An assessment of the need for pharmaceutical care in a general surgical ward at Steve Biko Academic Hospital in Gauteng Province

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Declaration

I, Georgina Pretorius, hereby declare that the work on which this dissertation is based is original (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for any other degree at this or any other university.

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This work is dedicated to my husband Wessel Pretorius as he never had any doubt in me and fully supported me, stood by me and cared for me to make this dream possible.

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Summary

The words “researcher” and “pharmacist” are used interchangeably.

In the last two decades, the role of the pharmacist has been expanding beyond product orientated functions, such as procurement, stock control and dispensing, towards patient centered functions, in which the pharmacist assumes responsibility for treatment outcomes as part of the health care team.

This research aimed to assess the need for the provision of pharmaceutical care from the pharmacist to the surgical wards of Steve Biko Academic Hospital. The objectives of the study were to determine the role of the pharmacist in the general surgical wards, to assist in the design of an antimicrobial ward protocol for the surgical wards, to record and assess antimicrobial patterns in the surgical wards, to describe and categorize the interventions performed by a pharmacist during the provision of pharmaceutical care, to identify factors which limited the provision of pharmaceutical care and provide recommendations for future undertakings, to calculate the cost implications of pharmaceutical care interventions made, to assess the time spent on interventions performed by a pharmacist during the provision of pharmaceutical care and to determine if the medical staff members in the surgical unit feel there is a need for the pharmacist providing pharmaceutical services to the wards.

The study was conducted in the surgical wards of Steve Biko Academic Hospital. The study design was a cross-sectional operational study in which 62 patients were recruited over the eight week period. A pilot study was conducted to validate the data collection instruments. The data was analyzed with the assistance of a statistician using various statistical methods for the different variables in the study.

Of the 62 study patients, 33 were female and 29 were male. The female-to-male ratio of the study patients was thus 1:0.88. The average age of the patient population, was 52.5 ± 17.2 years, with a range of 15 to 88 years. The mean duration of stay for the study patients was 8.9 days, with a range 1 to 111 days.

A total of 120 diagnoses were made for the 62 study patients. Conditions diagnosed most frequently included conditions affecting the gastro-intestinal tract (38 patients), conditions affecting the cardiovascular system (28 patients), conditions affecting the endocrine system (14 patients) and infections (12 patients). The five medicines used most frequently in terms of numbers of patients and duration of therapy were paracetamol (53 patients, 277 patient-days), morphine/papaverine/codeine (41 patients, 155 patient-days), enoxaparin sodium (24 patients, 113 patient-days), co-amoxiclav (21 patients, 101 patient-days) and metoclopramide (22 patients, 90 patient-days).

A total 188 interventions were made and documented during the study period and 153 (81.4%) interventions were accepted. The number of interventions suggested ranged from 0 to 10, with an average of three interventions per patient and a median of one intervention per patient. The most frequent interventions were made due to system error or non-compliance (29.3% of all interventions), on patient or nursing staffs' knowledge of the medication (18.6%), untreated medical conditions (11.2%), therapeutic duplications (9.0%) and on prescribed doses and dosing frequency (5.9%).

The total time spent providing pharmaceutical care services within the surgical wards over the study period was 32 days (227.9 hours) with an average time of 7.1 hours per day. Of the total time in the ward, 48% was spent on providing pharmaceutical care to the patients, 26% to record and access the total antibiotic usage in the ward, 9% on administration and 6% on meetings. Other functions comprising of 3% and less of the time was information to patients,

communication with doctors, educational sessions with nursing staff, communication with the pharmacy and stock control procedures.

Questionnaires were completed by the doctors and nursing staff before and after the study period to determine if they felt there was a need for a pharmacist in the surgical ward. The doctors felt that there was a need for a pharmacist in the ward in terms of providing information and assisting in the rational use of medication. All of the nursing staff felt that there was a need for a pharmacist to visit the surgical ward and specifically to assist with the legal aspects of the prescriptions and with the education of the nursing staff.

The pharmacist played an important role in the design of an antimicrobial ward protocol and in order to do so the pharmacist recorded and assessed the antimicrobial prescribing patterns of the surgical wards.

In conclusion, the pharmacist present in the ward functioned as a gateway between the nursing staff and the doctors. The interventions that require the most attention was made due to system error and non-compliance. Important interventions were made on the patients' and nursing staffs' knowledge of the prescribed medication. The pharmacist played an important role in the education of nursing staff to discuss relevant topics and problems often encountered. Educational sessions with the patients involved giving them advice on home medication and the medication prescribed to them to take home. The amount of patients seen per week increased with time and the average time spent per patient consultation decreased with time. This is a clear indication that the researcher gained confidence and became more familiar with the pharmaceutical care process as the time passed.

From the questionnaires completed by the doctors and nursing staff it was clear that they felt that there was a need for a pharmacist in the ward in terms of

providing information, assisting in the rational use of medication, to assist with the legal aspects of the prescriptions and with the education of the nursing staff.

Chapter 1: Introduction

The introductory chapter discusses the importance and the rationale for the study, aims and objectives including operational terms used and assumptions made for the purpose of the study.

1.1. Importance of the study

Antibiotic use or misuse is the primary cause of antibiotic resistance. Both these factors lead to an increased total cost of antimicrobial therapy, which does not only include the cost of the drugs, but also the length of hospitalization, readmissions, all directly provided health care goods and services as well as patient quality-of-life issues.

The pharmacist has a key role to play in reducing resistance to antibiotic agents, by providing information to patients and medical personnel, as well as monitoring antibiotic prescribing and infection control (Jones & Jones, 2008). Pharmacists perform countless activities that benefit not only patients and physicians but save money for third party payers, thus, enhancing the delivery of health care services (Fincham, 1998:41).

This study gained first-hand experience on specific issues of patient care and antimicrobial management in the general surgical wards of Steve Biko Academic Hospital in South Africa and provided and documented pharmaceutical care rendered to address these issues. The results provided insight into the various ways in which pharmacists can provide services which will benefit the patients and the health care team in this setting.

1.2. Rationale for the study

In a meeting held on 16 June 2010 with Prof. Becker (Head of Department of General Surgery, School of Medicine, University of Pretoria) the need for pharmaceutical services at ward level was identified. A specific need was identified in the general

surgical wards with prescribing of antimicrobials, antimicrobial resistance as well as the cost associated with it.

This research study proposed to identify and evaluate the impact of a clinical pharmacist on the rational use of antimicrobial drugs in the general surgical wards of Steve Biko Academic Hospital.

1.3. Research Question

Is there a need for the services of a clinical pharmacist in the general surgical wards of Steve Biko Academic Hospital in Gauteng Province?

1.4. Aim

The aim of the study was to determine the need for the provision of pharmaceutical care from the pharmacist to the general surgical wards of Steve Biko Academic Hospital.

1.5. Objectives

The following objectives were formulated:

1. To determine the role of the pharmacist in the general surgical wards
2. To assist in the design of an antimicrobial ward protocol in the general surgical wards
3. To record and assess antimicrobial prescribing patterns in the general surgical wards
4. To describe and categorize the interventions performed by a pharmacist during the provision of pharmaceutical care
5. To identify factors which limited the provision of pharmaceutical care and provide recommendations for future undertaking
6. To calculate the cost implications of pharmaceutical care interventions made
7. To assess the time spent on interventions performed by a pharmacist during the provision of pharmaceutical care
8. To determine if the medical staff members in the surgical unit felt there was a need for the pharmacist providing pharmaceutical services to the wards.

Chapter 2: Literature review

This chapter discusses different research studies that have been conducted in the field of pharmaceutical care. Section 2.1 refers to the concept of pharmaceutical care, the benefit derived from pharmaceutical care and the application thereof in South Africa. Section 2.2 focuses on antimicrobial therapy, specifically looking at rational drug use, cost implications and the role of the pharmacist.

2.1. Pharmaceutical care

2.1.1. The evolving concept of pharmaceutical care

Pharmacy entered the twentieth century performing a role of apothecary, which was preparing and selling of medicinal drugs. During this period the pharmacist's function was the procuring, preparing and evaluating of drug products. They were to ensure that the medication was pure and to provide good advice to customers who asked them to prescribe drugs over the counter (Hepler & Strand, 1990).

Then pharmaceutical industries started to prepare pharmaceuticals and the choice of therapeutic agents was passed on to the physician, the pharmacist was left with the role of dispenser of prefabricated drug products (Hepler & Strand, 1990).

Later on new pharmaceutical services involved, which, while moving the pharmacist closer to the patient, continued to focus on the drug and its delivery rather than to individual patients. Some proposed definitions of clinical pharmacy and pharmaceutical care placed drugs and its delivery systems at the forefront and only mentioned the patient (Hepler & Strand, 1990).

Lately, many pharmacists have crossed over into the patient-care stage. These pharmacists' have realized their responsibility to the patient and to ensure that there was an indication for every item of the patient's drug therapy and that any drug used was the most effective and the safest and that the patient was compliant. Pharmaceutical services like pharmacokinetic dosing, therapeutic monitoring and drug

information was introduced to contribute to the patient's welfare (Hepler & Strand, 1990).

In the day of the apothecary it may have been enough to dispense the correct drug, correctly labeled, but today, more is required from us. It is time for each pharmacist, pharmaceutical organization and educational institutions to decide whether they will adopt pharmaceutical care as a professional mission and want to be a part of the solution of drug related morbidity and mortality and the patient's welfare or not (Hepler & Strand, 1990).

2.1.2. Defining pharmaceutical care

Pharmaceutical care was described in 1975 as the care that a given patient requires and receives which assures safe and rational drug usage (Mikeal *et al*., 1975).

In 1990 pharmaceutical care was defined by Douglas Hepler and Linda Strand as the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life (Hepler & Strand, 1990).

In 1997, Linda Strand said that that definition was incomplete. The definition she now espouses is that pharmaceutical care is a practice in which the practitioner takes responsibility for a patient's drug related needs and holds him or herself accountable for meeting these needs (Strand, 1997).

During the Hoechst Marion Roussel lecture at the School of Pharmacy, Liverpool John Moores University, on 18 May 1998, Strand explained that pharmaceutical care consisted out of three components. The first one was to assess the patient's needs. Then resources had to be brought to bear to meet those needs. Finally, there should be follow-up to determine whether what had been done was beneficial or otherwise. This process is depicted in Figure 2.1.

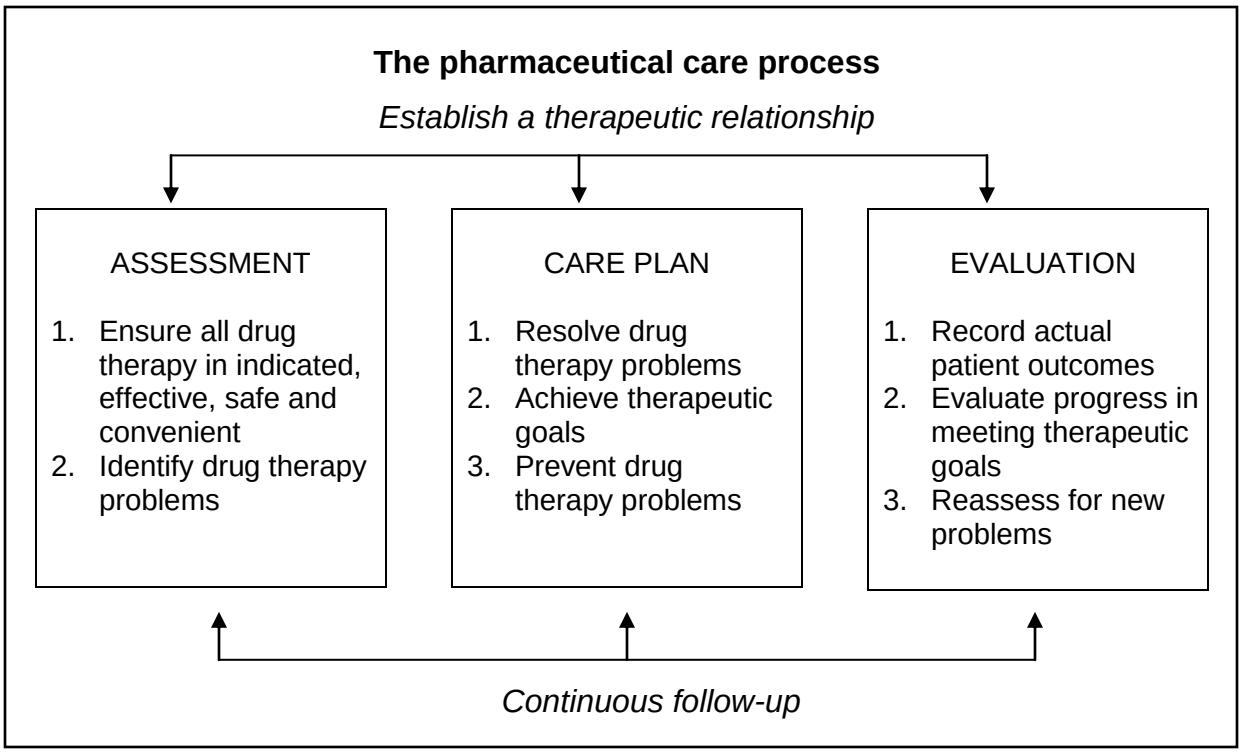


Figure 2.1: The pharmaceutical care process

Source: Strand, 1998

Strand (1998) also stated that pharmaceutical care reflected the same meeting of needs as medical care, dental care and nursing care, only it was focused on the drug related needs of a patient. What pharmacy could contribute was a rational decision making process for drug therapy decisions. It was that rational decision making process that was the foundation of the practice of pharmaceutical care.

2.1.3. The benefit derived from pharmaceutical care

It is very difficult to evaluate pharmaceutical care, as it is a complex, multi-fractional intervention. The cognitive processes and actions that pharmacists perform whilst providing pharmaceutical care are not easy to measure. Research into pharmaceutical care has tended to focus on structure and process as these are easier to measure.

Van Mil (2004) noted that a number of studies in different countries have found that the impact of pharmaceutical care on the different outcomes has been marginal. In other studies, in other countries, the improvements in outcomes as a result of comparable

interventions in comparable diseases were more satisfactory. Without a doubt, it will be difficult to prove the benefit of pharmaceutical care.

Zeind & McCloskey (2006) stated that pharmaceutical care can reduce preventable drug-related morbidity and mortality, improve outcomes and reduce health care costs.

Pharmacists perform countless activities that benefit not only patients and physicians but save money for third party payers, thus, enhancing the delivery of health care services (Fincham, 1998:41).

2.1.4. Pharmaceutical care in South Africa

The mission of the South African Pharmacy Council is to ensure the provision of quality pharmaceutical services in South Africa by developing, enhancing and upholding universally acceptable standards, professional ethics and conduct, on-going competence and pharmaceutical care.

There is still inadequate personnel for adequate pharmaceutical services in South Africa, with 25.5 pharmacists per 100 000 inhabitants. This is equivalent to about 10 000 pharmacists in the country, with 11% in the public sector. The shortage is worsened by the fact that there is a yearly loss of 30% of pharmacy graduates to other countries (Fomundam, 2007).

2.1.5. Conclusion

According to the literature presented in this section, the expanded role of the pharmacist in providing pharmaceutical care is clear. This includes monitoring and optimizing drug therapy to achieve definite outcomes which will improve patients' quality of life. Patients undergoing surgery are particularly vulnerable to drug therapy related problems. Clinical pharmacists as part of the health care team have a vital role to play in detecting and addressing these issues and intervening to resolve them (Schellack & Gous, 2010).

Since it is very difficult to evaluate pharmaceutical care, where is a lack of literature found regarding the benefits of pharmaceutical care, especially in South Africa. Its potential benefits, show that there is a need for further research on pharmaceutical care in South Africa.

2.2. Antimicrobials

2.2.1. Introduction

Antimicrobial is a general term that refers to a group of drugs that includes antibiotics, antifungal, antiprotozoal, and antiviral. Inappropriate use of antimicrobials leads to resistance, therapeutic failure, super infection and increased overall drug cost (Pasquale *et al*., 2004; Weller & Jamieson, 2004; Gyssens *et al.*, 1996).

2.2.2. Mechanism of action of antimicrobials

Each class of antibiotics has different mechanisms of action that presumably exploit a metabolic or structural vulnerability of the sensitive organism. The vulnerability of the target site is different in different species and therefore sensitivity to a given drug differs by species, depending on the presence or exposure of the target site (O'Leary & Capote, 2008).

2.2.2.1. Target site: bacterial and fungal cell wall or plasma membrane

Antibiotics that attack the outer envelope of the cell are the most common drugs employed in the treatment of clinical infections. These include the penicillins, cephalosporins, monobactams and carbapenems, which are collectively referred to as β-lactam antibiotics. The β-lactam group of antibiotics is bactericidal drugs that inhibit the synthesis of the bacterial cell wall (O'Leary & Capote, 2008).

Resistance to penicillin and other β-lactams is due to one of four mechanisms: inactivation of antibiotic by β-lactamase, modification of target penicillin-binding proteins, impaired penetration of drug to target penicillin-binding proteins and the presence of an efflux pump (Chambers, 2003a:735). Drugs that inhibit beta-lactamase include clavulanic acid, sulbactam and tazobactam and can protect hydrolyzable

penicillins from inactivation by these enzymes, thus extending the spectrum of penicillin (Chambers, 2003a:741).

Other inhibitors of cell wall synthesis include vancomycin, teicoplanin, fosfomycin, bacitracin and cyclosporine (Chambers, 2003a:748-750).

Amphotericin B binds to ergosterol and alters the permeability of the cell of the fungi, by forming amphotericin B-associated pores in the cell membrane. The pores allow the leakage of intracellular ions and macromolecules, eventually leading to cell death (Sheppard & Lampiris, 2003:793).

Azole drugs reduce ergosterol synthesis by inhibition of fungal cytochrome P450 enzymes. Azoles can be classified as either imidazoles or triazoles according to the number of nitrogen atoms in the five-membered azole ring. The imidazoles consist of ketoconazole, miconazole and clotrimazole. The triazoles include itraconazole, fluconazole and voriconazole (Sheppard & Lampiris, 2003:795).

Caspofungin acts at the level of the fungal cell wall by inhibiting the synthesis of β (1-3) glucan. This results in disruption of the fungal cell wall and cell death (Sheppard & Lampiris, 2003:798).

2.2.2.2. Target site: bacterial ribosome

Chloramphenicol is a potent inhibitor of microbial protein synthesis by binding reversibly to the 50S subunit of the bacterial ribosome (Chambers, 2003b:754).

Tetracyclines are broad-spectrum bacteriostatic antibiotics that inhibit microbial protein synthesis by binding reversibly to the 30S subunit of the bacterial ribosome. This group includes tetracycline, doxycycline, minocycline, oxytetracycline, demeclocycline and methacycline (Chambers, 2003b:756).

Macrolides may be bacteriostatic or bactericidal and inhibit protein synthesis by binding to the 50S ribosomal RNA. This group includes erythromycin, clarithromycin, azithromycin and telithromycin (Chambers, 2003b:758).

Clindamycin also inhibit protein synthesis by binding to the 50S ribosomal RNA (Chambers, 2003b:761).

Streptogramins like quinupristin-dalfopristin. Quinupristin inhibit protein synthesis by binding to the 50S subunit of the bacterial ribosome. Dalfopristin binds to the 23S portion of the 50S ribosomal subunit, and changes the conformation it, enhancing the binding of quinupristin (Chambers, 2003b:761).

Linezolid is a member of the oxazolidinones and inhibit protein synthesis by preventing formation of the ribosome complex that initiates protein synthesis. Linezolid binds to a unique binding site, located on the 23S ribosomal RNA of the 50S subunit (Chambers, 2003b:762).

Aminoglycosides are irreversible inhibitors of protein synthesis and bind to specific 30S-subunit ribosomal proteins. This group includes streptomycin, neomycin, kanamycin, amikacin, gentamicin, tobramicin, sisomicin, netilmicin, and others (Chambers, 2003c:764).

2.2.2.3. Target site: the enzymes required for nucleotide synthesis and DNA replication

Sulfonamides inhibit growth in the microorganisms by inhibiting dihydropteroate synthesis and thus reversible blocking folic acid synthesis. Trimethoprim inhibits bacterial dihydrofolic acid reductase. Trimethoprim, given together with sulfonamides, produces sequential blocking in this metabolic sequence, resulting in marked enhancement of the activity of both drugs (Chambers, 2003d:773-775).

Quinolones block bacterial DNA synthesis by inhibiting bacterial topoisomerase II and topoisomerase IV. Earlier quinolones (nalidixic acid and cinoxacin) do not achieve systemic antibacterial levels and are only useful for treatment of lower urinary tract infections. Fluorinated quinolones (ciprofloxacin, levofloxacin, etc.) have greatly improved antibacterial activity and achieved bactericidal levels in blood and tissues (Chambers, 2003d:777).

