THE EFFECTIVENESS OF IMPLEMENTING A PHARMACIST-DRIVEN INVENTORY MANAGEMENT SYSTEM IN THE WARDS AT DR GEORGE MUKHARI ACADEMIC HOSPITAL

A mini-dissertation submitted by

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2016
DECLARATION

I declare that the mini-dissertation hereby submitted to the Sefako Makgatho Health Sciences 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 it is my work in design and execution, and that all material contained herein has been duly acknowledged.

__________________________________________  ____________________________
Surname, Initials (Title)                        Date
DEDICATION

This work is dedicated to my beloved late father Faustino and my mother Epiphany for their unwavering love and support. Thank you for your encouragement, love, support and prayers and for motivating me to study further. I know Dad would have been proud. To my brothers Pat and Prince, and sister Precious, thank you for encouraging me to study further and supporting me when I felt overwhelmed. And to my sister Princess, thank you for being a great inspiration, motivating me and contributing ideas towards my research. Thank you all for believing in me.
“Health for all need not be a dream buried in the past”

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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
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<tbody>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
</tr>
<tr>
<td>DCIs</td>
<td>Data Collection Instruments</td>
</tr>
<tr>
<td>DGMAH</td>
<td>Dr George Mukhari Academic Hospital</td>
</tr>
<tr>
<td>FEFO</td>
<td>First Expiry First Out</td>
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<tr>
<td>FG</td>
<td>Focus Group</td>
</tr>
<tr>
<td>FIFO</td>
<td>First In First Out</td>
</tr>
<tr>
<td>FIP</td>
<td>Fédération Internationale Pharmaceutique (International Pharmaceutical Federation)</td>
</tr>
<tr>
<td>ICM</td>
<td>Inventory Control Management</td>
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<tr>
<td>ICMS</td>
<td>Inventory Control Management System</td>
</tr>
<tr>
<td>IMS</td>
<td>Inventory Management System</td>
</tr>
<tr>
<td>MCC</td>
<td>Medicines Control Council</td>
</tr>
<tr>
<td>MDG</td>
<td>Millennium Development Goal</td>
</tr>
<tr>
<td>MREC</td>
<td>Medunsa Research Ethics Committee</td>
</tr>
<tr>
<td>MSH</td>
<td>Management Sciences for Health</td>
</tr>
<tr>
<td>NDoH</td>
<td>National Department of Health (of South Africa)</td>
</tr>
<tr>
<td>PA</td>
<td>Pharmacist’s Assistant</td>
</tr>
<tr>
<td>SANC</td>
<td>South African Nursing Council</td>
</tr>
<tr>
<td>SAPC</td>
<td>South African Pharmacy Council</td>
</tr>
<tr>
<td>SOPs</td>
<td>Standard Operating Procedures</td>
</tr>
<tr>
<td>UHC</td>
<td>Universal Health Coverage</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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ABSTRACT

Introduction: In hospitals, medicines are kept as ward stock to ensure availability to patients when needed, but appropriate inventory management practices are essential to ensure that patients receive good quality safe and effective medicines. Nurses are generally responsible for ward medicines management in hospitals. However, it is important for pharmacists as the custodians of medicines to be actively involved with stock checking and stock rotation on a regular basis to ensure that adequate quantities of medication are provided, medicines are stored appropriately, and that no obsolete or expired medicines are present in the wards. Implementation projects tend to fail due to the way change is introduced. If new changes are not well detailed, uncertainty may be introduced and employees are likely to reject the new project. Therefore change management is imperative to increase the chances of success of a new project. In South Africa, pharmacist involvement in ward inventory management is understudied. Although pharmacists are the custodians of medicines, ward inventory management requires team effort.

Objectives: To determine the inventory management practices in the wards at a tertiary academic hospital in South Africa prior to and after the implementation of a pharmacist-driven inventory management system and to determine the perceptions of nursing and pharmacy staff on a pharmacist-driven inventory management system, successes achieved and challenges experienced by nursing and pharmacy staff during, and as a result of the implementation of the pharmacist-driven inventory management system in the wards at a tertiary academic hospital.

Method: This was a three-phased descriptive operational intervention and exploratory qualitative study which was conducted in eight intervention and 35 control wards with a pre-and post-intervention assessment. A 34-item indicator checklist was used to assess inventory management practices for wards at baseline (pre-test) and after intervention (post-test). Percentage improvement in indicator compliance for intervention wards was compared to that of control wards to determine the impact of the intervention. The intervention for the purpose of overseeing ward inventory management entailed pharmacist and pharmacist’s assistant allocation to each of the wards in the hospital. Focused pharmacist interventions were implemented in eight paediatric intervention wards. Four paired in-depth interviews and a focus group discussion were used to determine the experiences of nursing and pharmacy staff following the implementation of a pharmacist-driven inventory management system in paediatric wards of a tertiary hospital.
**Results:** Overall percentage compliance with checklist indicators for study wards (n=8) prior to the intervention was 42.3% and that of control wards (n=35) was 38.2%. After implementation of the intervention, the overall percentage improvement for study wards was 73.2% compared to that of control wards which was only 16.7%. This indicates that pharmacist interventions improved inventory management practices. One example of the indicators that the pharmacist had very little control over is the locking of the medicine rooms to improve medicines security, as that depended on the nurses who were in the wards most of the time. Pharmacist interventions in the wards included rearranging of medicines, removal of expired medicines, marking short-dated medicines and training nursing staff. Although there were time constraints active involvement of pharmacy staff in the wards bridged the gap between the pharmacy and the wards which resulted in improved communication. Outdated infrastructure and shortage of staff made it difficult to implement interventions. Both pharmacy and nursing staff perceived that the pharmacist-driven inventory management system improved their inventory management skills and that they gained new knowledge in terms of medicines management through the intervention.

**Conclusions:** Although inventory management was performed by nurses, it was evident that assistance with medicines management in the wards is required from pharmacists. It was evident from the results that focused interventions implemented by pharmacists are vital for proper ward inventory management. However, a multidisciplinary approach improves inventory management practices, reduces work load and improves communication among health care professionals.

**Recommendations:** Upgrading of infrastructure is required to facilitate proper inventory management. Access to medicine rooms can be more controlled and medicine stock records should be kept to promote traceability. Regular cycle counts are required to avoid expired and short-dated medication. Continuous pharmacist-driven interventions are required in ward inventory management.
CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

This chapter provides the background and rationale for this study and also explains the importance of the study. Operational definitions are provided for a better understanding of some of the terms used in this dissertation. The research questions, aim and objectives of the study are given. The chapter ends with an overview of the importance of the study and an outline of the dissertation.

1.2 BACKGROUND AND RATIONALE FOR THE STUDY

One of the basic requirements for effective inventory management is adequate records. It is also important to monitor stock movement and determine when to order more stock, where to order it from, and in what quantities to order it, in order to have effective inventory control management. Poor ward stock management could result in excess medication and this in turn could affect service delivery (Dias, 2011).

Ward stock management is generally carried out by nurses in hospital institutions (Schellack and Meyer, 2010). Although nurses are responsible for inventory management in the ward it is important for them to communicate and work with the pharmacy staff (Schellack, Martins, Botha and Meyer, 2009). According to Ally and Odendaal (2014), the active involvement of pharmacists in wards made a great impact in the medicine supply management cycle in the wards at Ermelo Hospital Pharmacy. Evidently there is a need for the involvement of pharmacists in the wards on a daily basis. Pharmacists at Ermelo Hospital were involved with training nurses on ward stock (inventory) management, promoting rational medicine use and compiling pharmacy monitoring reports, among other duties. This resulted in stock cards balancing with physical stock and less stock expiring, indicating effective inventory management.

The training of health care professionals (e.g. nurses) on stock management can improve medicine usage and inventory management while meeting patient needs, but without supervision, these improvements cannot be maintained. A pharmacist is therefore required to closely monitor and oversee ward stock management, especially reduction of obsolete stock (Trap, Todd, Moore and Laing, 2001).
Chapter 1: Introduction

Schellack et al., (2009) identified a need for regular ward visits by pharmacists to oversee ward stock management. Another need that was identified was the need for implementation of a uniform inventory management system in order to improve ward stock management (Schellack et al., 2009).

In 2011, a ward stock management project involving Bachelor of Pharmacy (BPharm.) students from the University of Limpopo, Medunsa Campus had been implemented at Dr George Mukhari Academic Hospital (DGMAH). The project however, was not sustainable as it was mainly student-driven.

A post-graduate project was then conducted in four wards of DGMAH to further investigate the role of the pharmacist in the management of medicines within the wards (Mayimele, 2013). Results from the first phase of the study reflected a need for the constant involvement of a pharmacist in ward stock management. Targeted interventions were implemented in Phase 2 of that study, which addressed the needs that were identified in Phase 1. The interventions included ward stock checklists, standard operating procedures (SOPs) for various activities and a ward stock record book. These documents were developed to aid in medicines inventory management at ward level (Mayimele, 2013).

This study was a follow-up on the interventions developed by Mayimele (2013) and aimed to implement the documents developed, in other wards of the hospital. A pharmacy team, each consisting of a pharmacist and a pharmacist’s assistant, were allocated to each of the paediatric wards at DGMAH, for the implementation of an inventory management system.

1.3 OPERATIONAL DEFINITIONS

The following operational definitions apply to this study:

- **Inventory**: The stock of any item or resource used in an organisation (Jacobs and Chase, 2013).

- **Inventory control**: The monitoring of stock levels periodically and determining what to order, and in what quantities to order (Adeyemi and Salami, 2010).

- **Inventory management**: The management of the routine ordering process and the activities involved in managing inventory levels (Dias, 2011).

- **Inventory system**: A set of policies and controls that monitor levels of inventory and determine what levels are required to be maintained, when stock may be ordered, and how large orders should be (Jacobs and Chase, 2013).
• **Ward stock management**: The management of the routine ordering process, along with the activities involved in managing inventory levels in wards (Dias, 2011).

For the purpose of this study, the terms inventory control, inventory management and ward stock management were used interchangeably.

### 1.4 RESEARCH QUESTIONS

What effect will a pharmacist-driven inventory management system have on ward stock management practices in DGMAH?

What are the possible successes and challenges of a pharmacist-driven inventory management system, implemented in the wards at DGMAH?

### 1.5 AIM OF THE STUDY

The aim of this study was to implement a pharmacist-driven inventory management system in the wards at DGMAH and to determine the successes and challenges of such a system.

### 1.6 OBJECTIVES OF THE STUDY

The objectives of the study were as follows:

- To determine the inventory management practices in the wards at DGMAH *prior to* the implementation of a pharmacist-driven inventory management system.
- To implement a pharmacist-driven inventory management system in the wards at DGMAH.
- To identify successes achieved and challenges experienced through the active involvement of pharmacists and pharmacist’s assistants in ward inventory management.
- To determine the time spent by the pharmacist on ward inventory management interventions.
- To determine the inventory management practices in the wards at DGMAH *after* the implementation of a pharmacist-driven inventory management system.

### 1.7 IMPORTANCE AND SIGNIFICANCE OF THE STUDY

The limited availability of data on the involvement of pharmacists in hospital wards with regards to inventory management, especially in South Africa, highlighted the importance of
Chapter 1: Introduction

This study. Most pharmacists in hospital settings are involved with dispensing and distribution of medication, but once medication is distributed, pharmacists provide very little support to nursing staff with regards to inventory management, to ensure medicines supply is adequate and the quality of medicines is maintained (Makholwa, 2014). Structured implementation of this kind of project can empower both pharmacy and nursing staff towards better inventory management practices and improve communication among health care professionals. Better inventory management could further reduce expiry of stock in alignment with the Public Finance Management Act (Act no.1 of 1999) and therefore save the government revenue, as pharmaceuticals contribute towards government expenditure (National Treasury, 1999).

The training provided by pharmacists is crucial in empowering nurses with knowledge (Ally and Odendaal, 2014). This boosts their confidence and improves work flow and patient care as they will be more knowledgeable on medicines management. The public’s confidence in the health care system, especially the government sector will also be restored (The Health Foundation, 2013).

According to the Minister of Health, Dr Aaron Motsoaledi, the importance of providing quality health services is non-negotiable as better quality of care is fundamental in improving South Africa’s current poor health outcomes and in restoring patient and staff confidence in the public health care system (National Department of Health (NDoH, 2011a). He defined quality as “getting the best possible results within available resources”. In this case, the best possible results or outcomes would be providing the patient with the “six rights”, i.e.; the right medicine, in the right quantity, of the right quality, at the right time, in the right place and for the right cost (USAID | DELIVER PROJECT, 2009).

1.8 OUTLINE OF THE DISSERTATION

Chapter 1: Gives an overview of the whole dissertation, explains its importance and provides operational definitions of the terms used in this dissertation.

Chapter 2: The chapter discusses the literature, related to the study topic.

Chapter 3: Presents the methods used in this study and discusses a few factors affecting the study, e.g. ethical considerations and bias.

Chapter 4: In this chapter, the results collated and compiled during data collection are presented and discussed in the form of two manuscripts.

Chapter 5: This chapter provides the limitations of the study, recommendations and final conclusion.
2.1 INTRODUCTION

This chapter presents a review of the literature related to the study. Pharmaceutical inventory management, ways of combating the wastage of stock and the relevance of having an effective inventory management system are discussed. This is followed by an overview of cycle counts and their relevance in managing stock, as well the means of preventing expiry of stock. Current ward inventory management, involvement of pharmacy personnel in ward inventory management and guidelines and legislation affecting ward inventory management are topics that are also explored in this chapter.

2.2 PHARMACEUTICAL INVENTORY MANAGEMENT

In order for inventory management to be effective and efficient, the purpose and type of distribution system should be established, adequate records and reports made available, and selection of items to be stocked carried out. Policies on when, where and what quantities of medicines to order can be put in place and there should be a balance between service levels, i.e. clinics and wards within the hospital. Control of costs associated with inventory management such as stock ordering, expiry and stock-outs are needed (Diaz, 2011). An effective inventory management system is supposed to be able to deliver the right medication in the right quantity and quality to the patient at the right time (Management Sciences for Health (MSH), 2012).

The initial step in combating wastage of stock is conducting an inventory review in order to identify the medicines which are being wasted through expiry. It is important that each ward keeps their own stock list to facilitate control and combat misuse (Sallet, 2011). The consumption of medicines by the ward could also be determined from stock movement records (Tan, Dodge, Chan, Giam and Heng, 2001). Over-stocking in wards results in short-dated stock being returned to the pharmacy or redistributed to other wards. Such practices are time-consuming, resource-consuming and rigorous (O'Leary, Burke and Kirs, 2006).

A designated medicine room for the supply of medicines in a hospital ward is required. Each medicine room should have a refrigerator in good working condition, an air conditioner, so as to keep the temperature suitable for medicine storage, i.e. below 25°C and suitable light conditions for the storage of medicines. Access to these medicine rooms must be controlled
Chapter 2: Literature Review

(SAPC, 2010). Stock movement ought to be determined for all items kept in the ward. Ordering practices would then be reviewed such that the wards would only order what they need, in sufficient quantities (United States Environmental Protection Agency (EPA), 2010). This would prevent under- or over-stocking and thus minimise costs. Stock can be arranged systematically for easy identification. This minimises the chances of stock getting lost and increases ease when ordering (Sallet, 2011). A medicine trolley equipped with essential medicines should be available in each ward to allow medical and nursing personnel to respond immediately, in case an emergency situation occurs (SAPC, 2010).

2.2.1 Cycle counts

Ineffective procurement has a negative impact on the entire drug management cycle. Determination of order quantities based on consumption is required to obtain the correct medication in adequate amounts which will, in turn, promote an effective procurement system (MSH, 2012).

Inventory records need to be accurate and up-to-date in order to have an effective drug management system. Inventory records and physical stock should be reconciled as often as possible in order to maintain accuracy, this can be achieved through cycle counts (Sallet, 2011). Errors in record keeping can result in inaccurate ordering, which in turn can result in over- or under-stocking, which could then lead to expiry of medication or stock outs. Errors can accumulate over time and may only be picked up when cycle counts are conducted. Cycle counts can therefore be considered as a way to correct errors that arise during the process of updating inventory records (Gürhan Kök and Shang, 2014).

2.2.2 Expiry of medicines

Pharmaceuticals contribute significantly to health care expenditure (Homedes and Ugalde, 2001). It is therefore important that wastage of pharmaceuticals be avoided. In a government facility setup, most pharmaceuticals are wasted through expiry (Nakyanzi, Kitutu, Oria and Kamba, 2008). More savings, in the health system, can be generated by controlling hospital costs which are greatly affected by the costs generated within the drug management cycle (Gumrukcu, Rossettı and Buyurgan, 2008).

Expiry of medicines is a challenge that is frequent in medicine supply chains in developing countries (Nakyanzi et al., 2008). Procurement of short-dated medicines, poor co-ordination between suppliers and their clients, duplicate procurement, over-stocking and irrational prescribing are some of the factors contributing to the expiry of medicines. Nakyanzi and colleagues (2008) recommended effective prescribing by authorised prescribers, which
could be improved by involving them in rigorous vigilance in inventory management. Expiry dates ought to be checked and recorded at regular intervals in order to minimise the storage of obsolete stock and therefore combat wastage (Dias, 2011). Good health services should ultimately deliver effective, safe, quality medicines to those that need them, when and where needed, with minimum waste of resources (WHO, 2007).

Ward stock is kept to ensure availability of medicines for use by ward staff when needed, but appropriate inventory management practices are essential for successful ward and institutional management (Embrey, 2011). Stock rotation is crucial in preventing the expiry of medicines. The first expiry first out (FEFO) rule ensures that short-dated stock is always used first. Upon receipt of stock, the expiry date should be noted in stock records. Short-dated stock must never be received unless it can be used before expiry. Expiry dates require to be monitored on a regular basis to ensure that the ward does not store expired stock. Marking short-dated stock and noting it in records, and removing expired medicines from shelves, makes managing medicines easier and reduces risk to patients (Sallet, 2011).

2.3 HOSPITAL PHARMACY PRACTICE

2.3.1 Legislation and guidelines pertaining to nursing staff

One of the objectives of The National Health Act 61 of 2003, is to unite the various elements of the health system in order to actively promote and improve the national health system in South Africa. Another objective is to promote a spirit of co-operation and shared responsibility among public and private health professionals and providers as well as other relevant sectors within the context of national, provincial and district health plans (NDoH, 2003).

Nurses are required to provide patients with care and treatment that meets basic patient care, contributes to their recovery and follows nursing protocols (NDoH, 2011a). The responsibilities of nursing practitioners are to protect, promote and restore health, to prevent illness, preserve life and alleviate suffering (South African Nursing Council (SANC), 2013).

Nurses are expected to observe and apply fundamental ethical principles in their interaction with other health care practitioners, and work effectively within a multidisciplinary team (SANC, 2013). Regular communication between nursing staff in the wards and pharmacy staff is important, especially with regards to the storage and use of medicines (SAPC, 2010). According to the Batho Pele “People First” principles, all citizens should have equal access to the services which they are entitled to. Special programmes for improved service delivery
may be developed and implemented (Department of Public Service and Administration (DPSA), 1997).

2.3.2 Legislation and guidelines pertaining to pharmacy staff

Health care professionals should endeavour to protect, promote, improve and maintain the health of the population (NDoH, 2003). A pharmacist’s first concern is supposed to be the welfare of the patient and the public in general. Pharmacists are entrusted to manage the distribution of medicines and to ensure that they are used safely and effectively (Fédération Internationale Pharmaceutique and World Health Organization (FIP/WHO), 2014). Pharmacists, as the custodians of medicines, should be committed to fulfilling the health care needs of the general population and to taking responsibility for meeting the medicine-related needs and therapeutic outcomes of therapy of patients (SAPC, 2010). They therefore need to be actively involved in the design, implementation and monitoring of and effective pharmaceutical service. It is important that pharmacists co-operate with other health care professionals in a multi-disciplinary team in the interest of the patient.

The responsible pharmacist (pharmacy manager) must ensure that ward medicine rooms are inspected regularly by pharmacy personnel (pharmacists and pharmacist’s assistants), at least once a month (SAPC, 2010). This inspection should include checking that medicine stock levels are adequate (calculation of minimum and maximum stock levels), no obsolete or expired stock is kept, stock rotation is practised and stock orders are recorded and kept for a minimum of five years.

It is necessary to build proper support systems so as to allow doctors, nurses, pharmacists and other health care professionals to constantly work to improve the care they provide (NDoH, 2011a). The ongoing relationship of health care professionals in a multi-disciplinary team should be seen as a therapeutic alliance involving mutual trust and confidence in all matters related to pharmacotherapeutics. Pharmacists are mainly responsible for the supply and distribution of medicines, and should therefore ensure the correct storage and use of medicines (SAPC, 2010). Although medication provided for a particular ward is the responsibility of the nursing staff of that ward, the ultimate responsibility lies with the pharmacist, since pharmaceutical services are licensed and supervised by a registered pharmacist (NDoH, 2011a).

2.3.3 Pharmacy staff hospital practice

Managing medicines safely, effectively and efficiently is the key to providing high quality, patient centered health care. Evidence has shown that involvement of pharmacists in the
ward can improve patient outcomes (Child, Cooke and Hey, 2011). It is the responsibility of the hospital pharmacist, as the custodian of medicines, to oversee the complete medicine distribution cycle (Mayimele, Meyer and Schellack, 2015).

Medicine availability in hospital wards is a major concern, therefore pharmacists need to be more involved with the monitoring of medicines in the wards. There is a need for pharmacists to visit the wards and spend more time there in order to ensure that patient needs are met and medicines are stored appropriately and safely. They may carry out regular audits so as to improve patient outcomes. Pharmacists ought to also attend ward rounds in order to get a view of what sort of medication patients are receiving, and also to be able to provide input or advice on what medication patients need. Ongoing communication between pharmacists and prescribers is necessary to ensure rational medicine use (Child, Cooke and Hey, 2011).

