
<tr>
<td>X 0.01 (1% of Fairview admissions experience discrepancies that would result in an ADE)</td>
<td></td>
</tr>
<tr>
<td>X 0.85 (85% of discrepancies avoided through medication reconciliation process)</td>
<td></td>
</tr>
<tr>
<td>X $2500 (conservative cost of an ADE)</td>
<td></td>
</tr>
<tr>
<td>= $191,250 annual gross savings</td>
<td></td>
</tr>
<tr>
<td>- $45,000 (salary and benefits of an incremental pharmacy technician)</td>
<td></td>
</tr>
<tr>
<td>= $146,250 annual net savings (325% return on investment in a new staff member)</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from American Society of Health Systems Pharmacists. Medications at Transitions and Clinical Handoffs (MATCH) Toolkit for Medication Reconciliation

Data analysis

Data were captured into and analysed using Microsoft Excel™ by the researcher. All estimations were performed on EpilInfo™ 7 StatCalc running under Microsoft Windows® on a personal computer. Data collection sheets were used to document the study subjects demographic details as well as information about their prescribed chronic medicines and classified according to the Anatomical Therapeutic Chemical (ATC) classification system. The data collection sheets also include diagnosis using International Classification of Diseases (ICD 10) codes.

The types of prescriptions were summarised descriptively using frequency counts. The Chi square test was performed to check the difference between prescription on admission and at discharge. The average number of medicines per prescription was calculated. Frequency counts were performed on different aspects of the data collection tool, e.g. omissions, same class different drug, class duplication, drug duplication, incorrect dose, incorrect frequency, contra-indications and drug interactions. The number of interventions made will be used as a measure of the outcomes of the study.

All statistical analysis was performed on SAS Release 9.4 or IBM SPSS Statistics 22 running under Microsoft Windows on a personal computer.

Ethical considerations

Informed consent was obtained from all subjects included in the study and the information obtained did not reveal the subject's or treating physician's details allowing for patient confidentiality/anonymity. The researcher was the only hospital staff member who had access
to the information obtained during the study period. Permission has also been obtained from the private hospital’s Ethics and Research Committee (UNIV-2015-0034), Sefako Makgatho Health Sciences University Research and Ethics Committee (SMUREC), approval number SMURECH/H/119/2015: PG.

All study material was stored in a locked cupboard in the Pharmacy Department that only the researcher had access to, in order to ensure the patients’ confidentiality was maintained throughout the study period.

RESULTS

PATIENT ENROLMENT

During the study period of six months, 321 patients were reviewed for potential inclusion into the study, and 200 were then found to be eligible to participate. One hundred and twenty one patients were excluded based on the reasons depicted in Figure 1.
Figure 1: Figure depicting number of patients included and excluded from the study

**PATIENT CHARACTERISTICS**

The majority of participants in this study were female (71%) and of white ethnicity (91%). Above the age of 50 (70%). Disorders of the respiratory system were the most common reason for admission (38%). Patient demographics and characteristics are illustrated in Table 3. Below.
Table 3: Patient demographics and characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Frequency (mean)</th>
<th>% (±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>142</td>
<td>71</td>
</tr>
<tr>
<td>Male</td>
<td>58</td>
<td>29</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Coloured</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Indian</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>White</td>
<td>182</td>
<td>91</td>
</tr>
<tr>
<td>Ages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-30 (yrs)</td>
<td>5</td>
<td>2.5 (5.68)</td>
</tr>
<tr>
<td>31-40 (yrs)</td>
<td>16</td>
<td>8 (2.24)</td>
</tr>
<tr>
<td>41-50 (yrs)</td>
<td>39</td>
<td>19.5 (3.64)</td>
</tr>
<tr>
<td>&gt;50 (yrs)</td>
<td>140</td>
<td>70 (2.93)</td>
</tr>
<tr>
<td>Number of chronic medications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admission</td>
<td>(4.97)</td>
<td>(2.74)</td>
</tr>
<tr>
<td>Discharge</td>
<td>(5.31)</td>
<td>(2.76)</td>
</tr>
<tr>
<td>Diagnosis per organ system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>76</td>
<td>38</td>
</tr>
<tr>
<td>Circulatory</td>
<td>25</td>
<td>12.5</td>
</tr>
<tr>
<td>Digestive</td>
<td>25</td>
<td>12.5</td>
</tr>
<tr>
<td>Discharge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>76</td>
<td>38</td>
</tr>
<tr>
<td>Circulatory</td>
<td>27</td>
<td>13.5</td>
</tr>
<tr>
<td>Digestive</td>
<td>26</td>
<td>13</td>
</tr>
</tbody>
</table>