2.2.3. Antimicrobial resistance

Antibiotic resistance is a type of drug resistance where a microorganism has developed the ability to survive exposure to an antibiotic. Genes can be transferred between bacteria in a horizontal fashion by conjugation, transduction, or transformation. Thus a gene for antibiotic resistance which had evolved via natural selection may be shared. Evolutionary stress such as exposure to antibiotics then selects for the antibiotic resistant trait. Many antibiotic resistance genes reside on plasmids, facilitating their transfer. If a bacterium carries several resistance genes, it is called multiresistant or, informally, a superbug. The primary cause of antibiotic resistance is antibiotic use. The greater the duration of exposure the greater the risk of the development of resistance irrespective of the severity of the need for antibiotics (http://thewatchers.adorraeli.com). The effective life of antimicrobial drugs can be prolonged only if use appropriately (Kunin, 1997). Increasing antibiotic resistance calls for optimal prescription of antimicrobial drugs in both inpatient and outpatient settings (Katende-Kyenda *et al*., 2007).

2.2.4. Examples of common and important resistant organisms

The Centers for Disease Control and Prevention (CDC) estimates that up to 2 million people in the United States suffer health care-associated (nosocomial) infections each year and that up to 90,000 patients die as a result of their infections. In addition, nosocomial infections are becoming increasingly difficult to treat because more than 70% of the bacterial pathogens that cause them are resistant to one or more of the antimicrobials commonly used for treatment (Diekema *et al*., 2004).

Colonization of the host with antibiotic-resistant hospital flora prior to or during surgery may lead to a surgical site infection that is unresponsive to routine antibiotic therapy. Patients treated with broad-spectrum antibiotic therapy are at increased risk for colonization with hospital flora (Kanji & Devlin, 2008:2030).

With cephalosporins established as first-line therapy agents for prophylaxis over the past decade, organisms resistant to cephalosporins represent the majority of pathogens causing surgical site infections (Kanji & Devlin, 2008:2030).

Methicillin resistant *Staphylococcus aureus* (MRSA) strains are responsible for more than half of all hospital-acquired *S. aureus* infections, and vancomycin-resistant enterococci (VRE) are responsible for more than one-quarter of all hospital-acquired enterococcal infections (Diekema *et al.*, 2004).

2.2.5. Antimicrobial use

It has been reported that 20 to 50% of antibiotic prescriptions in community settings are believed to be unnecessary (Hooton & Thomas, 2001). A study done by Katende-Kyenda *et al.* (2007) in private primary health care settings in South Africa, indicate that antimicrobials were commonly used and that in certain cases antimicrobials were probably overused and inappropriately used.

Katende-Kyenda *et al.* (2007) stated that antibiotics can decrease patient morbidity due to infections and can act as lifesaving drugs as well. However, their high efficacy and relative lack of adverse effects have resulted in overuse in many situations and increasing resistance to available drugs has become a worldwide problem. Antibiotic resistance is an inevitable consequence of selective pressures imposed by the widespread use and sometimes misuse of antibiotics (Essack, 2006).

Antimicrobial misuse will also increase the total cost of antimicrobial therapy, which includes the cost of the drugs, length of hospitalization, readmissions and all directly provided health care goods and services.

Resistance may be minimized by controlling antibiotic use by means of policies formulated from the evaluation of susceptibility patterns of organisms prevalent in different institutions or areas within institutions (Essack, 2006).

2.2.6. Rational drug use

Olson and Savelli (1997) quotes the definition of rational drug use, which was agreed upon during the Conference of Experts on the Rational Use of Drugs, convened by the World Health Organization in Nairobi in 1985, as follows: “the rational use of drugs requires that patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community.”

Ambwani and Mathur (2006) stated that medicines cannot be used rationally unless everyone involved in the pharmaceutical supply chain has access to objective information about the drug they buy and use. Knowledge and ideas about drugs are constantly changing and a clinician is expected to know about the new development in drug therapy.

2.2.7. The cost of antimicrobials

The costs of drug therapy are increasing dramatically and greater attention is being paid to the pharmacoeconomics of drug therapy, where patient outcomes are valued and the costs to arrive at those outcomes are estimated. With increasing numbers of patients enrolled in managed-care organizations, understanding the true cost of antimicrobial therapy is more important than ever (Burgess, 2008:1736). The total cost of antimicrobial therapy includes much more than just the cost of the drugs. Many additional costs and factors affect the true cost of therapy. These include factors such as length of hospitalization, readmissions and all directly provided health care goods and services. More difficult to value but equally as important are indirect costs such as patient quality-of-life issues. Pharmacoeconomic and outcomes analyses are becoming more widely applied and used in order to derive values such as cost-benefit ratios and

the cost-effectiveness of various products as compared with other products (Burgess, 2008:1736).

Studies have shown a decrease in antimicrobial resistance, antimicrobial drug costs and hospital stay costs after implementing guidelines or policies (Gould, 1999; Gyssens *et al.*, 1996; Khan *et al.*, 2009). In other studies a reduction of cost was associated with decreased usage of expensive antimicrobials, a shorter hospital stay, switching from injectable to oral forms, an alternative intravenous dosage, frequency and duration, changing antibiotic to a better coverage and discontinuing unnecessary drugs (Pasquale *et al*., 2004; Weller & Jamieson, 2004; Dickerson, Mainous & Carek, 2000).

Many new oral antimicrobials have been approved, including linezolid and fluoroquinolones that can be used in place of more expensive parenteral therapy. These agents offer extended-spectrum killing activity, increased tissue penetration, and excellent safety and pharmacokinetic profiles. Many older, less expensive oral agents also remain appropriate choices. When oral therapy is being considered, the choice between convenient once-a-day expensive agents versus multiple-dose inexpensive agents arises. It is easy to calculate the difference in acquisition cost; however, the overall cost between agents is more difficult to determine. Factors to weigh include safety, effectiveness, tolerability, patient compliance and potential drug-drug interactions (Burgess, 2008:1736).

2.2.8. The role of a pharmacist

An important role of a clinical pharmacist is to participate in antimicrobial management programmes and to focus on empirical and early treatment of an infection to minimize the duration of inappropriate usage of antibiotics that generally occurs between the time of initial therapy and reporting of culture results (Pasquale *et al*., 2004). It is the responsibility of a clinical pharmacist that appropriate antimicrobial policies are in place, to monitor these policies and the daily use of antimicrobials. If any deviations is detected the clinical pharmacist must discuss it with an appropriate suggested action to

the clinical team. The education given helps to promote the understanding and use of the guidelines (Weller & Jamieson, 2004).

Education is more effective when tailored to specific behaviours and specific providers and situations (Dickerson, Mainous & Carek, 2000). The clinical pharmacist must also deliver prospective feedback during hospital rounds (Dickerson, Mainous & Carek, 2000). Guidelines are best delivered via feedback and education sessions than passive mass mailing (Dickerson, Mainous & Carek, 2000). Pharmacists must study the following when screening patients for inappropriate use of antimicrobials: an empirical choice that failed to meet criteria of guidelines, improper dosage or frequency according to the daily drug doses, inadequate spectrum of activity, administration of an antimicrobial agent for an infection on which the causative micro-organism was resistant, renal function, duration of treatment, number of drugs per prescription, creatinine clearance, patient name, age, body weight, sex, IV to PO switching (Pasquale *et al*., 2004), microbiology laboratory data, pharmacokinetic information, diagnoses, patient, deaths, lengths of hospital stay, complications, costs of medication, hospital stay and laboratory charges (Dickerson, Mainous & Carek, 2000; Khan *et al.,* 2009; Gyssens *et al.*, 1996).

The pharmacist has a key role to play in reducing resistance to antibiotic agents, by providing information to patients and medical personnel, as well as monitoring antibiotic prescribing and infection control (Jones & Jones, 2008).

2.2.9. A review of treatment protocols

The establishment or updating of guidelines for the rational use of antimicrobials is a key issue for better care of patients and combating antimicrobial resistance. Guidelines should be widely discussed through professional meetings of multidisciplinary groups, involving clinicians, microbiologists and pharmacists (Gould, 1999; Dickerson, Mainous & Carek, 2000; Khan *et al.,* 2009). Some policies restricted certain parenteral antimicrobials because of their high cost and their potential for inappropriate use (Pasquale *et al*., 2004; Dickerson, Mainous & Carek, 2000).

Chapter 3: Methodology

This chapter discusses the methodology used to investigate the need for pharmaceutical care in a general surgical ward by focusing on pharmaceutical care, time spent on different activities and questionnaires completed by medical staff. This chapter also includes analysis of the data and the pertaining ethical considerations.

3.1. Study site

The study was conducted in the general surgical wards of Steve Biko Academic Hospital, a public teaching hospital in Pretoria, South Africa. The general surgical wards consist of two sections: male ward and female ward. The researcher worked in both the wards and document data from the patients in these units.

3.2. Sample population

The sample population included all the patients that were admitted to the general surgical wards during the study period. The wards have a capacity for 24 and 33 beds respectively. An average of 140-150 patients are treated in the general surgical wards on a monthly basis. A sample of about 62 patients was seen at random. These patients were chosen using systematic sampling of one out of every four patients admitted until 62 patients have been recruited.

3.3. Study design

The design of the study was descriptive quantitative and it was an operational research study which included indicators of program success, such as improving the quality of services and adding new services components. The data was collected prospectively. Quantitative aspects included patient demographics, clinical data, the number of interventions per patient, time spent, types of interventions, the cost of antimicrobials prescribed and resistance patterns. The study had a cross-sectional design.

A needs assessment questionnaire was administered to the medical staff before and after the study. Open ended questions were asked to justify yes and no responses.

3.4. Study period

A pilot study was conducted after approval from the research and ethics committee. The researcher used this period to pilot test the data collection forms and changes were made accordingly. After the pilot study 62 patients were seen over an eight week period. A ward protocol was designed and approval by the head of the department.

3.5. Data collection process

Figure 3.1 illustrates the data collection process used by the researcher during the study period. The researcher's ward rounds were focused on pharmaceutical care and included recording of interventions, communicating of interventions to doctors or nursing staff and recording if the interventions were successful or not. During this time doctors or nursing staff also requested information or requested for consultation with a patient and again interventions would be recorded and noted as successful or not. While busy with ward rounds, the researcher also recorded the time spent on different activities such as pharmaceutical care rendered, communication with doctors, educating nursing staff, meetings, etc.

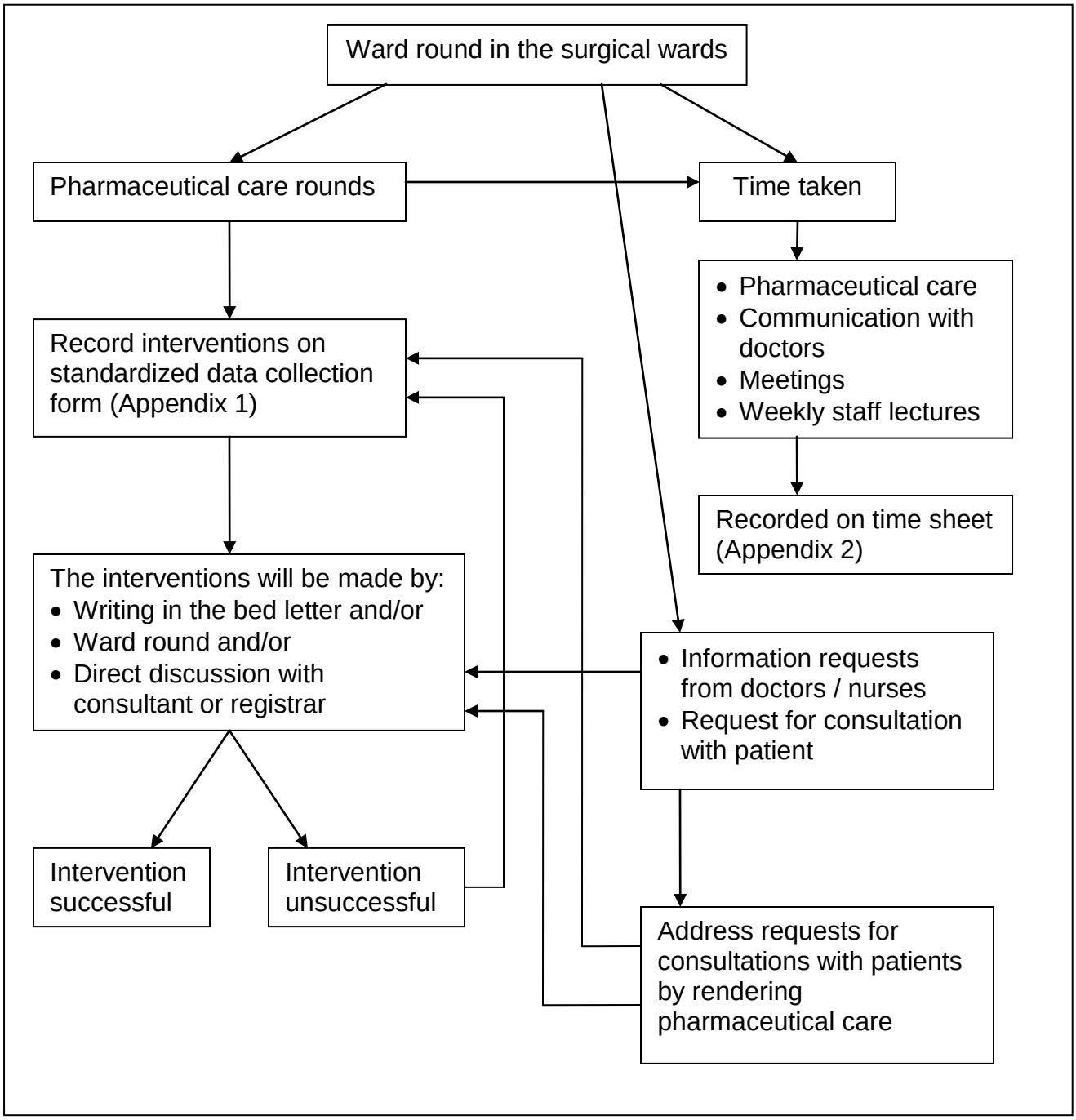


Figure 3.1: The outline of the pharmaceutical care process

3.6. Data collection instruments

Data pertaining to the pharmaceutical care that was rendered by the pharmacist during the study period was collected on three sets of forms:

- Pharmaceutical care forms, on which patient data and outcomes was documented (Appendix 1),
- A time sheet, on which the researcher documented the time spent on different activities (Appendix 2), and
- Questionnaires that was administered to the doctors and nurses to assess their perceived need and benefits of the pharmaceutical care rendered by the researcher during the study period (Appendix 3 & 4).

3.6.1. Pharmaceutical care forms

Standardized pharmaceutical care forms (Appendix 1) developed by the American Society of Hospital Pharmacists (1992) were adopted for documentation of pharmaceutical care. The set of standardized pharmaceutical care forms consisted of seven pages. One set of forms was used per patient while conducting pharmaceutical care rounds. The researcher monitored and made interventions on all the medication prescribed to the patient.

Pharmacist patient data base form

The first form of the set of pharmaceutical care forms summarizes all the patient demographics as illustrated in Figure 3.2. The top section of the first page includes all the administrative and general information which was completed on the first visit to the patient.

DEMOGRAPHIC AND ADMINISTRATIVE INFORMATION	
Patient study number: 2	
Dr: Prof. Pretorius	
Date of birth/age: 1962/10/27	Gender: M / ***F***
Height: 1.74	Weight: 66Kg
Admission date: 2011/04/11	Discharge date: 2011/04/15

Figure 3.2: Demographic and administrative section of the pharmaceutical care forms

Other information includes the vital signs on admission, the history of the present illness, the past medical history of surgery, medication used before admission at the hospital, family and social history, general lifestyle, acute and chronic medical problems, social drug use and allergies.

This part can also be used to see if the present illness could be a result of an adverse effect of the patient's demographics.

Current drug therapy

On this page, all the medication prescribed to the patient was indicated; an excerpt of this form is illustrated in Figure 3.3. This included the date on which the medication was started as well as all the dosages administered. With this page the pharmacist can have an overview of all the medication given to the patient and if the dosages were given according to the prescription.

Name/Dose/Route	Start Date	Date of Pharmaceutical Care			
		12/4	13/4	14/4	15/4
Co-amoxiclav 1.2g 8hly iv	11/4	√√√	√√√	√√√	√
Paracetamol 1g 6hly po prn	11/4	√√√√	√√	√√	√√

Figure 3.3: Current drug therapy of the patient

Laboratory data

For the purposes of this study, certain parameters were recorded as needed, to monitor medication adverse effects or contra-indications or to monitor drug serum concentrations. If the researcher had any reason to suspect that a certain laboratory test was needed, it was discussed with the treating doctor. This included parameters like urea, creatinine and electrolytes, blood elements, liver and kidney function tests, microbiology tests and other tests as needed per patient case. Only decrease or elevated levels were indicated.

Blood elements can be used to determine if the patient is anemic, have bone marrow suppression caused by certain drugs or if a viral, bacterial or parasitic infection is present.

Liver and kidney function test is important to determine if any prescribed medication is contra-indicated for the patient or to monitor the adverse effects of the prescribed medication on the liver and kidney functions.

Other parameters like C-reactive proteins can also be used as a marker of inflammation. An excerpt of this form is illustrated in Figure 3.4

	Reference Range	Date			
		12/4	13/4	14/4	15/4
CRP	0.1 – 7.5	121		35	
Na	135 – 147				
K	3.3 – 5.3				
WBC	4 – 10	14			
BP	120/80	180/110	155/90	130/88	130/85
Temp	36 – 37.5	38	37.8		

Figure 3.4: Laboratory data collection sheet

Microbiology monitoring worksheet

Microbiology tests were used to ensure that the patient receives specific antimicrobials to treat the specific infection to establish the rational use of antimicrobials.

On this page (as illustrated in Figure 3.5) the researcher recorded the diagnoses made, the sample used, the organism cultured and on which day this was done as well as the antimicrobial for which the organism is sensitive. This was compared with the antimicrobial prescribed and any intervention that can be made was recorded as well as the cost implicating which may accompany the intervention.

Empirical antibiotic use was documented on the pharmacist intervention form and was measured against the Essential Medicine List.

Date	Diagnoses	Sample	Organism	Day cultured	Sensitivity	Antimicrobial agent prescribed	Intervention	Cost implication
13/4	Wound sepsis	Pus	S. Aureus	12/4	Co-amoxiclav	Co-amoxiclav	None	

Figure 3.5: Microbiology data

Drug therapy assessment worksheet

This section served as a document (refer to Figure 3.6) that groups the interventions that was made on a day-to-day basis by the researcher. The interventions were classified according to the following categories of drug-related problems:

- Lack of correlation between drug therapy and medical problem, i.e. drugs without medical indication, unidentified medication, untreated medical conditions or outstanding investigations
- Appropriate drug selection with regards to the chosen medication, the safety, contraindications and warnings of the chosen medication and inappropriateness to the individual patient.
- Drug regimen, i.e. prescribed dose, dosing frequency, the route, dosage form or mode of administration or the duration of therapy
- Therapeutic duplication, i.e. treatment of any conditions with more types of medication than necessary.
- Drug allergy or intolerance to any medicine and if the patient is using any method to alert health care providers of the allergy.
- Adverse drug events that may be drug induced and the likelihood that the problem is drug related.
- Interactions including drug-drug interactions, drug-nutrient interactions, and drug-laboratory test interactions and any medicine contra-indicated for the patient.
- Social or recreational drug use which could be problematic or that sudden decrease or discontinuation of the drug could be related to patient symptoms.
- Failure to receive therapy due to systems error or non-compliance and if these factors are hindering the achievement of therapeutic efficacy.

- Financial impact of the chosen medication.
- Patient knowledge of drug therapy, i.e. if the nursing staff understand how to administer the medication and what the side-effects of the medication is and also if the nursing staff can benefit from education.

The interventions were classified as:

1. A problem exits
2. More information is needed for a determination
3. No problem exists or an intervention is not needed

Category of Problem	**Type of Problem**	**Daily assessment**				
	Date:	12/4	13/4	14/4	15/4	
Correlation between drug therapy and medical problem	1. Are there drugs without medical indication?	3	3	3	3	
	2. Are there medication unidentified (not labeled or unknown)?	3	3	3	3	
	3. Are there untreated medical conditions? If "Yes", do they require drug therapy?	1	3	3	3	
	4. Are investigations indicated or outstanding?	2	3	3	3	
1. A problem exits 2. More information is needed for a determination 3. No problem exists or an intervention is not needed						

Figure 3.6: Drug therapy assessment worksheet

Drug therapy problem list

Problems that were classified on the Drug therapy assessment worksheet as a level 1 or 2 was transferred to the drug therapy problem list; refer to Figure 3.7 for an excerpt of the form. On this page interventions were discussed on a day-to-day basis by stating a description of the problem as well as the proposed action of intervention. The interventions were made by writing in the bed letter or direct discussion with consultant or registrar or by giving feedback at the weekly Monday meetings. After the intervention was communicated to the prescribing doctor, he or she decided if the intervention was accepted or not.