Providing patients with medicines alone is not enough to achieve treatment outcomes, pharmacists need to ensure that the medicines they are providing are of high quality and that the quality is maintained throughout the distribution system, until it reaches the patient (FIP/WHO, 2014). The patient’s well-being should be the main goal at all times. Pharmacists need to ensure that the medicines are stored under appropriate conditions, this includes hospital wards, until they reach the patients. Monitoring treatment to assess its effectiveness and establish occurrence of adverse events is also an important role of the pharmacist. There should be a system in place that enables pharmacists to report and obtain feedback from patients and other health care professionals on adverse events, medication errors, product quality and any other medicine-related problems.

2.3.4 Nursing staff hospital practice

Professional practice environments support nurses to function at the highest scope of clinical practice. This enables them to work effectively in a multidisciplinary team of health care professionals, to mobilize resources quickly, and to meet patient health care needs, thus providing better quality of care (Fries, Lake, Aike, Silber and Sochalski, 2008). Hospitals with low nurse staffing levels tend to have higher rates of poor patient outcomes (Stanton, 2004). Increasing the nurse recruitment, especially that of registered nurses, improves quality of care.

There is a lack of qualified nursing staff, in general, and this contributes to poor patient outcomes as nurses have a large workload (Stanton, 2004). In nursing practice, certain tasks depend upon collaboration with others, and some depend on the performance or judgment of another member of the health care team (Herron-Rice, Casey, Day, Frii, Girard,
Harker, Juan, Panther, Sarisley and Schaeublin, 2009). There is therefore a need for health care professionals to work together to relieve the workload. Help may be required, especially with management of medicines.

2.3.5 Management of pharmaceuticals in the wards

Nurses are currently managing inventory, i.e. ordering, receiving, storage and issuing of medicines in the wards in health care facilities. There is a need for nursing staff to communicate with pharmacy staff for effective inventory management (Schellack and Meyer, 2010).

It is the responsibility of the pharmacist to inspect medication in the wards, at least once a month (SAPC, 2010). This should be done to ensure that medicines are stored under the correct requirements, expired or obsolete medicines are not kept, disinfectants are stored separately from medicines, stock levels are adequate, stock rotation is maintained and medication is available. Adequate inventory management systems for ward inventory must be maintained by calculation of minimum/maximum stock levels regularly (e.g. every three months), identification and proper disposal of expired or obsolete stock, and storage of stock records (e.g., invoices for ordering and receiving stock).

A hospital pharmacist has the opportunity to interact with other health care professionals, i.e. working in a multidisciplinary team and monitor drug usage, and therefore influence selection of medicines and dosage regimens (WHO, 1994). Pharmacists are the custodians of medicine, therefore their involvement in medicines management in hospital wards is vital for the improvement of service delivery (SAPC, 2010).

2.4 QUALITY OF CARE AND SERVICE DELIVERY

2.4.1 Service delivery

A health system comprises of all the resources, including economic, infrastructure, human resources, etc. whose primary purpose is to improve health (WHO, 2010). A health system should provide preventive, promotive, curative and rehabilitative interventions by combining public health activities and the hierarchy of health care facilities that deliver health care (WHO, 2010).

The complex nature of health systems and the span of responsibilities across various sectors pose challenges in monitoring performance (WHO, 2010). Inequality in the
distribution of health care professionals is a challenge, especially in third world countries (Speybroeck, Ebener, Sousa, Paraje, Evans and Prasad, 2006). Sub-Saharan Africa has the highest mortality rate of children under five. Most of these deaths are due to infectious diseases such as pneumonia and malaria, which can be curbed by providing medicines at the right time (Too-Kong, 2014). In order to reduce mortality, consistent support of child and maternal health through combined effort, sound strategies and adequate resources, throughout the health care system are essential. This applies to the health of the general population as well. Although South Africa might be able to meet immunization goals by the end of 2015, it is unlikely to meet targets to reduce infant and under-five mortality rates, therefore health care professionals need to work together to improve service delivery (Frolick and Tau, 2011). Shortage of human resources and equipment has hampered service delivery in the health care sector. There is need for proper resource allocation in order to meet Millennium Development Goal (MDG) targets.

Part of the mission of the NDoH is to consistently improve the health care delivery system by focusing on access, equity, efficiency, quality and sustainability (NDoH, 2014). Everyone has the right to health care and it is the responsibility of the government to take reasonable measures, within its available resources, to accomplish the progressive realisation of this right. Institutions are required to address structural disparities, ensure accountability for the quality of the health services offered and ultimately improve health outcomes, in order to achieve Universal Health Coverage (UHC) (NDoH, 2014).

2.4.2 Quality management

Quality is getting the best results possible within the available resources (NDoH, 2007). Quality can also be defined as the level of attainment of health systems’ intrinsic goals for health improvement and responsiveness to legitimate expectations of the population (WHO, 2006). Good pharmacy practice is the practice of pharmacy that responds to the needs of people requiring pharmaceutical services, to provide optimal, quality, evidence-based care. For this practice to be feasible there is need for an established framework of quality standards and guidelines (FIP/WHO, 2014).

A health care facility should ensure that its service delivery meets the highest possible quality standards that address patient needs (WHO, 2006). A standard is a statement of an expected level of quality delivery which can be used to measure performance (NDoH, 2011a). Standards reflect the ideal performance level of a health institution in providing quality care. Setting indicators and using surveys and surveillance systems can be a way of monitoring performance to identify gaps and improve quality.
The provision of quality health care services must never be compromised (NDoH, 2011a). The hospital’s management structure should be appropriate for the health establishment and needs to have the authority to ensure efficient service delivery. Medicines availability and delivery are obligated to be reliable, and their stock levels and storage need to be managed appropriately. Lack of sufficient funds, fragmentation of service delivery systems and poor quality are the main obstacles to the successful implementation of health programmes (WHO, 2006). The institution’s management should encourage staff to come up with new ways of providing better service, cutting costs, improving conditions, streamlining and generally making changes (KZN-DoH, 2001).

In order to maximise on output obtained from resources and provide quality service delivery, delivery of care needs to be organised (WHO, 2006). Infrastructure must be used appropriately according to level of care in order to maximise on outcomes achieved using available resources (NDoH, 2011a). Accomplishing the MDGs requires an organised whole-system perspective. Focusing on the health systems perspective and orienting the health care system to the delivery and improvement of quality helps meet the expectations of patients, health care professionals and the general public. It is imperative to improve quality of care in order to meet patient needs and produce better health care outcomes, therefore, continuous quality improvement should be sustained (NDoH, 2007).

2.4.3 Quality improvement

According to The Health Foundation (2013), there is no universally accepted definition of quality in health care. However, the following definition from the US Institute of Medicine (IoM) is often used: “... the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge”. The same applies to quality improvement, for which there is no single definition. A number of definitions describe it as a systematic approach that uses specific techniques to improve quality. The Health Foundation (2013) defines quality improvement as “better patient experience and outcomes achieved through changing provider behaviour and organisation through using a systematic change method and strategies”. The most important element in successful and sustained quality improvement is the way in which the change is introduced and implemented.

In order to be able to improve quality, there should be an understanding of what quality entails (WHO, 2006). Improving quality entails making health care more safe, effective, patient centred, timely, efficient and equitable (The Health Foundation, 2013).
Quality can be defined as having six dimensions, which a health institution should aim to improve (WHO, 2006). In order to attain quality, the health care system is required to be:

- Effective, i.e. deliver health care that is evidence based and addresses individual and community needs
- Efficient, i.e. maximise resource use and minimise waste
- Accessible, i.e. timely, geographically reasonable and should have skills and resources appropriate to medical needs of that community
- Acceptable / patient-centred, i.e. consider the preferences and aspirations of individual service users and their community’s cultures
- Equitable, i.e. of consistent quality, regardless of personal characteristics such as gender, race, ethnicity, geographical location, or socioeconomic status
- Safe, i.e. minimise harm and risks to service users

A quality improvement system should be in place and needs to be monitored for effectiveness. A committee is required in order to guide and coordinate the quality assurance system. It can comprise of various health care professionals, e.g. pharmacists, doctors and nurses (NDoH, 2011a). It is important to review the performance of the health care system regularly and to develop strategies for improving quality outcomes (WHO, 2006).

All quality improvement needs should be addressed, strategies plotted and implementation of these strategies monitored. Senior management ought to ensure that plans are implemented and targets met, e.g. the pharmacy manager could oversee that pharmacy staff go on ward visits where they supervise inventory management (NDoH, 2011a). Staff involved with improving services should be kept well-versed with current practices and are supposed to be able to identify room for improvement in order to improve service delivery (NDoH, 2011a).

### 2.4.4 Access to medicines

Every South African citizen has the right to have access to health care (Department of Justice and Constitutional Development (DoJ), 2012). Access to medicines is a challenge in sub-Saharan Africa (Penfold and Bertelsmann-Scott, 2014). According to the Fédération Internationale Pharmaceutique (FIP), barriers to good health include poor access to quality medical products, lack of access to trained health professionals and care, an inadequate

Medicines are an essential and crucial part of health care (FIP/WHO, 2014). Pharmacists play an important role in improving access to health care and closing the gap between the potential benefit of medicines and the actual benefit gained. Pharmacists should therefore provide accessible clinical services to bridge that gap (SAPC, 2010). Medicine supply limitations may result in poor economic and patient safety consequences (Mayimele, Meyer and Schellack, 2015). It is therefore imperative to apply necessary changes to improve medicine supply.

2.5 HEALTH SYSTEMS

Investing in health systems is fundamental for achieving institutional, national and international goals (WHO, 2007). The WHO systems framework (see Figure 2.1), was set up so as to strengthen health systems, and to give a platform for improvement of health intervention delivery in terms of effectiveness, safety and quality, as needed, with minimum waste of resources. Strengthening health system requires integration of the health system building blocks to achieve goals, as health systems comprise of interdependent components which need to work together in order to be effective. One extremely important investment for health systems strengthening is human resources, which falls under the health workforce building block (George, Quinlan, Reardon and Aguilera, 2012).

Adapted from: [http://www.wpro.who.int/health_services/health_systems_framework/en/](http://www.wpro.who.int/health_services/health_systems_framework/en/).

**Figure 2.1: The WHO Systems Framework**

Once well trained staff is available, it makes it easier to delegate authority and set up leadership which will be able to align financing and research, to optimise the use of medical
products and technologies, and other resources, so as to deliver good quality service delivery. Service delivery can be effectively provided with competent staff working with the right medicines and equipment, with sufficient financing, under effective management (WHO, 2007). Integrating the six building blocks of the WHO systems framework allows for efficient responsiveness which reduces financial risk, for example through wastage of medicines. This in turn improves efficiency as time is spent on actually providing much needed services, rather than mitigation of incidences due to errors and/ or disdain of seemingly trivial issues. All this then results in improved health as patients will be receiving the services they require.

Poverty can be linked to poor health. People in poor communities suffer from lack of resources, and as a result, the burden of disease is much higher than communities that are well off. The mobilisation behind the MDGs has produced the most successful anti-poverty movement in history (United Nations (UN), 2015a). The MDGs have managed to pull over a billion people out of extreme poverty, however, inequalities still exist and progress from the year 2000 to date has been uneven. The National Health Insurance (NHI) is a scheme to being implemented in South Africa, which aims to address disparities between the private and public health sectors and introduce equity such that everyone has access to appropriate, efficient and quality health services (NDoH, 2011b). This would be a good start in addressing inequalities which were not addressed by the MDGs.

The world’s underprivileged populations remain concentrated in certain parts of the world (UN, 2015a). Although South Africa meets the WHO minimum medical practitioner to people ratio, staff shortages are still faced in public institutions and rural provinces, which mostly cater for the poor (George et al., 2012). Unequal distribution of staff between provinces as well as between the private and public sectors, suggests the main challenge is producing and retaining an appropriate mix of skills and expertise in the health care system, particularly with regard to nurses. Eradicating poverty is a necessity to achieve sustainable development (UN, 2015b). A good contribution to eradicating poverty would be providing good quality health care services, especially to rural or poverty stricken communities. Ensuring that poor communities receive the same quality of health care as their richer counterparts will reduce, if not eliminate, inequality.

Although there is a shortage of health care professionals in South Africa, that is not the major human resource constraint. The major problem lies with inadequate exploitation of the skills and expertise of health care professionals, development of inappropriate skills, predominantly in the nursing care and recurrent and high levels of staff attrition (George et al., 2012). The uneven distribution of health care professionals between the private and public sectors, urban and rural hospitals, is a contributing factor to staff attrition. These
problems may be due to the change of burden of disease and changing demands on health care services. The proposed NHI system may see to it that health care professionals are equally distributed among institutions in both public and private sectors (NDoH, 2011b). Once it is implemented, people from all walks of life will be able to access private sector facilities, regardless of their income level.

Currently, the private and public sectors have approximately the same expenditures, except the private sector serves approximately 16%, and the public sector 84% of the country’s population (Naidoo, 2012). Since the independence of South Africa, efforts of creating a single, non-discriminatory health care system were hindered to a certain extent by the development of a two-tiered system of health care, public and private, which is largely based on social class determinants and propagates health inequalities (Naidoo, 2012). The NHI will totally transform the South African health care system, by providing a wide range of care, addressing a wide range of health care needs, reengineering Primary Health Care and introducing a radical change of administration and management (NDoH, 2011b).

Even though there are strategies to achieve the MDGs, more teamwork and team effort is required. Shareholders need to work together, and political will and support is required. It is crucial to address root causes of challenges faced and integrate economic, social and environmental dimensions of sustainable development, as all the dimensions affect one another (UN, 2015a). When considering the supply of medicines, it is therefore imperative to consider the health care system as a whole, to promote interdisciplinary team work. Just like with the economic, social and environmental dimensions, all departments of the health care system are integrated, one cannot function without the other. The millennium development goals are now going to be replaced by the sustainable development goals. Sustainable development goals aim to bridge the gap that was left by the MDGs, and promote equality for all countries and all sections of society (UN, 2015b).

2.6 CHANGE MANAGEMENT

Organisations operate within an increasingly volatile environment where change is inevitable (Boohene and Williams, 2012). It is nearly impossible to implement projects without considering change management (Ćirić and Raković, 2010). Changes are difficult to predict and so many factors come into play to influence change, for example, internal and external environment, societal, political, technological and political factors, etc. Organisational change is viewed as obstructive to organisational growth and development due to its negative impacts. The root cause of these negative impacts is resistance (Hultman, 2014).
Organisational change can be defined as reconfiguration of components of an organisation to increase efficiency and effectiveness (Boohene and Williams, 2012). Lunenburg describes change as the movement of an organisation away from its status quo toward a desired future state to increase its effectiveness (Lunenburg, 2010). Resistance to change, on the other hand, can be defined as employee behaviour (action or inaction), that seeks to avoid change and interfere with or disrupt successful implementation of change in its current form (Boohene and Williams, 2012).

Almost anything that thwarts change can be considered as resistance (Boohene and Williams, 2012). It is therefore imperative to address or eliminate such defiance if change is to be successfully implemented. Resistance can be good in some cases if handled properly. It may help challenge and improve strategies and decision making. There are two types of forces that influence change, driving and restraining forces (Kritsonis, 2005). Driving forces enable change and push employees in the desired direction, while restraining forces inhibit change, thus pushing employees in the opposite direction. Kurt Lewin’s force-field theory (three-step change model) can be used to steer things in the desired direction. The first step is unfreezing, which entails directing employees away from the status quo and towards the anticipated change. Managers should aim on decreasing restraining forces (resistance) and increasing driving forces (forces for change). The second step, movement, involves convincing employees that the current situation is not beneficial to them and getting them to view challenges from a new perspective. Refreezing, which is the third step involves integrating the new values into the old culture. This helps curb the reverting of employees to old practices (Kritsonis, 2005).

Organisational change is necessary in a health care institution which lacks multidisciplinary teamwork (Mental Health Commission (MHC), 2006). When implementing a new project in a health institution, involvement of people from different disciplines is very vital for improving the health care system, although bringing about such a radical change can be challenging. Communication barriers within such teams can arise due to difference in knowledge and skills, especially during the first stages of implementation (Raine, Wallace, Nic a’ Bháird, Xanthopoulou, Lanceley, Clarke, Prentice, Arden, Harris, Gibbs, Ferlie, King, Blazeby, Michie, Livingston and Barber, 2014). As time goes on communication then improves as all the parties start understanding one another’s roles and discover where they as individuals fit in within the group. They start to coordinate and complement each other and embrace the change together. Change usually aims at improving performance and employee behavioural patterns and therefore does not require as much managing as the people involved in it (Bourda, 2013). Following the status quo is usually preferred as employees are more comfortable in following the exact same predictable routine procedures which yield efficiency.
(Lunenburg, 2010). However, due to the evolving environment within healthcare, change is necessary and inevitable. Resistance to change usually occurs due to pressure on the employees to perform better, despite the changes introduced. This may result in stress as the employees try to take on more tasks or adapt to the new routines and procedures (Boohene and Williams, 2012). Several studies have shown that implementation projects tend to end in failure (Čirić and Raković, 2010). Failure sometimes results from lack of clarity about the reasons for change, using an approach which is not suitable for the change and organisation, and leaving the change to be handled by less motivated people (Bourda, 2013). Change management increases the chances of success of a new project. If new changes are not well detailed, uncertainty may be introduced as the employees will be unsure what their duties are, or whether they have a future in the organisation. Uncertainty results in reduced productivity, hence it is important to highlight the changes to be introduced as well as the reasons for introducing them.

Organisations are not necessarily the ones that change, but the individuals within organisations are the ones that do (Bourda, 2013). Success of the project is measured by the work done by each individual within the organisation. According to Bourda (2013), without an individual viewpoint, change management amounts to activities performed without goals or outcomes achieved. Usually when change is introduced, employees tend to show enthusiasm, which gradually deteriorates as problems arise (Čirić and Raković, 2010). Employees are likely to then reject the new project as they learn more about it and discover challenges, which more often than not are greater than they expected. This results in resistance. As time goes on the employees begin to want to solve the problems arising as a result of the introduced change. Eventually they cope with the challenges through discussion with their colleagues and management. According to Boohene and Williams, lack of involvement of employees in decision making and lack of trust in management were the chief contributing factors to resistance to change (Boohene and Williams, 2012). Stakeholder engagement (especially employee engagement) from the beginning, when conceptualising strategies that may alter the state of or the routine procedures in the organisation is therefore important.

Organisations that manage change thrive more than those that do not (Bourda, 2013). When implementing a new project, it is very important to consider competencies and commitment of the employees involved (Čirić and Raković, 2010). The ideal people to lead the project would be people who are highly competent and highly committed. Another target group that would also be most likely to produce results would be the employees who are highly committed but with low competence, as they can be trained. The group of people who are highly competent but with low commitment would need motivation to do the project.
However, the employees who lack both competency and commitment should not be involved in the project at all. The individuals involved in the project need to be well coordinated for change to be implemented (Bourda, 2013).

2.7 SUMMARY

In order to improve service delivery and medicines management in hospital wards, there is a need for health care professionals to work together as a team. In this multi-professional team, each health care professional needs to use their expertise to give advice and provide support to the other members of the team where necessary. Pharmacists should be actively involved in inventory management in the wards as they are ultimately the custodians of medicines. It is important for pharmacists to check ward stock on a regular basis to maintain the quality of medicines.

From the literature, it is evident that an efficient inventory management system is a crucial element for maintaining ward stock, and that pharmacists play a pivotal role in pharmaceutical inventory management. This study aimed to involve pharmacists in ward stock management and implement a structured inventory system in order to improve inventory management in the wards at DGMAH. Albeit the potential benefits that this initiative has of improving ward stock management, as well as medicine distribution, negative outcomes such as resistance to change can be expected.

Change is inevitable, especially due to the constantly evolving health care environment. Change is necessary for improving organisational practices. It should however be managed efficiently for it to be beneficial as resistance may arise. Management should focus on achieving organisational goals, but from an individual perspective. It is therefore crucial to actively engage all the individuals who will be involved or affected by the introduced change.

The following chapter will provide details on the methodology of the study.
3.1 INTRODUCTION

The methodology used in this study is discussed in this chapter. In the first part of the chapter, the study design, which is divided into three phases, the study site (Dr George Mukhari Academic Hospital) and the study population are described. Details on how the study sample, and inclusion and exclusion criteria of the study were determined are discussed. The data collection process is described in great detail, along with the data capture and analysis process. This is followed by an outline of how the reliability, validity and trustworthiness of the data were ensured, and bias that might have affected the study. A discussion of the ethical considerations concludes the chapter.

3.2 STUDY DESIGN

This was a three-phased descriptive operational and intervention study, conducted in three phases over a period of six months. Both quantitative and qualitative data were collected. In Phase 1, a baseline assessment (pre-test) of normal ward practices was conducted in all the wards of DGMAH. Phase 2 entailed the implementation of an operational intervention (pharmacist-driven inventory management system) in eight paediatric wards over a period of four months. During Phase 3 (post-test) the effectiveness of the operational intervention was assessed in all the wards of DHMAH. The intervention also included the allocation of a pharmacist and a pharmacist’s assistant to each ward to oversee ward inventory management. Their involvement was dependent on their availability according to the time schedule as allowed by the pharmacy. Both pharmacy and nursing staff received training prior to and during the implementation of the pharmacist-driven inventory management system. The qualitative part of the study entailed using paired in-depth interviews and a focus group discussion to determine the perceptions of nursing and pharmacy staff with regards to the implementation of the intervention in the eight paediatric wards. The study design and process is illustrated in Figure 3.1.
Figure 3.1: Study design and process

3.3 STUDY SITE

The study was conducted at Dr George Mukhari Academic Hospital (DGMAH), the second largest hospital in South Africa. It is an academic tertiary hospital located in Ga-Rankuwa, Gauteng Province, South Africa. Ga-Rankuwa spans over an area of 52.18 km², has a population of about 90 945 and approximately 28 147 households. Most of its population are people of African ethnicity. There are slightly more females (52%) than males (48%) in Ga-Rankuwa. The main first language in this community is Setswana, which is spoken by 69% of the population (Frith, 2011). DGMAH has approximately 1650 beds. It renders a variety of services including paediatric, dermatological, psychiatric, chemotherapy and surgical treatment and has a few satellite clinics and pharmacies. The hospital serves as a teaching facility for Sefako Makgatho Health Sciences University.
The pre- and post-implementation phases of the study were carried out in all the wards at DGMAH, and the implementation phase was carried out in only the eight paediatric wards of the hospital.