MEDICATION RECONCILIATION AT ADMISSION AND DISCHARGE

A total of 1001 interventions were made on 200 patients translates to 5.005 interventions per patient during the study period, when medication reconciliation was performed on admission and discharge. Six hundred and seventy seven interventions were made on admission (mean 3.4, SD ± 3.01) and 324 on discharge (mean 1.62, SD ± 1.92).
On admission, 575 transcriptions were performed due to incomplete prescriptions. The most frequently performed intervention on discharge was counselling for new medications. On admission, 27 of study subjects, had prescription discrepancies when the in-hospital prescription was compared with the chronic medications in terms of dose, frequency or dosage form.

The total number of medicine related interventions made on admission was 84 (12.4%), and on discharge was 25 (7.7%), with the majority of interventions being made on admission.

### Table 4: Number of interventions made when performing medication reconciliation on admission and discharge

<table>
<thead>
<tr>
<th>Intervention type on admission</th>
<th>Admission n (%)</th>
<th>Discharge n (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated medical condition</td>
<td>2 (0.29)</td>
<td>0 (0)</td>
<td>1.000</td>
</tr>
<tr>
<td>Contraindications</td>
<td>4 (0.59)</td>
<td>0 (0)</td>
<td>0.311</td>
</tr>
<tr>
<td>Class duplication</td>
<td>11 (1.62)</td>
<td>2 (0.62)</td>
<td>0.243</td>
</tr>
<tr>
<td>Counselling performed on changes to current therapy as a result of intervention</td>
<td>4 (0.59)</td>
<td>0 (0)</td>
<td>0.311</td>
</tr>
<tr>
<td>Drug duplication</td>
<td>27 (3.99)</td>
<td>15 (4.63)</td>
<td>0.617</td>
</tr>
<tr>
<td>Incorrect dose</td>
<td>0 (0)</td>
<td>1 (0.31)</td>
<td>0.324</td>
</tr>
<tr>
<td>Incorrect frequency</td>
<td>1 (0.15)</td>
<td>1 (0.31)</td>
<td>0.543</td>
</tr>
<tr>
<td>Omissions</td>
<td>32 (4.73)</td>
<td>5 (1.54)</td>
<td>0.012*</td>
</tr>
<tr>
<td>Patient requested advice on current therapy</td>
<td>4 (0.59)</td>
<td>0 (0)</td>
<td>0.311</td>
</tr>
<tr>
<td>Patient requested information on therapy prescribed in hospital</td>
<td>8 (1.18)</td>
<td>0 (0)</td>
<td>0.060</td>
</tr>
<tr>
<td>Therapeutic duplication</td>
<td>9 (1.33)</td>
<td>1 (0.31)</td>
<td>0.181</td>
</tr>
<tr>
<td>Transcriptions</td>
<td>575 (84.93)</td>
<td>0 (0)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Counselling performed on discharge</td>
<td>0 (0)</td>
<td>299 (92.28)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Total</td>
<td>677</td>
<td>324</td>
<td>-</td>
</tr>
<tr>
<td>Patients with prescription discrepancies</td>
<td>150 (75)</td>
<td>25 (12.5)</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

### INTERVENTIONS MADE PER ATC AND ORGAN SYSTEM

Table 5 below details the number of interventions made per organ system and ATC on admission and discharge as well as the drug name in each instance.
Table 5: Interventions made per organ system and ATC on admission