Date	Problem		Description of problem	Proposed Action / Intervention
	No.	Level		
12/4	3	1	Elevated blood pressure of 180/110	Suggest prescribing perindopril and hydrochlorthiazide
12/4	4	2	No microbiology results available	Check with microbiology laboratory

Figure 3.7: Drug therapy problem list

Pharmacist's care plan monitoring worksheet

Problems that are classified as a level 1 was then transferred to the Pharmacist's care plan monitoring worksheet and the problems was discussed on a day-to-day basis according to the description of the problem, the proposed action or intervention or monitoring parameter, the pharmacotherapeutic goals, if the outcomes were achieved and how or why this has happened. The consultant involved was also noted to determine if they have a contribution in the limitation of the provision of pharmaceutical care. Figure 3.8 is an excerpt of the Pharmacist's care plan monitoring sheet.

The cost of each intervention was calculated and noted in the last column. The tender price was used to calculate the cost. The costs were calculated per day since it was unknown for how long the patient would have continued on the medication.

Date	Level No.	Problem	Proposed action or Intervention	Goals and Desired Endpoints	Outcome Achieved Y / N	Explain who outcome was achieved or not	Consultant	Cost
12/4	3	Elevate blood pres-sure	Prescribe perindopril and hydrochlor-thiazide	Blood pressure below 140/90	Yes	Doctor prescribed the medication	Doctor R	+ R0.6 per day

Figure 3.8: Pharmacist's care plan monitoring sheet

3.6.2. Pharmacist's time spent in the ward

The pharmacist spent time on different functions in the ward, including ward rounds, pharmaceutical care or other functions. The time that was spent to do different tasks in the ward was noted together with the number of patients present in the ward (Appendix

2). This may help to determine the amount of time a future permanent appointed pharmacist would need to perform the various functions in the ward.

3.6.3. Questionnaires

A questionnaire was completed by the doctors and nurses working at the general surgical wards before and after the study were conducted at the wards to determine if the medical staff members can benefit from education provided by a pharmacist and if they have a need for the pharmacist providing pharmaceutical services to the wards. This was a quantitative study and only a need wanted to be established, more discerning information was not the main aim of the study, thus only yes-no questions was needed.

Questionnaires designed for the doctors (Appendix 3) contain open ended questions asked to justify yes and no responses. The first question was to determine if the doctor felt that there was a need for a pharmacist to routinely visit the surgical wards. The second question was asked to determine if the doctor would benefit from having the pharmacist present in the wards while conducting a ward round. The third question was used to determine if the pharmacist was able to provide the doctor with adequate information to his/her information requests.

The last two questions were asked to determine if the doctor felt that interventions made by a pharmacist would improve the rational use of antimicrobials and/or decrease the expenditure of antimicrobials. All questions were answered with a yes or no and justified with a comment. The first and last two questions were completed before the study was conducted and all of the questions were completed after the completion of the study.

Questionnaires completed by the nursing staff (Appendix 4) contain open ended questions asked to justify yes and no responses. The first question was asked to determine if they felt that there was a need for a pharmacist to routinely visit the surgical wards. In the second question they were asked what activities they felt the pharmacist could fulfill within their department. They could choose any of the given ten activities

and write down any other activities. The third question was to determine if they felt that a pharmacist round would facilitate improved drug distribution to the department. The last question was asked to determine if they felt that there was a need for weekly education sessions with the pharmacist. Question 1, 3 and 4 must be answered with a yes or no and justified with a comment. All the questions were completed before and after the study were conducted.

Education is more effective when tailored to specific behaviours and specific providers and situations (Dickerson, Mainous & Carek, 2000). Education took place in a formal and informal manner during the time of the study. Formal in service training was given on the specified areas where problems were identified according to the questionnaires completed prior to the study. Informal education took place by discussing a specific problem with a specific nurse or doctor working with a specific patient on the time that a problem occurred.

3.7. Data analysis

As a preliminary analysis, a summary of the descriptive statistics was produced; this included frequencies and percentages for categorical data, such as gender, type of surgery; continuous variable such as age was summarized using mean, median and standard deviation. The success or failure of the intervention was modeled using a logistic regression to investigate factors associated with success. Further, relevant factor (e.g. type of problem or diagnoses) specific-cost implications was summarised using means, standard deviations, medians, minima, maxima; formally using analysis of variance (ANOVA) and Bonferroni post-hoc test where significant differences were found. Throughout the analysis, two-sided statistical tests was used at $\alpha=0.05$. STATA 11.0 for Windows (STATA Corporation, College Station, TX, USA) was used in the analysis of data.

3.8. Reliability and Validity

Reliability and validity of the data collection instruments was tested during the pilot study as described in the study period on page 16. A change was made by including a

microbiology monitoring worksheet (refer to Figure 3.5) in the pharmaceutical care forms. However these instruments have been standardized by the American Society of Hospital Pharmacists (1992) and have been tested in a South African context by Schellack & Gous (2010). The pilot study that was done measured the stability, internal consistency and equivalence of the instruments in the particular study setting.

3.9. Bias

Due to the nature of the study; a descriptive operational study; in which the researcher was measuring interventions made in the study population, it was recognized that bias may be introduced. However some element of this was controlled due to the nature of the interactions. The researcher did not work on her own but in a multi-disciplinary team and all interventions were approved by either the treating physician or another member of the health care team (depending on the type of intervention). Randomized systematic sampling was used to reduce bias in patient selection.

3.10. Ethical Considerations

Ethical approval was obtained from the Faculty of Health Sciences Research Ethics Committee of the University of Pretoria (Appendix 6) and the Medunsa Research and Ethics Committee of the University of Limpopo (Medunsa Campus) (Appendix 7). A letter of intent was written to the CEO of the Steve Biko Academic Hospital to request permission to conduct the study (Appendix 8).

The researcher included a letter from Prof. Becker, Head of Department of General Surgery, School of Medicine, University of Pretoria and Steve Biko Academic Hospital to grant permission to do the research study in that department and to access the information of the patients (Appendix 9).

Although this was an operational study and services rendered to the patients were part of routine practice in a hospital, consent from the patients were obtained (Appendix 5). The researcher assured confidentiality by not discussing any of the patient's information

and data with anyone other than healthcare workers in a professional and clinical setting.

Consent was obtained from the health care workers before completing the questionnaires. Doctor's information leaflet, informed consent and questionnaire are available (Appendix 3) and nurses' information leaflet, informed consent and questionnaire are available (Appendix 4).

Chapter 4: Results and Discussion

This chapter discusses the results obtained from the pharmaceutical care rendered during the study. The results are discussed according to the patient demographics, the duration of stay, the diagnosis, medicines used and the interventions performed. The last part of the chapter discusses the time spent on the different functions performed by the researcher and also the results of the questionnaires completed by the doctors and nursing staff.

4.1. Patient demographics

4.1.1. Study population

A total of 348 patients were admitted to the general surgical wards during the study period of eight weeks (Ward Statistics: 2011). Pharmaceutical care was rendered to 62 patients who were chosen at random as described in the sample population of page 15.

4.1.2. Gender

Of the 62 study patients, 33 were female and 29 were male. The female-to-male ratio of the study patients was thus 1:0.88, compared with a female-to-male ratio of 1:0.96 in the general population (Statistics South Africa, 2007) and taking in consideration that the female ward had more beds than the male ward as described in the sample population of page 15. The female-to-male ratio is illustrated in Figure 4.1.

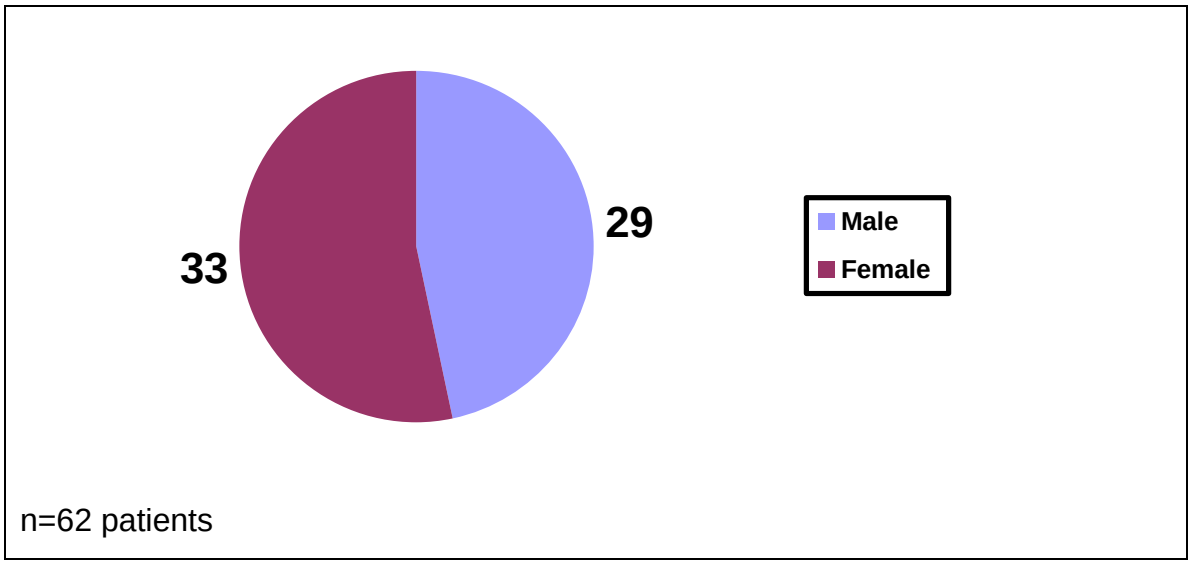


Figure 4.1: Gender ratio in the study patients

4.1.3. Age

The average age of the patient population, was 52.5 ± 17.2 years (range 15 to 88 years; n=62 patients). When this was evaluated, the following became apparent: of the 33 females the mean age was 53.8 ± 18.3 years (with a range of 15 to 88 years). For the 29 males the mean age was 51.0 ± 15.8 years (with a range of 16 to 87 years). Table 4.1 depicts the number of male and female patients according to age.

Table 4.1: Number of study patients according to age groups

Age group	Male		Female		Total	
	Number	%	Number	%	Number	%
0 - 35 years	3	10.3	5	15.2	8	12.9
36 - 45 years	7	24.1	6	18.2	13	21.0
46 - 55 years	8	27.6	6	18.2	14	22.6
56 - 65 years	7	24.1	4	12.1	11	17.7
66 - 75 years	2	6.9	9	27.3	11	17.7
76 - 88 years	2	6.9	3	9.1	5	8.1

From Table 4.1 it is clear that the highest male group was between ages 46 – 55 and the highest female group was between ages 66 – 75. In a survey done on all the patients admitted for general surgery in Glasgow, it was found that more female patients above the age of 65 were admitted in a general surgical ward than male patients over the age of 65 (Strang, Boddy & Jennett, 1977:547).

Age group 76 – 88 years was the smallest group for both the male and female patients. This could be because surgery is a risk in this age group. Intra-abdominal procedures invariably impair respiratory mechanics and in the elderly, this effect may be sufficient to provoke respiratory failure (Preston *et al*., 2008).

4.2. Diagnoses

Diagnoses were obtained from the patients' bed letters, as noted by the treating physicians. A total number of 120 diagnoses were recorded for the 62 patients. The median number of diagnoses made per patient was two. The list of diagnoses encountered in the ward is set out in Table 4.2. The list of diagnoses also includes the co-morbid conditions of the patient that could have affected the major diagnoses of the patient or extended the duration of hospitalization or contributed to the need of pharmaceutical care to the patient.

Table 4.2: The list of diagnoses encountered in the ward

System	**Diagnoses** (n=120)**	**Number of patients (n=62)**
Biliary tract	Cholecystitis	7
	Jaundice	1
Total		8
Cardiovascular	Heart failure*	1
	Hypertension*	25
	Hypercholesterolemia*	1
	Pulmonary embolism	1
Total		28
Endocrine-metabolic	Diabetes Mellitus*	12
	Hyperthyroidism	2
Total		14

Gastro-intestinal tract	Appendicitis	8
	Complicated ileostomy	1
	Diffuse gastritis and duodenitis	1
	Draining fistula	1
	Gastro-intestinal bleeding	6
	Hernia repair	3
	Intestinal obstruction	8
	Oesophageal tumour	3
	Rectal bleeding	2
	Rectal cancer	4
	Wound dehiscence	1
Total		38
Haematological	Buerger's disease	1
Total		1
Hepatic	Hepatocellular carcinoma	1
	Liver abscess	3
Total		4
Infectious	HIV*	1
	Oral and oesophageal candida	1
	Sepsis	9
	Vaginal candida	1
Total		12
Mammary glands	Mastectomy	1
Total		1
Neurological	Epilepsy*	2
	Cupital tunnel syndrome	1
Total		3
Pancreas	Pancreas cancer	1
Total		1
Polytrauma	Gunshot wound	1
	Motor vehicle accident	1
	Stab wounds	1
Total		3
Respiratory	Asthma*	3
Total		3
Other	Adrenalectomy	1
	Cystic mass removal	1
	Melanoma	1
	Submandibulectomy	1
Total		4
Grand total		120

* Diagnoses made before admission and recorded as co-morbidities.
** More than one diagnoses could be made for one patient

A total of 31.7% (38 of 120 patients) of the diagnoses were made on conditions affecting the gastro-intestinal tract. This can be related to a study done by Bowrey *et al.* (1997) which showed a total of 33.4% (97 of 290) of diagnoses were made on conditions affecting the gastro-intestinal tract. These diagnoses included non-specific abdominal pain (44 patients, 15%), appendicitis (29 patients, 10%), diverticular disease (24 patients, 8%).

The second largest group was diagnoses made on conditions affecting the cardiovascular system (28 of 120 patients). All diagnoses in this group were made before admission to the surgical ward and were recorded as the patients' co-morbid conditions, except the diagnoses of a pulmonary embolism that was made for a patient with multiple septic wound.

Fourteen diagnoses were made on the endocrine system which mainly consists of patients admitted with diabetes mellitus (12 of 14 patients) who were diagnosed before admission. In a surgical ward it is very important to identify the patients' co-morbid conditions, for example, the stress response to surgery resultants in hyperglycemia which impairs leukocyte functions and wound healing and for this reason glucose control after surgery is very important in diabetic patients (Dagogo-Jack & Alberti, 2002). The other two diagnoses in this group were patients with hyperthyroidism who were admitted for a thyroidectomy.

Twelve diagnoses of infections were made which consists of one patient with HIV, two patients diagnosed with *Candida* infections during their stay in the hospital and nine patients with sepsis. Three of the nine patients diagnosed with sepsis had diabetic foot infections; two patients had infections due to a spider and dog bite respectively and one patient, who had Buerger's disease, was diagnosed with a sepsis foot that needed debridement.

Other rare conditions seen during the study period included patients admitted for an adrenalectomy, cystic mass removal, submandibulectomy, mastectomy and cupital tunnel release.

4.3. Duration of hospital stay

The mean duration of stay for the study patients was 8.9 days (range 1 to 111 days; n=62). It was somewhat longer for female patients (10.2 days, ranging from 1 to 111 days; n=33) than for male patients (7.5 days, ranging from 2 to 26; n=29). The mean duration of stay of the female patients was increased due to the long stay of 111 days of a female patient who was admitted with serious septic stock, cellulitis and various other co-morbidities. This can be compared to the statistics of Hlabisa Hospital in Kwazulu Natal (2005) with a mean average stay of 5.3 days and 5.8 days for female and male patients respectively in a general surgical unit. A study done by Seymour and Pringle (1982) showed an average duration of stay of 10.1 days for female and 9.2 days for male patients admitted for surgery. All three studies showed a longer duration of stay for female patients.

According to a study of NHS Trust data, the length of time spent in hospital after surgery varies significantly depending on the hospital in which the patient is treated and can vary up to 16 days following bowel surgery (Brind, 2008).

4.4. Diagnosis affecting duration of stay

The duration of stay also varies according to the patient's history and reason for admission. Figure 4.2 sets out the duration of stay, in relation to the history of the study patients.

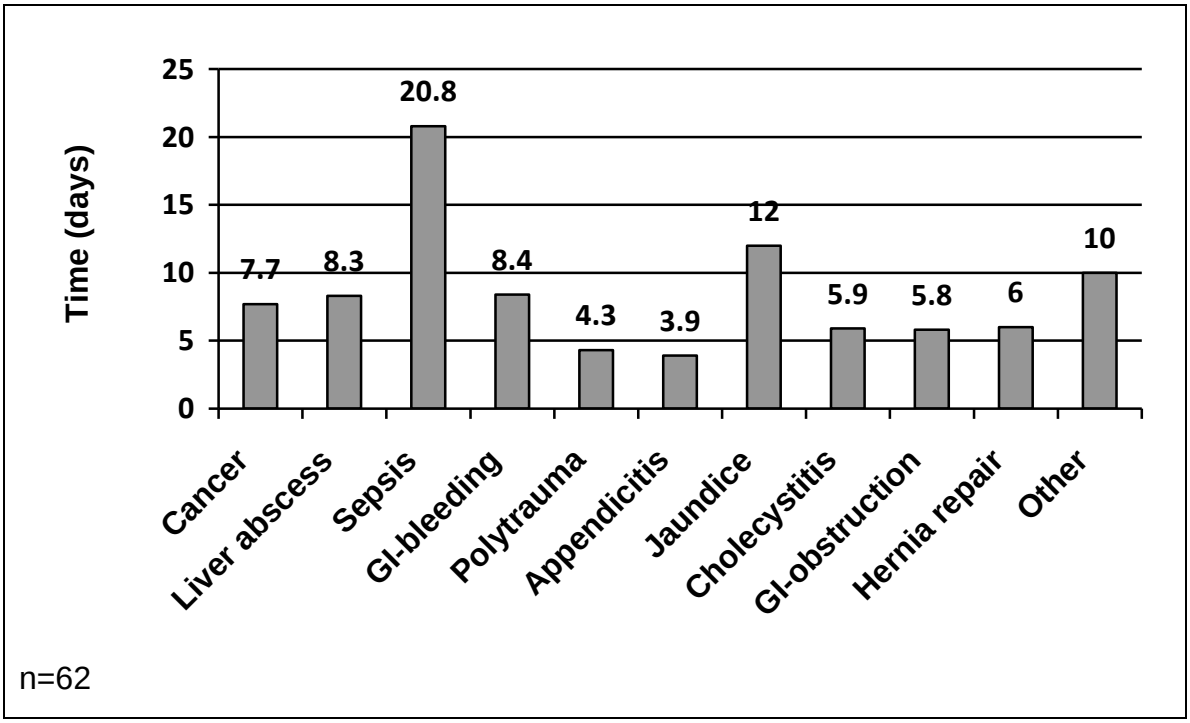
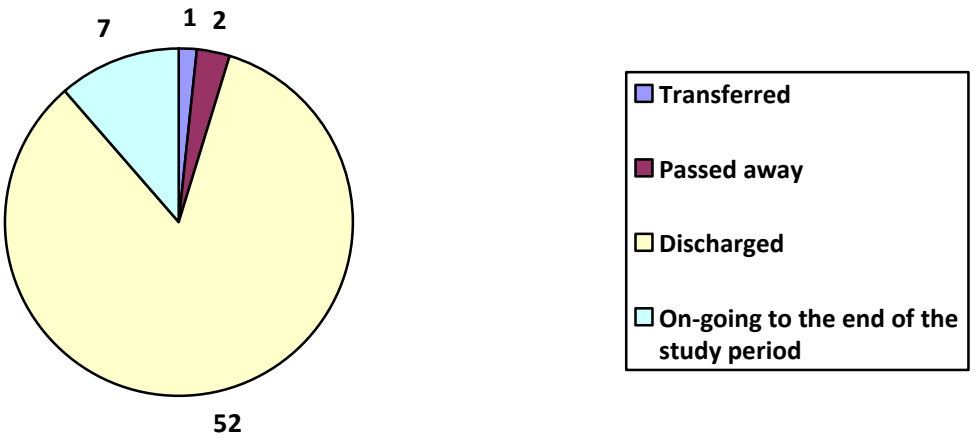


Figure 4.2: Duration of stay, in relation to the history of the patients

The study patients admitted with sepsis, had the longest mean duration of stay. These included patients with septic wounds from previous surgery, dog bites, spider bites and also diabetic foot infections. The study patients with the shortest duration of stay, was patients admitted with jaundice. The last group named as others include patients with gastro-intestinal complications such as a complicated ileostomy and an anal fistula and rare surgical procedures such as cubital tunnel release, mastectomy, cystic mass removal, thyroid lobectomy, adrenalectomy and submandibulectomy.

4.5. Patient outcomes

Patient outcomes at the end of the study period are set out in Figure 4.3.



n= 62 patients

Figure 4.3: Patient outcomes at the end of the study period

Of the 62 patients consulted for pharmaceutical care, 52 (83.9%) were discharged from the hospital. Two patients passed away during the study period and only one patient was transferred to a high care unit. Seven patients were still admitted in the surgical ward at the end of the study period and pharmaceutical care was discontinued.

4.6. Medicines used

Table 4.3 lists the number of study patients and mean duration of use of the medicines prescribed during the study period, classified according to the anatomical therapeutic chemical (ATC) classification system. The ATC system divides drugs into different groups according to the organ or system on which they act and/or their therapeutic and chemical characteristics (Rønning, 2011). The complete table of medication used in the surgical ward according to the number of study patients and the mean duration of use was attached as Appendix 10.