3.4 STUDY POPULATION AND SAMPLE SELECTION

The pre-implementation baseline assessment was carried out in all the wards of DGMAH, so as to obtain an overview of inventory management in the whole hospital. The sample included 43 wards at DGMAH, i.e. Wards 1 to 39, intensive care unit (ICU), male psychiatric unit, female psychiatric unit, spinal unit, renal unit, casualties (accident and emergency) unit and theatre. The only exclusion criteria applied to wards that were not operational at the time of the study, which included Ward 6 and Ward 33, which were undergoing renovations, and Ward 21, a lodger mother ward which hosts mothers that are either nursing or taking care of babies, being admitted to the hospital. The post-implementation assessment sample was the same as that of the baseline assessment (n=43).

Because this was an operational study, pharmacy teams consisting of a pharmacist and at least one pharmacist’s assistant were allocated to each of the 43 wards after the baseline assessment. According to the hospital statistics at the time of the study, the pharmacy staff compliment included 29 (including the two managers) pharmacists and 33 pharmacist’s assistants.\(^1\)

The eight paediatric wards of DGMAH were selected purposively for targeted pharmacist interventions during the implementation phase, as the paediatrics division was one of the busy sections of the hospital at the time of the study. The exclusion criteria, in this phase, applied to all the wards that were not in the paediatrics division of DGMAH. The study sample for the implementation phase therefore included Wards 17 to 20, 22 to 24 and 28.

3.5 DATA COLLECTION PROCESS AND INSTRUMENTS

Data collection for this study was carried out by the researcher and took place in three phases over a period of six months (see Figure 3.1). The pharmacy teams (pharmacists and pharmacist’s assistants) and nurses responsible for ward stock management, who

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\(^1\) Oladipupo V. 3 July 2014. Personal communication. Pharmacy Manager, Dr George Mukhari Academic Hospital.
participated in the implementation of the targeted interventions, provided written informed consent for their participation, after they were provided with information about the study. Both the study information leaflet and the consent form were only available in English, as it is the official language of communication at DGMAH (see Appendix 1 and 2).

3.5.1 Data collection period

Data collection for the pre-implementation baseline assessment period was over a period of one month. The data collection period of the implementation phase was over a period of four months. Post-implementation assessment data collection was over a period of one month.

3.5.2 Data collection training

Data collection training was imparted to the researcher by the supervisor, who has extensive experience in operational research, before and during the data collection period.

3.5.3 Data collection tool

A 34-item indicator checklist, adapted from Mayimele (2013), was used to determine ward inventory management practices for each ward at baseline (pre-test) and post-implementation (post-test) (see Appendix 3). The indicators were developed based on inventory management practices recommended in legislative requirements stipulated in the Good Pharmacy Practice (GPP) of the SAPC. The indicators were grouped into four categories: Medicines security, Stock control, Record keeping and Storage conditions.

3.5.4 Phase 1: Pre-implementation baseline assessment (pre-test)

A pre-implementation baseline assessment was conducted in all the wards of DGMAH, within the first month of the study using the 34-item indicator ward inventory management checklist. The pre-implementation assessment assisted in determining inventory management practices at baseline, before the implementation of the ward inventory management system.

3.5.5 Phase 2: Implementation of pharmacist-driven inventory control system (operational intervention)

Following the baseline assessment, a pharmacist and a pharmacist's assistant were allocated to each of the 43 wards of the hospital to oversee inventory management in the wards. In addition, targeted pharmacist interventions, in the form of an inventory
A management system was implemented in the eight paediatric wards, which served as the study group. The remaining wards (35 wards) served as the control group.

The following activities were implemented in the paediatric wards as part of the intervention:

- A team was set-up, headed by a pharmacist and supported by a pharmacist’s assistant from the pharmacy, for each ward.
- Training sessions were conducted for the pharmacists and pharmacist’s assistants on inventory management.
- Pharmacy teams implemented the inventory management system, including the following tools and activities, in the wards:
  - Implementation of applicable standard operating procedures (SOPs)
  - Weekly cycle counts
  - Use of a ward stock record book for ordering and receiving stock
  - Calculation of minimum and maximum levels according to the information in the ward stock record book
  - Monitoring of expiry dates according to ward stock record book and SOPs
  - Training sessions for nurses on inventory management activities
  - Pharmacy teams to record time spent in the wards (see Appendix 4)
- The activities of the pharmacy teams in the wards were overseen by accessing the wards at least twice a week and consulting with both pharmacy and nursing staff if there were any improvements with regards to inventory management or if they needed assistance.

3.5.6 Phase 3: Post-implementation assessment (post-test)

During Phase 3 (post-test) the impact of the operational intervention was assessed by comparing inventory management practices of study (intervention) wards to the rest of the wards. The baseline assessment was repeated, using the same 34-indicator checklist as the one used at baseline, to determine if there was any change in ward inventory management practices with the active involvement of the pharmacy teams. The post-assessment was carried out in all the wards of DGMAH.

Two paired in-depth interviews were conducted with four nurses from the intervention wards and another two paired in-depth interviews were conducted with four pharmacists allocated
to the intervention wards. Paired in-depth interviews, as opposed to focus group discussions, were a more suitable data collection method for the nurses and pharmacists due to the unavailability of all the staff at the same time. A focus group discussion was conducted with four pharmacist’s assistants who were allocated to the intervention wards. All participants (nurses, pharmacists and pharmacist’s assistants) were selected based on their involvement in the intervention wards and according to their availability. All participants provided written informed consent for participation prior to the interviews and focus group discussion (Appendices 1 and 2).

The focus group discussion and paired in-depth interviews were facilitated by an experienced focus group moderator, who was a pharmacist and experienced in qualitative research. A focus group and interview guide, comprising open-ended questions was used to lead the discussion. Probes were used to verify unclear responses. Possible questions were formulated prior to, and amended as necessary throughout the implementation of the project (Appendix 5). The interviews and discussion took place in a private room and was recorded with a digital voice recorder for later transcription. Notes were taken by the researcher during all sessions (see Appendix 6).

3.6 PILOT STUDY

A pilot study was not required as this was an implementation and operational project. The checklist had been used previously by Mayimele (2013).

3.7 DATA CAPTURE AND ANALYSIS

3.7.1 Quantitative data

Data collected with the checklists were captured onto a Microsoft Excel® spreadsheet, checked for accuracy and correctness and imported into SAS® Release 9.2 for statistical analysis. Percentage compliance with the indicators was calculated at baseline and post-intervention. Improvement was calculated based on the indicators that had the potential to improve, meaning that indicators that complied prior to the intervention were excluded. Percentage improvement of the intervention wards was compared to that of control wards with the Fisher’s exact test to determine the impact of the intervention. Statistical significance was set at $p \leq 0.05$. 


3.7.2 Qualitative data

The recorded focus group discussion and paired in-depth interviews were transferred from the digital voice recorder to a computer and stored as Windows Media Audio files. Each discussion was transcribed verbatim and saved as a Microsoft Word® document. Transcripts were checked by the researcher for accuracy, after which they were imported into NVivo10®, a software program used for qualitative data analysis.

A process of coding and development of themes was followed (Richards, 2005). The transcripts were read a number of times to obtain an understanding of the data. NVivo10® software was used to code the data into categories, referred to as “nodes” in NVivo10®. Connections within and between categories were identified. Categories were developed into a framework of themes to describe the successes achieved and challenges experienced through the active involvement of pharmacists and pharmacist’s assistants in ward stock management.

Verbatim quotations are used in the manuscript to support the findings presented. All quotations were edited for punctuation to enhance the readability. Words were added in square brackets to correct defective grammar or provide meanings implied from preceding statements or circumstances unknown to the reader. Phrases or words removed from a quotation were replaced by three dots.

3.8 RELIABILITY, VALIDITY AND TRUSTWORTHINESS OF DATA

The ward inventory checklist that was used in this study was used in a previous study by Mayimele (2013), thus increasing the validity of the data. Data entry was verified for correctness prior to the analysis, to increase the reliability.

The focus group discussion and paired in-depth interviews were conducted by an experienced moderator, which enhanced the trustworthiness of the focus group data. Code-recode procedures through consensus discussions between the researcher and the supervisors were used to increase the dependability of the results. The credibility of the results was ensured through discussions of the research process and findings between the researcher and the supervisors who have experience in qualitative data capture and analysis. Transferability was demonstrated by the possibility of implementation of the intervention in different wards (eight paediatric wards) which had different staff. Thus showing that the conclusions drawn from this study can be applied in a different setting. Confirmability was ensured by ensuring that the researcher did not interfere with the day-to-
day functioning of the wards, except the aspects covered in the research (Lincoln and Guba, 1985).

3.9 BIAS

Since this study was an operational study with the implementation of inventory control tools in practice, the only form of bias was selection bias. Selection bias was introduced by only including paediatric wards in the study group for the implementation of targeted interventions.

The selection of pharmacists, pharmacist’s assistants and nurses for the focus group discussion and paired in-depth interviews was influenced by the availability of the participants. However, only nurses working in the intervention wards and pharmacists and pharmacist’s assistants who were allocated to those wards, were approached for participation.

3.10 ETHICAL CONSIDERATIONS

Ethical clearance for the study was obtained from the Medunsa Research Ethics Committee (MREC) of the University of Limpopo Medunsa Campus, now known as Sefako Makgatho Health Sciences University, prior to commencement of the study (MREC/H/233/2014) (see Appendix 8). Permission to conduct the study at DGMAH was obtained from the hospital's Chief Executive Officer (CEO).

All participants in the study provided written consent prior to participation (see Appendix 1). Confidentiality was maintained as the information they provided remained anonymous.

All data will be kept safe for the required period of five years with only the authors having access to the data. After five years the data will be destroyed according to university’s standard operating procedures.

3.11 SUMMARY

This chapter described the methodology used for data collection in this study. This was a three-phased descriptive operational intervention and exploratory qualitative study, which entailed allocation of a pharmacist and a pharmacist’s assistant to each ward to oversee ward inventory management. The qualitative part of the study entailed using paired in-depth interviews and a focus group discussion to determine the perceptions of nursing and
pharmacy staff with regards to the implementation of an intervention in eight wards of DGMAH.

A 34-item indicator checklist was used to determine ward inventory management practices for each ward at baseline (pre-test) and post-implementation (post-test). Data collected with the checklists were captured onto a Microsoft Excel® spread sheet and checked for accuracy and correctness and imported into SAS® Release 9.2 for statistical analysis. Statistical significance was considered where p≤0.05.

The recorded focus group discussion and paired in-depth interviews were transferred from the digital voice recorder to a computer and stored as Windows Media Audio files. Each discussion was transcribed verbatim and saved as a Microsoft Word® document. Transcripts were checked by the researcher for accuracy, after which they were imported into NVivo10®, a software program used for qualitative data analysis.

Ethical clearance for the study was obtained from the Medunsa Research Ethics Committee (MREC) of the University of Limpopo Medunsa Campus, now known as Sefako Makgatho Health Sciences University, prior to commencement of the study (MREC/H/233/2014). Permission to conduct the study at DGMAH was obtained from the hospital’s Chief Executive Officer.

The results of the data collected in this study, are presented and discussed in Chapter 4, in the form of two manuscripts for publication in accredited journals.
CHAPTER 4
RESULTS AND DISCUSSION

4.1 INTRODUCTION

Results and discussion based on this 3-phased operational and intervention study are presented in this chapter in manuscript format. The manuscripts are formatted according to the requirements and guidelines of the journals. Each manuscript is followed by the letter to the editor of the particular journal.

Manuscript 1 will be submitted to the Health Policy and Planning journal under the title “Implementation of a Pharmacist-Driven Inventory Management System in the Wards of a Tertiary Academic Hospital in South Africa”. The author guidelines for this journal are attached in Appendix 9 and can be accessed electronically at: http://www.oxfordjournals.org/our_journals/heapol/for_authors/.

Manuscript 2 will be submitted to the Curationis journal under the title “Hospital Pharmacy and Nursing Staff’s Perceptions of Pharmacist-Driven Ward Inventory Management”. The author guidelines for this journal are attached in Appendix 10 and can be accessed electronically at: http://www.curationis.org.za/index.php/curationis/pages/view/authors.
4.2 MANUSCRIPT 1

This section contains the manuscript formatted according to the journal’s requirements. For the purpose of the dissertation, 1.15 line spacing were used for tables and they are included in the text.

Title: Implementation of a Pharmacist-Driven Inventory Management System in the Wards of a Tertiary Academic Hospital in South Africa

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Keywords: intervention, health care, pharmacy, pharmacists, nurses, inventory management, hospital wards, quality improvement

Abbreviated running title: Pharmacist-Driven Ward Inventory Management System

Key Messages:

- Active involvement of pharmacists in ward inventory management improves inventory management practices for medicines

- Multidisciplinary teamwork improves communication, reduces work effort and achieves the common goal of delivering good quality, safe and effective medicines to the patient
Acknowledgements: All the nursing and pharmacy staff who assisted with the implementation of the project are gratefully acknowledged.

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Full word count: 4 868
Abstract

In hospitals, medicines are kept as ward stock to ensure availability to patients when needed. Appropriate inventory management practices are essential to ensure that patients receive good quality, safe and effective medicines. Nurses are generally responsible for ward medicines management in hospitals. However, it is important for pharmacists as the custodians of medicines to be actively involved on a regular basis to ensure that adequate quantities of medication are provided, medicines are stored appropriately, and that no obsolete or expired medicines are present in the wards. The aim of this study was to determine the inventory management practices in the wards at a tertiary academic hospital in South Africa prior to and after the implementation of a pharmacist-driven inventory management system. It was a three-phased descriptive operational intervention study which was conducted in eight intervention and 35 control wards with a pre- and post-intervention assessment. A 34-item indicator checklist was used to assess ward inventory management practices for wards at baseline (pre-test) and after intervention (post-test). Percentage improvement in indicator compliance for intervention wards was compared to that of control wards to determine the impact of the intervention. The intervention for the purpose of overseeing ward inventory management entailed a pharmacist and a pharmacist’s assistant allocated to each of the wards in the hospital. Focused pharmacist interventions were implemented in only eight wards. Overall percentage compliance for study wards (n=8) prior to the intervention was 42.3% and that of control wards (n=35) was 38.2%. After implementation of the intervention, the overall percentage improvement for study wards was 73.2% compared to that of control wards which was only 16.7%. This indicates that targeted pharmacist interventions improved inventory management practices. Although inventory management is performed by nurses, it was evident that assistance with medicines management in the wards is required from pharmacists.
Introduction

Everyone has the right to have access to good quality health care (DoJ 2012). The provision of quality health care services, including, good quality medicines, must never be compromised (NDoH 2011). Quality is getting the best results possible within the available resources (NDoH 2007).

In order to maximise on output obtained from resources and provide quality service delivery, delivery of care needs to be organised (WHO 2006). Infrastructure must be used appropriately according to level of care in order to maximise on outcomes achieved (NDoH 2011). Focusing on the health systems perspective and orienting the health care system to the delivery and improvement of quality helps meeting the expectations of patients, health care professionals and the general public (NDoH 2007).

Improving quality entails making health care more safe, effective, patient centred, timely, efficient and equitable (The Health Foundation, 2013). In order to attain quality, the health care system is required to meet these criteria (WHO 2006). Hence, a quality improvement system should be in place and needs to be monitored for its effectiveness in improving the various aspects of quality (NDoH 2011).

According to Nakyanzi and colleagues (2008), in government facilities, most pharmaceuticals are wasted through expiry. Ward stock is kept to ensure availability of medicines for use by ward staff when needed, but appropriate inventory management practices are essential for successful ward and institutional management (Embrey 2011). Each item held in stock should have dedicated inventory records which need to be reviewed regularly.

Pharmaceuticals contribute significantly to health care expenditure (Homedes & Ugalde 2001). Measured Total Pharmaceutical Expenditure (TPE), accounts for 1.41% to 1.63% of Gross Domestic Product (GDP) by income groups and regions although there is considerable variation between countries ranging from 0.2% to 3.8% of GDP (Lu et al. 2011). Total Pharmaceutical Expenditure is closely related with Total Health Expenditures (THE) and the GDP. The proportion spent on medicines is higher in low per capita income countries. An average of 24.9% of the budget is spent on medicines, with a wide range from 7.7% to 67.6%. Monitoring stock movement and adequate record keeping is therefore important for effective inventory control management and preventing wastage of resources (Dias 2011).
Nurses are expected to observe and apply fundamental ethical principles in their interaction with other health care practitioners, and work effectively within a multidisciplinary team (South African Nursing Council (SANC) 2013). Although medication provided for a particular ward is the responsibility of the nursing staff of that ward, the ultimate responsibility lies with the pharmacist, as the custodian of medicines, since pharmaceutical services ought to be licensed and supervised by a registered pharmacist (NDoH 2011). It is important that pharmacists co-operate with other health care professionals in a multi-disciplinary team in the interest of the patient (South African Pharmacy Council (SAPC) 2010). Regular communication between nursing staff in the wards and pharmacy staff is important, especially with regards to the storage and use of medicines (SAPC 2010).

A pharmacist’s first concern should be the welfare of the patient and the public in general. Pharmacists are entrusted to manage the distribution of medicines and to ensure that they are used safely and effectively (Fédération Internationale Pharmaceutique and World Health Organization (FIP/WHO) 2014). Evidence has shown that involvement of pharmacists in the ward can improve patient outcomes (Child et al. 2011).

A number of activities are key to ward inventory management. Adequate inventory management systems for ward inventory must be maintained by calculation of minimum/maximum (min/max) stock levels regularly (e.g., every three months), identification and proper disposal of expired or obsolete stock, and storage of stock records (e.g., invoices for ordering and receiving stock). Access to medicine storage areas must be controlled to avoid pilferage and temperatures monitoring and regulation is vital to ensure medicines are stored in optimal temperatures (SAPC 2010). The responsible pharmacist (pharmacy manager) must therefore ensure that ward medicine rooms are inspected regularly by pharmacy personnel (pharmacists and pharmacist assistants), at least once a month so as to guarantee the safe keeping and appropriate storage of medicines (SAPC, 2010). To this effect, this study aimed to determine the inventory management practices in the wards at a tertiary academic hospital in South Africa prior to and after the implementation of a pharmacist-driven inventory management system.

Methods

Study design and setting

This was a three-phased descriptive operational intervention study. Due to the operational nature of the study it initially entailed a pharmacist and a pharmacist’s assistant allocated to each of the 43 wards of the hospital to oversee inventory management in the wards. Their involvement was dependent on their availability according to the time schedule as allowed
by the pharmacy. In addition, targeted pharmacist interventions were implemented in eight paediatric wards, which served as the study (intervention) group while the rest of the wards served as the control group (35 wards).

The study was conducted at Dr George Mukhari Academic Hospital, the second largest hospital in South Africa. It is a 1650 bed academic tertiary hospital, located in Ga-Rankuwa, South Africa. The hospital renders a variety of services including paediatric, dermatological, psychiatric, chemotherapy and surgical treatment and has a few satellite clinics and pharmacies. It serves as an academic hospital for Sefako Makgatho Health Sciences University.

Data collection

A baseline assessment (pre-test) of normal practices was conducted in all the 43 wards using a 34-indicator checklist. This was followed by the implementation of an operational intervention (inventory management project) in eight wards by a pharmacist over a period of four months. During Phase 3 (post-test) the effectiveness of the operational intervention was assessed. The impact of the intervention was measured by comparing inventory management practices of the eight intervention wards to the 35 control wards, using the same 34-indicator checklist as the one used at baseline.

Data collection tool

A 34-item indicator checklist was used to determine ward inventory management practices for each ward at baseline (pre-test) and post-implementation (post-test). The indicators were developed based on inventory management practices recommended in legislative requirements stipulated in the Good Pharmacy Practice (GPP) of the SAPC. For the purpose of presenting the results, the indicators were grouped into four categories; Medicines security, Stock control, Record keeping and Storage conditions.

Intervention

A pharmacist implemented targeted interventions in eight paediatric hospital wards. The pharmacist interventions are summarised in Table 1. The average time spent per activity per ward is displayed in Table 2.
<table>
<thead>
<tr>
<th>Type of intervention</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inventory management</strong></td>
<td>Checklist assessment</td>
</tr>
<tr>
<td></td>
<td>Implementation of a ward stock record book</td>
</tr>
<tr>
<td></td>
<td>Implementation of inventory management Standard Operating Procedures (SOPs)</td>
</tr>
<tr>
<td></td>
<td>Updating stock records</td>
</tr>
<tr>
<td></td>
<td>Filing ordering and receiving invoices</td>
</tr>
<tr>
<td></td>
<td>Cycle counts</td>
</tr>
<tr>
<td></td>
<td>Rearranging and labelling of medicines</td>
</tr>
<tr>
<td></td>
<td>Checking expiry dates</td>
</tr>
<tr>
<td></td>
<td>Marking short-dated medicines</td>
</tr>
<tr>
<td></td>
<td>Removal of obsolete and expired stock</td>
</tr>
<tr>
<td><strong>Training</strong></td>
<td>Temperature monitoring (medicine room and fridge)</td>
</tr>
<tr>
<td></td>
<td>Use of temperature monitoring charts</td>
</tr>
<tr>
<td></td>
<td>Types of thermometers</td>
</tr>
<tr>
<td></td>
<td>Packing and arranging of stock in the medicine room (according to first expiry first out [FEFO])</td>
</tr>
<tr>
<td></td>
<td>Determining whether medicine should be stored in the fridge or medicines room</td>
</tr>
<tr>
<td></td>
<td>Maintenance of cold chain management</td>
</tr>
<tr>
<td></td>
<td>Packing medicines in the fridge according to guidelines</td>
</tr>
<tr>
<td></td>
<td>Cleaning of the medicines fridge</td>
</tr>
<tr>
<td></td>
<td>Ordering and receiving medicines</td>
</tr>
<tr>
<td></td>
<td>Importance of record keeping</td>
</tr>
<tr>
<td></td>
<td>Types of records that can be kept and for how long</td>
</tr>
<tr>
<td></td>
<td>Use of ward stock record book</td>
</tr>
<tr>
<td></td>
<td>Use of standard operating procedures (SOPs)</td>
</tr>
</tbody>
</table>
Table 2 Average time spent per intervention activity per ward

<table>
<thead>
<tr>
<th>Ward activity</th>
<th>Average time spent per ward (hours:minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (pre-implementation) checklist</td>
<td>00:37</td>
</tr>
<tr>
<td>Post-assessment (post-implementation) checklist</td>
<td>00:27</td>
</tr>
<tr>
<td>Invoice filing</td>
<td>01:00</td>
</tr>
<tr>
<td>Cycle counts and marking of short-dated medicines</td>
<td>03:17</td>
</tr>
<tr>
<td>Labelling and rearranging medicines</td>
<td>01:59</td>
</tr>
<tr>
<td>Displaying inventory management guidance posters</td>
<td>00:11</td>
</tr>
<tr>
<td>Training of nursing staff on inventory management</td>
<td>00:54</td>
</tr>
<tr>
<td><strong>Average time spent in the ward</strong></td>
<td><strong>01:12</strong></td>
</tr>
</tbody>
</table>

Data analysis

Data collected with the checklists were captured onto a Microsoft Excel® spreadsheet, checked for accuracy and correctness and imported into SAS® Release 9.2 for statistical analysis. Percentage compliance with the indicators was calculated at baseline and post-intervention. Only indicators in which the wards were non-compliant at baseline, prior to the intervention, were considered at post-intervention, meaning that indicators that complied prior to the intervention were excluded. Percentage improvement of the intervention wards was compared to that of control wards with the Fisher's exact test to determine the impact of the intervention. Statistical significance was set at p≤0.05.