<table>
<thead>
<tr>
<th>Organ system</th>
<th>Active ingredient</th>
<th>ATC</th>
<th>Admission</th>
<th>Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Blood and blood forming organs</td>
<td>Aspirin</td>
<td>C01AC06</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rivaroxaban</td>
<td>C07AC06</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>B. Cardiovascular</td>
<td>Amlodipine</td>
<td>C08CA01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Bisoprolol</td>
<td>C07AB07</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Candesartan</td>
<td>C09CA06</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Enalapril/Hydrochlorothiazide</td>
<td>C09BA02</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Ezetimibe</td>
<td>C10AC09</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Furosemide</td>
<td>C03CA01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Irbesartan</td>
<td>C09DA04</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Irbesartan/Hydrochlorothiazide</td>
<td>C09CA04/C03AA03</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Lisinopril</td>
<td>C09AA03</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Perindopril</td>
<td>C09AA04</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Simvastatin</td>
<td>C10AA01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Spironolactone</td>
<td>C03DA01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Torasemide</td>
<td>C09DA04</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>G. Genito-urinary</td>
<td>Conjugated Oestrogens</td>
<td>G03CA57</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Conjugated Oestrogens/Medroxyprogesterone acetate</td>
<td>G03FA12/B06</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>H. Hormones</td>
<td>Prednisolone</td>
<td>H02AA02</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>M. Musculoskeletal</td>
<td>Allopurinol</td>
<td>M04AA01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Etoricoxib</td>
<td>M01AH02</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Naproxen/esomeprazole</td>
<td>M01AE02/A02BC05</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>N. Nervous system</td>
<td>Alprazolam</td>
<td>N05BA12</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Carbamazepine CR</td>
<td>N03AF01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Diazepam</td>
<td>N05BA01</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Duloxetine</td>
<td>N06AX21</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Escitalopram</td>
<td>N06AB10</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Paracetamol, Codeine Phosphate, Meprobamate</td>
<td>N05BC01/N02BE01/</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Pregabalin</td>
<td>N03AX16</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Tramadol/Paracetamol</td>
<td>N02AX02/N02BE01</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>R. Respiratory</td>
<td>Levocetirazine</td>
<td>R06AE09</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Montelukast</td>
<td>R03DC03</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Salmeterol/Fluticasone</td>
<td>R03BA05</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Theophylline</td>
<td>R03DA04</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

On admission, the most frequently omitted drug class were those treating conditions of the cardiovascular system (46.88%).

INTERVENTIONS MADE PER DRUG AND ORGAN SYSTEM

Table 6 below illustrates the types of interventions made on admission and discharge per organ system.
Table 6: Types of interventions made per drug per organ system

<table>
<thead>
<tr>
<th>Intervention</th>
<th>C/I A(D)</th>
<th>Class duplication A(D)</th>
<th>Drug duplication A(D)</th>
<th>Incorrect dose A(D)</th>
<th>Incorrect frequency A(D)</th>
<th>Omission A(D)</th>
<th>Therapeutic duplication A(D)</th>
<th>Grand Total A(D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alimentary tract and metabolism</td>
<td>0(0)</td>
<td>6(1)</td>
<td>11(8)</td>
<td>0(1)</td>
<td>0(1)</td>
<td>5</td>
<td>7(1)</td>
<td>29(11)</td>
</tr>
<tr>
<td>Blood and blood forming organs</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>1(1)</td>
<td>1(0)</td>
<td>2(0)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>3(0)</td>
<td>2(0)</td>
<td>3(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>15(0)</td>
<td>0(0)</td>
<td>23(0)</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>0(0)</td>
<td>0(0)</td>
<td>1(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>4(1)</td>
<td>0(0)</td>
<td>5(0)</td>
</tr>
<tr>
<td>Hormones</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(1)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(1)</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>0(0)</td>
<td>0(0)</td>
<td>1(2)</td>
<td>0(0)</td>
<td>1(0)</td>
<td>1(0)</td>
<td>0(0)</td>
<td>3(2)</td>
</tr>
<tr>
<td>Nervous system</td>
<td>0(0)</td>
<td>3(1)</td>
<td>2(3)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>4(2)</td>
<td>1(0)</td>
<td>10(4)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>0(0)</td>
<td>0(0)</td>
<td>7(1)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>2(1)</td>
<td>0(0)</td>
<td>9(1)</td>
</tr>
<tr>
<td>Sensory organs</td>
<td>1(0)</td>
<td>0(0)</td>
<td>2(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>0(0)</td>
<td>3(0)</td>
</tr>
<tr>
<td>Grand Total</td>
<td>4(0)</td>
<td>11(2)</td>
<td>27(15)</td>
<td>0(1)</td>
<td>1(1)</td>
<td>32(5)</td>
<td>9(1)</td>
<td>84(25)</td>
</tr>
</tbody>
</table>