Table 4.3: Medication used in the surgical ward: number of study patients and the mean duration of use

System	ATC Code	International non-proprietary name	Number of patients (n=62)	Mean duration of use (days)
A Alimentary tract and metabolism	A02BA01	Cimetidine	5	4
	A02BC01	Omeprazole	10	2
	A02BC02	Pantoprazole	16	4
	A02BC05	Esomeprazole	3	1
	A02BX02	Sucralfate	8	4
	A03BB01	Hyoscine butylbromide	3	3
	A03FA01	Metoclopramide	22	4
	A04A01	Ondansetron	1	5
	A06AB02	Bisacodyl	2	1
	A06AD11	Lactulose	4	7
	A06AG01	Phosphate	2	1
	A07C	IV fluids	2	2
	A07DA03	Loperamide	1	3
	A07EC02	Mesalazine	1	2
	A10AA01	Insulin rapid acting	6	6
	A10AA02	Insulin long acting	3	10
	A10AA03	Insulin biphasic	1	25
	A10BA02	Metformin	4	6
	A10BB09	Gliclazide	2	5
	A11EB	Vitamin B complex	1	9
	A12AA03	Calcium gluconate	1	3
	A12BA01	Potassium chloride	13	4

The most frequently prescribed antibacterial agent was co-amoxiclav, used by 21 study patients (34%), with a mean duration of use of five days. Other frequently used antibacterials included cefazolin (nine patients), ciprofloxacin (nine patients) and gentamicin (six patients). Antimicrobials were used to treat or prevent sepsis and to treat infections like appendicitis, cholecystitis and gastric ulcers caused by *Helicobacter pylori*.

The antifungal agent, fluconazole was used for two patients to treat oral and oesophageal candidiasis. The only antiparasitic product was metronidazole and was used in 15 patients.

The most frequently prescribed gastro-intestinal drug was metoclopramide. Metoclopramide was mostly used as an intestinal prokinetic agent, but due to the antiemetic effect, it also reduces postoperative nausea and vomiting (Williams & Schade, 2008:563). Other frequently prescribed medication in this group includes the proton pump inhibitors (PPIs), omeprazole and pantoprazole. The PPIs was prescribed for the treatment of gastric ulcers as well as the prevention of stress induces gastric ulcers following surgery.

Of the blood and blood forming drugs enoxaparin was prescribed the most often and used in 24 patients (39%). It was used for the prevention of venous thromboembolism after abdominal surgery. The mean duration of use was five days and no patients were discharged with enoxaparin to take home. The proposed period of use is 7-10 days following abdominal surgery but literature also indicates a significant benefit of 4-week enoxaparin thromboprophylaxis compared with a standard regimen, at no cost to safety (Bergqvist, 2004).

Of the cardiovascular drugs nifedipine, perindopril and hydrochlorothiazide was prescribed the most often. This group of agents consisted mainly of the patients' home medication.

Other frequently prescribed drugs include pain management with paracetamol (53 patients), ibuprofen (17 patients) and morphine/papaverine/codeine combination (trade name: Omnopon®) which was prescribed to 41 patients.

Table 4.4 gives an overview of the top ten ranking of medication by total duration of use, which gives a clear indication of rational drug use in the ward.

Table 4.4: Top ten ranking medicines according to total duration of use

Active ingredient	ATC code	Patients (n=62)	Rank	Patient-days	Rank
Paracetamol	N02BE01	53	1	277	1
Morphine/papaverine/codeine	N02AG01	41	2	155	2
Enoxaparin sodium	B01AB06	24	3	113	3
Co-amoxiclav	J01CR02	21	5	101	4
Perindopril	C09AA04	14	9	91	5
Metoclopramide	A03FA01	22	4	90	6
Hydrochlorothiazide	C03AA03	12	11	84	7
Nifedipine	C08CA05	16	7	84	7
Ibuprofen	M01AE01	17	6	66	8
Furosemide	C03CA01	7	15	63	9
Metronidazole	P01AB01	15	8	62	10
Pantoprazole	A02BC02	16	7	62	10
Potassium chloride	A12BA01	13	10	51	11

A completed table of the ranking of medicines by total duration of use was attached as Appendix 11. Table 4.4 confirms some of the findings already established when analyzing Table 4.3. Paracetamol and morphine/papaverine/ codeine (Omnopon®) had the highest total number of patient-days (277 and 155 days respectively) and was prescribed for pain management. This was expected in light of the fact that the study was done in a surgical ward. Enoxaparin (113 days) was the drug with the third longest duration of use and was prescribed for the prevention of thromboembolic complications.

4.6.1. Number of medicines per patient

Figure 4.4 illustrates the number of medicines used per study patient during the study period.

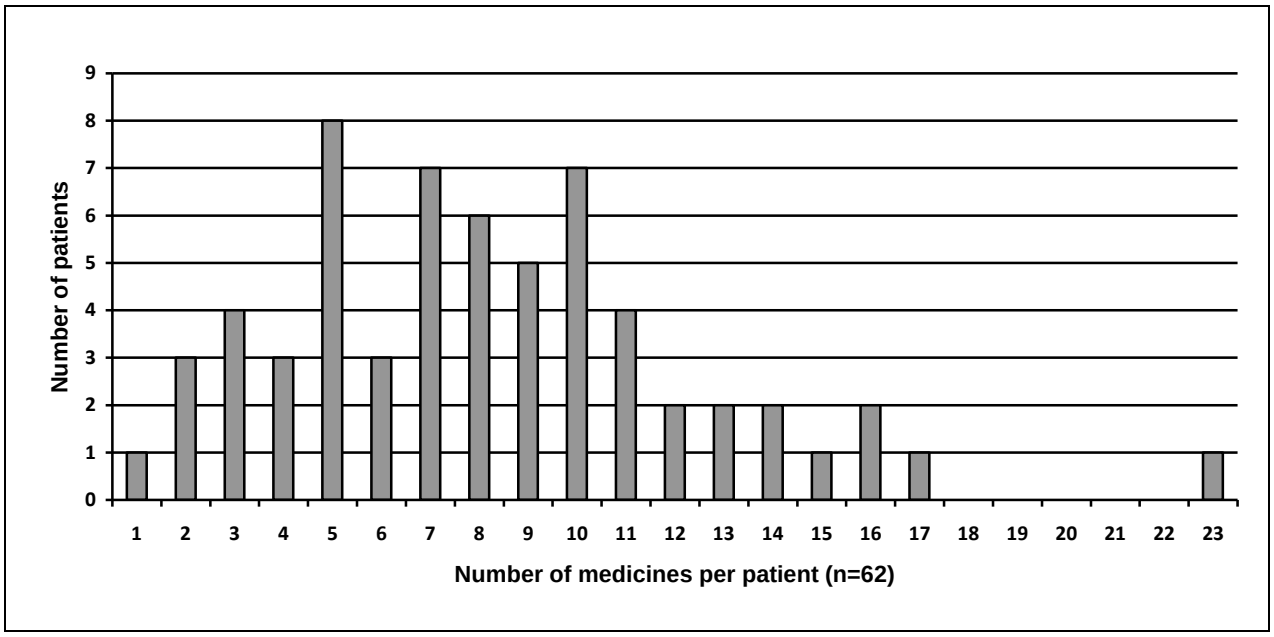


Figure 4.4: Number of medicines per patient

The largest proportion of patients (8 of 62) received five medicines during their hospital stay. Two groups of seven patients each received either seven or ten medicines during their hospital stay and six patients received eight medicines each.

The mean number of medicine prescribed per patient was eight. This can be compared with a study done on intensive drug monitoring of surgical patients, in which an average of nine drugs was prescribed per patient (Danielson *et al.,* 1982). A more recent study done in a teaching hospital in India showed an average of 4.8 drugs prescribed per patient (Salman *et al*., 2008).

4.7. Antibiotic usage in the surgical ward

Of the 62 patients followed, 37 received antibiotics. The antibiotics included for the purpose of compiling this section are listed in Table 4.5.

Table 4.5: Antibiotics included in the investigation of antibiotic usage

Amoxicillin	Clarithromycin	Meropenem
Ampicillin	Clindamycin	Metronidazole
Cefazolin	Co-amoxiclav	Piperacillin/tazobactam
Ciprofloxacin	Gentamicin	

4.7.1. Frequency of use

Figure 4.5 illustrate the seven antibiotics most frequently used in the 62 patients monitored in this study. Note that some patients received more than one antibiotic.

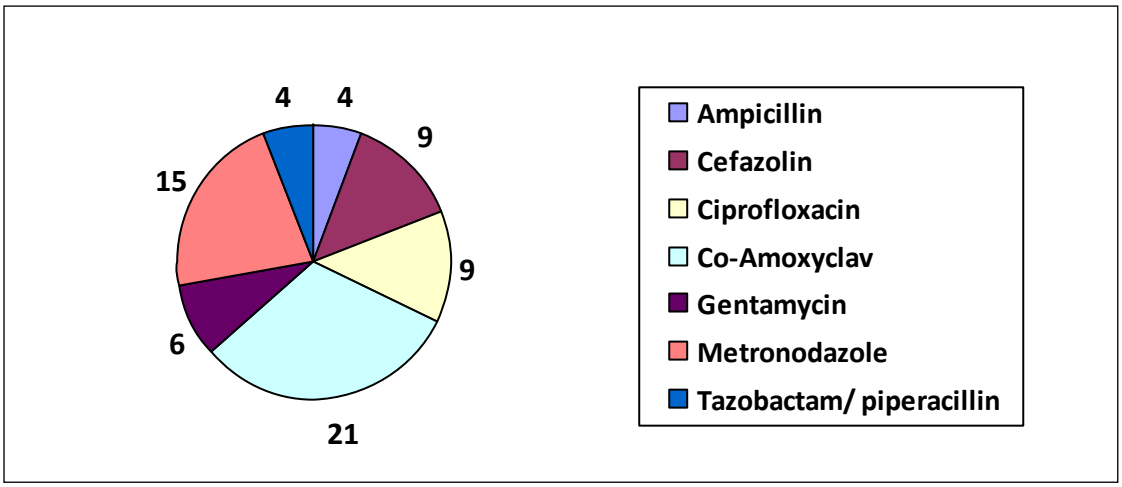


Figure 4.5: Ranking of antibiotics by number of patients

Co-amoxiclav was prescribed to 21 patients and was mostly prescribed for cholecystitis, appendicitis, wound infections including diabetic foot infections and gastro-intestinal tract infections due to gastro-intestinal obstruction.

Cefazolin or ampicillin was used in combination with gentamicin and metronidazole for a broad antibacterial cover in treatment of appendicitis or foot infections in diabetic and non-diabetic patients.

Metronidazole was also used in combination with other medication to treat different conditions. Two patients diagnosed with a liver abscess received

metronidazole. One patient cultured *Entamoeba histolytica* and was treated with a combination of piperacillin/tazobactam and metronidazole. One patient received metronidazole in combination with amoxicillin for treatment of *H. Pylori* and another patient who was allergic to penicillin received a combination of metronidazole and clindamycin for the treatment of appendicitis. A patient admitted for a septic wound after a previous laparotomy, where treated with co-amoxiclav and metronidazole. The pharmacist suggested stopping the metronidazole since co-amoxiclav did have the proper anaerobe coverage (Brazier *et al*., 2003; Galkin *et al*., 2006; Odou *et al*., 2007).

All patients who received piperacillin/tazobactam were transferred either from high care or intensive care where this antimicrobial agent was first prescribed.

4.7.2. Number of antibiotics per patient

The average number of antibiotics used per patient during the study period was 1.7. This can be compare with the study done by Salman *et al.* (2008), which showed an average of 2.2 antibiotics per patient. Figure 4.6 shows the number of patients who received different numbers of antibiotics.

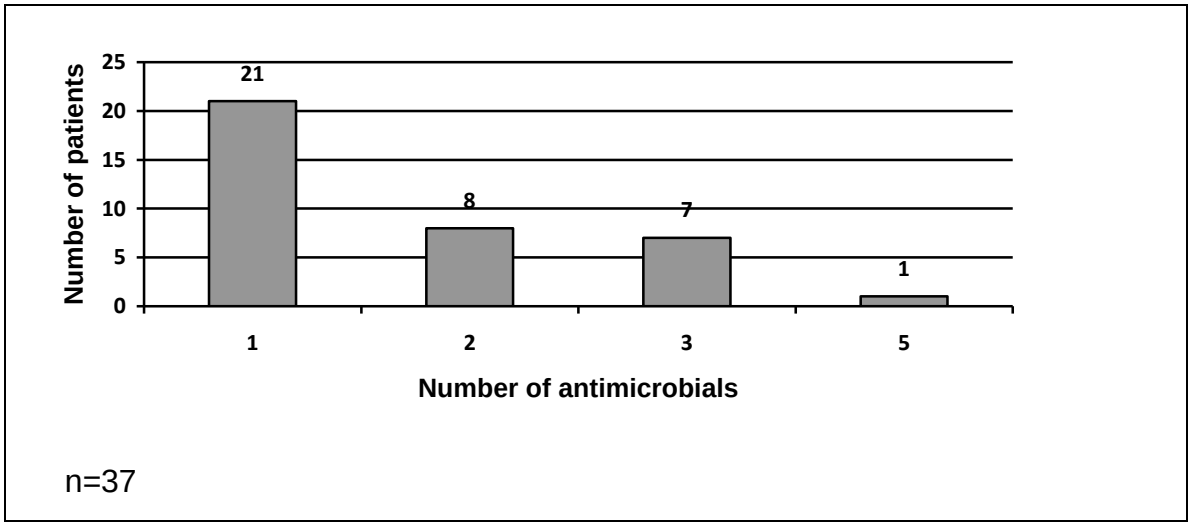


Figure 4.6: Number of antibiotics per patient

Twenty one patients only received one antibiotic during their stay in the hospital. Eight patients received double antibiotic therapy and seven patients received triple antibiotic therapy.

Only one patient received five antibiotics during his stay in the hospital. This patient did not receive all five antibiotics all at once, but used at least two at a time. He was being treated for *H. Pylori* and was changed over a period of ten days from clarithromycin and amoxicillin oral to ampicillin and metronidazole intravenous to co-amoxiclav and metronidazole oral to amoxicillin and clarithromycin oral therapy. The antibiotics were changed to intravenous therapy because the patient could not take any oral therapy for four days. This usage of antibiotics was irrational and a better option would have been to start with intravenous therapy and switching to amoxicillin and clarithromycin oral therapy.

4.7.3. Duration of use

Table 4.6 shows the minimum, average and maximum number of days of use of each antibiotic.

Table 4.6: Duration of antibiotic use, showing the minimum, average and maximum number of days per drug

Duration of use	Average	Minimum	Maximum
Amoxicillin	2	1	4
Ampicillin	4.5	3	6
Cefazolin	3.5	1	9
Ciprofloxacin	4	1	9
Clarithromycin	3	2	4
Clindamycin	2	2	2
Co-amoxiclav	4.8	1	13
Gentamicin	4.2	3	6
Meropenem	6	6	6
Metronidazole	4.1	2	10
Piperacillin/tazobactam	5.3	3	7

The duration of antibiotic use was only calculated for the days admitted in the surgical ward. Amoxicillin was prescribed for an average of two days. For one patient amoxicillin was prescribed for a patient who was kept *nil per os*. for three days and the pharmacist made an intervention to change the regimen to an intravenous treatment of ampicillin. For two patients amoxicillin was prescribed while admitted in the hospital and they were also discharged with a course of amoxicillin.

Clindamycin was also prescribed for an average of two days. One patient admitted with appendicitis received clindamycin for two days after the doctors performed an appendectomy. Clindamycin is the choice of prophylaxis in a patient allergic to penicillin, but is usually administered as a single pre-operative dosage.

Meropenem was prescribed for six days to a female patient who was admitted with serious septic stock, cellulitis and various other co-morbidities. All infection markers were decreasing and the treatment was stopped.

4.8. Antibiotic ward protocol

A ward protocol was designed and approval by the head of the department. The Essential Medicine List was used as guidelines, incorporating the opinions of the clinical supervisor (Prof. Becker, Head of Department of General Surgery, School of Medicine, University of Pretoria) and cultures and sensitivity. The antimicrobial ward protocol contained guidelines for the prophylaxis and treatment of the most common surgical procedures and infections seen in the general surgical wards, guidelines on septic screening, duration of use of antibiotics and intravenous to oral switching of antibiotics. The antibiotic ward protocol is attached as Appendix 12.

4.9. Pharmaceutical care interventions performed

A total 188 interventions were made and documented in the 62 study patients during the study period of eight weeks. Of the 188 interventions suggested, 153 interventions were accepted, giving an achievement rate of 81.4% (see table 4.7 for details). The researcher used the first week of the study period to observe and to learn the system and although a few patients were enrolled in the study during this week, no interventions were suggested to the doctors. All interventions performed and the reason for interventions being unsuccessful as well as those interventions not made during the first week of the study period was discussed individually under the narrative description of interventions made.

4.9.1. Frequency of drug therapy interventions

The number of interventions suggested ranged from 0 to 10, with an average of three interventions per patient and a median of one intervention per patient. Figure 4.7 illustrate the number of interventions made per patient.

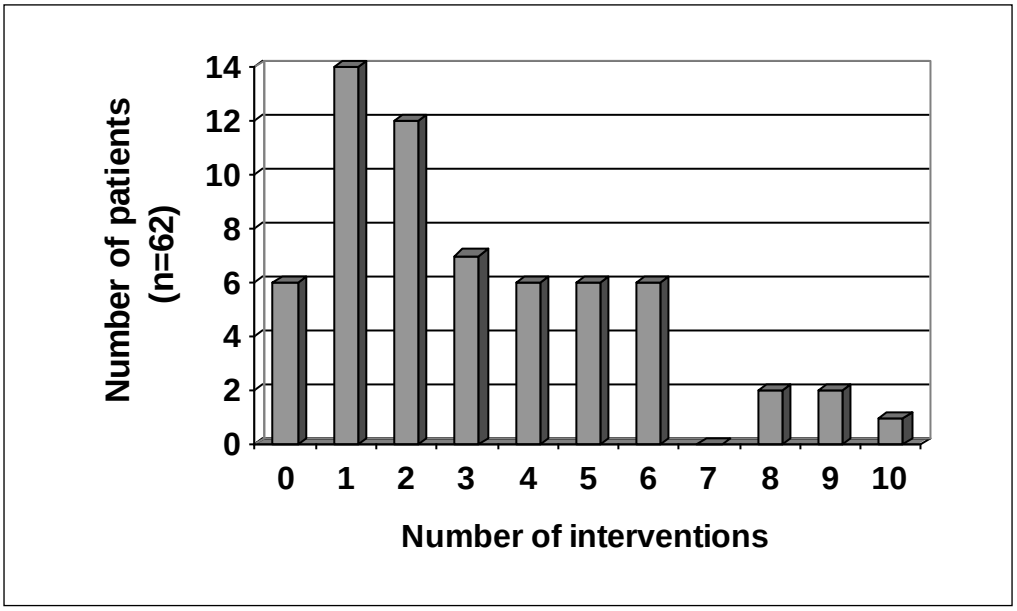


Figure 4.7: Number of interventions per patient

Six study patients did not receive any interventions. All six patients had different diagnoses, different durations of stay in the unit and different types and amounts of medication was prescribed for the patients. One correlation was that none of them had any co-morbidities which would have increased their health or duration of stay.

Fourteen patients received one intervention each and these interventions mainly consisted of interventions made due to system error or non-compliance and on patient or nursing staffs' knowledge of the medication.

Ten interventions were performed for a patient admitted for a gastro-intestinal obstruction caused by an oesophageal tumor with co-morbidities of hypertension, asthma, epilepsy and gout. Interventions were made to identify home medications, for therapeutic duplication of pain medication, to calculate the correct dosage of the anti-epileptic drug prescribed and several interventions were made due to system error or non-compliance and to explain to the patients and nursing staff what the purpose of the patients' medication were and how it should have been taken.

This is a very good description of the variety of patients being admitted in the general surgical ward and this information could be used to determine how much time a pharmacist need to spent in the surgical ward.

4.9.2. Types of pharmaceutical care interventions

Figure 4.8 illustrates the most frequent types of interventions performed.