Ethical considerations

Ethical clearance for the study was obtained from the Medunsa Research Ethics Committee (MREC) of the University of Limpopo Medunsa Campus, now known as Sefako Makgatho Health Sciences University, prior to commencement of the study (MREC/H/233/2014). Permission to conduct the study was provided by the Chief Executive Officer of the hospital.

Results

Compliance with indicators prior to intervention

The percentage compliance to each individual indicator on the 34-item indicator checklist, for the study wards (n=8) and the control wards (n=35) prior to the implementation of the intervention, is shown in Table 3. The difference in percentage compliance between the study group and the control group prior to implementing the intervention was statistically
significant (p≤0.05; Fisher’s exact test) in only three of the 34 indicators. The difference in percentage compliance for the rest of the indicators was either statistically insignificant or not applicable (N/A).

In Table 4, the overall percentage compliance to the indicator categories for the two groups, prior to the implementation of the intervention is shown. There was no statistically significant difference between the study wards and the control wards with regards to the percentage compliance for individual checklist categories.
Table 3 Compliance of wards to the checklist indicators at baseline assessment

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>Number (%) compliance</th>
<th>Study wards (n=8)</th>
<th>Control wards (n=35)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicines security</td>
<td>Locked medicine room</td>
<td>2 (25%)</td>
<td>22 (62.9%)</td>
<td>0.1109</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flow of stock controlled (ward transfers recorded)</td>
<td>3 (37.5%)</td>
<td>6 (17.1%)</td>
<td>0.3322</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to medicine room controlled</td>
<td>0 (0%)</td>
<td>7 (20%)</td>
<td>0.3150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emergency trolley closed</td>
<td>8 (100%)</td>
<td>33 (94.3%)</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Stock control</td>
<td>Stock expiring in 3 months marked</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stock expiring in 2 months marked</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stock expiring in 1 month absent</td>
<td>1 (12.5%)</td>
<td>1 (2.9%)</td>
<td>0.3411</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cycle counts done</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Min/max levels present</td>
<td>8 (100%)</td>
<td>31 (88.6%)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Min/max levels recalculated</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stock records kept</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orders done on designated days</td>
<td>8 (100%)</td>
<td>33 (94.3%)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FEFO practiced</td>
<td>3 (37.5%)</td>
<td>1 (2.9%)</td>
<td>0.0164*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All medicines in stock</td>
<td>2 (25%)</td>
<td>7 (20%)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expired medicines absent</td>
<td>5 (62.5%)</td>
<td>1 (2.9%)</td>
<td>0.0003*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PC medication absent as stock</td>
<td>3 (37.5%)</td>
<td>17 (48.6%)</td>
<td>0.7041</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emergency trolley complete</td>
<td>5 (62.5%)</td>
<td>24 (68.6%)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td>SOPs for stock control used</td>
<td>1 (12.5%)</td>
<td>1 (2.9%)</td>
<td>0.3411</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOPs for stock control displayed</td>
<td>1 (12.5%)</td>
<td>1 (2.9%)</td>
<td>0.3411</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stock records up to date</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Invoices kept in orderly manner</td>
<td>1 (12.5%)</td>
<td>10 (28.6%)</td>
<td>0.6563</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ward stock list pasted in room</td>
<td>4 (50%)</td>
<td>18 (51.4%)</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schedule 5 &amp; 6 lists pasted on cupboard</td>
<td>4 (50%)</td>
<td>31 (88.6%)</td>
<td>0.0279*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schedule 5 &amp; 6 registers kept</td>
<td>7 (87.5%)</td>
<td>35 (100%)</td>
<td>0.1860</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schedule 5 &amp; 6 registers up to date</td>
<td>4 (50%)</td>
<td>25 (71.4%)</td>
<td>0.4038</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fridge list pasted on fridge</td>
<td>5 (62.5%)</td>
<td>10 (28.6%)</td>
<td>0.1036</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reconstitution date indicated</td>
<td>6 (75%)</td>
<td>13 (37.1%)</td>
<td>0.1109</td>
<td></td>
</tr>
<tr>
<td>Storage conditions</td>
<td>Storage area clean</td>
<td>5 (62.5%)</td>
<td>15 (42.9%)</td>
<td>0.4396</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arranged in orderly manner</td>
<td>1 (12.5%)</td>
<td>1 (2.9%)</td>
<td>0.3411</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stored off the floor</td>
<td>8 (100%)</td>
<td>30 (85.7%)</td>
<td>0.5648</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Separate from disinfectants</td>
<td>7 (87.5%)</td>
<td>28 (80%)</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dosage forms separated</td>
<td>3 (37.5%)</td>
<td>18 (51.4%)</td>
<td>0.6981</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Food stored in separate fridge</td>
<td>7 (87.5%)</td>
<td>31 (88.6%)</td>
<td>1.000</td>
<td></td>
</tr>
</tbody>
</table>

*Fisher’s exact test; *Statistically significant, p≤0.05; N/A: Statistical test not applicable
Table 4 Overall compliance of wards to checklist categories at baseline assessment

<table>
<thead>
<tr>
<th>Checklist category</th>
<th>Study wards (n=8)</th>
<th>Control wards (n=35)</th>
<th>P²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number of indicators</td>
<td>Number (%) compliance</td>
<td>Total number of indicators</td>
</tr>
<tr>
<td>Medicines security</td>
<td>32</td>
<td>13 (40.6%)</td>
<td>140</td>
</tr>
<tr>
<td>Stock control</td>
<td>104</td>
<td>35 (33.7%)</td>
<td>455</td>
</tr>
<tr>
<td>Record keeping</td>
<td>88</td>
<td>36 (40.9%)</td>
<td>385</td>
</tr>
<tr>
<td>Storage conditions</td>
<td>48</td>
<td>31 (64.6%)</td>
<td>210</td>
</tr>
<tr>
<td>All categories</td>
<td>272</td>
<td>115 (42.3%)</td>
<td>1190</td>
</tr>
</tbody>
</table>

²Fisher’s exact test

Table 5 shows the number of indicators with a possibility for improvement and the percentage improvement per individual indicator for the study wards (n=8) and the control wards (n=35) post-intervention. The percentage improvement in the study wards compared to the control wards was statistically significant (p≤0.05; Fisher’s exact test) in 12 of the 34 indicators. The difference in percentage improvement for the rest of the indicators was either statistically insignificant or not applicable.

In Table 6 the overall number of indicators with a possibility for improvement and the percentage improvement per indicator category are shown for the study wards and the control wards post-intervention. The percentage improvement for individual category was statistically highly significant (p<0.001) for all indicator categories except ‘Medicines security’. The difference in overall percentage improvement between the study and control wards for all the indicator categories was statistically highly significant (p=0001).
### Table 5 Improvement of ward compliance to checklist indicators at post-intervention

<table>
<thead>
<tr>
<th>Indicator category</th>
<th>Indicator</th>
<th>Study wards (n=8)</th>
<th>Control wards (n=35)</th>
<th>P²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Indicators with possibility for improvement</td>
<td>Number (%) improvement</td>
<td>Number of indicators with possibility for improvement</td>
<td>Number (%) improvement</td>
</tr>
<tr>
<td>Medicines security</td>
<td>Locked medicine room</td>
<td>6</td>
<td>2 (33.3%)</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Flow of stock controlled (ward transfers recorded)</td>
<td>5</td>
<td>0 (0%)</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Access to medicine room controlled</td>
<td>8</td>
<td>4 (50%)</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Emergency trolley closed</td>
<td>0</td>
<td>N/A</td>
<td>2</td>
</tr>
<tr>
<td>Stock control</td>
<td>Stock expiring in 3 months marked</td>
<td>8</td>
<td>8 (100%)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Stock expiring in 2 months marked</td>
<td>8</td>
<td>8 (100%)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Stock expiring in 1 month absent</td>
<td>7</td>
<td>3 (42.9%)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Cycle counts done</td>
<td>8</td>
<td>6 (75%)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Min/max levels present</td>
<td>0</td>
<td>N/A</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Min/max levels recalculated</td>
<td>8</td>
<td>6 (75%)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Stock records kept</td>
<td>8</td>
<td>6 (75%)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Orders done on designated days</td>
<td>0</td>
<td>N/A</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>FEFO practiced</td>
<td>5</td>
<td>2 (40%)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>All medicines in stock</td>
<td>6</td>
<td>3 (50%)</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Expired medicines absent</td>
<td>3</td>
<td>2 (66.7%)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>PC medication absent as stock</td>
<td>5</td>
<td>4 (80%)</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Emergency trolley complete</td>
<td>3</td>
<td>3 (100%)</td>
<td>11</td>
</tr>
<tr>
<td>Record keeping</td>
<td>SOPs for stock control used</td>
<td>7</td>
<td>7 (100%)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>SOPs for stock control displayed</td>
<td>7</td>
<td>7 (100%)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>SOPs for returning expired medicines</td>
<td>8</td>
<td>8 (100%)</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Stock records up to date</td>
<td>8</td>
<td>6 (75%)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Invoices kept in orderly manner</td>
<td>7</td>
<td>7 (100%)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Ward stock list pasted in room</td>
<td>4</td>
<td>3 (75%)</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Schedule 5 &amp; 6 lists pasted on cupboard</td>
<td>3</td>
<td>2 (66.7%)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Schedule 5 &amp; 6 registers kept</td>
<td>0</td>
<td>N/A</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Schedule 5 &amp; 6 registers up to date</td>
<td>3</td>
<td>3 (100%)</td>
<td>10</td>
</tr>
</tbody>
</table>
# Chapter 4: Results and Discussion

<table>
<thead>
<tr>
<th>Storage conditions</th>
<th>Count</th>
<th>Percentage</th>
<th>Count</th>
<th>Percentage</th>
<th>Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fridge list pasted on fridge</td>
<td>3</td>
<td>0 (0%)</td>
<td>25</td>
<td>3 (12%)</td>
<td>1</td>
</tr>
<tr>
<td>Reconstitution date indicated</td>
<td>2</td>
<td>1 (50%)</td>
<td>21</td>
<td>1 (4.8)</td>
<td>0.1700</td>
</tr>
<tr>
<td>Storage area clean</td>
<td>3</td>
<td>3 (100%)</td>
<td>20</td>
<td>9 (45%)</td>
<td>0.2174</td>
</tr>
<tr>
<td>Arranged in orderly manner</td>
<td>7</td>
<td>4 (57.1%)</td>
<td>34</td>
<td>4 (11.8%)</td>
<td>0.0183*</td>
</tr>
<tr>
<td>Stored off the floor</td>
<td>0</td>
<td>N/A</td>
<td>5</td>
<td>3 (60%)</td>
<td>N/A</td>
</tr>
<tr>
<td>Separate from disinfectants</td>
<td>1</td>
<td>1 (100%)</td>
<td>7</td>
<td>5 (71.4%)</td>
<td>1</td>
</tr>
<tr>
<td>Dosage forms separated</td>
<td>5</td>
<td>4 (80%)</td>
<td>16</td>
<td>5 (31.3%)</td>
<td>0.1194</td>
</tr>
<tr>
<td>Food stored in separate fridge</td>
<td>1</td>
<td>1 (100%)</td>
<td>4</td>
<td>3 (75%)</td>
<td>1</td>
</tr>
</tbody>
</table>

*Fisher’s exact test; *Statistically significant, p≤0.05; N/A: Statistical test not applicable
Table 6 Overall improvement in ward compliance to checklist categories post-intervention

<table>
<thead>
<tr>
<th>Checklist category</th>
<th>Study wards (n=8)</th>
<th>Control wards (n=35)</th>
<th>P#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number</td>
<td>Number (%)</td>
<td>Total number</td>
</tr>
<tr>
<td></td>
<td>of indicators</td>
<td>improvement</td>
<td>of indicators</td>
</tr>
<tr>
<td>Medicines security</td>
<td>19</td>
<td>6 (31.6%)</td>
<td>72</td>
</tr>
<tr>
<td>Stock control</td>
<td>69</td>
<td>52 (75.4%)</td>
<td>339</td>
</tr>
<tr>
<td>Record keeping</td>
<td>52</td>
<td>44 (84.6%)</td>
<td>239</td>
</tr>
<tr>
<td>Storage conditions</td>
<td>17</td>
<td>13 (76.5%)</td>
<td>86</td>
</tr>
<tr>
<td>All categories</td>
<td>157</td>
<td>115 (73.2%)</td>
<td>736</td>
</tr>
</tbody>
</table>

*Fisher’s exact test; *Statistically significant, p≤0.05

Discussion

This study assessed percentage compliance of study wards against that of control wards with checklist indicators prior to, and after the implementation of a pharmacist-driven inventory management system.

During the baseline assessment, the inventory management practices of the study wards and the controls wards were similar for the majority of indicators. Statistically significant differences were identified in only three of the indicators, where in one of the indicators (Schedule 5 & 6 lists pasted on cupboard), the control wards had better practices compared to those of the study wards. From the results, it is evident that both groups did not comply with most of the indicators prior to the implementation of the intervention. The study and control wards showed zero compliance with indicators such as ‘Stock expiring in 3 months marked’, ‘Stock expiring in 2 months marked’, ‘Cycle counts done’, ‘Stock records up to date’, ‘Min/max levels recalculated’ and ‘Stock records kept’. At the time of the post-intervention assessment, most of the study wards complied with the majority of these indicators, whereas in the control wards only a few or none of the wards complied.

After the intervention was implemented, a significant improvement was noticed in the study wards, compared to the control wards, with highly significant difference evident in a number of indicators. This suggests that the intervention introduced improved inventory management practices in the wards. For the overall indicator categories, there was a highly significant improvement in the study wards for all categories, except ‘Medicines security’. The reason for this was that pharmacists had no direct influence over all the indicators within this
particular category. For example, pharmacists could only advise nurses to lock their medicine storage areas, but it was up to the nurses to actually see it through, because unlike the nurses, pharmacists were not in the wards throughout the day. Similarly, there were a few indicators in the other categories where the pharmacist could not directly influence improvement.

Although keeping medicines in wards has shown to be one of the biggest contributors to medicines expiry, it is important that each of the ward keeps their own medicines to facilitate control and combat misuse (Sallet 2011). From the indicator compliance results it is evident that most of the wards had expired medicines in the medicines room, i.e. they did not comply with the particular indicator. Although the difference in improvement between the study and the control wards was not statistically significant (p=0.0856) for the particular indicator, the 66.7% improvement amongst the study wards, compared to a 14.7% improvement in the control wards must be recognised.

Pharmacists are the custodians of medicines and should therefore be involved in inventory management of medicines from the time it is received in the pharmacy, redistributed to wards, and until these medicines are used by the patient (SAPC 2010). According to legislation, it is the responsibility of the pharmacist to inspect medication in the wards, at least once a month (SAPC 2010). This should be done to ensure that medicines are stored under the correct requirements, expired or obsolete medicines are not kept, disinfectants are stored separately from medicines, stock levels are adequate, stock rotation is maintained, stock orders are recorded and kept for a minimum of five years and medication is available.

Cycle counts can be used to correct errors that arise during the process of updating inventory records (Gürhan, Kök & Shang 2014). Pharmacists in this study, as part of the intervention, were involved in conducting cycle counts, marking short-dated medicines (i.e. medicines expiring in three months, two months and one month), and stock rotation (i.e. FEFO). This helped minimise short-dated medicines as they were redistributed to other wards, or sent back to the pharmacy to be dispensed to patients who would use them immediately. This in turn reduced the number of expired medicines recovered. A further advantage of cycle counts, together with recording all stock movement, can assist in determining medicines consumption of each ward (Tan et al. 2001). The results showed the benefits of cycle counts, as in these wards (study wards), minimum and maximum levels were up to date, short-dated medicines were marked, hence, they had less expired medicines. Regular cycle counts enabled the pharmacist to recalculate minimum/maximum stock levels for the study wards, therefore the wards kept only medicines they needed, subsequently reducing obsolete stock.
The time spent implementing interventions in the wards was recorded using a time sheet and the average time spent was calculated. On average, the pharmacist spent slightly over an hour in the wards, as shown in Table 2. Activities such as conducting cycle counts, invoice filing and labelling and rearranging medicines took much longer to complete. Inventory management practice assessments using a checklist took approximately half an hour. It is crucial when carrying out inventory management activities to be able to manage time well and prioritise (Wild 2007). Planning beforehand and setting up a schedule of when and how to conduct certain activities assists with time management, as not all activities need to be carried out on a daily or weekly basis.

The results showed that targeted intervention activities by the pharmacist in this study culminated in improvement in various ward inventory management practices. Previous data has also shown that the active involvement of pharmacists in ward inventory management improved inventory management practices (Ally & Odendaal, 2014). Training health care professionals (e.g. nurses) on stock management, can improve medicine usage and inventory management while meeting patient needs, but without supervision, these improvements cannot be maintained (Trap et al. 2001). Nurses are generally responsible for ward inventory management of medicines in hospital institutions (Schellack and Meyer 2010). However, it is important for pharmacists to be actively involved and liaise with them on a regular basis (Schellack et al. 2009). In this study, the pharmacist not only trained nursing staff but implemented SOPs which guided procedures for correct inventory management practices. Pharmacy staff has to train nurses on inventory management and assist them with activities like conducting cycle counts, marking and redistributing short-dated medicines, and compiling and updating stock control records and medicines monitoring reports (Ally & Odendaal, 2014). Implementing these practices can reduce obsolete and expired stock, and ensure the patient receives medicines that they require, ultimately saving costs.

**Study limitations**

A limitation to this operational study was the non-availability of pharmacists for the implementation of ward inventory management activities in all the wards of the hospital. Although a pharmacist and a pharmacist’s assistant were allocated to each ward, their involvement in overseeing inventory management in the wards was dependent on their availability according to the time schedule as allowed by the pharmacy. Most of the hospital pharmacists were not able to visit the wards as often as required, while targeted interventions by a pharmacist were implemented in the study wards only. This was evident...
from the difference between the study and control wards in terms of indicator compliance post-intervention.

The post-intervention assessment indicated a reduced quantity of expired medicines in the study wards. The monetary value of expired medicines in the two groups were not calculated, which is recognised as a limitation of the study.

Conclusion

Although inventory management is being carried out by nurses, it was evident that assistance with the management of pharmaceuticals in the wards is required. Pharmacists hence need to be actively involved with ward medicines inventory management. Access to medicine rooms can be more controlled and medicine stock records should be kept to promote traceability. Regular cycle counts are required to avoid expired and short-dated medication. Even though pharmacists avail themselves to assist with ward inventory management, nurses need to also fulfil their duties, roles and responsibilities. It is therefore imperative for pharmacists and nurses to work together as multidisciplinary teamwork improves communication, reduces work effort and achieves the common goal of delivering good quality, safe and effective medicines to the patient.

Acknowledgements

Prof HS Schoeman is acknowledged for his assistance with the statistical analysis of the data. All the nursing and pharmacy staff who assisted with the implementation of the project are gratefully recognised. The Department of Pharmacy at Sefako Makgatho Health Sciences University is acknowledged for financial and logistical support.
Chapter 4: Results and Discussion

References


4.2.1 Letter to the editor (Manuscript 1)

The letter to the editor of *Health Policy and Planning* which will accompany the manuscript appears below.

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Dr Virginia Wiseman and Mrs Sandra Mounier-Jack  
Editors-in-Chief  
Health Policy and Planning

Dear Dr Virginia Wiseman and Mrs Sandra Mounier-Jack

Re: Submission of manuscript for publication

I am writing to submit our manuscript entitled “Implementation of a Pharmacist-Driven Inventory Management System in the Wards of a Tertiary Academic Hospital in South Africa” by Pamela Harirari, Johanna Meyer, Moliehi Matlala and Victoria Oladipupo for consideration for publication in *Health Policy and Planning*. This study aimed to determine the inventory management practices in the wards at a tertiary academic hospital prior to and after the implementation of a pharmacist-driven inventory management system.

In this manuscript, the study was a three-phased descriptive operational intervention study which was conducted in eight intervention and 35 control wards with a pre and post intervention assessment. A 34-item indicator checklist was used to determine ward inventory management practices for each ward during the pre-implementation baseline assessment (pre-test) and post-implementation assessment (post-test). Percentage improvement of the intervention wards was compared to that of control wards to determine the impact of the intervention. Focused interventions were implemented only in the eight study wards by a pharmacist. Prior to the intervention, all the wards, study and control, did not comply (0% compliance, n=8 and n-35, respectively) with a few indicators. Overall percentage compliance for study wards (n=8) prior to the intervention was 42.3% and that of control wards (n=35) was 38.2%. After implementation of the intervention, the overall percentage
improvement for study wards was 73.2% compared to that of control wards which was only 16.7%.