C/I-Contraindicated; A-Admission; D-Discharge

**TIME TAKEN TO PERFORM MEDICATION RECONCILIATION**

The time taken for medication reconciliation is reflected in Figure 3 below and is compared with the number of chronic medications on admission and discharge. The mean total time for medication reconciliation services on admission was 18.32 (SD±5.28) minutes and 29.31(SD±3) minutes during the study and on discharge 10.99 minutes (SD±6.89) per patient,

The number of chronic medications on admission and discharge versus the time taken to perform medication reconciliation is depicted in Figure 2. Study subjects who had twelve chronic medications on admission were shown to have the longest times taken, to perform medication reconciliation.
Figure 2: Number of chronic medicines at admission and discharge versus time taken for performing medication reconciliation

TOTAL COSTS FOR MEDICATION RECONCILIATION

The total cost for the provision of this service was R22 439.01 for the entire study period based on time spent performing medication reconciliation and the hourly pharmacist rate. The average cost for medication reconciliation services in this study was R112.20 per patient.

COST SAVINGS DURING THE STUDY PERIOD DUE TO PREVENTED MEDICATION RELATED EVENTS

The cost saving calculation depicted below is based on the methodology by Steve Rough as published in the MATCH Toolkit from the American Society of Health Systems Pharmacists and the cost of managing an adverse drug event has been estimated at between 5000-10000USD.\( ^{15} \) The calculation below has been performed using the 2500USD estimate. The Medication related events that had the potential to cause significant harm (6.3), is based on the published data on adverse drug event rates in South Africa.\( ^{16,17} \)
Table 7: Cost savings from medication reconciliation during the study period

<table>
<thead>
<tr>
<th>Table 7: Cost savings from medication reconciliation during the study period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of medication related events per patient</td>
</tr>
<tr>
<td>Number of admissions to the medical ward during study period</td>
</tr>
<tr>
<td>Potential Medication related events avoided pa</td>
</tr>
<tr>
<td>Percentage of MRE that were potentially harmful</td>
</tr>
<tr>
<td>Number that were potentially harmful</td>
</tr>
<tr>
<td>Cost implications per ADE (5000 USD)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Cost of a Clinical pharmacist during study period</td>
</tr>
<tr>
<td>Cost savings after resource costs</td>
</tr>
</tbody>
</table>

DISCUSSION

This study evaluated medication reconciliation implemented according to the WHO, High Five’s, Standard Operating procedure for medication reconciliation, in a medical ward in South Africa.\(^{18}\) To the best of our knowledge, this study is the first of its kind to assess medication reconciliation on admission and discharge in adult patients treated in a private hospital in South Africa. Our study described the interventions made by the pharmacist when performing medication reconciliation on admission and at discharge. The majority of the study participants were older than 50 and in line with previously published studies of similar design.\(^{19,20,21,22,23}\)

The risk of adverse drug events increases dramatically, when the number of medications a patient takes increases.\(^{24}\) The mean number of chronic medications on admission was lower than similar studies performed on medication reconciliation.\(^{25,26}\) This is a positive finding since the risk of adverse drug events increases dramatically, when the number of medications a patient takes increases.\(^{1}\)

The results presented above reaffirm the need for medication reconciliation on admission as the largest proportion of interventions (65%) were performed on incomplete prescriptions on admission and this finding is comparable to similar studies.\(^{27}\) The incomplete prescriptions on admission resulted in 547 transcriptions being performed by the pharmacist.