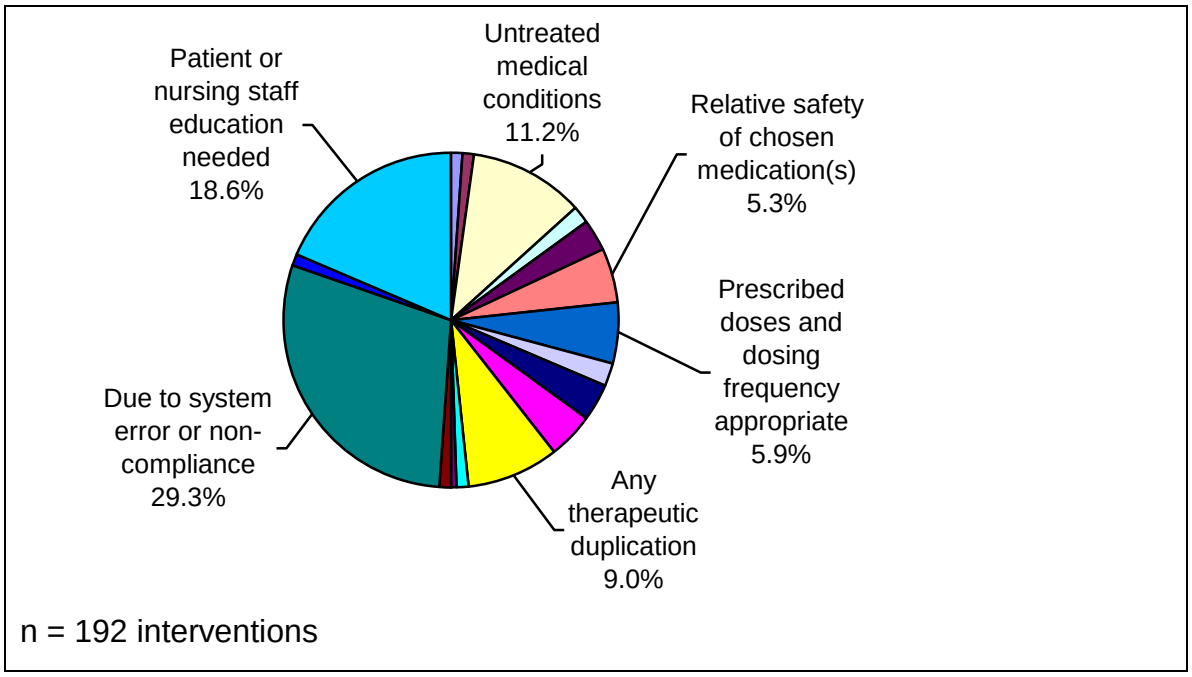


Figure 4.8: Most frequent types of interventions performed

The most frequent interventions were made due to system error or non-compliance (55 of 188 intervention, 29.3%) and on patient or nursing staffs' knowledge of the medication (35 interventions, 18.6%). Other frequently proposed interventions were focused on untreated medical conditions (21 interventions, 11.2%), therapeutic duplication (17 interventions, 9.0%) and on prescribed doses and dosing frequency (11 interventions, 5.9%).

The smallest groups of interventions were concerning the comparative efficacy of chosen medication (6, 3.2%), the length or course of therapy (8, 4.3%), the relative safety of chosen medication (10, 5.3%), doses scheduled to maximize

therapeutic efficacy (7, 3.7%) and if the route or dosage form or mode of administration was appropriate (4, 2.1%). Other interventions that made out less than 2% individually of the total interventions made were factors hindering achievement of therapeutic efficacy, investigations indicated or outstanding, drug-laboratory test interactions, medication without indication, unidentified medications, allergic reactions to or intolerance of any medicines and symptoms that was drug induced.

Of a total of 188 interventions suggested, 153 (81%) were accepted and implemented by the medical and nursing staff. Details are shown in Table 4.7.

Table 4.7: Interventions made and percentage achieved

Problem type	Description	Number of intervention	Number achieved	%
1	Without indication	2	0	0%
2	Unidentified medications	2	2	100%
3	Untreated medical conditions	21	13	62%
4	Investigations indicated or Outstanding	3	2	67%
5	Comparative efficacy of chosen medication(s)	6	3	50%
6	Relative safety of chosen medication(s)	10	7	70%
8	Appropriateness of the prescribed doses and dosing frequency	11	9	82%
9	Route/dosage form/mode of administration appropriate	4	4	100%
10	Doses scheduled to maximize therapeutic efficacy	7	1	14%
11	Appropriateness of the length or course of therapy	8	7	88%
12	Therapeutic duplication	17	15	88%
13	Allergic to or intolerant of any medicines	2	2	100%
15	Symptoms drug induced, problem drug related	1	1	100%
19	Drug-Laboratory test interactions	2	2	100%
22	Due to system error or non-compliance	55	50	91%
23	Factors hindering achievement of therapeutic efficacy	2	2	100%
26	Patient or nursing staffs' knowledge of the medication	35	33	94%
Total		188	153	81%

4.9.3. Narrative description of interventions

Medicines used without indication (Two interventions)

In two cases (n=188), interventions were performed to monitor the need of an antibiotic prescribed to a patient and no intervention was accepted, resulting in a success rate of 0%.

The intervention was then typically to check for infection markers, like an increased white blood cells count, C-reactive protein or procalcitonin if available, to monitor if the prescribed medication could be stopped. The medicines queried were ciprofloxacin and co-amoxiclav respectively. No laboratory or microbiology results were available and so the clinicians did not accept the intervention because the patient presented clinically as septic.

Unidentified medications (Two interventions)

Two interventions were made on unidentified medication and both were accepted thus resulting in a 100% success rate.

It regularly happened that patients were admitted to hospital with a bag full of unidentified home medication. In order to continue with the home medication the medication needed to be identified. In one case, the researcher assisted the prescribing doctor to fully identify the name and strength of all the medication brought in by a patient. These medications were removed from their original container into a weekly tablet organizer container.

In a different case, the medication prescribed was unidentifiable. The script read (sic) co-trimoxazole “persany” 200mg. In such a case the nursing staff won’t issue any medication to the patient, since the prescription is very unclear. The researcher discussed the prescription with the prescribing doctor and the script was corrected to read clotrimazole pessaries.

Untreated medical conditions (21 interventions)

Untreated medical conditions were addressed in 21 cases and 13 of these interventions were accepted thus resulting in a 62% success rate.

Most of these interventions were concerning home medication that was not prescribed for the patients. Each patient's home medication was discussed with the attending doctor.

- The stress response to surgery results in hyperglycemia which impairs leukocyte functions and wound healing (Dagogo-Jack & Alberti, 2002). For this reason glucose control after surgery is very important, especially in diabetic patients. The researcher identified five diabetic patients not being monitored closely or with no anti-diabetic medication prescribed at all. In two instances patients were taking their own medication, without the doctor or nursing staff knowing about it and these two patients were discharged and their anti-diabetic medication was never prescribed. These medication not prescribed was noted as interventions not accepted. The three interventions that were accepted added metformin, gliclazide and rapid acting insulin to the different patients' regimens and increased the costs with a total of R0.82 per day for the metformin and gliclazide and R28.22 for the rapid acting insulin.
- The researcher also identified three hypertensive patients with no prescription for any anti-hypertensive medication. In all of these cases the patients had elevated blood pressure levels. A study done by Ahmed *et al*. (2011) demonstrated that hypertension is associated with delayed wound healing following surgery and therefore it is very important to control the patient blood pressure after surgery. One of these patients was discharged and his anti-hypertensive medication was never prescribed and this intervention was noted as not accepted. The two interventions that were accepted added perindopril, hydrochlorthiazide and nifedipine to the different patient's regimens and increased the costs with a total of R1.26 per day.

- Two patients with hypertension and diabetes mellitus did not have any anti-hypertensive or anti-diabetic medication prescribed. After discussing it with the individual doctors, the one patient's home-medications were prescribed and increased her costs with R0.20 per day. The other patient's medication was never prescribed and she did not receive her home-medication during her 2 days of admission in the general surgical ward. The pharmacist did continue checking blood pressure and glucose levels and although she was a known hypertensive patient, her blood pressure levels relatively maintained in the normal ranges.
- One patient, using aspirin as anti-coagulant at home, did not receive it during her admission in the hospital. This was discussed with the doctor and she did not want the patient to take the aspirin before and after surgery. In a study done by Mantz *et al.* (2011) were found that there is not any difference in terms of occurrence of major thrombotic or bleeding events between preoperative maintenance or interruption of aspirin in patients undergoing elective non-cardiac surgery.
- Another patient's nifedipine was prescribed at a lower dosage than the dosage the patient usually takes at home. The researcher monitored the patient's blood pressure during the time of admission. This patient did not have any other co-morbidities and therefore his goal blood pressure was less than 140/90 mmHg (Saseen & MacLaughlin, 2008:147). His blood pressure maintained an average of 143/86 mmHg during his stay in the general surgical ward.
- A discharged patient received her prescribed medication to take home, but the doctor did not include the furosemide on the prescription. The researcher confirmed with the doctor if she wanted to include it on the prescription and it was included. This intervention added R0.08 to the patient's daily costs.
- Other interventions made regarding home-medication were concerning two patients with incontinence and a patient who is human immunodeficiency virus (HIV) positive. The two patients with incontinence

never received their medication to treat this condition while in the hospital. The first patient had a urinary bladder prolapse and the doctor first want to treat the current condition before prescribing the oxybutynin. The other patient never received the imipramine because it was not prescribed, even after the pharmacist reminded the doctor to prescribe the medication.

After a surgical procedure the aim is to reduce the patients' pain as much as possible and therefore pain management is very important. The management of postoperative pain relieves suffering and leads to earlier mobilization, shortened hospital stay, reduced hospital costs, and increased patient satisfaction (Kodali & Oberoi, 2011). The major goal in the management of postoperative pain is minimizing the dose of medications to lessen side effects while still providing adequate analgesia. In two cases, interventions were made for patients who were experiencing a lot of pain and no pain medication was prescribed. The medication available for pain management was paracetamol and the morphine/papaverine/codeine combination (Omnopon®) and these medications were also prescribed the most frequently during the study period (see table 4.4). Both of these interventions were accepted and added a total of R67.25 to these two patients' daily costs.

In three cases, interventions were made for patients with elevated blood pressure. On the day the intervention was made the patients' blood pressure levels were 164/110 mmHg, 160/112 mmHg and 175/110 mmHg respectively. The first patient only received hydrochlorthiazide tablets and the pharmacist suggested including perindopril to the treatment. The doctor prescribed nifedipine which added R0.70 to the patient's daily costs and two days later also added perindopril. The second patient was never diagnosed with hypertension and the pharmacist suggested starting with hydrochlorthiazide and perindopril which added R0.56 to the patient's daily costs. The intervention was accepted and the patient was started on this regimen. The third patient was also never diagnosed with hypertension and the pharmacist suggested starting the patient on

hydrochlorthiazide and perindopril but the doctor did not accept the intervention because he wanted to treat the cholecystitis first.

Investigations indicated or outstanding (Three interventions)

Three interventions were made in this category and two were accepted thus resulting in a 67% success rate.

These interventions consisted from any information needed to perform pharmaceutical care or information requested from the medical personal. A doctor requested information on the use of carbamazepine for phantom limb pain for a patient who had a leg amputation below the knee as well as the ordering procedures of carbamazepine. Carbamazepine is an anticonvulsant drug which is effective in neuropathic pain and is also effective in treating phantom limb pains (Nikolajsen & Jensen, 2001). The researcher phoned the pharmacy to confirm if any special ordering procedures were in place for ordering carbamazepine. No special ordering procedures were necessary and the researcher asked the nursing staff to order the medication from the pharmacy.

For one diabetic patient, no blood glucose levels were taken since the day of admission. The researcher brought it under the attention of the doctor and the nursing staff, and the patient's blood glucose levels were taken and monitored for the rest of her stay in the hospital.

In one case, a patient had a thyroidectomy and the researcher asked the doctor to request thyroid hormone levels before the patient is discharged. Unfortunately the patient was discharged and no thyroid hormone levels were tested.

Comparative efficacy of chosen medications (Six interventions)

Six interventions were made in this category and three were accepted thus resulting in a 50% success rate.

In the most cases interventions was made on the choice of antibiotic versus the most susceptible organism.

- The first intervention was made for a patient with a diabetic foot infection. The patient was started on a cefazolin, gentamicin and metronidazole triple therapy. The microbiology results showed cultures of *Escherichia coli* and *Proteus mirabilis* both sensitive to co-amoxiclav. The researcher suggested changing the antibiotic therapy to co-amoxiclav. Superiority of combination therapy over single-agent therapy is not demonstrated with the exception of those patients with rapidly declining diseases such as severe sepsis (Kang-Birken & DiPiro, 2008:1950). Changing the triple therapy to co-amoxiclav monotherapy would mean an increase of R8.79 per day for the antibiotic therapy. This intervention was not accepted because the doctor wanted to continue on the triple therapy he started.
- Co-amoxiclav and metronidazole was prescribed for a patient to treat *H. pylori*. The antibiotic regimen to treat *H. pylori* should rather consist of clarithromycin plus amoxicillin or metronidazole (Berardi & Welage, 2008:577). It would be irrational to treat the patient with co-amoxiclav. This intervention was accepted and the change in therapy to amoxicillin and clarithromycin meant a cost increase of R2.04 per day.
- A patient treated for a perforated appendix received cefazolin as post-operative treatment. Since therapeutic courses of metronidazole significantly reduce wound sepsis rates in those with perforated appendices, the researcher suggested adding metronidazole to the regimen (Pinto & Sanderson, 1980). This intervention was not accepted and would have added R16.98 to the patient's daily costs. The reason for not accepting the intervention is still not clear.
- The researcher investigated microbiology results for two patients started on co-amoxiclav therapy. The first patient's microbiology results came back with a non-resistant *S. aureus* infection, making co-amoxiclav a very good treatment choice. The second patient did not have any microbiology results; this was followed up again with no success.

One intervention was made for a newly diagnosed hypertensive patient, whom the doctor wanted to start on nifedipine treatment. The researcher suggested starting the patient on hydrochlorthiazide and perindopril, since this is the first line of anti-hypertensive treatment for a patient with no other co-morbidities (Saseen & MacLaughlin, 2008:149). This intervention was accepted and the patient was started on hydrochlorthiazide and perindopril treatment which increased the patient's daily costs with R0.56 per day.

Relative safety of chosen medications (Ten interventions)

Ten interventions were made in this category and seven were accepted thus resulting in a 70% success rate.

Most of the interventions in this group were made to monitor patients' potassium levels. In three cases patients received drugs that could lead to increased potassium levels.

- The first patient was admitted for a hepatocellular carcinoma and received perindopril and spironolactone for hypertension as well as potassium chloride tablets. The potassium level for this patient was 3.1 (normal range: 3.3 – 5.3 mmol/l). A single potassium chloride infusion was prescribed and potassium levels were monitored closely. The potassium level was low despite the administration of three medications that would increase the potassium levels. The potassium levels did normalize after the potassium infusion.
- The second patient used spironolactone, perindopril and furosemide for hypertension. The first serum potassium level was 5.8 mmol/l which was slightly higher than the normal reference range of 3.3 – 5.3 mmol/l. During the patient consultation session it was clear that the patient stopped taking the furosemide tablets due to her problem with incontinence. The situation was discussed with the doctor and the pharmacist explained to the patient the importance of taking the furosemide tablets to maintain normal potassium levels.

- The third patient used captopril for hypertension and his potassium level was 5.4 mmol/l (normal range: 3.3 – 5.3 mmol/l). Even though this was slightly higher than the recommended range it was still monitored closely.

In three cases diabetic patients were prescribed furosemide. Furosemide should be used with caution in patients with diabetes mellitus, because it decreases potassium levels and can so decrease insulin secretion (Natali *et al*., 1993). The researcher monitored potassium levels during all of these patients' stay in the hospital and it was in the normal ranges of 3.3 to 5.3 mmol/l. Two of these patients' glucose levels were also in normal ranges of 3.5 to 6.2 mmol/l, but the third patient had a very high glucose level of 16.7 mmol/l. This was discussed with the doctor and fast acting insulin was added to her treatment and the following blood glucose levels were monitored closely.

The researcher made an intervention for a patient that received five drugs that could all enhance central nervous system suppression. The patient received morphine for pain, amitriptyline for depression, oxazepam for anxiety and carbamazepine for epilepsy. The doctor also prescribed hydroxyzine (Aterax®) for the patient after the patient requested the medication. After investigation and discussion with both the doctor and the patient it was clear that the fifth item was prescribed in error and that the patient actually requested indomethacin (Arthexin®) for gout. The prescription was corrected by the doctor.

Other interventions in this group involved monitoring white blood cell counts, red blood cell counts and liver functions for patients receiving carbamazepine and monitoring renal functions like plasma creatinine levels and calculation of creatinine clearance for patients receiving gentamicin. These interventions were not successful since none of the mentioned laboratory results were available.

More of these interventions are described under the drug-laboratory test interactions category.

Prescribed doses and dosing frequency appropriate (11 interventions)

This category consists of 11 interventions whereof nine were accepted thus resulting in an 82% success rate. Queried medicines involved in this intervention included the following:

- Cefazolin (n=2)
- Insulin (n=2)
- Captopril (n=1)
- Carbamazepine (n=1)
- Carbimazole (n=1)
- Ciprofloxacin (n=1)
- Co-amoxiclav (n=1)
- Prochlorperazine (n=1)
- Vitamin K (n=1)

Two cefazolin interventions were made to increase dosages according to patient specific conditions and according to the drug's pharmacodynamics.

- Cefazolin was prescribed to a patient with appendicitis as a twelve hourly dosage and since cefazolin is a time-dependent antibiotic (Burgess, 2008:1735) the researcher suggested increasing the previous twelve hourly dosages to an eight hourly dosage. This intervention was accepted and added R5.13 to the patient's daily costs.
- Cefazolin was prescribed to a patient who was admitted with a septic spider bite. The microbiology results showed a *S. Aureus* infection with sensitivity to cloxacillin. After a five day therapy of cefazolin 1g every eight hours the patient still presented clinically ill. The pharmacist suggested increasing the dosage to 1.5g every 6 hours but the doctor did not accept the intervention and rather did a wound debridement in theatre.

Two insulin interventions were made to increase dosages according to patient specific conditions to maintain glucose levels in the normal range of 3.5 – 6.2 mmol/l.

- An insulin intervention was made to improve blood glucose control for a patient with a diabetic foot infection by calculating the required insulin dosage according to the patient's weight. This intervention was not accepted because the doctor was afraid that an increased dosage might cause hypoglycemia and the researcher continued monitoring this patient's blood glucose levels. The blood glucose levels remained unstable.
- The second patient had very high uncontrolled glucose levels that were previous well controlled. This was discussed with the doctor and fast acting insulin was added to her treatment and the following blood glucose levels were monitored closely. This intervention added R28.22 to the patient's costs. The amount per day could not be calculated because the insulin needs varies each day and thus the amount administered.

The dosage of captopril was confused with the dosage of carvedilol. After the researcher discussed the prescription with the prescribing doctor the dosage was changed to 12.5mg from a previous 6.25mg dosage.

The carbamazepine plasma levels were obtained for an epileptic patient who was using the treatment for an extended period. The result was used to determine if the patient was compliant with the treatment and if any dosage adjustments was needed. Although the carbamazepine plasma level was below the therapeutic range (24 – 51 µmol/L), the patient was compliant and since she did not have any epileptic attacks in a very long time, no dosage adjustment was needed. Compliance was determined by calculating the patient's suspected carbamazepine plasma level by using the dosage (300mg twice daily) and normal carbamazepine clearance (0.07 L/kg/hr) and relating this to the measured plasma concentration of 9 µmol/L.

Ciprofloxacin is a concentration dependent antibiotic (Burgess, 2008:1734) and the researcher suggested changing the dosage to 500mg twice daily form a

previous prescribed 250mg three times per day. This intervention was accepted and made no difference on the patient's daily costs.

Vitamin K dosage was increased to 10mg daily from a previously prescribed 1mg daily for a patient with a serious liver disease (Standard Treatment Guidelines and Essential Drug List, 2006). This intervention was accepted and added R15.24 to the patient's daily costs.

One intervention each was made on the following medications because the prescribed dosage was vague or unclear: carbimazole, co-amoxiclav and prochlorperazine. These three interventions were also accepted and changed to the correct dosages.

Route/dosage form/mode of administration appropriate (Four interventions)
Four interventions were made on the route of administration and all of these interventions were accepted thus resulting in a 100% success rate.

In one patient an intervention was made and accepted for intravenous to oral switching. Metronidazole and ampicillin intravenous therapy was changed to metronidazole and amoxicillin oral therapy because the patient was able to take oral therapy. This intervention decreased the patient's costs with R23.17 per day.

In one case oral clarithromycin and amoxicillin was prescribed to a patient who was *nil per os*. The result was that the patient did not receive any antibiotics for two days, because the nursing staff could not administer it orally. The researcher discussed it with the doctor and he prescribed intravenous metronidazole and ampicillin which increased the patient's costs with R24.66 per day.

Two interventions were made on medication prescribed with an incorrect route of administration: ampicillin prescribed as an oral dosage and morphine/papaverine/

codeine (Omnopon®) prescribed as an intravenous dosage and it may only be administered intramuscular. Both of these interventions were accepted.

Doses scheduled to maximize therapeutic efficacy (Seven interventions)

Seven interventions were made to maximize therapeutic efficacy, but only one intervention was accepted thus resulting in a 14% success rate.