Based on the results of our study, it is evident that active involvement of pharmacists improves ward inventory management practices and reduces wastage of medicines. In South Africa, there are not many studies carried out on pharmacist involvement in ward inventory management. This manuscript serves to promote the importance of implementing a pharmacist-driven inventory management system.

We believe that this manuscript is appropriate for publication by Health Policy and Planning because it reflects on the impact of active involvement of pharmacists in ward medicines management.

This manuscript describes original work and is not under consideration by any other journal. All authors approved the manuscript and this submission.

Thank you for your consideration. We appreciate your time and look forward to your response.

Sincerely,

____________________
Miss Pamela Harirari (pamelaharirari@gmail.com)

First Author
9 December 2015
4.3 MANUSCRIPT 2

This section contains the manuscript formatted according to the journal’s requirements.

Title page

Article title: Hospital Pharmacy and Nursing Staff’s Perceptions of Pharmacist-Driven Ward Inventory Management

Significance of work: This manuscript reflects on challenges faced by nursing staff regarding inventory management and how multidisciplinary teamwork, especially with pharmacists, improved medicines inventory management.

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Contributions:

Pamela Tendai Harirari: Master’s degree student, designed the study, collected data and wrote the first draft of the manuscript.

Johanna Catharina Meyer: Main supervisor, designed the study, supervised the data collection, interpreted the data and reviewed the manuscript.

Moliehi Matlala: Co-supervisor, designed the study, supervised the data collection, interpreted the data and reviewed the manuscript.

Victoria Oladipupo: Co-supervisor, guided the data collection and reviewed the manuscript.

Summary:

Number of words (abstract): 250

Number of words (body): 7 025 (excluding abstract, references and tables)

Number of pages: 27

Number of tables: 3
Hospital Pharmacy and Nursing Staff’s Perceptions of Pharmacist-Driven Ward Inventory Management

Abstract

Background: When considering the supply of medicines, it is imperative to consider the health care system as a whole, to promote interdisciplinary team work in order to meet the common goal of treating the patient by managing medicines effectively. In South Africa, pharmacist involvement in ward inventory management is understudied. Although pharmacists are the custodians of medicines, ward inventory management is mainly done by nurses, and therefore requires a team effort between these health care professionals.

Objectives: To determine the perceptions of nursing and pharmacy staff on the successes achieved and challenges experienced during, and as a result of, the implementation of a pharmacist-driven inventory management system in the wards at a tertiary academic hospital.

Method: This was an exploratory qualitative study that used paired in-depth interviews and a focus group discussion to determine the experiences of nursing and pharmacy staff following the implementation of a pharmacist-driven inventory management system in the paediatric wards of a tertiary hospital. Pharmacist interventions in the wards included rearranging of medicines, removal of expired medicines, marking short-dated medicines and training nursing staff.

Results: Active involvement of pharmacy staff in the wards bridged the gap between the pharmacy and the wards which resulted in improved communication. Both pharmacy and nursing staff gained new knowledge in terms of medicines management through the intervention.

Conclusion: It is evident that focused interventions implemented by pharmacists are vital for proper ward inventory management. A multidisciplinary approach improves inventory management practices, reduces work load and improves communication among various disciplines.

Keywords: intervention, implementation, health care, multidisciplinary teamwork, pharmacy, pharmacist, nurses, inventory management, hospital wards
Introduction

Problem statement

Aims and objectives of the study

This study aimed to determine the perceptions of nursing and pharmacy staff on the successes achieved and challenges experienced during, and as a result of, the implementation of a pharmacist-driven inventory management system in the wards at a tertiary academic hospital.

Background

When considering the supply of medicines, it is imperative to consider the health care system as a whole, to promote interdisciplinary team work in order to meet the common goal of treating the patient by managing medicines effectively. In South Africa, pharmacist involvement in ward inventory management is understudied. Although pharmacists are the custodians of medicines, ward inventory management requires a multidisciplinary team effort. Implementation projects tend to fail due to the way change is introduced. If new changes are not well detailed, uncertainty may be introduced and employees are likely to reject them. Therefore change management is extremely important to increase the chances of success of a new project (Čirić & Raković 2010).

Research objectives

- To describe successes achieved through the active involvement of pharmacists and pharmacist’s assistants in ward inventory management.
- To describe challenges experienced through the active involvement of pharmacists and pharmacist’s assistants in ward inventory management.

Definition of key concepts

- **Inventory**: The stock of any medication in the hospital (Jacobs & Chase 2013).
- **Inventory control**: The monitoring of stock levels periodically and determining what to order, and in what quantities to order (Adeyemi & Salami 2010).
- **Inventory system**: A set of policies and controls that monitor levels of inventory and determine what levels are required to be maintained, when stock may be ordered, and what quantities to order (Jacobs & Chase 2013).
Chapter 4: Results and Discussion

- **Ward stock / inventory management:** The management of the routine ordering process, along with the activities involved in managing inventory levels in wards (Dias 2011).

- **Change management:** A structured approach to transitioning individuals, teams, and organisations from a current state to a desired future state, to implement a strategy. It is aimed at empowering employees to accept and embrace changes in their current environment (Ryerson University 2011).

**Contribution to field**

This study serves to raise awareness on the importance of inter-professional interaction. It reflects on challenges faced by nursing staff regarding inventory management and how multidisciplinary teamwork, especially with pharmacists, improves inventory management.

**Literature review**

Investing in health systems is fundamental for achieving institutional, national and international goals. The World Health Organization (WHO) systems framework can be used as a platform for strengthening and improvement of health intervention delivery in terms of effectiveness, safety and quality, as needed, with minimum waste of resources (WHO 2007).

A health system comprises interdependent components which need to work together in order to improve health and be effective, for example, resources such as economic, infrastructure and human resources (WHO 2010). A health system should provide preventive, promotive, curative and rehabilitative interventions by combining public health activities and the hierarchy of health care facilities that deliver health care. The complex nature of health systems and the span of responsibilities across various sectors pose challenges in monitoring performance (WHO 2010).

Inequality in the distribution of health care professionals is a challenge, especially in developing countries (Speybroeck, Ebener, Sousa, Paraje, Evans & Prasad 2006). Although there is a shortage of health care professionals in South Africa, the major problem lies with inadequate exploitation of the skills and expertise of health care professionals, development of inappropriate skills, predominantly in the nursing care, and recurrent high levels of staff attrition (George, Quinlan, Reardon & Aguilera 2012).

Health care professionals need to work together, and political will and support is required to achieve this. It is crucial to address root causes of challenges faced and integrate economic, social and environmental dimensions of sustainable development, as they are interdependent (United Nations 2015a). When considering the supply of medicines, it is
therefore imperative to consider the health care system as a whole, to promote interdisciplinary team work in order to meet the common goal of treating the patient by managing medicines effectively.

Health care institutions operate within an increasingly volatile environment where change is inevitable (Boohene & Williams 2012). It is nearly impossible to implement projects without considering change management (Ćirić & Raković 2010). Changes are difficult to predict and many factors come into play to influence change, for example, internal and external environment, societal, political, technological and political factors. Organisational change is generally viewed as obstructive to organisational growth and development due to its negative impacts. The root cause of these negative impacts is resistance (Hultman 2014). Resistance and failure sometimes results from lack of clarity about the reasons for change, using an unsuitable approach for the change and organisation, and leaving the change to be handled by less motivated people (Bourda 2013). Roles and responsibilities of health care professionals need to be clearly defined to promote team work and smooth work flow. Organisations that manage change thrive more than those that do not (Bourda 2013).

The most important element in successful and sustained quality improvement is the way in which the change is introduced and implemented (The Health Foundation 2013). Usually when change is introduced, employees tend to show enthusiasm, which gradually deteriorates as problems arise (Ćirić & Raković, 2010). This results in resistance. According to Boohene and Williams (2012), lack of involvement of employees in decision making and lack of trust in management were found to be the chief contributing factors to resistance to change. Stakeholder engagement when conceptualising strategies may alter the state of the organisation or the routine procedures in the organisation, and is therefore important (KwaZulu-Natal Department of Health (KZN-DoH) 2001). This study aimed to determine the perceptions of nursing and pharmacy staff on the implementation of a pharmacist-driven inventory management system in the wards of a tertiary academic hospital.

**Methods**

**Design**

This was an exploratory qualitative study that used paired in-depth interviews and a focus group discussion to determine the perceptions of nursing and pharmacy staff with regards to the implementation of an intervention in eight wards of a tertiary academic hospital. The intervention entailed allocation of a pharmacist and a pharmacist’s assistant to each ward to implement a pharmacist-driven inventory management system. Both pharmacy and nursing staff received training prior to and during the implementation of the intervention.
Data collection

Two paired in-depth interviews were conducted with four nurses from the intervention wards and another two paired in-depth interviews were conducted with four pharmacists allocated to the intervention wards. Paired in-depth interviews, as opposed to focus group discussions, were a more suitable data collection method for the nurses and pharmacists due to the unavailability of all the staff at the same time. A focus group discussion was conducted with four pharmacist’s assistants who were allocated to the intervention wards. All participants (nurses, pharmacists and pharmacist’s assistants) were selected based on their involvement in the intervention wards, willingness to participate and according to their availability.

The focus group discussion and paired in-depth interviews were facilitated by an experienced focus group moderator and recorded with a digital voice recorder. A focus group and interview guide, comprising open-ended questions was used to lead the discussion. Probes were used to verify unclear responses.

Data analysis

The audio recordings were transcribed verbatim and crosschecked. Transcripts were checked for accuracy, after which they were imported for analysis into NVivo10®, a software program used for qualitative data analysis. A process of coding and development of themes was followed (Richards 2005). The transcripts were first read a number of times to obtain an understanding of the data. Data were coded into categories and connections within and between categories were identified. Categories were developed into a framework of themes to describe the successes achieved and challenges experienced through the active involvement of pharmacists and pharmacist’s assistants in ward inventory management.

Verbatim quotations are used in this paper to support the findings. All quotations were edited for punctuation to enhance the readability. Words were added in square brackets to correct defective grammar or provide meanings implied from preceding statements or circumstances unknown to the reader. Phrases or words removed from a quotation were replaced by three dots.

Context of the study

The study was conducted at Dr George Mukhari Academic Hospital, a tertiary hospital located in Ga-Rankuwa, South Africa and an academic hospital for Sefako Makgatho Health Sciences University. It is the second largest hospital in South Africa and has 46 wards and approximately 1650 beds. The hospital renders a variety of services including paediatric,
dermatological, psychiatric, cancer and surgical treatment. It has a few satellite clinics and pharmacies, for example an antiretroviral (ARV) clinic and psychiatric clinic.

**Ethical considerations**

Ethical clearance was obtained from the Medunsa Research Ethics Committee of the University of Limpopo Medunsa Campus now known as Sefako Makgatho Health Sciences University, prior to commencement of the study (MREC/H/233/2014).

**Informed consent**

All participants provided written informed consent prior to participation. Confidentiality was maintained as the information they provided remained anonymous.

**Data protection**

All data will be kept safe for the required period of five years with only the authors having access to the data. After five years the data will be destroyed according to university’s standard operating procedures.

**Trustworthiness**

The focus group discussion and paired in-depth interviews were conducted by an experienced moderator, which enhanced the trustworthiness of the data. Provision of a detailed description of the research methodology and data analysis to guide use by other researchers ensured transferability. Conformability was ensured by including actual discussions with participants to provide comprehensive evidence. Code-recode procedures through consensus discussions between the authors were used to increase the dependability of the results. The credibility of the results was ensured through discussions of the research process and findings between the authors, some of which have experience in qualitative data capture and analysis (Lincoln & Guba 1985).

**Results and Discussion**

The participants were pharmacy and nursing staff. Table 1 shows the interviewees’ professions and positions within the hospital. The main themes identified are presented in Table 2, and Table 3 gives a summary of the findings per theme.
Practical Implementation

Roles, responsibilities and multidisciplinary team work

Pharmacists are the custodians of medicines. However, it is crucial to work closely with other health care professionals, especially with nurses, as they are responsible for administering medication to patients. Both nurses and pharmacists shared the opinion that the responsibility for medicines lies with both parties and requires team work.

‘Our [pharmacists] main job description is dispensing. The sisters in the wards know the exact minimum and maximum quantities as they are the ones working directly with the patients, but the expiry dates and the availability of medicines are the responsibility of pharmacists.’ (Pharmacist 4)

‘We are not the only ones responsible for inventory management, but the nurses are also responsible, they have to communicate with each other as well so that they are all involved, because we need their help.’ (Pharmacist assistant 2)

‘It’s a chain. We are all linked to each other for the end user to get medication; from doctors to nurses to pharmacists, but for the cycle to be complete we have to work hand in hand.’ (Nurse 4)

When implementing a pharmacist-driven inventory management system, one of the challenges is establishing relationships among health care professionals, especially in the beginning. It was evident that initially, some of the nurses felt uncomfortable or threatened by the presence of pharmacy staff, as they thought the intention was to inspect them, or their routine practices. With time, nurses became comfortable and working relationships were strengthened.

‘When I first saw them [pharmacists] it was difficult [for me], I wondered “what do they want exactly, are they coming to inspect us?” but when we [nurses] got to know them we got information from them, we worked together and everything became easy’ (Nurse 2)

‘At first it was difficult but as time went on we adjusted because they were [initially] asking a lot of questions.’ (Nurse 1)

Working in a large health care facility can make interaction with other health care professionals difficult, especially for pharmacists as they spend most of their time in the pharmacy, dispensing medicines. Having a dedicated pharmacist allocated to a particular
ward, regularly visiting the ward, improved interaction with other health care professionals. One of the pharmacists explained these benefits as follows:

‘... because the hospital is very big, it’s not easy for pharmacy personnel to interact with everybody in the hospital, so if we are allocated as we are at the moment, it’s better, because they [nurses] know whom they are working with on the pharmacy side. We can do our work effectively and their confidence in us is improved.’ (Pharmacist 2)

Another pharmacist and pharmacist assistant highlighted the need for the pharmacy staff to assist nursing staff and rectify routine practices which are not in line with Good Pharmacy Practice (SAPC 2010).

‘I discovered that they [nurses] have specific routines in which they conduct certain activities when managing stock, even though those routines are flawed, they continue using them because they have used them for several years’ (Pharmacist 1)

‘They [nurses] were now able to record room temperature every day. They were not recording anything initially.’ (Pharmacist’s assistant 3)

The ongoing relationship of health care professionals in a multi-disciplinary team should be seen as a beneficial alliance involving mutual trust and confidence in all matters related to pharmacotherapeutics (NDoH 2011a). It is therefore necessary to build proper support systems. The individuals involved in the project need to be well coordinated for change to be implemented (Bourda 2013). Both pharmacists and nurses appreciated the benefits of a good working relationship, while one of the nurses stated that they miss the pharmacist if he/she is not there.

‘There was very little interaction in the whole chain [of health care professionals], but since the project started, nurses ask for help [from pharmacists].’ (Pharmacist 1)

‘We miss them [pharmacists]. We had a good working relationship.’ (Nurse 4)

When implementing a new project in a health institution, involvement of people from different disciplines is vital for improving the health care system, although bringing about such a radical change can be challenging (Mental Health Commission 2006). Interaction between health care professionals may result in resistance to change, but with time, as they become acquainted, interaction improves (Raine, Wallace, Nic a’ Bháird, Xanthopoulou, Lanceley, Clarke, Prentice, Ardron, Harris, Gibbs, Ferlie, King, Blazeby, Michie, Livingston & Barber
2014). As shown in the study, initially the health care professionals were sceptical of working together but with time, they began to realise the benefits thereof.

**Policies, procedures and guidelines**

Policies need to guide practice and to ensure that systems, in this case the pharmacist-driven inventory management system, is implemented and operates successfully. Pharmacy staff expressed the importance of having such policies and standard operating procedures (SOPs) in place:

‘I think most of the people [pharmacy staff] would be interested [if project becomes part of policy].’ (Pharmacist’s assistant 4)

Due to the project not being part of the standard operating procedures (SOPs), lack of supervision and a time schedule to include the initiative within the pharmacy, affected how the initiative was accepted.

‘It’s [pharmacist-driven inventory management system] not detailed within the SOPs so there’s no specific time for it, we tend to prioritise our daily activities. I think if it’s included within the policy then it can work, provided the structures and policies are well detailed. It also required an internal person [from the pharmacy] who was in charge of it.’ (Pharmacist 1)

‘There must be a fixed roster. We must find out which days are not so busy and allocate accordingly, otherwise it’s not feasible.’ (Pharmacist 4)

‘It should be compulsory, that way everyone will participate. Each and every individual will know that he or she has a responsibility.’ (Pharmacist’s assistant 3)

**Initial expectations**

It was evident that the expectations of the staff regarding the situation in the ward medicine rooms, were slightly different from their actual experiences.

‘There were several surprises with regards to the nurses’ approach to certain things.’ (Pharmacist 1)

‘At the main pharmacy, everything is packed alphabetically. That was my expectation when I went to the wards, but I found that nurses pack the medicines randomly, as long as they know where to find them.’ (Pharmacist’s assistant 3)
Benefits and positive experiences

According to pharmacists and pharmacist’s assistants, when they first visited the wards there was not much structure and compliance with legal requirements (SAPC 2010). Medicines were not stored correctly and a lot of expired medicines were recovered. The nurses agreed that before the implementation of the project their wards were not in the best of conditions, but the pharmacy staff helped them improve inventory management practices through in-service training and assistance with activities such as removal of expired stock and rearrangement of medicines on the shelves.

‘It [inventory management] improved since the project started. It’s helping to get the wards organised, to get rid of expired medicines, and it is assisting with correct storage of medicines. It has benefited both the nursing and pharmacy staff because expired medicines were a very serious problem.’ (Pharmacist 1)

‘The rate of expired stock decreased. We were monitoring [medicines], and that’s why eventually there was less expired stock.’ (Pharmacist’s assistant 1)

‘They [nurses] were open for anything and they wanted to learn more, nobody was resistant, they actually appreciated [what we were doing].’ (Pharmacist 4)

‘If nurses come and ask for help, you have to teach them. They were not sure of the storage conditions of some of the items [medicines], especially fridge items. They [nurses] were really happy with the intervention.’ (Pharmacist 3)

‘The intervention was a very good thing because it assisted us as nurses. Since they [pharmacists] started coming we don’t have expired medication anymore. We [nurses] don’t have time to check the expiry dates so they have made work easier for us. Our medicine rooms are nicely packed now compared to how they looked before.’ (Nurse 1)

Pharmacist involvement in the wards reduced the nurses’ work load and saved them time. The nurses became aware that they could rely on pharmacists whenever they required assistance with medicine-related issues. The labelling and rearranging of medicines done by pharmacists was evidently very beneficial to the nurses.

‘We no longer spend a lot of time in the medicine room. We know that they [pharmacy staff] take care of that. They arranged medicines according to their generic names and according to the alphabet so it’s easy for us to access the medication. It is user friendly for us therefore we can work faster now.’ (Nurse 1)
Chapter 4: Results and Discussion

'It helped us because if you have a question about medication, you have somebody nearby to grab and ask “how do you do this?”' (Nurse 4)

‘At times we would go to the medicine cupboard and look for something but couldn’t find it, it’s time consuming, but with the labelling we now know where to go and grab what we are looking for.’ (Nurse 3)

‘It [the project] took off some of the load we have because we now knew that there was somebody [a pharmacist] in charge of the medicine cupboard.’ (Nurse 4)

Initially, a lot of expired medicines were recovered from the wards, but since the involvement of pharmacy staff in inventory management, wastage of medicines was reduced and costs were saved though redistribution of short-dated medicines.

‘We don’t waste money on medication that we don’t need in the unit anymore. Since pharmacy staff came, they took away medication we don’t need, so there is a financial benefit. It has also benefited pharmacists because they don’t have to dispense medication that we wouldn’t use.’ (Nurse 1)

In government facilities, most pharmaceuticals are wasted through expiry (Nakyanzi, Kitutu, Oria & Kamba 2008). The above perceived reduction in expired medicines in the wards through the project resulted in reduction of wastage.

Visiting the wards made pharmacy staff more aware about ward inventory management. Both nurses and pharmacists became more alert to and vigilant in terms of inventory management.

‘It was a very good project because it got us involved with managing the stock that we had dispensed to the wards. It also helped us to get closer to the nurses and doctors so that they can communicate with us if they have any issues relating to medicines.’ (Pharmacist 3)

‘They [nurses] make mistakes unknowingly, but some make them knowingly so we have to inform them that we could come at any time so they should expect us at any time.’ (Pharmacist’s assistant 4)

‘We enjoyed going to the wards. When we did stock taking, it helped us a lot, because we were no longer coming back with expired stock.’ (Pharmacist’s assistant 2)
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‘They [pharmacists] get to see how much medication we use. It also awakened us not to keep expired medication in the ward because we know that pharmacists will come and find them. Now we are on our toes. If they [pharmacists] find expired medication our operational manager is on to us “why is the medication expired?”, if it was just us it would end up between me and the enrolled nurse, it wouldn’t go to the operational manager but now that we know that she will know. We are more vigilant. We need a push sometimes.’ (Nurse 4)

‘Now I stay alert, and when going to the wards. Sometimes I don’t even refer to my pharmacist, I know what answer to give, I’m always watching my step.’ (Pharmacist’s assistant 3)

Communication improved between nurses and pharmacists as there was a communication gap prior to the project. Nurses indicated that this made their work flow easier as they knew which pharmacist to contact when they needed assistance with medicine-related issues.