Our study demonstrated that more study subjects (27 %) had prescription discrepancies on admission than on discharge (12 %). Prescription discrepancies on admission is still lower than similar studies where findings of between 40-56.3%.\(^{26,30}\) Medication discrepancies on discharge may be attributed to a lack of communication between health care workers on discharge prescriptions regarding medications changed or discontinued during hospital stay.\(^{30,31,32}\)
A total of eighty four medicine related interventions were made on admission. The majority of these medicine related interventions were made on drugs used to treat ailments of the alimentary tract and metabolism (34.5%) as per the ATC classification. In this study, cardiovascular drugs (27.4%) were the second most frequently intervened upon at admission and is comparable with results from similar studies.\textsuperscript{23,25} Some studies report that cardiovascular drugs may cause half of all hospital admissions due to adverse drug reactions.\textsuperscript{33} Patients receiving cardiovascular drugs are often prescribed complex drug regimens and are elderly. The largest number of drugs, were prescribed for conditions affecting the alimentary tract and metabolism and this could be the reason for the large number of interventions made on this class. Twenty five medicine related interventions were made on discharge with drug duplication being the most frequent intervention and drugs of the alimentary tract and metabolism being the class most intervened upon.

The mean time taken to perform medication reconciliation in this study was slightly higher than what was reported in similar studies, and may be attributed to the fact that the study participants spoke more than one language.\textsuperscript{14,34}

The total cost for the provision of this service was R22 439.01 (1405.95USD) for the entire study period based on time spent performing medication reconciliation and the hourly pharmacist rate. The average cost for medication reconciliation services on admission and discharge in this study was found to be less than half the costs demonstrated by published literature.\textsuperscript{34}

It has been demonstrated in published literature that pharmacist-led medication reconciliation has a 60% probability of cost-effectiveness, by its ability to prevent adverse drug events following discharge and decrease rehospitalisation rates.\textsuperscript{31} This study revealed that the costs of medication reconciliation implementation are approximately one tenth of the total cost savings from the prevention of adverse drug events.\textsuperscript{31}

**LIMITATIONS AND RECOMMENDATIONS**

The study sample was small (200) and therefore the findings of this study cannot be generalized for the entire population. There was no control group for this study and therefore the difference between patients receiving medication reconciliation and those receiving the standard of care could not be assessed. The study was conducted by one researcher and therefore the opportunity for selection bias must be considered. The effect on patient outcomes after the intervention was not assessed.
The results found in this study can motivate reasons for training on medication reconciliation for pharmacists, in order to prevent adverse drug events. It further identified the need for targeted interventions from the pharmacist. Studies such as these demonstrates a snapshot of the current situation, however, additional research would allow for a more comprehensive understanding.

CONCLUSION

Medication reconciliation as investigated in this study demonstrated the effect that a pharmacist can have when involved in admission and discharge processes. The findings of this study are in agreement with the available literature which demonstrates the benefits of a pharmacist performing medication reconciliation at admission and discharge.

Performing medication reconciliation can prevent medication errors, adverse drug events and the related treatment costs. The cost-savings demonstrated by this study justifies the time invested in providing this service and illustrates that medication reconciliation is a fruitful investment in patient safety.

Future studies should aim to evaluate the impact of medication reconciliation interventions.

The multi-disciplinary (physician, pharmacist and nurse) management of a patient during their hospital stay could help to reduce adverse drug events as demonstrated in this study. A larger study population is needed for the study to be generalizable. This study will facilitate future discourse on medication reconciliation performed by a pharmacist in South Africa.
REFERENCES


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CHAPTER 5
LIMITATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.1 INTRODUCTION

The limitations encountered during the study period are detailed in Section 5.2. Section 5.3 focuses on recommendations for similar studies in future and Section 5.4 serves to conclude the study.

5.2 LIMITATIONS

This study only included adult patients who were admitted to the medical ward during the hospital stay and excluded any patients who were transferred to or from higher levels of care. This was done to ensure that a greater severity of illness as seen with high care and intensive care patients did not influence the interventions made.