Four interventions were made to calculate the correct gentamicin dosage for the patients who received gentamicin for three dosages and more but since no gentamicin blood levels was made available, these interventions were not followed through. This was mainly because most patients' gentamicin prescriptions were stopped after the fourth dosages and because therapeutic drug monitoring is not standard procedure in these units. The researcher explained the purpose and benefit of therapeutic drug monitoring at the mortality and morbidity meetings on Mondays and requested it from individual doctors. The median duration of use of gentamicin was four days. This can be related to a study done by Nicolau *et al.* (1995) that showed a median duration of use of three days. When focusing on the adverse effects of gentamicin, any duration shorter than five days is good since nephrotoxicity and ototoxicity occurs after five days of therapy (Chambers, 2003c:769).

The researcher also suggested doing drug therapeutic monitoring for the anti-epileptic medications used by three patients. These patients used phenytoin, valproate and carbamazepine respectively and all of them have been using these medications for a long time. The researcher only received blood levels on the patient using carbamazepine, and was able to calculate if the patient was compliant and if the dosage needed to be adjusted.

Length or course of therapy appropriate (Eight interventions)

Eight interventions were made on the length of the therapy and seven of these interventions were accepted thus resulting in an 88% success rate.

If the length of the course of antibiotic was not indicated, the researcher would monitor the patients' infection markers to determine if the patients' still clinically need the antibiotics. Antibiotics should be stopped if the patient has been normothermic for 48 hours with decreasing infection markers, which include white blood cell count, procalcitonin and C-reactive protein. Elevated C-reactive protein could also be elevated due to inflammation and trauma (Rybak & Aeschilimann, 2008).

In four cases, the researcher suggested that the antibiotics should be stopped because the infection markers were decreased and the patients' temperature was normal. In all four cases the antibiotic was stopped. The antibiotics prescribed included co-amoxiclav tablets for two patients (R3.45 per day per patient), co-amoxiclav intravenous for one patient (R47.25 per day) and metronidazole intravenous and clindamycin intravenous for one patient (R41.62 per day). This amounted to a total saving of R92.32 per day.

In three cases, the infection markers were still elevated and the patients were continued on the current therapies prescribed to them. In one case, no information or blood test was available to monitor the patient's infection markers.

Any therapeutic duplication (17 interventions)

Seventeen interventions were suggested in this category and fifteen of these interventions were accepted thus resulting in an 88% success rate.

A patient admitted for the revision of an open gastrostomy was treated with co-amoxiclav as well as metronidazole. Co-amoxiclav provides a good anaerobic cover (Brazier *et al*., 2003; Galkin *et al*., 2006; Odou *et al*., 2007). Co-amoxiclav showed 84% sensitivity to *Bacteroides fragilis* in the study done by Odou *et al*. (2007) and 95.7% in the study done by Galkin *et al*. (2006). The researcher suggested stopping the metronidazole administration and decreased the patient's daily costs with R16.98. This intervention was accepted.

Co-amoxiclav was prescribed with piperacillin/tazobactam for one patient on two different prescriptions charts. No microbiology results were available, the patient had a C-reactive protein of 35.6 (normal range: 0.1 - 7.5) and maintained a temperature below 37.3°C. The researcher suggested stopping the piperacillin/tazobactam and it was accepted. This intervention decreased the patient's costs with R321.90 per day.

A patient was receiving both clonazepam and oxazepam as an anxiolytic drug. The patient was admitted with a diabetic foot infection and experienced anxiety before the foot debridement. After suggesting stopping one of the medications, the doctor stopped both. The patient showed great emotional improvement after the surgery. This decreased the patient's cost with R5.51 per day.

Four interventions were made for the proton pump inhibitors and histamine receptor blockers group. The first patient received pantoprazole intravenously with omeprazole oral that was prescribed twice under different trade names and was administered like that. For this patient, the pantoprazole was stopped and one of the omeprazole prescriptions was also stopped. These interventions reduced the patient's daily costs with R81.65. The second patient was discharged the same day she was admitted, because her procedure was cancelled. These interventions made were concerning her home-medications. She was taking omeprazole capsules that were prescribed twice, under different trade names as well as cimetidine with the omeprazole. After discussing this with the doctor, the researcher advised the patient to stop taking the cimetidine and to stop one of the omeprazole prescriptions.

Three interventions were made concerning metoclopramide. For two patients metoclopramide and erythromycin was both administered for their prokinetic effects. Only one patient's intervention was accepted and the erythromycin treatment was stopped. This intervention reduced the patient's cost by R163.14 per day. For the third patient metoclopramide and prochlorperazine was both

prescribed for nausea, but since the patient wasn't nauseous any more, the doctor stopped both of the drugs. This reduced the patient's cost with R24.75 per day.

Diclofenac and indomethacin was prescribed together for a patient admitted for an appendectomy and the researcher suggested stopping the indomethacin prescription. The indomethacin was stopped and reduced the patient's costs with R3.64 per day.

Morphine and pethidine was prescribed together for a patient with oesophageal tumor. The researcher suggested stopping the morphine and only continuing with the pethidine, since the morphine was prescribed orally and the patient was struggling to swallow. This intervention was also accepted and the morphine was stopped.

Beclomethasone inhaler was prescribed twice for a patient with asthma. The one prescription was prescribed as daily and the other as twice daily. The researcher confirmed the correct dosage with the doctor and the prescription with the daily dosage was cancelled. This intervention saved R0.51 per day.

Four interventions were made for medication prescribed as an intravenous and oral treatment. Three interventions were made with paracetamol prescribed as an infusion and as oral treatment and both were administered. The paracetamol infusion contains 1000 mg paracetamol and the maximum amount of paracetamol that can be administered per dosage is 1000 mg; thus if the infusion is given with oral medication it will result in a paracetamol overdose. With the first patient the researcher educated the nursing staff on administering the infusion at least four to six hours apart from the tablets, but since this did not succeed, the doctor was contacted and the intravenous dosages was stopped. This reduced each patient's costs with at least R76.60 per day. Metoclopramide was also prescribed as both intravenous and oral therapy to one patient and after the

doctor was contacted, the intravenous dosages were stopped. This reduced the patient's cost with R4.23 per day.

Allergic to or intolerant of any medicines (Two interventions)

Only two interventions were made for patients allergic to prescribed medication and both of these interventions were accepted thus resulting in a 100% success rate.

The first patient was allergic to metoclopramide and prochlorperazine and the doctor requested information on other medication that can be used since the patient was very nauseous. The researcher suggested ondansetron and also found out that it can only be ordered from the oncology pharmacy with special motivation from the doctor. Ondansetron was prescribed to the patient; the stock was ordered and administered to the patient. This intervention increased the patient's daily costs with R16.92.

The second patient was itching severely after a dose of omnopon®. The researcher contacted the doctor, the omnopon® was stopped and he prescribed tilidine drops for the patient. The patient was monitored for other side-effects.

Symptoms drug induced, problem drug related (One intervention)

Only one intervention was made on symptoms that were drug induced and this intervention was accepted thus resulting in a 100% success rate.

A patient admitted for an upper gastro-intestinal bleeding, used meloxicam as home-medication for a long period. After consulting the doctor, the patient was advised to never use the meloxicam again and to first consult a doctor or pharmacist before using any anti-inflammatory medication again.

Drug-Laboratory test interactions (Two interventions)

Two interventions were made in the category of drug-laboratory test and both of these interventions were accepted thus resulting in a 100% success rate.

Enoxaparin was prescribed for a patient with a low platelet count, which can decrease even further with the use of enoxaparin. The platelet count was monitored during the patient's stay in the hospital and it remained stable.

A patient, that was on spironolactone, perindopril and furosemide as home-medication had an increased potassium level on admission. The researcher discovered that the patient refused to take her furosemide tablets and that this could be the reason for the increased potassium levels. The situation was discussed with the doctor and the researcher consulted the patient on the importance of taking the furosemide and the effect of her medication on the potassium levels.

Due to system error or non-compliance (55 interventions)

Fifty-five interventions were made due to system errors and non-compliance and fifty of these interventions were accepted by the doctors and nursing staff thus resulting in a 91% success rate.

Twenty four interventions were made for missed dosages. For every dosage missed, the researcher checked with the nursing staff responsible for administering the medication on that specific day and gave them information on the importance of administering that specific drug. One patient missed his dosages again after having such a session with the nursing staff responsible for administering the medication and the researcher followed it up with the sister in charge of the unit.

Next to the prescribed medication, the nursing staff have seven columns (one for each day) to sign for the medication given out to the patients. If the space next to

the prescribed medication is full, the nursing staff does not indicate if the medication is given and we assume that it is not given because it is not signed for. It is the doctors' responsibility to rewrite the prescription so the nursing staff can indicate the medication administered. The researcher made six interventions to ask doctors to rewrite their patients' prescription cards. Only one intervention was not accepted despite that the researcher reminded the doctor a few times.

Six interventions were made for patients not being able to receive their medication, because their peripheral intravenous lines were either out or in the tissue surrounding the veins. With each intervention, the researcher contacted the doctor to reinsert the intravenous lines. Only one intervention did not succeed, the doctor did not come out to reinsert the line and the nursing staff eventually removed the line.

In two cases, medication was administered incorrectly. One patient received a double dosage aspirin because it was prescribed twice. This was discussed with the nursing staff and one of the two prescriptions was cancelled. The second patient was treated for *Entamoeba histolytica* with metronidazole and it was prescribed as metronidazole 800 mg three times a day orally. The nursing staff administered it as 500 mg intravenously; the researcher explained to them how it should be administered and the patient received the next dosages correctly. This intervention decreased the patient's costs with R16.48 per day.

One patient did not receive her warfarin treatment, because she refused to take it. The researcher explained to her the importance of taking her medication and she took the following dosages.

Sixteen interventions were for out of stock medication and twelve of these interventions were successful. The medications involved in these interventions were as follow:

- Amitriptyline tablets (n=1)
- Beclomethasone inhaler and methyl prednisone tablets (n=1)
- Clotrimazole tablets (n=1)
- Co-amoxiclav (n=2)
- Dalteparin (n=2)
- Enoxaparin (n=2)
- Indomethacin capsules (n=1)
- Long acting insulin or phenytoin capsules (n=1)
- Losartan (n=1)
- Macrodantin (n=1)
- Ondansetron (n=1)
- Needles for insulin pen sets (n=1)
- Paracetamol and tilidine drops (n=1)

Amitriptyline, co-amoxiclav, dalteparin, long acting insulin, ondansetron, phenytoin capsules, losartan, paracetamol and tilidine drops were only out of stock in the ward. The researcher phoned the pharmacy to find out if they had stock available and then asked the nursing staff to order the medication from the pharmacy.

Beclomethasone and methyl prednisone were not administered as they are not on code. The researcher told the doctor and asked if he wanted to prescribe sometimes else, but the prescription was left like that and nothing was administered.

Clotrimazole was prescribed for a patient to treat oral candidiasis, but clotrimazole tablets are not on code. The researcher discussed it with the doctor and he prescribed nystatin oral drops.

Enoxaparin was prescribed to two patients, but it was out of stock at the pharmacy. The researcher phoned the on call doctor to rather prescribe

dalteparin. Both interventions were accepted. This intervention increased the cost with R14.78 per patient per day, but the enoxaparin would have cost R16.28 per patient per day if it was available and the resultant probable shortened the duration of hospital stay or morbidity which was not measured.

Indomethacin capsules were out of stock at the pharmacy and the researcher asked the doctor to rather prescribe the indomethacin suppositories for the patient's arthritis. This intervention was accepted and increased the patient's costs with R1.82 per day.

Nitrofurantoin is out of stock at the pharmacy and the researcher asked the doctor to rather prescribe something else for the patient's urinary tract infection. This intervention was accepted and the doctor prescribed ciprofloxacin which increased the patient's costs with R0.85 per day.

Needles for insulin pen sets were also out of stock at the pharmacy. The researcher phoned the diabetic department in the hospital and was able to get their last two needles for the patient.

Ninety-eight types of medication were prescribed during the study period (Appendix 11) and fifteen of these medications were out of stock for some time during the study period (15%). Out of stock situations refer to one of three situations:

- Medication is not available in the ward, but it is available in the pharmacy. In such a situation the pharmacist played a role in optimizing stock control especially during the time the pharmacy was closed. During the study period the pharmacist did several interventions on medication not available in the ward because it was not ordered from the pharmacy.
- Medication is not available in the ward or the pharmacy. Is such situation the pharmacist played a role in informing the doctors of these specific situations and proposed a substitution.

- Medication is not on code for the public sector and stock won't be obtained. The pharmacist played a role in informing the doctors at meetings about medication that was not on code for the hospital.

Factors hindering achievement of therapeutic efficacy (Two interventions)

Two interventions were made in this category and both of these interventions were accepted thus resulting in a 100% success rate.

The first patient was previously admitted for an ileostomy and she was readmitted for dehydration and undigested food and liquid was found in her ileostomy bag. The patient was not absorbing anything but was still receiving co-amoxiclav orally. The co-amoxiclav was administered for fourteen days and according to the laboratory results the white blood cell count was 8.14 $x10^9$/l (normal range: 4 – 10 $x10^9$/l) and the temperature was in the normal range of 36 – 37.5°C. The researcher discussed it with the doctor and she decided to stop the co-amoxiclav treatment. This intervention reduced the patient's costs with R3.45 daily.

The second patient did not have a peripheral intravenous line and could not receive the antibiotic intravenously and the nursing staff gave the oral dosage form with the same active ingredient, orally. The researcher discussed it with the doctor and they reinserted the intravenous line.

Patient or nursing staffs' knowledge of the medication (35 interventions)

Thirty five interventions were made to give patients and nursing staff more information on the use and administration of medication. Thirty three of these interventions were accepted by the patients and nursing staff thus resulting in a 94% success rate.

Eighteen interventions were made to explain to the patients' who was discharged what the purpose was of the medication prescribe to them, how to take it and

what the potential side effects of the therapy was. All of the interventions were accepted by the patients.

Six interventions were made to educate the patients admitted in the unit on their home-medication and how to take it. The medications involved were mostly phenytoin, insulin therapies, inhalers for asthma treatment and warfarin and pain medication. A 68-year-old lady was using a beclomethasone and a salbutamol inhaler for asthma treatment and she uses both as an emergency inhaler. The researcher explained to her that the beclomethasone should be used only twice a day and the salbutamol inhaler as the emergency inhaler, but she insisted on taking them together. The rest of the patients accepted the information.

Other educational sessions for the patients and the nursing staff involved the following medication:

- Miconazole oral gel (n=1)
- Nystacid drops (n=1)
- Potassium chloride infusion (n=1)
- Simvastatin (n=3)
- Sucralfate (n=5)

Potassium chloride is high risk medication that should be diluted to at least 40mmol per liter of 0.9% sodium chloride solution and given via a peripheral vein at a rate no faster than 20mmol per hour (Gibbon, 2004:91).

The researcher gave the nursing staff information on simvastatin that should be administered at night because the human cholesterol production peak at night (Talbert, 2008: 396).

Sucralfate was prescribed as 1 g every eight hours and the strength of the suspension is 1 g/5 ml, but the nursing staff was administering 10 ml (thus 2 g).

The researcher gave education on the dosage and when it should be administered as well as the influence on other medication and food.

Interventions not made

During the first week of the study period the researcher did not make any suggestions towards the doctors in order to use this week for observation and to get to know the system and other procedures. This was done as suggested by the researcher's clinical supervisor Prof. Becker (Head of Department of General Surgery, School of Medicine, University of Pretoria). The following interventions would have been made during the first week:

- A patient admitted after a myocardial infarction might have benefitted from adding a β-blocker to his current regimen of aspirin as an anticoagulant, enalapril for hypertension, isosorbide mononitrate for chest discomfort, insulin long acting and metformin for glycemic control and simvastatin for hypercholesterolemia.
- Simvastatin was prescribed as a twice daily dosage, which the researcher would have suggested to be changed to a once daily dosage at night, since the humans' cholesterol is being produced at night (Talbert, 2008: 396).
- Pantoprazole intravenous therapy could have be changed to omeprazole oral therapy because the patient was taking other oral medications.
- An intervention would have been made to monitor the effect carbimazole on the anti-coagulant effect of enoxaparin. No coagulation factors were available on the laboratory results.
- Co-amoxiclav was prescribed to one patient and it was out of stock from the pharmacy. The researcher would have called the doctor to prescribe a different antibiotic.

4.9.4. Costs implications of interventions

This section discusses the costs implications of the interventions made as discussed under the narrative description of interventions made. All costs was calculate by using the tender price on the Gauteng formulary and it was calculate as a cost per patient per day since it was unknown for how long the patient would have continued on the specific medication. Table 4.8 summarizes the increase and decrease of costs in a specific intervention category. This table should be used to compare the increases with the decreases rather than looking at the amount separately.

Table 4.8: Cost implication of interventions made

Interventions category	**Increased per day**	**Decreased per day**
Untreated medical conditions	R70.87	-
Comparative efficacy of chosen medication(s)	R2.60	-
Prescribed doses and dosing frequency appropriate	R20.37	-
Route/dosage form/mode of administration appropriate	R24.66	R23.17
Length or course of therapy appropriate	-	R95.77
Any therapeutic duplication	-	R703.06
Allergic to or intolerant of any medicines	R16.92	-
Due to system error or non-compliance	R17.45	R16.48
Factors hindering achievement of therapeutic efficacy	-	R3.45
Total	**R152.87**	**R841.93**

The increased costs of R152.87 showed the direct cost but the resultant probable shortened duration of hospital stay or morbidity which was not measured. The decreased costs of R841.93 were in favour of the patient and to rationalize the use of medication, specifically antibiotics, to prevent resistance and unwanted adverse reactions.

A future recommendation can be made to focus more specifically on the costs saved by a pharmacist providing pharmaceutical care services to a ward.

4.10. Time spent in the ward

The researcher noted the total of time spent on different activities per day. The time taken was recorded on the form titled “Pharmacist time spent in the ward” (Appendix 2) on a daily basis while pharmaceutical care was rendered to the ward.

The process of documenting the time spent in the ward was challenging, as it was difficult to keep track of the exact time spent on each intervention or other ward function, because two or three activities often occurred at the same time.

The time spent in the ward encompassed the duration of the study period (21 February to 15 April 2011) during working hours from Mondays to Fridays, excluding a total of seven working days which was taken for study leave.

The total time spent providing pharmaceutical care services within the general surgical wards over the study period was 32 days (227.9 hours). The average time spent providing pharmaceutical services per day was 7.1 hours (see Table 4.9).

Table 4.9: Pharmacist's time spent in the surgical wards for the study period

Month, Year	Days spent	Hours spent	Average hours/day
Feb 2011	6	37.8	6.3
Mar 2011	20	143.4	7.2
Apr 2011	6	46.8	7.8
Total	32	228	7.1

The average hours per day spent in the surgical ward in February were 6.3 hours and it increased to 7.8 hours per day in April. It is clear that the researcher spent more time per day on pharmaceutical care services at the end of the study, than at the beginning. This is due to the fact that the researcher needed time to get to known the system, ward functions and medical personnel and with that, responsibilities increased and more time was needed to accomplish these tasks.

The different functions performed by the pharmacist in the study period are illustrated in Figure 4.9.

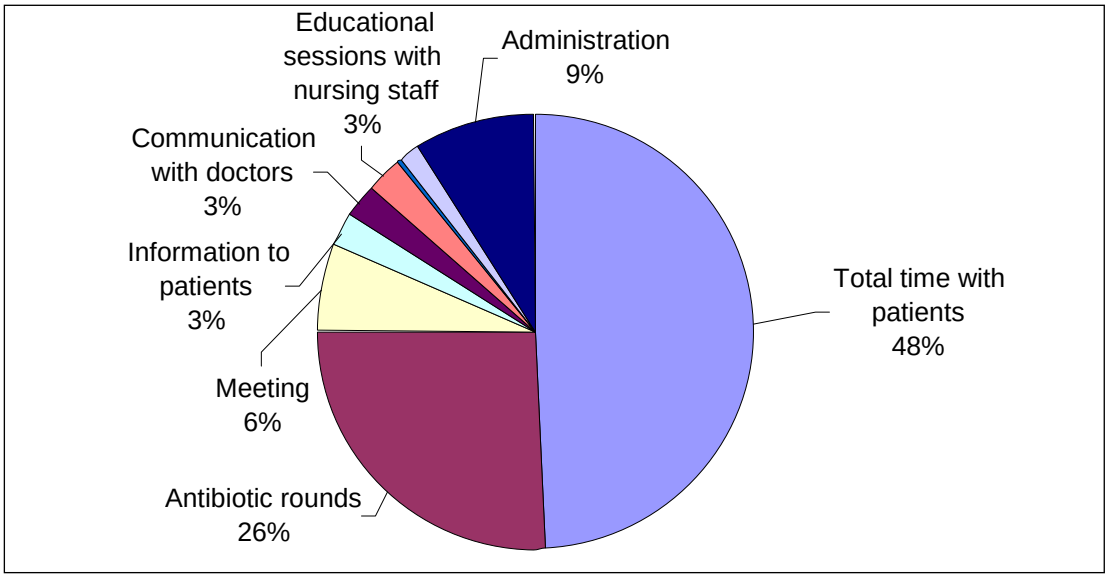


Figure 4.9: Different functions performed by the pharmacist

The most time, 48% (112.1 or 227.9 hours) was spent on providing

pharmaceutical care to the patients. The pharmacist did daily antibiotic rounds on her own to record and access the total antibiotic usage in the ward. This took 26% (58.8 of 227.9 hours) of the time. Administration made up 9% and meetings 6% of the time. Other functions comprising of 3% and less of the time was information to patients, communication with doctors, educational sessions with nursing staff, communication with the pharmacy and stock control procedures.