‘At first there were challenges but in the end they [nurses] knew us, so communication became better.’ (Pharmacist’s assistant 4)

‘There is now an element of communication which was not there before.’ (Pharmacist 1)

‘Communication improved. We had this gap and the project bridged it. Now the particular wards that I am handling know me by name so if they have a problem they’re not afraid to call.’ (Pharmacist 3)

‘We have got a pharmacist that is allocated to us. We know who is responsible, we know that if we phone, this person will help, and if the doctor has prescribed something that the patient doesn’t need that person will phone us and say that “no, you can’t use that medication on this patient”.’ (Nurse 1)

‘They [pharmacists] were communicating with us and we were helping each other, where they did not understand they would ask and where we did not understand we would ask them. I think it is a good initiative.’ (Nurse 4)

Following the status quo is usually preferred as employees are more comfortable in following the exact same predictable routine procedures which yield efficiency (Lunenburg 2010). However, due to the evolving environment within healthcare, change is necessary and inevitable. Both pharmacy and nursing staff gained new knowledge from the intervention.
‘Even the pharmacist’s assistant learners were excited as they saw a different side of pharmacy. They were learning other scopes of their practice that under normal circumstances they wouldn’t have learnt if they were in the dispensary.’ (Pharmacist 3)

‘It’s a good thing because they [pharmacy staff] are also benefiting from it… it is a learning curve for them, with a different perspective. So I think it is very good for them as well’ (Nurse 1)

‘We have learnt a lot of things. We’ve learnt from wrong to right and it helped with our modules.’ (Pharmacist’s assistant 3)

The training provided by the researcher was perceived as beneficial by both pharmacy and nursing staff:

‘It was helpful in bringing out several aspects, especially calculations. We got an overview of what to check, what to do, and so on. It was quite beneficial.’ (Pharmacist 1)

‘Some of them [pharmacy staff] still ask “what we are going to do when we go to the ward?”, even though we were trained so we just need refresher courses. It was useful but it was broad, it should be simplified.’ (Pharmacist 3)

‘She [the researcher] taught us that you are not supposed to put vials on the fridge door because that used to be the practice in our ward and we didn’t know that it was wrong.’ (Nurse 1)

Tools implemented in the wards to guide inventory management, e.g. posters and colour coding for soon-to-expire medicines, were perceived as a beneficial initiative:

‘I think the charts which were placed on the wall regarding what the sisters have to check, really work for them.’ (Pharmacist 1)

‘They [pharmacists] used colour coding for medication that’s going to expire in a month, in two months, in three months [soon-to-expire medicines]. That is a very good initiative because we never thought of that as nurses.’ (Nurse 1)

Challenges faced

Time constraints was one of the major challenges that both pharmacy and nursing staff faced. The nurses had huge workloads caring for patients; as a result they did not have enough time to attend to inventory management. Similarly, pharmacy staff were too busy
with outpatients in the pharmacy, hence they could not find time to assist nurses with ward inventory management. Staff had to learn to manage their time well.

‘We tried but we didn’t go all the time as expected. Time was one of the major challenges in terms of the whole project.’ (Pharmacist 1)

‘Normally Pharmacist X and I chose one of the days that was not busy, which was on Fridays' (Pharmacist’s assistant 3)

‘When I went for the first time, we took a little bit longer; it was also a little bit complicated. We had lot of things [to do] in the initial stage, but as time went on, some things were cleared.’ (Pharmacist 1)

‘We no longer have to go into the medicine room to check the expired medication, because we don’t have time as nurses, so it [the project] helped us in terms of time management because of assistance we got from the pharmacists.’ (Nurse 1)

Although most of the nurses were welcoming, a few were resistant initially, as is expected with change and the introduction of a new project.

‘I encountered one sister who was a bit resistant. I went in there with the students and I was trying to introduce what we were going to do, stock management. She said, “No, we have nursing students that are supposed to be trained that are supposed to be doing these things, so if you come in and you organise everything for them then what do they have left to do?”’ so I told her, “But if you have nursing students who are supposed to do this it means it’s not being done. Introduce us to the nursing students; we will all work together because it’s a common goal’.” (Pharmacist 3)

‘When you are young as we are and they [nurses] are older, when you try to say something it’s like “What is this child talking about, we have been here for more than 15 years, who is she to tell us what to do?”’ (Pharmacist’s assistant 4)

One of the reasons nursing and pharmacy staff had time constraints, was due to large work load and shortage of staff.

‘We have shortage [of staff].’ (Pharmacist 1)

‘That is the problem here; we have a staff [shortage] problem.’ (Pharmacist 4)
Initially, pharmacists spent a lot of time rearranging medicines in the wards, but with time, they spent less time as medicines were now arranged in an orderly manner. It was easier to identify and use short-dated medicines first to prevent expiry.

'It doesn't really take a long time as time goes on, but when we went for the first time it did.' (Pharmacist 1)

'The first time when we went, there was chaos, it was a mess. We labelled [medicines] and then put extra containers so that the medicines could be in order, then after a few weeks it became better because most of the stock was packed correctly so you could count and check easily not like before.' (Pharmacist’s assistant 3)

'It was not easy [to take time out to visit the wards] because staff take tea breaks at different times, there are many patients [outpatients] outside waiting to be served… it's too full, then this results in long patient waiting times. Here at the pharmacy we are busy but we have to do the right thing.' (Pharmacist’s assistant 2)

Pharmacy staff faced challenges with convincing their colleagues that ward visits were a positive thing, especially those who were not allocated to any particular wards. Some of the staff members were not interested at all.

'I am doing a lot of things, but when you go to the wards and you come back, people still look at you like “where have you been?” One assistant actually said, “You are at work, you spend two hours in a ward and then you're taking your lunch as well and you want the hospital to pay for eight hours of work?” She feels if I’m not here [at the pharmacy] I don’t even qualify to get my full salary.' (Pharmacist 3)

'When Pharmacist X goes to the ward, it's a challenge to most of us [our colleagues], it's like “you left the activities, we have a shortage [of staff]”. Well, every change has resistance.' (Pharmacist 1)

'There were staff constraints and [lack of] staff willingness. There are assistants who say ‘I am not interested, and I will never go”, to them it’s not part of their job description and they never go [to the wards].’ (Pharmacist 3)

The above statement affirms that if new changes are not well detailed, uncertainty may be introduced as employees will be unsure what their duties are, or whether they have a future in the organisation. Uncertainty results in reduced productivity, hence it is important to highlight the changes to be introduced as well as the reasons for introducing them (Bourda
Resistance to change usually occurs due to pressure on employees to perform better, despite the changes introduced. This may result in stress as the employees try to take on more tasks or adapt to the new routines and procedures (Boohene & Williams, 2012).

Medicines storage was one of the main inventory management practices nurses were struggling with.

‘Nurses were using ampoules three times, and then they would use sticky tape to close them.’ (Pharmacist’s assistant 3)

‘They reused ampoules, and covered them with sticky tape or a bandage… we were shocked.’ (Pharmacist’s assistant 4)

Although assistance from pharmacy staff brought about many benefits, nurses realised that they could have communicated better with the pharmacists. They became confused because they were not accustomed to the new changes. They pointed out in retrospect that they should have worked closely with pharmacists from the beginning.

‘Although on rearranging the room sometimes we got confused because we are used to a certain way of doing things but I think it is a good thing. Labelling is okay but maybe we should have discussed with them [pharmacists] before [rearranging] to come to a compromise where all of us are happy.’ (Nurse 4)

Infrastructure was another challenge identified. Medicine rooms were too small to store medicines and in some cases they were used for storing other materials that are not medicines as they were the only form of storage space available in the wards. In some wards, medicines were then stored in admission rooms, which are accessible to just about anyone, therefore their security was compromised. Due to the structure of the buildings, the wards tend to become very hot, which is not conducive for medicines storage.

‘Our medicine room is small. We don't have space, that's the thing.' (Nurse 4)

‘Medicines were all crammed up in a cupboard in one of the consulting rooms; their admission rooms … the medicines room had other things [in it].’ (Pharmacist 3)

‘Our medicine room is always very hot … over 30°C.’ (Nurse 2)

‘Schedule 5 and 6 cupboards are stored in the sister-in-charge’s office, far from other medicines and thermometers.’ (Pharmacist 1)

Shortage of personnel poses a challenge to ward medicines management, as staff have multiple other responsibilities, especially because of the size of the tertiary hospital. As a
result when things are not in order, there is blame-shifting. Using an electronic inventory management system reduces the impact of shortage of staff as little time will be spent searching for and updating stock records (Lwiki, Ojera, Mugenda & Wachira 2013).

‘In the wards it’s really sometimes terribly busy and there is a shortage of nurses… so there is a shortage of hands to keep the medicine cupboards neat.’ (Pharmacist 4)

‘Sometimes it’s difficult to fit it [going to the wards] in because we find that this side [pharmacy] is busy… There is no staff. Sometimes on the date which may be allocated for us, you find that maybe there isn’t enough staff.’ (Pharmacist 2)

‘Though it [electronic inventory management system] can be a very huge or sophisticated project to implement, it will benefit the ward in terms of management of the stock. Because in the present position we are in, calculating their re-order level is quite challenging, because there are no stock records.’ (Pharmacist 1)

‘In smaller hospitals you’ll find that as a pharmacist, you do rounds because it’s a smaller hospital. Here you need to check what’s happening. So maybe because this is a bigger hospital, other people can do certain things and others concentrate on something else.’ (Pharmacist 2)

‘Most of them [nurses] blame the others [nurses].’ (Pharmacist’s assistant 4)

Investing and maximising on resources is vital for a quality health care system (WHO 2010). There is only so much that health care professionals can do. They need to be equipped with suitable facilities which are conducive for optimal service delivery (George et al. 2012). Service delivery can be effectively provided with competent staff working with the right medicines and equipment, with sufficient financing, under effective management (WHO 2007). Another extremely important investment for health systems strengthening is human resources. Both nurses and pharmacists indicated that the current infrastructure had some limitations on their ability to manage inventory effectively, for example the medicine rooms were too hot for medicines storage, due to the lack of air conditioners they could not be guaranteed that the medicines would be safe and effective for patients.

**The way forward**

The implementation of a pharmacist-driven inventory management system had a significant impact on both the wards and the pharmacy such that both nursing and pharmacy staff were of the opinion that the programme should continue in the future. If new projects are correctly
implemented there will be reduction in the work load and work flow becomes smooth (Čirić & Raković 2010).

‘Pharmacists should continue with the service, because before this project when we did a stock take, we used to come back with a lot of expired stock… but since the beginning of this project we have less expired stock.’ (Pharmacist’s assistant 3)

‘I think they are supposed to take it [the project] forward because there are other learners [pharmacist’s assistants] who will come through.’ (Pharmacist’s assistant 1)

‘Besides the learners [learner basic pharmacist’s assistants], we are all part of the pharmacy and we have to know what are we dealing with in the wards.’ (Pharmacist’s assistant 4)

‘I think continuing with the project would be good for us, because if we didn’t see the difference they made we wouldn’t miss that “hey man, there are people [pharmacists] that are not coming in any more”.’ (Nurse 4)

‘I think we should do it regularly, to help them [nurses], and to help us also.’ (Pharmacist 2)

‘I think it must definitely continue. The positive [thing] to take out of that is that less medication expires in the wards and that’s got a budget impact for the whole hospital.’ (Pharmacist 4)

‘I think that it is something that can be owned by the pharmacy on condition that they make provision for more staff because it’s the same old staff here and our hands are already full.’ (Pharmacist 3)

‘It has to be part of practice, because since they [pharmacists] have started coming our job is much better. The project has to continue. We really need those people [pharmacists], they have to come.’ (Nurse 1)

Participants appreciated the improvement brought about by the initiative; however, there is still room for more improvement.

‘There'll still be need to fill all the gaps, because anything in the initial stages still has some gaps here and there.’ (Pharmacist 1)

Nurses were concerned about their limited knowledge on medicines management, which was one of the gaps identified by participants. The nurses suggested that they require more knowledge through in-service training, as the training they received in nursing school did not
cover certain aspects on medicines. Studies that have been conducted showed that training nurses on inventory management improves inventory management practices in the wards (Trap, Todd, Moore & Laing 2001).

‘Maybe the storage of medication, if you can teach us such things.’ (Nurse 1)

‘That’s why the others [nurses] cover open ampoules, they don’t know what to do because if you throw away again it’s a waste.’ (Nurse 2)

‘Some are using plasters to cover open ampoules, some are using sticky tape.’ (Nurse 1)

‘If a medication is reconstituted, for how long can we use it? If we discard, how do we discard it?’ (Nurse 4)

‘When we were training back in the day [in nursing school], we were told that if medication expires, you can use it three months after it has expired. So those are things that we need to know. We want you to teach us. Is it really working like that?’ (Nurse 1)

‘I think sometimes we have to find time to go to the wards and educate the sisters on how they are supposed to pack the medication.’ (Pharmacist’s assistant 1)

The discussions illustrated that pharmacy staff require motivation for the initiative to work. Active involvement from management is crucial as it can influence how staff respond to the initiative.

‘If we make the other staff members [pharmacy staff] feel that they are part of this thing, then it becomes easy’ (Pharmacist 2)

‘I think we need to just get people [pharmacy staff] positive.’ (Pharmacist 4)

‘Getting people [pharmacy staff] positive must come from the bosses and it is the bosses that must say it in the meetings that this is what is happening so that everybody will know it and understand it.’ (Pharmacist 3)

This type of initiative is vital for all hospitals as medication is usually the most common curative intervention used to treat patients. It should therefore be implemented in as many hospitals as possible. It is very crucial to get medicines organised, as it makes it easier to find medicines, especially in emergency situations.
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‘Medication should be organised in the interest of safe use by doctors such that if sisters need to run and fetch a certain drug they know exactly where to find it, especially if there is an emergency.’ (Pharmacist 4)

From the results it is evident that a pharmacist-driven inventory management system is a necessity. Both pharmacy and nursing staff believed that they learnt a lot and became aware of certain aspects they were previously oblivious to before the project was implemented. They also shared the view that the project improved communication and bridged the gap between the wards and the pharmacy. The participants indicated that they were looking forward to continuing with the pharmacist-driven inventory management system in future.

Limitations

The only limitation to the study was the non-availability of both pharmacy and nursing staff all at the same time, for a focus group discussion. Paired in-depth interviews were therefore a more suitable data collection method for the nurses and pharmacists.

Recommendations

A follow-up study is required to assess the nursing curriculum in order to identify knowledge gaps on medicines management. The South African Nursing Council could include, as part of policy, compulsory continuing professional development on medicines management to keep nurses abreast with medicines management concepts. Nurses can benefit from in-service training sessions conducted by pharmacists on a regular basis. Various aspects on inventory management such as medicines storage and use can be covered in such training sessions.

Hospital policies should include the involvement of pharmacists in ward inventory management, at least once a month, as required by legislation (South African Pharmacy Council 2010). Such an intervention would require supervision, therefore hospital and pharmacy management would be required to appoint supervisors and delegate authority to ensure that all the staff are involved. Such an initiative would facilitate the process for pharmacists and nurses to work closely with each other. Multidisciplinary team work allows for efficient responsiveness which reduces financial risk like wastage of medicines (WHO 2010). This in turn improves efficiency as time is spent on actually providing much needed services, rather than mitigation of incidences due to errors and/or disdain of seemingly trivial issues.

Implementation projects tend to fail due to the way change is introduced. If new changes are not well detailed, uncertainty may be introduced and employees are likely to reject the new
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project. Therefore, involvement of pharmacy and nursing management in targeted change management, would be imperative to increase the chances of success of a new project, such as this pharmacist-driven ward-inventory management initiative.

Structural changes to hospitals, especially the older ones, to accommodate proper storage of medicines are fundamental, for example, installation of air conditioners in medicine rooms for temperature regulation, provision of lockable dedicated medicine rooms or cupboards for the safe keeping of medicines, provision of medicine fridges, to mention but a few. Proper infrastructure improves health as patients will be receiving the good quality, safe and effective medicines they require (WHO 2010).

Conclusion

It is evident that focused interventions implemented by pharmacists are vital for proper ward inventory management. A multidisciplinary approach reduces work load and improves communication between various disciplines, and in turn improves inventory management practices.

Acknowledgements

All the participants are gratefully acknowledged as well as the contribution of Princess Harirari during data analysis.
Table 1: Professional details of study participants

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Table 2: Main themes identified

<table>
<thead>
<tr>
<th>Theme</th>
<th>Data analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical Implementation</td>
<td>Technicalities involved with implementing a pharmacist-driven inventory management system</td>
</tr>
<tr>
<td>Benefits</td>
<td>Advantages or benefits brought about by the implementation of a pharmacist-driven inventory management system</td>
</tr>
<tr>
<td>Challenges</td>
<td>Challenges faced during the implementation of a pharmacist-driven inventory management system</td>
</tr>
<tr>
<td>Way forward</td>
<td>Suggestions on how to improve the implementation or rolling out of a pharmacist-driven inventory management system</td>
</tr>
</tbody>
</table>
### Table 3: Results of secondary analysis (categories identified)

<table>
<thead>
<tr>
<th>Practical Implementation</th>
<th>Benefits</th>
<th>Challenges</th>
<th>Way forward</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Multidisciplinary teamwork and interaction with other health care professionals</td>
<td>• Improved alertness and vigilance</td>
<td>• Acceptance and reception of the project</td>
<td>• Gaps to be filled</td>
</tr>
<tr>
<td>• Policies, procedures and guidelines</td>
<td>• Cold chain management and temperature monitoring</td>
<td>• Age difference</td>
<td>• Infrastructural changes</td>
</tr>
<tr>
<td>• Practical implementation and expectations</td>
<td>• Communication</td>
<td>• Blame shifting</td>
<td>• Staff motivation</td>
</tr>
<tr>
<td>• Roles, responsibility, authority and accountability</td>
<td>• Confidence</td>
<td>• Change and resistance to change</td>
<td>• Training needs</td>
</tr>
<tr>
<td>• Costs and saving</td>
<td>• Coordination</td>
<td>• Hospital size</td>
<td></td>
</tr>
<tr>
<td>• Improved inventory management</td>
<td>• Costs and saving</td>
<td>• Lack of interest</td>
<td></td>
</tr>
<tr>
<td>• New knowledge</td>
<td>• Improved inventory management</td>
<td>• Lack of knowledge</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Scepticism</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Short staffed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Staff attitudes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Time</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Work load</td>
<td></td>
</tr>
</tbody>
</table>
References


Chapter 4: Results and Discussion


4.3.1 Letter to the editor (Manuscript 2)

The letter to the editor of Curationis which will accompany the manuscript appears below.

Department of Pharmacy
Molotlegi Street, Ga-Rankuwa, 0208

Telephone: 012 521 3286 | Fax: 012 521 3992

Email: hannelie.meyer@smu.ac.za

P. O. Box 218, Medunsia, 0204

Dr Fhumulani Mavis Mulaudzi
Editor-in-Chief
Curationis

Dear Dr Mulaudzi

Re: Submission of manuscript for publication

I am writing to submit our manuscript entitled “Hospital Pharmacy and Nursing Staff’s Perceptions of Pharmacist-Driven Ward Inventory Management” by Pamela Harirari, Johanna Meyer, Moliehi Matlala and Victoria Oladipupo for consideration for publication in Curationis. This study aimed to determine the perceptions of nursing and pharmacy staff on the successes achieved and challenges experienced, during and as a result of, the implementation of a pharmacist-driven inventory management system in the wards at a tertiary academic hospital.

In this manuscript, a focus group discussion and four paired in-depth interviews were carried out to determine the perceptions of pharmacy and nursing staff on the implementation of a pharmacist-driven inventory management system. Generally, both pharmacists and nurses perceived that such a system improves inventory management practices. The major benefit was observed to be reduction of financial costs through the decrease of expired medicines. Other benefits were improvement of communication and coordination between the two disciplines of health care professionals which decreased work load, especially for the nurses. Both nurses and pharmacists indicated that they gained new knowledge through the implementation of the new inventory management system.

Based on the results of our study, it is evident that multidisciplinary teamwork is essential for medicines management. Although pharmacists are the custodians of medicines, working together with nurses improves ward inventory management practices and reduces wastage of medicines. In South Africa, there are not many studies carried out on pharmacist
involvement in ward inventory management. This manuscript serves to raise awareness on the importance of inter-professional interactions.

We therefore believe that this manuscript is appropriate for publication by *Curationis* because it reflects on challenges faced by nursing staff regarding inventory management and how multidisciplinary teamwork, especially with pharmacists, improves medicines inventory management.

This manuscript describes original work and is not under consideration by any other journal. All authors approved the manuscript and this submission.

Thank you for your consideration. We appreciate your time and look forward to your response.

Sincerely,

_________________________
Miss Pamela Harirari (pamelaharirari@gmail.com)
First Author
9 December 2015

### 4.4 SUMMARY

In this chapter, the results and discussion based on this study were presented in manuscript format.

From the checklist results, overall percentage compliance for study wards (n=8) prior to the intervention was 42.3% and that of control wards (n=35) was 38.2%. After implementation of the intervention, the overall percentage improvement for study wards was 73.2% compared to that of control wards which was only 16.7%. This indicates that pharmacist interventions improved inventory management practices. One example of the indicators that the pharmacist had very little control over is the locking of the medicine rooms to improve medicines security as that depended on the nurses who were in the wards most of the time. Pharmacist interventions in the wards included rearranging of medicines, removal of expired medicines, marking short-dated medicines and training nursing staff. Although there were time constraints active involvement of pharmacy staff in the wards bridged the gap between the pharmacy and the wards which resulted in improved communication. Outdated infrastructure and shortage of staff made it difficult to implement interventions. Both
pharmacy and nursing staff perceived that the pharmacist-driven inventory management system improved their inventory management skills and that they gained new knowledge in terms of medicines management through the intervention.

Although the results indicated some improvement, there is still room for more improvement on inventory management practices. Active involvement and support from the hospital pharmacists is required.

The conclusion, recommendations and limitations of the study are presented in the next chapter.
CHAPTER 5
LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

In this chapter, the limitations of the study are outlined, followed by recommendations offered based on the results. The chapter ends with the final conclusion to the study.