The study sample was small ($N=200$) and therefore the findings of this study cannot be generalized for the entire population. There was no control group for this study and therefore the difference between patients receiving medication reconciliation and those receiving the standard of care could not be assessed. The study was conducted by one researcher and therefore the opportunity for selection bias must be considered. The effect on patient outcomes after the intervention was not assessed.

5.3 RECOMMENDATIONS

- Future studies should aim to evaluate the impact of medication reconciliation interventions
- The clinical importance of interventions made should be evaluated
- A larger sample size would make a study of this nature more generalizable
- Multiple site studies on medication reconciliation performed by a pharmacist would make the data more generalizable (Michaelsen 2015)

5.4 CONCLUSION OF THE STUDY

The overall aim of the study was to evaluate a pharmacist initiated medication reconciliation program at admission and discharge in a private hospital medical ward.
The following objectives of the study were met:

The number of interventions made during admission and discharge were determined and described.

The admission and discharge prescriptions were compared and discrepancies identified were resolved.

The outcomes of the medication reconciliation programme were described in terms of cost reduction and feasibility in terms of staffing and medication errors prevented.

The findings of this study are in agreement with the available literature which demonstrates the benefits of a pharmacist performing medication reconciliation at admission and discharge. This study was also able to demonstrate the cost-effectiveness of providing this service with regards to adverse drug events prevented.

The multi-disciplinary (physician, pharmacist and nurse) management of a patient during their hospital stay could help to reduce adverse drug events as demonstrated in this study. A larger study population is needed for the study to be generalizable. This study will facilitate future discourse on medication reconciliation performed by a pharmacist in South Africa.
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APPENDICES

Appendix 1: Medication reconciliation data collection sheet (Admission)

<table>
<thead>
<tr>
<th>Patient No.: _____________</th>
<th>Subject no.: _____________</th>
<th>Date: _____________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age: _____________</td>
<td>Co-morbid conditions: _____________</td>
<td>Gender: _____________</td>
</tr>
<tr>
<td>Admission Diagnosis: _____________</td>
<td>ICD10 code: _____________</td>
<td>Time taken: _____________</td>
</tr>
</tbody>
</table>
Appendices

Appendix 2: Medication reconciliation data collection sheet (Discharge)

<table>
<thead>
<tr>
<th>Chronic prescription on admission</th>
<th>ATC Code</th>
<th>Chronic prescription in hospital</th>
<th>ATC Code</th>
<th>Omission</th>
<th>Same class diff. Drug</th>
<th>Class duplication</th>
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Patient No.: ________________
Subject no.: ________________
Date: ________________
Age: ________________
Co-morbid conditions: ____________________
Gender: ________________
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<tr>
<th>Chronic prescription on admission</th>
<th>ATC Code</th>
<th>Chronic prescription in hospital</th>
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Age: ___________________    Co-morbid conditions: ___________________    Gender: ________________
### Appendices

**Time taken:** _________________  **Discharge diagnosis:** _________________  **ICD10 code:** _________________

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**Total no. of interventions made:** _____________________________  **Intervention detail:** _____________________________

**Intervention accepted:** Y/N  **Allergies:** _____________________________  **Doctor:** _____________________________
Appendices

Appendix 3: English consent form

SEFAKO MAKGATHO HEALTH SCIENCES UNIVERSITY ENGLISH CONSENT FORM

Statement concerning participation in a Clinical Trial/Research Project*.

Name of Project / Study / Trial*

A pharmacist-mediated, medication reconciliation programme at the point of discharge in A Private Hospital medical ward, in Gauteng, South Africa

I have read the information on */heard the aims and objectives of* the proposed study and was provided the opportunity to ask questions and given adequate time to rethink the issue. The aim and objectives of the study are sufficiently clear to me. I have not been pressurized to participate in any way.

I understand that participation in this Clinical Trial / Study / Project* is completely voluntary and that I may withdraw from it at any time and without supplying reasons. This will have no influence on the regular treatment that holds for my condition neither will it influence the care that I receive from my regular doctor.