Time spent on patient care

In 1990 pharmaceutical care was defined by Douglas Hepler and Linda Strand as the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life (Hepler & Strand, 1990). Keeping this in mind it should make sense that the largest proportion of time should be spent on doing just that for the patients.

During this time 62 study patients were seen and pharmaceutical care forms were completed and interventions were planned. The time spent on interventions was documented into specific categories, e.g. communicating the problem to the doctor. Average number of patients in the wards and the number of patients seen by the pharmacist is illustrated in Figure 4.10.

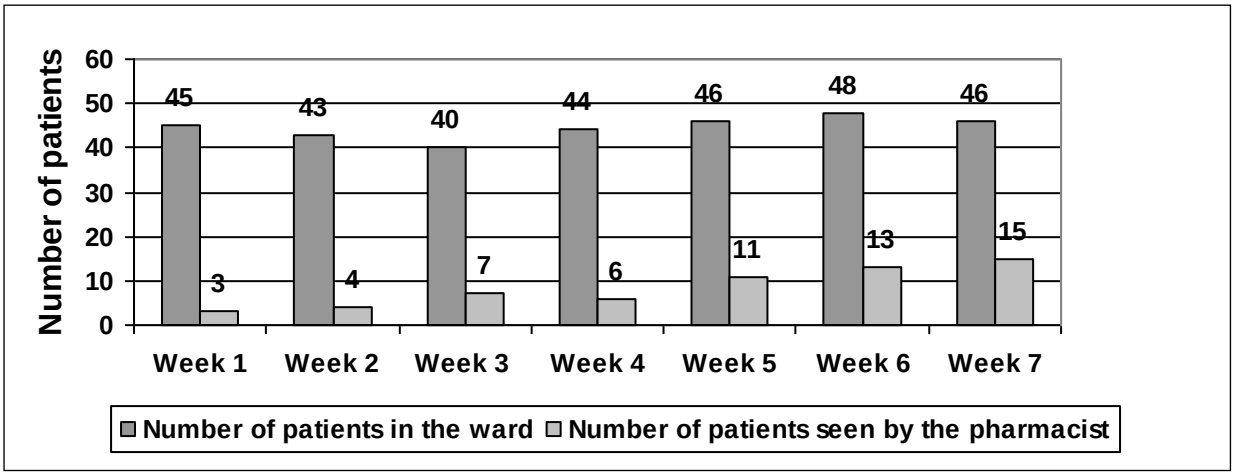


Figure 4.10: Average number of patients in the wards and the number of patients seen by the pharmacist

During the first week 45 patients were admitted into the wards and only three pharmaceutical care interventions were made by the pharmacist. This could be compared to the last week where 46 patients were admitted and 15 pharmaceutical care interventions been made. The average time spent per patient consultation is illustrated in Figure 4.11.

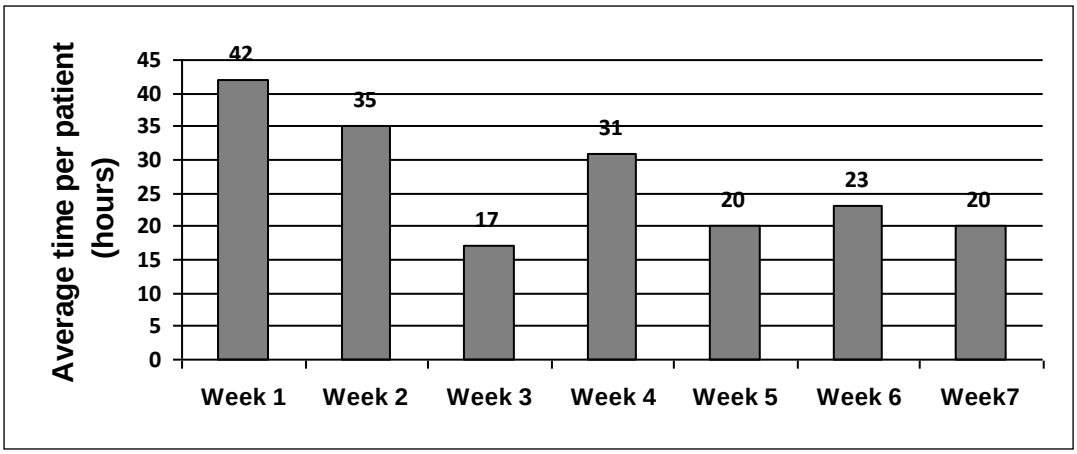


Figure 4.11: Average time spent per patient consultation

The average time spent per patient decreased with time. During week three the researcher spent less time on patient consultations due to study leave.

The amount of patients seen per week increased with time and the average time spent per patient consultation decreased with time. This is a clear indication that the researcher gained confidence and became more familiar with the pharmaceutical care process as the time passed.

Antibiotic rounds

Despite the 62 patients that were seen for pharmaceutical care interventions, the researcher recorded and assessed the antibiotic usage of all the patients in the general surgical wards to give weekly feedback at the morbidity and mortality meetings. The researcher spent 26% (58.8 of 227.9 hours) of the time on the antibiotic rounds.

The average time spent per day on the antibiotic rounds is illustrated in Figure 4.12.

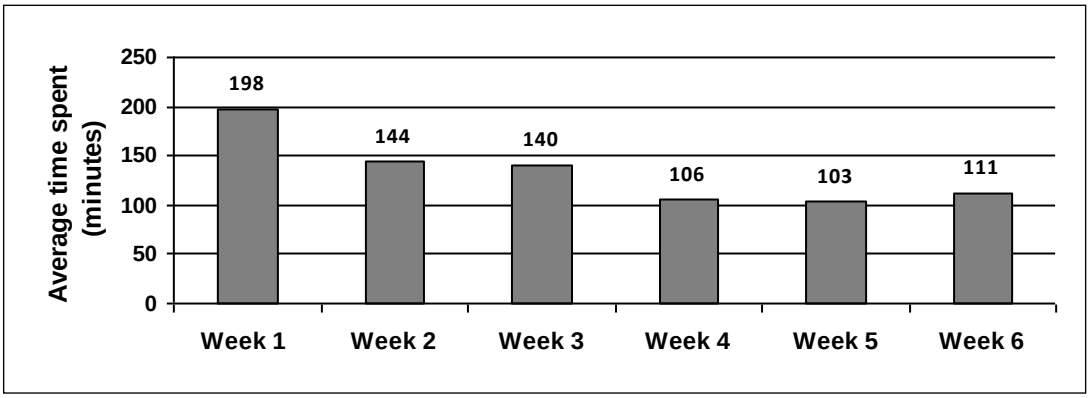


Figure 4.12: Average time spent per day on antibiotic rounds

The average time spent per day on the antibiotic rounds decreased with time, which is an indication that the researcher became familiar with the system and found it easier to investigate the available documentation.

The antibiotic usages were recorded according to the number of antibiotics prescribed to a patient on a specific time, thus looking at mono-, double- and triple therapy. The difference between the first and the last week is illustrated in Figure 4.13.

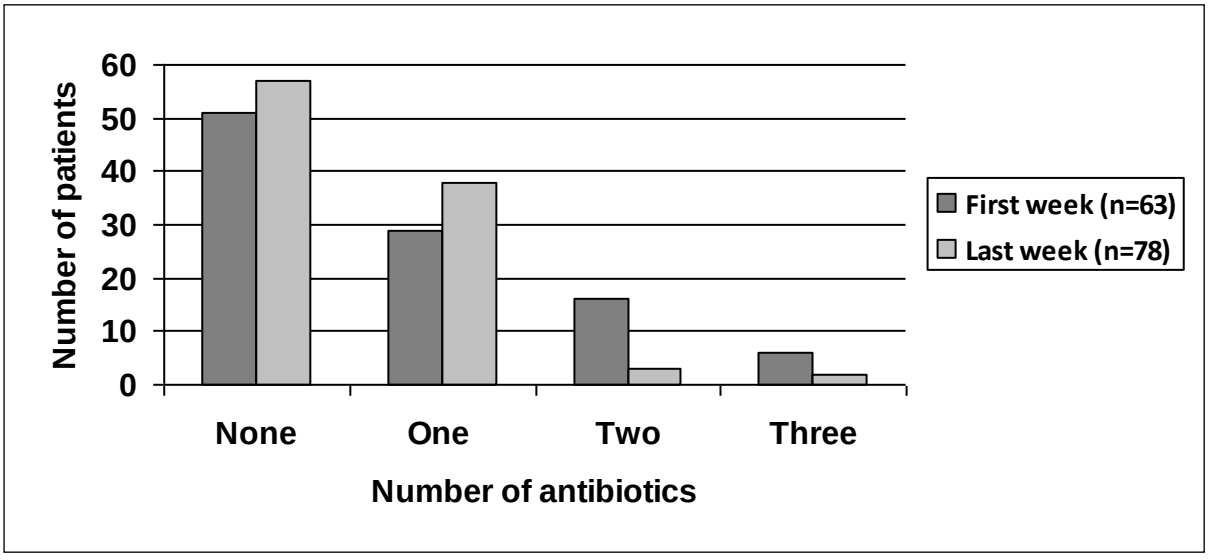


Figure 4.13: Number of antibiotics prescribed per patient for the first and last weeks of the study period.

The patients receiving no antibiotics increased from the first to the last week. The use of antibiotics was not discouraged but the researcher rather focused on the rational use of antibiotics. According to Olson and Savelli (1997) the rational use of antibiotics requires that patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community.

The number of patients receiving monotherapy increased and the number of patients receiving double- or triple therapy decreased from the first to the last week. Superiority of combination therapy over single-agent therapy is not demonstrated with the exception of those patients with rapidly declining diseases such as severe sepsis (Kang-Birken & DiPiro, 2008:1950). The benefit of monotherapy is decreased adverse effects and triple therapy will results in a broader antimicrobial coverage, which is not necessarily desired.

Meetings

The meetings attended during the study period consist of 6% (14.5 of 227.9 hours) of the time spent. The time spent on meetings can be divided into the following groups:

- Meetings with nursing staff to explain the purpose of the study and to fill out the questionnaires. The questionnaires were filled out before and after the study period.
- Attending and giving feedback at the mortality and morbidity meetings on Monday afternoons.
- Attending HIV meetings at the microbiology department.
- Presentation of the study at the research committee meeting.
- Meetings held with the supervisor of the research project.

Information to patients

Six hours (2.6%) were spent to communicate with patients and to provide them with information and knowledge on their medication used as home medication, medication prescribed to them while in the hospital as well as the medication prescribed when going home. The interventions done was explained and described under the patient or nursing staffs' knowledge of the medication on page 69.

Communication with doctors

Communication with the doctors took 2.6% (5.9 of 227.9 hours) of the time. The researcher planned to communicate interventions to the doctors by writing in the bed letter or during ward round or by direct discussion with consultant or registrar or by giving feedback at the weekly Monday meetings.

- Leaving a note in the bed letter was unsuccessful and only one intervention was made by writing a note in the bed letter. The rest of the notes were never responded to.
- The researcher never attended ward rounds, because it would have been every time consuming. The doctors attending the patients in the general surgical wards consists out of five firms, each including the head of the firm, clinical associates and interns. Each firm did ward rounds on their own scheduled time during the day. During the study period an average of 45 patients were admitted in the two units per day and only an average of nine patients were seen by the pharmacist per day.
- Direct discussion with the doctor was the best method and most of the interventions were communicated in this manner. During the first two weeks it was difficult to correlate the doctor’s handwriting with his/her name and also to know who they are and where to find their telephone numbers. Thus reaching the doctors became much easier and quicker as the time passed.
- The mortality and morbidity meetings that were held on a Monday are discussed under the time spent on meetings on page 78. Feedback given

was focused on the general antibiotic use of the units and other problems that was often encountered. This did not include interventions on individual patients.

Educational session with nursing staff

The researcher spent 2.5% (5.8 of 227.9 hours) of the time educating the nursing staff on the indications, adverse effects and administration of various medications. The interventions made with nursing staff is discussed under the interventions made due to system error or non-compliance (page 65) and patient or nursing staffs' knowledge of the medication (page 69). These educational sessions were informal and took place by discussing a specific problem with a specific nurse working with a specific patient at the time that a problem occurred.

Formal in-service training was given on the specified areas where problems were identified according to the questionnaires completed prior to the study as well as any problem areas identified by the researcher during the study period. The researcher made posters for each ward with information on medication containing penicillin (Appendix 13) as well as a table with information on generic names, trade names, indications, administration and the most common adverse effects on medication used the most in the wards during the study period (Appendix 14).

The researcher also spent some time in helping a nursing student with a research project on post-surgery wound sepsis.

Communication with the pharmacy

The researcher spent 0.4% (0.9 of 227.9 hours) of the time communicating with the pharmacy about out of stock situations. The interventions made on out of stock situations are discussed under interventions made due to system error or non-compliance on page 65.

Other ward functions

The researcher spent 1.7% (3.8 of 227.9 hours) of the time on other ward functions, which mainly included stock control by checking expiry dates and by repacking ward stock of both the male and female wards.

Administration

The researcher spent 8.9% (20.3 of 227.9 hours) of the time on administration.

The time spent on administration was mainly because the researcher needed time to get familiar with the system and documentation. Some of this time was also used for the preparation of the different meetings attended. The time spent on administration reduced as the researcher gained confidence and familiarized herself with the system.

4.11. Need for pharmaceutical care by a pharmacist in the surgical wards

Questionnaires were handed out to the doctors and nursing staff before and after the study period to determine if they feel that there is a need for a pharmacist rendering pharmaceutical care in the general surgical wards. Separate questionnaires were used for the doctors and the nurses.

4.11.1. Doctor's questionnaire

A total of 10 doctors completed the questionnaire before the study and a total of 14 doctors completed the questionnaire after the study period. An average of 25 doctors work in the general surgical wards. The questionnaires were handed out at the mortality and morbidity meetings. The interns rotated just before the end of the study and therefore the questionnaires were not completed by exactly the same doctors before and after the study.

Question 1:

Do you feel there is a need for a pharmacist to routinely visit the surgical wards?

This question was asked before and after the study period. All of the doctors answered that they did feel there is a need for a pharmacist to visit the surgical ward before and after the study period. The doctors who completed the questionnaires before the study did not provide any comments. The following quotes were provided in the questionnaires completed after the study period, quoted verbatim:

"Important for training of junior doctors and beneficial to the safety of the patient"

"Very helpful, at least twice a week"

"Least problems with clinical use and availability, advice went doing interactions"

Question 2:

Do you benefit from having the pharmacist present in the wards while you are conducting your ward rounds?

This question was completed at the end of the study period. Nine of the fourteen doctors who completed the post-test questionnaire responded that they benefited from having the pharmacist present in the surgical ward whilst conducting ward rounds. The following quote (quoted verbatim) where provided by one of these doctors: *"Added knowledge presented at rounds to the benefit of all participating"*

The other five doctors who answered negatively to this question provided the following quotes:

"Was never present"

"No need to do ward rounds"

"No pharmacist on rounds with me ever"

As explained on page 79 under the time spent on communication with doctors, the pharmacist did not attend ward rounds with the doctors. At the end of the study period some of the doctors came to the pharmacist after and during the ward rounds to ask for help or to explain a chosen regimen. A future suggestion for a pharmacist that would be employed full time would be to attend these ward rounds.

Question 3:

Is the pharmacist able to provide you with adequate information to your information requests?

This question was completed at the end of the study period. Thirteen of the fourteen doctors confirmed that the pharmacist was able to provide them with adequate information. Two of these doctors presented the following quotes (quoted verbatim)

"Mostly the pharmacist knows more about pharmacology and pharmacotherapy"

"Very helpful, I enjoyed the fact that there is someone to ask about medicine, side-effects etc. when I was unsure or alternative options of medicine"

The last doctor never asked the pharmacist any questions concerning medication and pharmacology and therefor did not answer the question.

Question 4:

Do you feel that interventions made by a pharmacist would improve the rational use of antimicrobials in your department?

This question was asked before and after the study period. Eight of the doctors who completed this question before the study period responded affirmatively to this question. The other two doctors did not feel that interventions made by a pharmacist would improve the rational use of antimicrobials and they did not provide any comments.

All of the doctors completing this question after the study period responded affirmatively and two responded with the following quotes:

"Especially with empiric choice of antibiotics"

"Antibiotic stewardship is very important"

Question 5:

Do you feel that the provision of pharmaceutical care would decrease the expenditure of antimicrobials in your department?

This question was asked before and after the study period. All of the doctors responded that they did feel that the provision of pharmaceutical care would decrease the expenditure of antimicrobials. This quote was provided by one of these doctors (quoted verbatim):

"More knowledgeable prescribing of antibiotics and combinations, and also to the benefit of patients by decreasing the unnecessary exposure to antibiotics"

4.11.2. Nurses questionnaire

A total of 20 nurses completed the questionnaire before the study and a total of 13 nurses completed the questionnaire after the study period. The nursing staff worked shifts and therefore the questionnaires were not completed by the same nurses before and after the study, but the researcher did work with all the nurses of the different shifts.

Question 1

Do you feel that there is a need for a pharmacist to routinely visit the surgical wards?

In both the pre-test (n=20) and in the post-test (n=13) the nursing staff stated that they did feel that there is a need for a pharmacist to routinely visit the surgical ward. The comments provided are listed in Table 4.10.

Table 4.10: Need for a pharmacist according to nursing staff in the surgical ward

Pre-test (n=20)	Post-test (n=13)
Education and information *"Regular in-service training is a need"* *"To help with educating staff"* *"That way staff is able to ask any questions about medication that they give and to also know any changes that may come about, e.g. different dosages"*	Education and information *"To come and educate the staff about the drugs that is being administered"* *"To give use more knowledge about the medication"* *"Is best to have a researcher because people just give medication not knowing the purpose"* *"It helps to know the importance of giving medication and how it works and saving patients"* *"It will help with updating staff members with new drugs on the market and their usage"*
Legal prescribing *"To review prescription chart"* *"To check the prescriptions that need to be renewed"* *"To check prescriptions and medicines"* *"To make sure that prescriptions are valid at all times"* *"There are often prescriptions illegal to nurses, a pharmacist presence would greatly help in reading them"* *"Because some of the prescriptions need clarification"* *"Because there is prescriptions that need clarity"* *"Because some of the prescriptions is invalid, the dosage and frequently they are not properly written"*	Legal prescribing *"To check prescriptions that need to be transcribed"*
Stock control *"To check the expiry date of the drugs"*	
Dosages *"So that our patients can have*	

treatment according to prescription (time and route) and correct medication" *"So that the patients can get their medication at correct time and to monitor the prescribed drugs to the patient, e.g. how often and how long should the patient get the medication"*	

The most concerns rose before the study was on the legality and clarification of prescriptions. As discussed on page 65 under interventions made due to system error and non-compliance, the researcher made six interventions for prescriptions that needed to be renewed. Different interventions were made for prescriptions that were unclear and the nursing staff issued either no medication or the wrong medication.

The other comment that was raised was about education and information. As explained on page 80, the researcher spent 5.8 hours on educating the nursing staff in a formal and informal manner. An educational session about good medication administration practices provided by a pharmacist is a very simple way to decrease medication administration error rates and to raise awareness on the possible clinical significance of the errors (Verrue *et al*., 2010).

Question 2

What activities do you feel the pharmacist could fulfill within your department?

In this question the nursing staff could choose between ten possible activities that they felt the pharmacist could fulfill in their ward. Table 4.11 illustrates the activities chosen by the nursing staff in the pre- and post-tests'.

Table 4.11: Need for a pharmacist's assistance in the surgical ward

Assistance with:	Number of times mentioned			
	Pre-test (n=20)		Post-test (n=13)	
	Number	Percentage	Number	Percentage
Patient counseling/education	12	60	8	**62**
Drug identification	16	**80**	5	38
Prescription chart reviews	15	75	8	**62**
Drug ordering for patients	12	60	3	23
Checking for drug interactions	12	60	8	**62**
Staff education	16	**80**	8	**62**
Checking ward stock for expiries	16	**80**	7	54
Dealing with pharmaceutical queries	15	75	8	**62**
Schedule 5,6 & 7 Ordering	12	60	3	23
Checking for adverse drug reactions	17	**85**	7	54

The function that was mostly chosen before and after the study period was staff education. This topic was already discussed in the previous question as well as the section on page 80 on the time spent on educating the nursing staff in the surgical ward.

Checking for adverse drug reactions were also highly chosen, especially in the pre-test and although not a lot of interventions were made for adverse drug reactions, it was one of the problem types checked and monitored by the pharmacist during the pharmaceutical care process (Appendix 1: Pharmaceutical care forms).