5.2 LIMITATIONS OF THE STUDY

The major limitation to this operational study was the availability of pharmacists for the implementation of the inventory management system in all the wards. Most of the hospital pharmacists were not able to visit the wards as often as required. The researcher implemented targeted interventions in eight paediatric wards, which was evident from the better compliance to checklist indicators in these wards post-intervention. Another limitation to the study was the availability of both pharmacy and nursing staff for the focus group discussions. Paired in-depth interviews were therefore a more suitable data collection method for the nurses and pharmacists due to the unavailability of all the staff at the same time.

5.3 RECOMMENDATIONS

The following recommendations are made based on the results of the study:

- There is a need for the active involvement of pharmacists, as the custodians of medicine, when it comes to ward inventory management. This involvement can be encouraged, either by making it part of the pharmacists’ daily routine, where a ward pharmacist is specifically allocated or where the pharmacists rotate and take turns just as they would in the various departments of the pharmacy, or it could be encouraged by making policies and delegating authority to a supervisor(s) who would then monitor all the people involved.

- Offering incentives to pharmacists and pharmacist’s assistants who participate may entice pharmacy staff to conduct ward visits, for example, if each individual receives Continuing Professional Development (CPD) points for carrying out ward inventory management interventions. To ensure that this kind of initiative is regulated, an information technology (IT) system can be used to login and input stats.
Chapter 5: Limitations, Recommendations and Conclusion

- Pharmacists could organise regular in-service training sessions for nursing staff on different aspects of inventory management, at least once a month per ward.

- Nursing schools may benefit from including a few concepts on medicines management as part of the nursing curriculum, in cases where these concepts are not included.

- The South African Nursing Council (SANC) should include as part of policy, a mandatory CPD on medicines management to keep nurses abreast with medicine related issues.

- Upgrading of infrastructure is required to facilitate proper inventory management.

- Access to medicine rooms should be controlled and medicine stock records should be kept to promote traceability.

- Regular cycle counts are required to avoid expired and short-dated medication.

- A follow-up study is required to assess the nursing curriculum in order to identify knowledge gaps on medicines management in order for them to be addressed.

5.4 CONCLUSIONS

From the results, it is evident that compliance to most of the checklist indicators improved in wards where a pharmacist was actively involved. Prior to the pharmacist intervention, at baseline, most of the study wards did not comply with indicators such as conducting cycle counts to reduce the presence of short-dated and expired medicines, presence of SOPs to guide practice and ensure the same standards are adhered to when handling medication, to mention but a few. Post-intervention, compliance with such indicators improved.

Through the focus group discussions, the strengths and weaknesses of having a pharmacist-driven inventory management system were identified. Improvement of communication was one of the major strengths identified by both nurses and pharmacists. Although both parties were initially sceptical of the intervention, they later realised its importance. One of the major challenges faced was time, especially for the pharmacists. Due to having many responsibilities that they were obligated to fulfil, it was difficult for them to find time to visit the wards. However, team effort from both nurses and pharmacists improved inventory management practices and work flow in general.

Although inventory management is being carried out by nurses, it was evident that assistance with the management of pharmaceuticals in the wards is required. Even though pharmacists avail themselves to assist with ward inventory management, nurses need to
also fulfil their duties, roles and responsibilities. It is therefore empirical for pharmacists and nurses to work together as multidisciplinary teamwork improves communication, reduces work effort and achieves the common goal of delivering good quality safe and effective medicines to the patient. It was evident that initially, a multidisciplinary approach (pharmacists and nurses) for ward medicines management was not in place.

As shown by the results, focused interventions implemented by pharmacists are vital for proper ward inventory management. Although the results indicated some improvement there is still room for improvement on inventory management practices. Active involvement and support from the hospital pharmacists is required.
REFERENCES


References


APPENDICES

Appendix 1: Consent Form

THE EFFECTIVENESS OF IMPLEMENTING A PHARMACIST-DRIVEN INVENTORY MANAGEMENT SYSTEM IN THE WARDS AT DR GEORGE MUKHARI ACADEMIC HOSPITAL

The aims and objectives of the proposed study have been clearly explained to me and I was provided with the opportunity to ask questions and given time to re-think the issue. The aim and objectives are clear to me and I have not been pressurised to participate in any way.

I understand that participation in this research project is completely voluntary and that I may withdraw from it at any time and without supplying reasons. This will have no influence on my employment with the hospital.

I know that this research project has been approved by the Medunsa Research Ethics Committee (MREC) University of Limpopo (Medunsa Campus)/ Dr George Mukhari Hospital. I am fully aware that the results of this 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 project.

......................................................... .........................................................
Name of participant Signature

......................................................... .........................................................
Place Date

Statement by the Researcher

I provided verbal and written information regarding this Project. I agree to answer any future questions concerning the Project as best as I am able. I will adhere to the approved protocol.

......................................................... ................. ................. .................
Name of Researcher Signature Date Place
Appendix 2: Study Information Leaflet

THE EFFECTIVENESS OF IMPLEMENTING A PHARMACIST-DRIVEN INVENTORY MANAGEMENT SYSTEM IN THE WARDS AT DR GEORGE MUKHARI ACADEMIC HOSPITAL

Dear Colleague

Please read the information provided below concerning this study.

I am a pharmacist intern and a registered Master’s degree student at the University of Limpopo (Medunsa Campus). I will be conducting a study at this hospital (Dr George Mukhari Academic Hospital) and will be collecting data mainly in the wards.

The aim of the study is to implement a pharmacist-driven inventory control system and determine the successes gained and challenges faced through the active involvement of pharmacists and pharmacist’s assistants in the wards at Dr George Mukhari Academic Hospital.

In order to make this study a success, I will need to collate data with the use of data collection tools and will also be asking you for information that may be necessary. I will need assistance with sourcing the right documents from the right places, and will therefore be asking you if need be. I will also need to conduct a focus group discussion (at the end of the study) in which I will require some of you to participate.

The study has been approved by the Medunsa Research Ethics Committee (MREC) University of Limpopo (Medunsa Campus) and the CEO of the hospital.

If you agree to take part in the study you will be required to provide written consent to indicate your willingness for participating.

Your participation in the study will highly be appreciated.

Please feel free to contact me and my supervisor for further information or enquiries about the study.

Regards

Pamela Harirari
012 521 5058

Supervisor: Prof JC Meyer (012 521 4567)
Appendices

Appendix 3: Ward Inventory Management Checklist

THE EFFECTIVENESS OF IMPLEMENTING A PHARMACIST-DRIVEN INVENTORY MANAGEMENT SYSTEM IN THE WARDS AT DR GEORGE MUKHARI ACADEMIC HOSPITAL

| Ward: ______________________ | Date: ______________________ |

<table>
<thead>
<tr>
<th>Required Standard</th>
<th>Tick Appropriate Box</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All medicines and medicine trolleys are stored in a locked medicine room (except emergency trolley)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication storage area is clean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicines are arranged in an orderly manner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication stored above the ground/ elevated (i.e. medication is not stored directly on the floor)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication is kept separate from disinfectants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral dosage forms, injectables and toxic medication are kept separate from each other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bin/ stock cards (ward stock record book) are present for all items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/max stock levels present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min/max stock levels are recalculated every 3 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle counts done weekly (check stock record book)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td></td>
<td></td>
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<tr>
<td>Stock records are up to date (i.e. stock on the shelves balances with the stock card entry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOPs for stock control are used (evidence)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOPs for stock control are displayed in the relevant place (poster illustration)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invoices are kept in an orderly manner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expired medicines absent on shelves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock about to expire within 3 months marked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock about to expire within 2 months marked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock about to expire within 1 month absent</td>
<td></td>
<td></td>
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<tr>
<td>19.</td>
<td></td>
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<tr>
<td>FEOFO practiced</td>
<td></td>
<td></td>
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<tr>
<td>20.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOPs for returning of expired medicines to the pharmacy are in place</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ward stock list is pasted on the appropriate cupboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 5 and 6 lists are pasted on the appropriate cupboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 5 and 6 registers are kept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule 5 and 6 registers are up to date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fridge list is pasted on the appropriate fridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food is stored in a separate fridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td></td>
<td></td>
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<tr>
<td>Date of reconstitution is indicated on reconstituted items</td>
<td></td>
<td></td>
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<tr>
<td>28.</td>
<td></td>
<td></td>
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<tr>
<td>Emergency trolley is kept closed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency trolley/ tray is complete in terms of stock</td>
<td></td>
<td></td>
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<tr>
<td>30.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ward medicines orders are made on designated days only</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td></td>
<td></td>
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<tr>
<td>Access to medicines cupboard/ room is controlled such that there is record of persons entering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td></td>
<td></td>
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<tr>
<td>Flow of stock is controlled such that theft of medicines is easily identifiable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33.</td>
<td></td>
<td></td>
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<tr>
<td>All medicines are in stock</td>
<td></td>
<td></td>
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<tr>
<td>34.</td>
<td></td>
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<tr>
<td>Patient card prescription items absent as ward stock</td>
<td></td>
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</tr>
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</table>

**TOTAL NUMBER OF ANSWERS**
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Appendix 4: Time Sheet for Ward Visits

THE EFFECTIVENESS OF IMPLEMENTING A PHARMACIST-DRIVEN INVENTORY MANAGEMENT SYSTEM IN THE WARDS AT DR GEORGE MUKHARI ACADEMIC HOSPITAL

Ward: ________________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Time in</th>
<th>Tick appropriate</th>
<th>Summary of task(s) undertaken</th>
<th>Time out</th>
<th>Total time spent (minutes)</th>
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<tr>
<td></td>
<td></td>
<td>Pharmacist</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Pharmacist’s Assistant</td>
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</table>

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Appendix 5: Focus Group and Interview Guide

THE EFFECTIVENESS OF IMPLEMENTING A PHARMACIST-DRIVEN INVENTORY MANAGEMENT SYSTEM IN THE WARDS AT DR GEORGE MUKHARI ACADEMIC HOSPITAL

1. Welcome the participants to the discussion and thank them for their willingness to participate.
2. Explain the purpose of the focus group discussion and obtain written consent to take part in the study.
3. Assure participant that there are no wrong or right answers.
4. Encourage participants to speak freely.
5. Explain that the researcher will make notes and that the discussion will be recorded using a digital voice recorder.

_ Interviewer to note:_ Start the digital audio recorder to record the interview. Rephrase questions and prompt for additional information where necessary.

_ Observer: Make observational notes._

6. Pose the following questions to the group:
   In your opinion, what was the influence of implementing a pharmacist-driven inventory management system on practices in the wards at Dr George Mukhari Academic Hospital?

   What positive changes did you observe with the implementation of the pharmacist-driven inventory management system in the wards?

   What challenges did you experience with the pharmacist-driven inventory management system in the wards at Dr George Mukhari Academic Hospital?

   How much time did you spend in the ward on inventory management?

   What effect did the time spent on ward stock management have on your normal daily work load?

7. The following probes can be used during the discussion to ensure that views are obtained on all the aspects:

   “Anything else?”

   Repeating what the participants have just said, e.g. “Did you say / Are you saying / Did you mean / What did you mean by saying that?”
Appendices

“Do you have anything to add to what was already said / Are there any other important topics which were not covered?”

8. Thank the participants for taking part in the discussion.

Close the discussion.
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Appendix 6: Observation Form

THE EFFECTIVENESS OF IMPLEMENTING A PHARMACIST-DRIVEN INVENTORY MANAGEMENT SYSTEM IN THE WARDS AT DR GEORGE MUKHARI ACADEMIC HOSPITAL

Date:___________________  Focus group:___________________

Observational Notes:

____________________________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________________________

____________________________________________________________________________________________________________________________________________________________

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Appendices

Appendix 7: Letter to the Hospital’s CEO Requesting Permission

University of Limpopo
Department of Pharmacy
P.O. Box 218, Medunsa, 0204, South Africa
Tel: (012) 521 3699/ 4567, Fax: (012) 521 3992, Email: pamelaharirari@ul.ac.za

Dr P Shembe
Chief Executive Officer
Dr George Mukhari Academic Hospital

04 July 2014

Dear Dr Shembe

RE: Request to conduct a study at Dr George Mukhari Hospital

I am a Master of Pharmacy student and academic intern at the University of Limpopo, Medunsa Campus. As part of my post-graduate degree, I am required to conduct a research project. The title of my study is “The Effectiveness of Implementing a Pharmacist-Driven Inventory Management System in The Wards at Dr George Mukhari Academic Hospital”. The study will only be conducted after ethical approval by the Medunsa Research Ethics Committee (MREC) of the University of Limpopo.

I hereby kindly request your permission to conduct the research project at Dr George Mukhari Hospital.

Please find attached a copy of my research proposal for your information. Please do not hesitate to contact me or my supervisors should you require further information.

Thank you for your consideration.

Yours in anticipation,

___________________
Pamela Harirari (Miss)
Tel: 012 521 5058

_____________________
Prof JC Meyer (Supervisor)
Tel: 012 521 4567
Appendices

Appendix 8: MREC Ethical Clearance Certificate

MEDUNSA RESEARCH & ETHICS COMMITTEE

CLEARANCE CERTIFICATE

MEETING: 06/2014
PROJECT NUMBER: MREC/H/233/2014: PG
PROJECT:
Title: The effectiveness of implementing a pharmacist-driven inventory management system in the wards at Dr George Mukhari Academic Hospital
Researcher: Miss PT Hafriri
Supervisor: Dr JC Meyer
Co-supervisor: Mrs M Matlala
Hospital Superintendent: Mrs B Oladipupo
Department: Pharmacy
School: Health Care Sciences
Degree: MSc (Med) Pharmacy

DECISION OF THE COMMITTEE:
MREC approved the project.

DATE: 21 August 2014

The Medunsa Research Ethics Committee (UREC) for Health Research is registered with the US Department of Health and Human Services as an International Organisation (ICRG0004319), as an Institutional Review Board (IRB00005122), and functions under a Federal Wide Assurance (FWA00009419) Expiry date: 11 October 2016.

Note:

i) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.

ii) The budget for the research will be considered separately from the protocol. PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

Finding Solutions for Africa
Appendices

Appendix 9: Author Guidelines for Health Policy and Planning

INFORMATION FOR AUTHORS

Health Policy and Planning's aim is to improve the design and implementation of health systems and policies in low- and middle- income countries through providing a forum for publishing high quality research and original ideas, for an audience of policy and public health researchers and practitioners. HPP is published six times a year.

HPP has a double-blinded peer-review policy. All papers, in each of the categories described below, are peer reviewed.

Specific objectives are to:

key

Ensure wide geographical coverage of papers including coverage of the poorest countries and those in transition;

Encourage and support researchers from low- and middle-income countries to publish in HPP;

Ensure papers reflect a broad range of disciplines, methodologies and topics;

Ensure that papers are clearly explained and accessible to readers from the range of disciplines used to analyse health systems and policies; and

Provide a fair, supportive and high quality peer review process.

Health Policy and Planning welcomes submissions of the following types: original articles, review papers, methodological musings, research in practice, commentaries, and papers in our series 'How to do (or not to do)..' [for example, see Hutton & Baltussen, HPP, 20(4): 252-9] and '10 best resources' [for example, see David & Haberlen, HPP, 20(4): 260-3].

Authors should pay close attention to the factors that will increase likelihood of acceptance. As well as the high overall quality required for publication in an international journal, authors should address HPP’s readership: national and international policy makers, practitioners, academics and general readers with a particular interest in health systems and policy issues and debates in low- and middle- income countries. Manuscripts that fail to set out the international debates to which the paper contributes, and to draw out policy lessons and conclusions, are more likely to be rejected or returned to the authors for redrafting prior to being reviewed. In addition, economists should note that papers accepted for publication in
HPP will consider the broad policy implications of an economic analysis rather than focusing primarily on the methodological or theoretical aspects of the study.

Public health specialists writing about a specific health, policy, challenge or service should discuss the relevance of the analysis for the broader health system. Those submitting health policy analyses should draw on relevant bodies of theory in their analysis, or justify why they have not, rather than only presenting a narrative based on empirical data.

The editors cannot enter into correspondence about papers considered unsuitable for publication and their decision is final. Neither the editors nor the publishers accept responsibility for the views of authors expressed in their contributions. The editors reserve the right to make amendments to the papers submitted although, whenever possible, they will seek the authors’ consent to any significant changes made.

Manuscripts must be submitted online. Once you have prepared your manuscript according to the instructions below please visit the online submission website. Instructions on submitting your manuscript online can be viewed here.

Manuscripts containing original material are accepted for consideration with the understanding that neither the article nor any part of its essential substance, tables, or figures has been or will be published or submitted for publication elsewhere. This restriction does not apply to abstracts or short press reports published in connection with scientific meetings. Copies of any closely related manuscripts should be submitted along with the manuscript that is to be considered by HPP. HPP discourages the submission of more than one article dealing with related aspects of the same study.

Should you require any assistance in submitting your article or have any queries, please do not hesitate to contact the editorial office at hpp.editorialoffice@oup.com

During the online submission procedure, authors are asked to provide: a) information on prior or duplicate publication or submission elsewhere of any part of the work; b) a statement of financial or other relationships that might lead to a conflict of interest or a statement that the authors do not have any conflict of interest; c) a statement that the manuscript has been read and approved by all authors (see also section on authorship below); d) the name, address, telephone and fax number of the corresponding author who is responsible for negotiations concerning the manuscript. The manuscript must be accompanied by copies of any permissions (see heading Permissions below) to reproduce already published material, or to use illustrations or report sensitive personal information about identifiable persons.
All papers submitted to HPP are checked by the editorial office for conformance to author and other instructions all specified below. Non-conforming manuscripts will be returned to authors.

**AUTHORSHIP**

All persons designated as authors should qualify for authorship. The order of authorship should be a joint decision of the co-authors. Each author should have participated sufficiently in the work to take public responsibility for the content. Authorship credit should be based on substantial contribution to conception and design, execution, or analysis and interpretation of data. All authors should be involved in drafting the article or revising it critically for important intellectual content, must have read and approved the final version of the manuscript and approve of its submission to this journal. An email confirming submission of a manuscript is sent to all authors. Any change in authorship following initial submission would have to be agreed by all authors as would any change in the order of authors.

**SUBMISSION**

Please read these instructions carefully and follow them closely to ensure that the review and publication of your paper is as efficient and quick as possible. The Editorial Office reserve the right to return manuscripts that are not in accordance with these instructions.

All material to be considered for publication in Health Policy and Planning should be submitted in electronic form via the journal’s online submission system. Once you have prepared your manuscript according to the instructions below, instructions on how to submit your manuscript online can be found by clicking here.

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**MANUSCRIPT TYPES AND PREPARATION**

- original articles
- review papers
methodological musings

research in practice

commentaries

papers in our series 'How to do (or not to do)...' [for example, see Hutton & Baltussen, HPP, 20(4): 252-9] and '10 best resources' [for example, see David & Haberlen, HPP, 20(4): 260-3].

ORIGINAL RESEARCH

Manuscripts should preferably be a maximum of 6000 words, excluding tables, figures/diagrams and references.

The title page should contain:

Title - please keep as concise as possible and ensure it reflects the subject matter;

Corresponding author's name, address, telephone/fax numbers and e-mail address;

Each author's affiliation and qualifications;

Keywords and an abbreviated running title;

2-4 Key Messages, detailing concisely the main points made in the paper;

Acknowledgements

A word count of the full article.

The manuscript will generally follow through sections: Abstract (no more than 300 words), Introduction, Methods, Results, Discussion, Conclusion, References. However, it may be appropriate to combine the results and discussion sections in some papers. Tables and Figures should not be placed within the text, rather provided in separate file/s.

In the acknowledgements, all sources of funding for research must be explicitly stated, including grant numbers if appropriate. Other financial and material support, specifying the nature of the support, should be acknowledged as well.

Figures should be designed using a well-known software package for standard personal computers. If a figure has been published earlier, acknowledge the original source and submit written permission from the copyright holder to reproduce the material. Colour figures are permitted but authors will be required to pay the cost of reproduction.
All measures should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see 'The SI for the Health Professions' (WHO 1977).

Statistics:

For the reporting of statistical analyses please consider the following additional points:

Focus the statistical analysis at the research question.

Report simple analyses first, then only more sophisticated results.

Provide information about participation and missing data.

As much as possible, describe results using meaningful phrases (E.g., do not say "beta" or "regression coefficient", but "mean change in Y per unit of X"). Provide 95% confidence intervals for estimates.

Report the proportions as N (%), not just %.

Report p values with 2 digits after the decimal, 3 if <0.01 or near 0.05. E.g., 0.54, 0.03, 0.007, <0.001, 0.048. Do not report p values greater than 0.05 as "NS".

Always include a leading zero before the decimal point (e.g., 0.32 not .32).

Do not report tests statistics (such as chi-2, T, F, etc).

REVIEW ARTICLES:

Manuscripts should preferably be a maximum of 10,000 words, excluding tables, figures/diagrams and references.

Reviews may be invited. They generally address recent advances in health policy, health systems and implementation. Systematic reviews are particularly welcomed, but may not be appropriate for every topic. If authors are submitting a review article that is not a systematic review then the paper should explain why a systematic review was not feasible/desirable, and the review methods should be described in a way that is as clear and as replicable as possible.

The title page should contain:

Title - please keep as concise as possible and ensure it reflects the subject matter;
Appendices

Corresponding author's name, address, telephone/fax numbers and e-mail address;

Each author's affiliation and qualifications;

Keywords and an abbreviated running title;

2-4 Key Messages, detailing concisely the main points made in the paper;

Acknowledgements

A word count of the full article.

The manuscript will generally follow through sections: Abstract (no more than 300 words), Introduction, Methods, Results, Discussion, Conclusion, References. However, it may be appropriate to combine the results and discussion sections in some papers. Tables and Figures should not be placed within the text, rather provided in separate file/s.

In the acknowledgements, all sources of funding for research must be explicitly stated, including grant numbers if appropriate. Other financial and material support, specifying the nature of the support, should be acknowledged as well.

Figures should be designed using a well-known software package for standard personal computers. If a figure has been published earlier, acknowledge the original source and submit written permission from the copyright holder to reproduce the material. Colour figures are permitted but authors will be required to pay the cost of reproduction.