I know that this Trial / Study / Project* has been approved by the Sefako Makgatho Health Sciences University Research Ethics Committee (SMUREC), Sefako Makgatho Health Sciences University (Sefako Makgatho Health Sciences University) / Hospital. I am fully aware that the results of this results of this Trial / Study / Project* will be used for scientific purposes and may be published. I agree to this, provided my privacy is guaranteed.

I hereby give consent to participate in this Trial / Study / Project*.

____________________________ ______________________________
Name of patient/volunteer Signature of patient or guardian

_______________________        _______________________       _______________________
Place Date Witness

Statement by the Researcher

I provided verbal and/or written* information regarding this Trial / Study / Project*

I agree to answer any future questions concerning the Trial / Study / Project* as best as I am able.

I will adhere to the approved protocol.

____________________________ ______________________________
Name of Researcher Signature Date Place
Appendices

Appendix 4: Afrikaans consent form

SEFAKO MAKGATHO HEALTH SCIENCES UNIVERSITY AFRIKAANS CONSENT FORM

Verklaring ten opsigte van deelname aan ’n kliniese eksperiment/navorsingsprojek*

Naam van projek/studie/eksperiment*

**A pharmacist-mediated, medication reconciliation programme at the point of discharge in A Private Hospital medical ward, in Gauteng, South Africa**

Ek het die inligting in verband met die beoogde studie gelees*/het die doelwitte en oogmerke van die beoogde studie aangehoor* en is die geleentheid gegun om vrae te stel asook voldoende tyd toegelaat om oor die aangeleentheid te besin. Die doelwit en oogmerke van die studie is duidelik genoeg vir my. Ek is geensins onder enige druk geplaas om deel te neem nie.

Ek verstaan dat deelname aan hierdie Kliniese Eksperiment/Studie/Projek* geheel en al vrywillig is en dat ek te eniger tyd daarvan kan onttrek sonder om enige redes aan te voer. Dit sal geen invloed hê op die gereelde behandeling van my toestand nie, en sal ook nie die behandeling wat ek van my eie dokter ontvang, beïnvloed nie.

Ek is bewus daarvan dat hierdie Studie goedgekeur is deur die ‘Sefako Makgatho Health Sciences University Research Ethics Committee (SMUREC)’, (Sefako Makgatho Health Sciences University-kampus)/Dr George Mukhari Hospitaal. Ek is ten volle bewus daarvan dat die uitslae van hierdie Studie aangewend sal word vir wetenskaplike doeleindes, en gepubliseer mag word. Ek stem daartoe in, met dien verstande dat my privaatheid gewaarborg is.

Hiermee verleen ek toestemming om deel te neem aan hierdie Studie

_I hereby give consent to participate in this Trial / Study / Project*. 

__________________________  __________________________
Naam van pasiënt/vrywilliger  Handtekening van pasiënt of voog

__________________________  __________________________  __________________________
Plek  Datum  Getuie

Verklaring deur Navorser

Ek het mondelingse en/of skriftelike* inligting ten opsigte van hierdie Eksperiment/Studie/Projek* voorsien.

Ek verklaar myself bereid om enige toekomstige vrae ten opsigte van die Eksperiment/Studie/Projek* na die beste van my vermoë te beantwoord.

Ek sal myself onderwerp aan die goedgekeurde protokol.
<table>
<thead>
<tr>
<th>Naam van Navorser</th>
<th>Handtekening</th>
<th>Datum</th>
<th>Plek</th>
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Appendices
Appendix 5: Study information letter for patients

Dear patient

You have been identified as a possible participant in a research study whilst you are in hospital. The name of the study is: “A pharmacist initiated, medication reconciliation programme at the point of discharge in a private hospital medical ward, in Gauteng, South Africa.”

This study is being done as part of a Masters degree in Clinical Pharmacy.

Medication reconciliation at the point of discharge is the process whereby the researcher will evaluate a patient’s chronic prescription before admission against the prescription on discharge.

The aim of this process is to identify any changes that may have been made during the hospital stay, both intentional and inadvertent. This process has been practiced in many First World Countries, however has not been done in South Africa before.

This process aims to facilitate a hassle free discharge process and to provide the patient with information regarding their treatment. The objective of the study is to reduce patient confusion and address any concerns patients may have regarding their treatment upon discharge.

The medication reconciliation study will require the use of your age, gender, prescription, but will not require personal information such as your name, ID number or hospital number. This will ensure that your confidentiality is maintained.
The researcher will carry out the following steps during the reconciliation process:

1. Your prescription will be assigned a number for the study purposes.
2. The researcher will ask for a list of all chronic medicines that you were using before hospital admission.
3. The researcher will then evaluate your discharge prescription to ascertain if any errors, duplications, omissions, dosage error, frequency errors, drug-interactions or change in drug.
4. The researcher will then note the no. of differences between both prescriptions and then investigate any omissions or changes.
5. Once all queries have been resolved, the researcher will then explain to you what changes, if any, have been made to your treatment during your stay in hospital.
6. You will then have an opportunity to ask any questions you may have regarding your treatment.

All data collected will be used for the submission of a Masters Dissertation, a requirement for a MSc. Med in Clinical Pharmacy at the Sefako Makgatho Health Sciences University.

Your identity and personal details will be kept confidential at all times. This study will not infringe on your privacy or financial status, and it will not interfere with your treatment whilst you are in the hospital.

You may refuse to participate, or discontinue participation at any stage of the process.

For any questions, feel free to contact me, the researcher at 0834074688 or 011 897 1763

___________________

Delyne Subrayen

Researcher (Researcher)/Ward Pharmacist

011 897 1763/ 083 407 4688
Appendices

Appendix 6: SMUREC Clearance Certificate

The New Application received on 16 March 2015, was reviewed by members of Sefako Makgatho University Research Ethics Committee on 09 April 2015 and was approved on 07 May 2015.

Please note the following information about your approved research protocol:


Please remember to use your protocol number (SMURECH/11920/1: PG) on any documents or correspondence with the REC concerning your research protocol.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modification, or monitor the conduct of your research and the consent process.

After Ethical Review: Please note a template of the progress report is obtainable in the Research Office and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit. Translators of the consent document in the language applicable to the study participants should be submitted.

International Organisation (IORG0004318), Institutional Review Board (ERB00003122), Federal Wide Assurance (FWA00009419)

Prof O Shisana (Chairperson), Ms SA Mchunu, Mr P Staci, Dr N Simelise, Prof AM Segone, Dr E van Staden
Appendices

Appendix 7: Netcare Research Operations Committee Approval

RESEARCH OPERATIONS COMMITTEE FINAL APPROVAL OF RESEARCH

Approval number: LINV-2015-0034

Ms Delyne Subrayen
E-mail: Delyne.Subrayen@netcare.co.za

Dear Ms Subrayen

RE: A PHARMACIST INITIATED, MEDICATION RECONCILIATION PROGRAMME AT A PRIVATE HOSPITAL, GAUTENG, SOUTH AFRICA

The above-mentioned research was reviewed by the Research Operations Committee’s delegated members and it is with pleasure that we inform you that your application to conduct this research at private Hospital, has been approved, subject to the following:

i) Research may now commence with this FINAL APPROVAL from the Committee.

ii) All information regarding the Company will be treated as legally privileged and confidential.

iii) The Company’s name will not be mentioned without written consent from the Committee.

iv) All legal requirements regarding patient / participant’s rights and confidentiality will be complied with.

v) The research will be conducted in compliance with the GUIDELINES FOR GOOD PRACTICE IN THE CONDUCT OF CLINICAL TRIALS IN HUMAN PARTICIPANTS IN SOUTH AFRICA (2006)

vi) The Company must be furnished with a STATUS REPORT on the progress of the study at least annually on 30th September irrespective of the date of approval from the Committee as well as a FINAL REPORT with reference to intention to publish and probable journals for publication, on completion of the study.

vii) A copy of the research report will be provided to the Committee once it is finally approved by the relevant primary party or tertiary institution, or once complete or if discontinued for any reason whatsoever prior to the expected completion date.

viii) The Company has the right to implement any recommendations from the research.