All measures should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see 'The SI for the Health Professions' (WHO 1977).

Commentaries – Short commentaries on topical issues in health systems are welcomed. Most such commentaries are commissioned by the editors, but the journal will also consider unsolicited submissions. Commentaries should of broad interest to readers of Health Policy and Planning, and while they are not research papers, they should be well substantiated. Manuscripts should preferably be a maximum of 1200 words, excluding tables, figures/diagrams and references.

The title page should contain:

Title - please keep as concise as possible and ensure it reflects the subject matter;

Corresponding author's name, address, telephone/fax numbers and e-mail address;
Each author's affiliation and qualifications;

Keywords and an abbreviated running title;

2-4 Key Messages, detailing concisely the main points made in the paper;

Acknowledgements

A word count of the full article.

The manuscript will generally follow through sections: Abstract (no more than 300 words), Introduction, Discussion, Conclusion, References. However, it may be appropriate to combine the results and discussion sections in some papers. Tables and Figures should not be placed within the text, rather provided in separate file/s.

In the acknowledgements, all sources of funding for research must be explicitly stated, including grant numbers if appropriate. Other financial and material support, specifying the nature of the support, should be acknowledged as well.

Figures should be designed using a well-known software package for standard personal computers. If a figure has been published earlier, acknowledge the original source and submit written permission from the copyright holder to reproduce the material. Colour figures are permitted but authors will be required to pay the cost of reproduction.

All measures should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see 'The SI for the Health Professions' (WHO 1977).

HOW TO DO...OR NOT TO DO

This series is meant to explain how to use a particular research or analytical method (e.g. social network analysis, discrete choice experiment etc). The research or analytical methods discussed should be well accepted and clearly defined: this category of paper is not meant to address methodological debates but rather to help disseminate and promote the use of well-accepted methodologies.

Manuscripts should preferably be a maximum of 3000 words excluding tables, figures/diagrams and references.

The sections must be arranged as follows: i) Title page, ii) Abstract, iii) Introduction, iv) Body of the paper, and v) References. Main sections should be coordinated by the author, and
inserted between Introduction and Reference sessions. Please contact our office before submitting a manuscript in this category.

The title page should contain:

Title - please keep as concise as possible and ensure it reflects the subject matter;
Corresponding author's name, address, telephone/fax numbers and e-mail address;
Each author's affiliation and qualifications;
Keywords and an abbreviated running title;
2-4 Key Messages, detailing concisely the main points made in the paper;

Acknowledgements

A word count of the full article.

Tables and Figures should not be placed within the text, rather provided in separate file/s.

In the acknowledgements, all sources of funding for research must be explicitly stated, including grant numbers if appropriate. Other financial and material support, specifying the nature of the support, should be acknowledged as well.

Figures should be designed using a well-known software package for standard personal computers. If a figure has been published earlier, acknowledge the original source and submit written permission from the copyright holder to reproduce the material. Colour figures are permitted but authors will be required to pay the cost of reproduction.

All measures should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see 'The SI for the Health Professions' (WHO 1977).

10 best - is a series of articles that identify and outline the 10 most useful resources from a range of sources to help facilitate a better understanding of a particular issue in global health'

We often commission these articles but we also hear unsolicited suggestions.
METHODOLOGICAL MUSINGS

This series is meant to address methodological issues in health policy and systems research, where there is currently a lack of clarity about accepted research methods. This series is intended to support the development of the health policy and systems research field, through supporting methodological discussion.

Manuscripts should preferably be a maximum of 3000 words, excluding tables, figures/diagrams and references.

The sections must be arranged as follows: i) Title page, ii) Abstract, iii) Introduction, iv) Body of the paper, and v) References. Main sections should be coordinated by the author, and inserted between Introduction and Reference sessions. Please contact our office before submitting a manuscript in this category.

The title page should contain:

Title - please keep as concise as possible and ensure it reflects the subject matter;

Corresponding author's name, address, telephone/fax numbers and e-mail address;

Each author's affiliation and qualifications;

Keywords and an abbreviated running title;

2-4 Key Messages, detailing concisely the main points made in the paper;

Acknowledgements

A word count of the full article.

In the acknowledgements, all sources of funding for research must be explicitly stated, including grant numbers if appropriate. Other financial and material support, specifying the nature of the support, should be acknowledged as well.

Figures should be designed using a well-known software package for standard personal computers. If a figure has been published earlier, acknowledge the original source and submit written permission from the copyright holder to reproduce the material. Colour figures are permitted but authors will be required to pay the cost of reproduction.

All measures should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in
mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see ‘The SI for the Health Professions’ (WHO 1977).

INNOVATION AND PRACTICE REPORTS

These short reports are narratives from the perspective of health managers operating at the national or sub-national level which focus on innovative approaches to strengthen health systems. Papers should highlight the practical experience of health managers or practitioners involved in taking action to strengthen health systems through innovative activities and new practices. The new activities and practices should preferably have been implemented for a sufficiently long time to allow authors to demonstrate the potential for sustained improvement or change in the health system. Examples might include practices to build capacity, develop new partnerships or restructure relationships within health systems. Papers should identify 2-4 key messages or lessons for consideration in other settings. We will not consider clinical and pharmaceutical innovations and practices. Manuscripts should be a maximum of 2000 words.

Requirements: title, abstract, introduction, body of paper, references. In the main body of the paper, sub-headings may be useful to signal key elements of the experience reported. Reports must be led by local practitioners, managers or policy-makers.

The manuscript will generally follow through sections: Key Messages, Abstract (no more than 300 words), Introduction, Methods, Results, Discussion, Conclusion, References. However, it may be appropriate to combine the results and discussion sections in some papers. Tables and Figures should not be placed within the text, rather provided in separate file/s.

MANUSCRIPT FORMAT AND STYLE

Only articles in English are considered for publication

Prepare your manuscript, including tables, using a word processing program and save it as a .doc, .rtf or .ps file. Use a minimum font size of 11, double-spaced and paginated throughout including references and tables, with margins of at least 2.5 cm. The text should be left justified and not hyphenated.

Manuscript file must include text body. Title Page, Figures and Tables should be uploaded separately.

Manuscript Preparation:
Appendices

Page 1: Title Page - please keep as concise as possible and ensure it reflects the subject matter;

Each author's affiliation and qualifications;

Keywords and an abbreviated running title;

2-4 Key Messages, detailing concisely the main points made in the paper;

Acknowledgements

A word count of the full article.

Page 2: Abstract

Abstract should be prepared in one paragraph, with a limit of 300 words. No headings are required. It should describe the purpose, materials

Page 3: Introduction

The Introduction should state the purpose of the investigation and give a short review of the pertinent literature, and be followed by:

Materials and methods. The Materials and methods section should follow the Introduction and should provide enough information to permit repetition of the experimental work. For particular chemicals or equipment, the name and location of the supplier should be given in parentheses.

Results. The Results section should describe the outcome of the study. Data should be presented as concisely as possible, if appropriate in the form of tables or figures, although very large tables should be avoided.

Discussion. The Discussion should be an interpretation of the results and their significance with reference to work by other authors.

Abbreviations. Non-standard abbreviations should be defined at the first occurrence and introduced only where multiple use is made. Authors should not use abbreviations in headings.

All measures should be reported in SI units, followed (where necessary) by the traditional units in parentheses. There are two exceptions: blood pressure should be expressed in mmHg and haemoglobin in g/dl. For general guidance on the International System of Units, and some useful conversion factors, see 'The SI for the Health Professions' (WHO 1977).
References:

Baker and Watts (1993) found...

In an earlier study (Baker and Watts 1993), it...

Where works by more than two authors are cited, only the first author is named followed by '
et al.' and the year. The reference list must be typed double-spaced in alphabetical order and include the full title of both paper (or chapter) and journal (or book), thus:


Up to five authors should be cited. If there are more, cite the first three authors and follow with 'et al.', e.g.:


For more details, please consult the journal's mini style checklist.

Tables

All tables should be on separate pages and accompanied by a title - and footnotes where necessary. The tables should be numbered consecutively using Arabic numerals. Units in which results are expressed should be given in parentheses at the top of each column and not repeated in each line of the table. Ditto signs are not used. Avoid overcrowding the tables and the excessive use of words. The format of tables should be in keeping with that normally used by the journal; in particular, vertical lines, coloured text and shading should not be used. Please be certain that the data given in tables are correct

CONFLICT OF INTEREST

Authors must declare any conflicts of interest during the online submissions process. The lead author is responsible for confirming with the co-authors whether they also have any conflicts to declare and may be required to co-ordinate the completion of written forms from all co-authors where appropriate.

ETHICAL APPROVAL

A requirement of publication is that research involving human subjects was conducted with the ethical approval of the appropriate bodies in the country where the research was conducted and of the ethical approval committees of affiliated research institutions.
elsewhere. A clear statement to this effect must be made in any submitted manuscript presenting such research, specifying that the free and informed consent of the subjects was obtained.

**FUNDING**

The following rules should be followed:

The sentence should begin: ‘This work was supported by …’

The full official funding agency name should be given, i.e. ‘the National Cancer Institute at the National Institutes of Health’ or simply ‘National Institutes of Health’ not ‘NCI’ (one of the 27 subinstitutions) or ‘NCI at NIH’ - see the full RIN-approved list of UK funding agencies for details

Grant numbers should be complete and accurate and provided in brackets as follows: ‘[grant number ABX CDXXXXXX]’ Multiple grant numbers should be separated by a comma as follows: ‘[grant numbers ABX CDXXXXXX, EFX GHXXXXXX]’ Agencies should be separated by a semi-colon (plus ‘and’ before the last funding agency)

Where individuals need to be specified for certain sources of funding the following text should be added after the relevant agency or grant number ‘to [author initials].’

An example is given here: ‘This work was supported by the National Institutes of Health [P50 CA098252 and CA118790 to R.B.S.R.] and the Alcohol & Education Research Council [HFY GR667789].

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PROOFS

Authors are sent page proofs by email. These should be checked immediately and corrections, as well as answers to any queries, returned to the publishers as an annotated PDF via email or fax within 3 working days (further details are supplied with the proof). It is the author's responsibility to check proofs thoroughly.

FIGURES & ILLUSTRATIONS

FIGURES AND ILLUSTRATIONS

Please be aware that the requirements for online submission and for reproduction in the journal are different: (i) for online submission and peer review, please upload your figures separately as low-resolution images (.jpg, .tif, .gif or .eps); (ii) for reproduction in the journal, you will be required after acceptance to supply high-resolution .tif files. Minimum resolutions are 300 d.p.i. for colour or tone images, and 600 d.p.i. for line drawings. We advise that you create your high-resolution images first as these can be easily converted into low-resolution images for online submission.

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When creating figures, please make sure any embedded text is large enough to read. Many figures contain miniscule characters such as numbers on a chart or graph. If these characters are not easily readable, they will most likely be illegible in the final version.

Certain image formats such as .jpg and .gif do not have high resolutions, so you may elect to save your figures and insert them as .tif instead.

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SUPPLEMENTARY DATA

Supporting material that is not essential for inclusion in the full text of the manuscript, but would nevertheless benefit the reader, can be made available by the publisher as online-only content, linked to the online manuscript. The material should not be essential to understanding the conclusions of the paper, but should contain data that is additional or complementary and directly relevant to the article content. Such information might include more detailed methods, extended data sets/data analysis, or additional figures.

It is standard practice for appendices to be made available online-only as supplementary data. All text and figures must be provided in suitable electronic formats. All material to be considered as supplementary data must be submitted at the same time as the main manuscript for peer review. It cannot be altered or replaced after the paper has been accepted for publication, and will not be edited. Please indicate clearly all material intended as supplementary data upon submission and name the files e.g. 'Supplementary Figure 1', 'Supplementary Data', etc. Also ensure that the supplementary data is referred to in the main manuscript where necessary, for example as '(see Supplementary data)' or '(see Supplementary Figure 1)'.

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Authors are encouraged to consult http://www.publicationethics.org.uk/guidelines for more information.

In reports of investigations in humans or animals, authors must explicitly indicate (in the appropriate section of the Methods) their adherence to ethical standards and note the approval of an ethics committee when this is relevant.
Appendices

Appendix 10: Author Guidelines for Curationis

Structure and style of your empirical research article

The page provides an overview of the structure and style of your empirical research article to be submitted to the *Curationis*. The empirical research article provides an overview of innovative research in a particular field within or related to the focus and scope of the journal presented according to a clear and well-structured format (between 3500 and 7000 words with a maximum of 60 references).

- **Language:** Manuscripts must be written in British English.

- **Line numbers:** Insert continuous line numbers.

- **Font:**
  - Font type: Palatino
  - Symbols font type: Times New Roman
  - General font size: 12pt

- **Line spacing:** 1.5

- **Headings:** Ensure that formatting for headings is consistent in the manuscript.
  - First headings: normal case, bold and 14pt
  - Second headings: normal case, underlined and 14pt
  - Third headings: normal case, bold and 12pt
  - Fourth headings: normal case, bold, running-in text and separated by a colon.

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Appendices

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**The structure and style of your original article**

**Page 1**

The format of the compulsory cover letter forms part of your submission and is on the first page of your manuscript and should always be presented in English. You should provide all of the following elements:

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- Significance of work: Briefly state the significance of the work being reported on.

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**Page 2 and onwards**

**Title:** The article’s full title should contain a maximum of 95 characters (including spaces).

**Abstract (first-level heading)**

- Do not cite references in the abstract.

- Do not use abbreviations excessively in the abstract.

- The abstract should be written in English.

- The abstract should be no longer than 250 words and must be written in the past tense. The abstract should give a succinct account of the objectives, methods, results and significance of the matter. The structured abstract for an Original Research article should consist of five paragraphs labelled Background, Objectives, Method, Results and Conclusion.
Appendices

- Background: *Why do we care about the problem?* The context and purpose of the study (what practical, scientific or theoretical gap is your research filling?).

- Objectives: *What problem are you trying to solve?* What is the scope of your work (a generalised approach, or for specific situation). Be careful not to use too much jargon.

- Method: *How did you go about solving or making progress on the problem?* How the study was performed and statistical tests used (what did you actually do to get the results). Clearly express the basic design of the study, name or briefly describe the basic methodology used without going into excessive detail. Be sure to indicate the key techniques used.

- Results: *What is the answer?* The main findings (as a result of completing the above procedure/study what did you learn/invent/create?). Identify trends, relative change or differences on answers to questions.

- Conclusion: *What are the implications of your answer?* Brief summary and potential implications (what are the larger implications of your findings, especially for the problem/gap identified in your motivation?).

**Introduction (first-level heading)**

The introduction contains two subsections, namely the background section and the literature review.

- Problem statement (second-level heading): The setting section should be written from the standpoint of readers, that is, without specialist knowledge in that area and must clearly state and illustrate the introduction to the research and its aims in the context of previous work bearing directly on the subject. The setting section to the article normally contains the following five elements.

  - Aims of the study/Key focus (third-level heading): A thought-provoking introductory statement on the broad theme or topic of the research.

  - Background (third-level heading): Providing the background or the context to the study (explaining the role of other relevant key variables in this study);

  - Trends (third-level heading): Cite the most important published studies previously conducted on this topic or that has any relevance to this study (provide a high-level synopsis of the research literature on this topic).
Research objectives (third-level heading): Indicate the most important controversies, gaps and inconsistencies in the literature that will be addressed by this study. In view of the above trends, state the core research problem and specific research objectives that will be addressed in this study and provide the reader with an outline of what to expect in the rest of the article.

Definition of key concepts (third-level heading)

Contribution to field (third-level heading): Explanation of the study’s academic (theoretical and methodological) or practical merit and/or importance (provide the value-add and/or rationale for the study).

Literature review (second-level heading): The literature review is the second subsection under the Introduction and provides a brief and concise overview of the literature under a separate second-level heading, e.g. literature review. A synthesis and critical evaluation of the literature (not a compilation of citations and references) should at least include or address the following elements, ensure these are in the literature review. Define conceptual (theoretical) definitions of all key concepts; A critical review and summary of previous research findings (theories, models, frameworks, etc.) on the topic; A clear indication of the gap in the literature and for the necessity to address this void; and A clearly established link exists between formulated research objectives and theoretical support from the relevant literature.

Research method and design (first-level heading)

This section should include:

Design (second-level heading): Describe your experimental design clearly, including a power calculation if appropriate. Note: Additional details can be placed in the online supplementary location.

Materials (second-level heading): Describe the type of organism(s) or material(s) involved in the study.

Data collection method/Procedure (second-level heading): Describe the protocol for your study in sufficient detail (clear description of all interventions and comparisons) that other scientists could repeat your work to verify your findings.

Data analysis (second-level heading): Describe how the data were summarised and analysed, additional details can be placed in the online supplementary information.
● Context of the study (second-level heading): Describe the site and setting where your field study was conducted.

**Results (first-level heading)**

This section provides a synthesis of the obtained literature grouped or categorised according to some organising or analysis principle.

Tables may be used and/or models may be drafted to indicate key components of the results of the study.

● Organise the results based on the sequence of Tables and Figures you will include in the manuscript.

● The body of the Results section is a text presentation of the key findings which includes references to each of the Tables and Figures.

● Statistical test summaries (test name, p-value) are usually reported parenthetically in conjunction with the biological results they support, use SI unit.

● Present the results of your experiment(s)/research data in a sequence that will logically support (or provide evidence against) the hypothesis, or answer the question, stated in the Introduction.

All units should conform to the SI convention and be abbreviated accordingly. Metric units and their international symbols are used throughout, as is the decimal point (not the decimal comma).

**Ethical considerations (first-level heading)**

Articles based on the involvement of animals or humans must have been conducted in accordance with relevant national and international guidelines. Approval must have been obtained for all protocols from the author’s institutional or other relevant ethics committee and the institution name and permit numbers provided at submission.

● Potential benefits and hazards (second-level heading): What risks to the subject are entailed in involvement in the research? Are there any potential physical, psychological or disclosure dangers that can be anticipated? What is the possible benefit or harm to the subject or society from their participation or from the project as a whole? What procedures have been established for the care and protection of subjects (e.g. insurance, medical cover) and the control of any information gained from them or about them?
Appendices

- Recruitment procedures (second-level heading): Was there any sense in which subjects might be ‘obliged’ to participate – as in the case of students, prisoners, learners or patients – or were volunteers being recruited? If participation was compulsory, the potential consequences of non-compliance must be indicated to subjects; if voluntary, entitlement to withdraw consent must be indicated and when that entitlement lapses.

- Informed consent (second-level heading): Authors must include how informed consent was handled in the study.

- Data protection (second-level heading): Authors must include in detail the way in which data protection was handled.

**Trustworthiness (first-level heading)**

This refers to the findings of the study being based on the discovery of human experience as it was experienced and observed by the participants.

- Reliability (second-level heading): Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials. Without the agreement of independent observers able to replicate research procedures, or the ability to use research tools and procedures that yield consistent measurements, researchers would be unable to satisfactorily draw conclusions, formulate theories, or make claims about the generalisability of their research.

- Validity (second-level heading): Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. While reliability is concerned with the accuracy of the actual measuring instrument or procedure, validity is concerned with the study’s success at measuring what the researchers set out to measure. Researchers should be concerned with both external and internal validity. External validity refers to the extent to which the results of a study are generalisable or transferable. Internal validity refers to (1) the rigor with which the study was conducted (e.g. the study’s design, the care taken to conduct measurements, and decisions concerning what was and wasn’t measured) and (2) the extent to which the designers of a study have taken into account alternative explanations for any causal relationships they explore. In studies that do not explore causal relationships, only the first of these definitions should be considered when assessing internal validity.
Discussion (first-level heading)

This section normally contains the following four elements. It is suggested that subheadings are used in this section:

- **Outline of the results** (second-level heading): Restate the main objective of the study and reaffirm the importance of the study by restating its main contributions; summarise the results in relation to each stated research objective or research hypothesis; link the findings back to the literature and to the results reported by other researchers; provide explanations for unexpected results.

- **Practical implications** (second-level heading): Reaffirm the importance of the study by restating its main contributions and provide the implications for the practical implementation your research.

**Limitations of the study** (first-level heading): Point out the possible limitations of the study and provide suggestions for future research.

**Recommendations** (first-level heading): Provide the recommendations emerging out of the current research.

**Conclusion** (first-level heading)

This should state clearly the main conclusions of the research and give a clear explanation of their importance and relevance, with a recommendation for future research (implications for practice). Provide a brief conclusion that restates the objectives; the research design; the results and their meaning.

**Acknowledgements** (first-level heading)

If, through your study, you received any significant help in conceiving, designing, or carrying out the work, or received materials from someone who did you a favour by supplying them, you must acknowledge their assistance and the service or material provided. Authors should always acknowledge outside reviewers of their drafts and any sources of funding that supported the research.

- **Competing interests** (second-level heading): A competing interest exists when your interpretation of data or presentation of information may be influenced by your personal or financial relationship with other people or organisations that can potentially prevent you from executing and publishing unbiased research. Authors should disclose any financial competing interests but also any non-financial competing interests that may cause them
embarrassment were they to become public after the publication of the manuscript. Where
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Authors’ contributions (second-level heading): This section is necessary to give appropriate
credit to each author, and to the authors’ applicable institution. The individual contributions of
authors should be specified with their affiliation at the time of the study and completion of the
work. An ‘author’ is generally considered to be someone who has made substantive
intellectual contributions to a published study. Contributions made by each of the authors
listed, along the lines of the following (please note the use of author initials):

J.K. (University of Pretoria) was the project leader, L.M.N. (University of KwaZulu-Natal) and
A.B. (University of Stellenbosch) were responsible for experimental and project design.
L.M.N. performed most of the experiments. P.R. made conceptual contributions and S.T.
(University of Cape Town), U.V. (University of Cape Town) and C.D. (University of Cape
Town) performed some of the experiments. S.M. (Cape Peninsula University of Technology)
and V.C. (Cape Peninsula University of Technology) prepared the samples and calculations
were performed by C.S., J.K. (Cape Peninsula University of Technology) and U.V. wrote the
manuscript.

References (first-level heading)

Begin the reference list on a separate page with no more than 60 references. *Curationis*
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