Question 3

Do you feel that a pharmacist round would facilitate improved drug distribution to your department?

All of the nurses completing the questionnaire before and after the study felt that a pharmacist would improve drug distribution of the surgical ward. The following quotes were provided (verbatim) by the nursing staff:

"*By reviewing the prescriptions"*

"The doctors writing is not legible, we find it difficult to read instructions"
"So that we solve the patients' drug addiction (control) and not run short"
"Because they would be sure of the real need for the drug"
"Because there won't be any medication legal hazard"
"Even students will benefit from it"
"To ensure that there is adequate supply of drugs for patients"
"Correct time and patient counseling of good and bad effects of using drugs"
"Correct drugs will be ordered in the correct manner as needed"
"Drugs need to be handled with care and you should know the restrictions"
"Medication are given according to the prescription and time; and expiry dates are checked regularly"

Question 4

Do you feel that there is a need for weekly education sessions with the pharmacist?

Once again all the nurses completing the questionnaire responded affirmatively to the need for education sessions. The following are quoted verbatim:

"For us to give correct medication as prescribed"
"For nurses to give proper total patient care, they should have a clear understanding of the patients' medication"
"To understand the reason of giving medication and not to harm the patient and the patient not to have resistance to antibiotics"
"We need to know more and be reminded about medications"
"This will be beneficial to students"
"To empower the staff"
"That is very important, educations about actions and adverse effects of drugs"
"That will help nursing staff to be able to administer drugs safely"
"So that the staff may know the importance of giving medication especially antibiotics"
"Help to improve the administration of drugs"

“With the education session’s staff will be able to get clarity on what they don't understand”

“It is beneficial because some of us sometimes forget about the effects of drugs”

“Sometimes doctors prescribe medication that you don't know”

“To keep us reminded about the medications, side-effects and indications”

“To educate the patients more with their medication and for clarifying the medications for the nurses”

“To improve and safe patients' life's and to understand and to know why do we give medication”

4.11.3. Conclusion

The doctors felt that there is a need for a pharmacist in the ward in terms of providing information and assisting in the rational use of medication. It was only in relation to the topic of ward round attended by the pharmacist that some of the doctors disagreed, and with very good reason since the pharmacist did not attend the ward rounds.

All of the nursing staff felt that there is a need for a pharmacist to visit the surgical ward and specifically to assist with the legal aspects of the prescriptions and with the education of the nursing staff.

These results clearly indicate that there is a big role for the pharmacist in a general surgical ward.

Chapter 5: Conclusions, limitations and recommendations

The aim of the study was to assess the need of pharmaceutical care by a pharmacist in a general surgical ward. The provision of pharmaceutical care was focused on the assessment of prescribed medication, describing and categorizing of interventions and recording of time spent on the provision of pharmaceutical care.

Pharmaceutical care services were not provided to the patients of the general surgical wards before the researcher commenced the study. During this time the only connection between the pharmacy and the general surgical wards was through ordering of medication. The presence of a pharmacist in the ward did not only improve the communication of the pharmacy with the nursing staff and doctors but also functioned as a gateway between the nursing staff and the doctors.

The pharmacist played an important role in the design of an antimicrobial ward protocol that contained guidelines for the prophylaxis and treatment of the most common surgical procedures and infections seen in these wards, guidelines on septic screening, duration of use of antibiotics and intravenous to oral switching of antibiotics. In order to do so the pharmacist recorded and assessed the antimicrobial prescribing patterns of the surgical wards and gave feedback on these findings at the mortality and morbidity meetings held in the department of general surgery.

Interventions made addressed a broad spectrum of drug related problems. The category that require the most attention was interventions made due to system error and non-compliance because of negligence of nursing staff to administer

medication, because prescriptions were not renewed, because the patients' intravenous lines were faulty and because of out of stock situations.

Various interventions were made on the patients' and nursing staffs' knowledge of the prescribed medication. Educational sessions were scheduled for the nursing staff to discuss relevant topic and problems often encountered. Short informal education sessions with the involved nurses commenced on the specific time a drug related problem were established. Educational sessions with the patients involved giving them information on home medication used and most importantly to give them information on the medication prescribe to take home. These medications were delivered to the wards and the pharmacist working in the pharmacy cannot provide the patient with drug related advice.

The most time (48%) was spent with patients to assess the prescribed medication for the provision of pharmaceutical care. The amount of patients seen per week increased with time and the average time spent per patient consultation decreased with time. This is a clear indication that the researcher gained confidence and became more familiar with the pharmaceutical care process as the time passed.

From the questionnaires completed by the doctors and nursing staff it was clear that they felt that there is a need for a pharmacist in the ward in terms of providing information, assisting in the rational use of medication, to assist with the legal aspects of the prescriptions and with educating nursing staff.

5.1. Limitations

The limitations arising from this study was generally concerning the short study period. Time is essential to gain the trust of the doctors and nursing staff and for the pharmacist to gain confidence and more knowledge in the clinical field.

The researcher needed time to get to know the medical staff and the system. This refers to the ward setup, the patients' documentation, the division of doctors into different firms and identifying and reaching doctors.

During the study period the pharmacist designed an antibiotic ward protocol but due to the short duration of the study period the antibiotic ward protocol was not implemented and tested in the general surgical wards.

Another limitation was that the patients' prescription cards were send to the pharmacy during the day to order medication. This took place from 9:00 to 14:00. During this time it was difficult for the researcher to consult patients and to plan interventions since most of the prescriptions were not available.

5.2. Recommendations

Based on the findings of this study, the researcher proposes recommendations to promote pharmaceutical care in a ward setup and to develop and improve methodologies for further studies.

Recommendations to promote pharmaceutical care

- According to the data available a pharmacist should be present in the ward on a full time basis. Pharmaceutical care was rendered to 62 of the 348 patients admitted in the wards during the study period and to be able to attend to all the patients a pharmacist should be appointed on a full time basis. A future suggestion for a pharmacist that would be employed full time would be to attend ward rounds with the doctors.
- After appointment of a clinical pharmacist in the ward, the unit can function as a training area for other pharmacists.
- Therapeutic drug monitoring should be implemented for medication like gentamicin and epileptic drugs like carbamazepine. This will be associated with the appointment of a clinical pharmacist in the wards.
- Training for nursing staff should be implemented and maintained.

- The designed antibiotic ward policy should be implemented and tested in the general surgical wards.

Recommendations for further research

- Take time to get to know the system and to gain the trust of the medical personnel. The study period should preferable be longer than twelve weeks.
- Create and implement a score sheet to determine which patients admitted to the unit is most in need of pharmaceutical care services.
- A future recommendation can be made to focus more specifically on the costs saved by a pharmacist providing pharmaceutical care services to a ward.

5.3. Closing remarks

The aim of the study was to assess the need of pharmaceutical care by a pharmacist in the general surgical wards. According to the results of the study and the data made available it is clear that the pharmacist had an important role as a part of a multidisciplinary team in the general surgical wards of Steve Biko Academic Hospital.

The results showed a high acceptance rate of interventions suggested and important interventions were made on the administration of medication and education on the purpose and side-effects of medication to the nursing staff and patients.

The questionnaires showed that the medical staff of the general surgical wards felt that there is a need for a pharmacist in the wards and encouraged the involvement of a pharmacist in their unit.

References

Ahmed, A.A., Mooar, P.A., Kleiner, M., Torg, J.S. & Miyamoto, C.T. 2011. Hypertensive Patients Show Delayed Wound Healing following Total Hip Arthroplasty. *PLoS ONE*, 6(8): 1-6. Available at: http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0023224 (Accessed: 23 December 2011)

Ambwani, S. & Mathur, A.K. 2006. Rational drug use. *The official journal of the Indian society of health administrators*, XIX(1):5-7. Available at: http://medind.nic.in/haa/t06/i1/haat07i1p5.pdf (Accessed: 18 August 2010).

American Society of Hospital Pharmacists. 1992. *Clinical Skills Program: Advancing Pharmaceutical care.* Bethesda. Available at: www.ashp.org.com (Accessed: 22 August 2010).

Berardi, R.R. & Welage, L.S. 2008. Peptic Ulcer Disease. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors). *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Bergqvist, D. 2004. Low molecular weight heparin for the prevention of venous thromboembolism after abdominal. *British Journal of Surgery,* 91(8):965-974.

Brind, M. 2008. Geographical variation in recovery times. *The Clinical services journal*. Available at: http://www.reducinglengthofstay.org/doc/pp52-53%20CSJapr08.pdf (Accessed: 18 October 2011).

Bowrey, D.J., Wheeler, J.M.D., Evans, R.O.N., Fligelstone, L.J. & Vellacott, K.D. 1997. Can emergency general surgical referrals be reduced? A prospective study. *J.R. Coll. Surg. Edinb*., 42:381-382.

Brazier, J.S., Hall, V., Morris, T.E., Gal, M. & Duerden, B.I. 2003. Antibiotic susceptibilities of Gram-positive anaerobic cocci: results of a sentinel study in England and Wales. *Journal of Antimicrobial Chemotherapy*, 52(2):224-228. Available at: http://www.ncbi.nlm.nih.gov/pubmed/12837734 (Accessed: 26 December 2011)

Burgess, D.S. 2008. Antimicrobial Regimen Selection. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors). *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Chambers, H.F. 2003a. Beta-Lactam Antibiotics and Other Inhibitors of Cell Wall Synthesis. In: Katzung, B.G. (Editor). *Basic and Clinical Pharmacology.* Ninth edition. New York: McGraw Hill.

Chambers, H.F. 2003b. Chloramphenicol, Tetracyclines, Macrolides, Clindamycin and Streptogramins. In: Katzung, B.G. (Editor). *Basic and Clinical Pharmacology.* Ninth edition. New York: McGraw Hill.

Chambers, H.F. 2003c. Aminoglycosides and Spectinomycin. In: Katzung, B.G. (Editor). *Basic and Clinical Pharmacology.* Ninth edition. New York: McGraw Hill.

Chambers, H.F. 2003d. Sulfonamides, Trimethoprim and Quinolones. In: Katzung, B.G. (Editor). *Basic and Clinical Pharmacology.* Ninth edition. New York: McGraw Hill.

Dagogo-Jack, S. & Alberti, K.G. 2002. Management of Diabetes Mellitus in Surgical Patients. *Diabetes Spectrum*, 15(1):44-48.

Danielson, D.A., Porter, J.B., Dinan, B.J., O'Connor, P.C., Lawson, D.C., Kellaway, G.S.M. & Jick, J. 1982. Drug Monitoring of Surgical Patients. *The Journal of the American Medical Association*, 248(12):1482-1485.

Department of Health. 2006. *Standard Treatment Guidelines and Essential Drug List.* Pretoria: Department of Health.

Dickerson, L.M., Mainous, A.G. & Carek, P.J. 2000. The Pharmacist's Role in Promoting Optimal Antimicrobial Use. *Pharmacotherapy*, 20(6):711-723. Available at: http://www.medscape.com/viewarticle/409567 (Accessed: 17 June 2010).

Diekema, D.J., Dodgson, K.J., Sigurdardottir, B. & Pfaller, M.A. 2004. Rapid Detection of Antimicrobial-Resistant Organism Carriage: an Unmet Clinical Need. *Journal of Clinical Microbiology*, 42(7):2879–2883. Available at: http://jcm.asm.org/cgi/reprint/42/7/2879 (Accessed: 16 August 2010).

Essack, S.Y. 2006. Strategies for the Prevention and Containment of Antibiotic Resistance. *South African Family Practice journal*, 48(1):51. Available at: http://www.safpj.co.za/index.php/safpj/article/viewFile/460/436 (Accessed: 18 August 2010).

Fincham, J.E. 1998. Pharmaceutical Care Studies: A Review and Update. *Drug Benefit Trends*, 10(6):41-45. Available at: http://abello.dic.uchile.cl/~hechavez/atfar/atfar2.html (Accessed: 16 August 2010).

Fomundam, H. 2007. The Challenges of Pharmaceutical care in Africa - The case of South Africa - HIV and AIDS. [Presentation] Medunsa Pharmacovigilance Centre. Republic of South Africa. Available at:

http://www.pacecenter.net/powerpoints/Fomundam/fomundam_files/slide0001.htm (Accessed: 16 August 2010).

Galkin, D., Kretchikova, O., Sukhorukova, M. & Kozlov, R. 2006. Antimicrobial susceptibility of gram-negative anaerobic bacteria from two hospitals in Smolensk, Russia. *Institute of Antimicrobial Chemotherapy (IAC) of the Smolensk State Medical Academy, Smolensk, Russia.* Available at: http://www.antibiotic.ru/files/pdf/en/eccmid16-p1633.pdf (Accessed: 26 December 2011)

Gibbon, C.J. 2004. South African Medicines Formulary. Sixth edition. Pinelands: Health and Medical Publishing Group.

Gould, I.M. 1999. A review of the role of antibiotic policies in the control of antibiotic resistance. *Journal of antimicrobial chemotherapy*, 43(4):459-465. Available at: http://jac.oxfordjournals.org/cgi/reprint/43/4/459 (Accessed: 17 June 2010).

Gyssens, I.C., Geerligs, I.E.J., Dony, J.M.J., Van der Vliet, J.A., Van Kampen, A., Van den Broek, P.J., Hekster, Y.A. & Van der Meer, J.W.M. 1996. Optimizing antimicrobial drug use in surgery: an intervention study in a Dutch university hospital. *Journal of antimicrobial chemotherapy*, 38(6):1001-1012. Available at: http://jac.oxfordjournals.org/cgi/reprint/38/6/1001 (Accessed: 19 June 2010).

Hepler, C.D. & Strand, L.M. 1990. Opportunities and responsibilities in pharmaceutical care. *America journal of hospital pharmacy*, 47(3):533-543.

Hlabisa Hospital quarterly mortality and morbidity report. 2005. Department of health Province of Kwazulu Natal. Available at: http://www.kznhealth.gov.za/hlabisa/report2.pdf (Accessed: 18 October 2011).

Hooton, M.D. & Thomas, M. 2001. Antimicrobial resistance: A plan of action for community practice. *American family physician*, 63(6):1087-1097. Available at: http://www.aafp.org/afp/2001/0315/p1087.html (Accessed: 18 August 2010).

Jones, S. & Jones, R. 2008. Antibiotics. *South African Pharmaceutical Journal*, 75(4):38-43. Available: http://www.sapj.co.za/index.php/SAPJ/article/viewFile/318/299 (Accessed: 18 August 2010).

Kang-Birken, S.L. & DiPiro, J.T. 2008. Sepsis and Septic Shock. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors). *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Kanji, S. & Devlin, J.W. 2008. Antimicrobial Prophylaxis in Surgery. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors) *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Katende-Kyenda, N.L., Lubbe, M.S., Serfontein, J.H.P. & Truter, I. 2007. Antimicrobial prescribing patterns in a group of private primary health care clinics in South African. *Health South Africa*, 12(1):21-29. Available at: http://www.hsag.co.za/index.php/HSAG/article/viewFile/240/230 (Accessed: 18 August 2010).

Khan, N.A., Chattopadhyay, P., Abid, M., Patra, A., Maheshwari, K.K., Wahi, A.K., Kaviarasan, P.K. & Mohanta, G.P. 2009. Impact of Clinical Pharmacist's Intervention on Use of Antimicrobials in Dermatology Department in Tertiary Care Hospital. *Indian Journal of Pharmacy Practice*, 2(2): 66-70. Available at: http://ijopp.org/ijpp_3rd_issue/research_articles9.pdf (Accessed: 19 June 2010).

Kodali, B.S. & Oberoi, J.S. 2011. Management of postoperative pain. *Up To Date*, version 19.3. Available at: http://www.uptodate.com/contents/management-of-postoperative-pain (Accessed: 24 December 2011)

Kunin, C.M. 1997. Editorial Response: Antibiotic Armageddon. *Clinical infectious diseases*, 25(2):240-241. Available at: http://www.journals.uchicago.edu/doi/pdf/10.1086/514544 (Accessed: 23 June 2010).

Mantz, J., Samama, C.M., Tubach, F., Devereaux, P.J., Collet, J.P., Albaladejo, P., Cholley, B., Nizard, R., Barré, J., Piriou, V., Poirier, N., Mignon, A., Schlumberger, S., Longrois, D., Aubrun, F., Farèse, M.E., Ravaud, P. & Steg, P.G. 2011. Impact of preoperative maintenance or interruption of aspirin on thrombotic and bleeding events after elective non-cardiac surgery: the multicentre, randomized, blinded, placebo-controlled, STRATAGEM trial. *British Journal of Anaesthesia*, 107 (6): 899–910 Available at: http://bja.oxfordjournals.org/content/107/6/899.full.pdf+html (Accessed: 23 December 2011)

Mikeal, R.L., Brown, T.R., Lazarus, H.L & Vinson, M.C. 1975. Quality of pharmaceutical care in hospitals. *American Journal of Hospital Pharmacy,* 32(6):567-74.

Natali, A., Quiñones, G.A., Santoro, D., Pecori, N., Taddei, S., Salvetti, A. & Ferrannini, E. 1993. Relationship between insulin release, antinatriuresis and hypokalemia after glucose ingestion in normal and hypertensive man. Clinical Science Journal, 85(3):327-35.

Nicolau, D.P., Freeman, C.D., Belliveau, P.P., Nightingale, C.H., Ross, J.W. & Quintiliani, R. 1995. Experience with a once-daily aminoglycoside program administered to 2,184 adult patients. *Antimicrobial Agents and Chemotherapy,* 39(3):650-655. Available at:

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC162599/pdf/390650.pdf (Accessed: 26 December 2011)

Nikolajsen, L. & Jensen, T.S. 2001. Phantom limb pain. British Journal of Anesthesia, 87(1):107-116. Available at: http://bja.oxfordjournals.org/content/87/1/107.full#ref-21 (Accessed: 26 December 2011)

Odou, M.F., Muller, C., Calvet, L. & Dubreuil, L. 2007. In vitro activity against anaerobes of retapamulin, a new topical antibiotic for treatment of skin infections. *Journal of Antimicrobial Chemotherapy,* 59(4):646–651. Available at: http://jac.oxfordjournals.org/content/59/4/646.full.pdf (Accessed: 26 December 2011)

O'Leary, J.P. & Capote, L.R. 2008. *The physiologic basis of surgery*. Fourth Edition. Philadelphia: Wolters Kluwer.

Olson, C.B. & Savelli, A. 1997. *Hospital Drug Services In Managing Drug Supply*. Second Edition. United States of America: Kumarian Press.

Pasquale, T.R., Komorny, K.M., Letting-Mangira, D. & Peshek, S. 2004. A Pharmacist–Physician Antibiotic Support Team. *Pharmacy & Therapeutics*, 29(1):33-40.

Pinto, D.J. & Sanderson, P.J. 1980. Rational use of antibiotic therapy after appendectomy. *British medical journal*, 280(6210):275-7.

Preston, D.P., Southall, A.R.D., Nel, M. & Das, S.K. 2008. Geriatric surgery is about disease, not age. *Journal of the Royal Society of Medicine*, 101(8):409-415.

Rønning, M. 2011. ATC (Anatomical Therapeutic Chemical) classification of medicines and the WHO Collaborating Centre for Drug Statistics Methodology. Available at: http://www.whocc.no/atc_ddd_index/ (Accessed: 10 October 2011).

Rybak, M.J. & Aeschliman, J.R. 2008. Laboratory Tests to Direct Antimicrobial Pharmacotherapy. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors). *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Salman, M.T., Akram, M.F., Rahman, S., Khan, F.A., Haseen, M.A. & Khan, S.W. 2008. Drug Prescribing Pattern in Surgical Wards of a Teaching Hospital in North India. *Indian Journal for the Practicing Doctor*, 5(2). Available at: http://www.indmedica.com/journals.php?journalid=3&issueid=125&articleid=1657&action=article (Accessed: 19 December 2011)

Saseen, J.J. & MacLaughlin, E.J. 2008. Hypertension. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors). *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Schellack, N. & Gous, A.G.S. 2010. *An assessment of the need for pharmaceutical care in an NICU in South Africa*. Lambert Academic Publishing. ISBN: 978-3-8433-7604-4.

Scientists are calling for urgent action by health authorities worldwide to tackle the new superbug strains. Available at: http://thewatchers.adorraeli.com/2011/04/27/scientists-are-calling-for-urgent-action-by-health-authorities-worldwide-to-tackle-the-new-superbug-strains/ (Accessed: 18 August 2011)

Seymour, D.G. & Pringle, R. 1982. Elderly patients in a general surgical unit: do they block beds? *British medical journal*, 284:1921-1923.

Sheppard, D. & Lampiris, H.W. 2003. Antifungal Agents. In: Katzung, B.G. (Editor). *Basic and Clinical Pharmacology.* Ninth edition. New York: McGraw Hill.

Strand, L. 1997. Pharmaceutical care: the Minnesota model. *Pharmaceutical Journal (Special Feature)*, 258:899-904. Available at: http:///www.pjonline.com/Editorial/19970628/articles/minnesotamodel.html. (Accessed: 10 August 2010).

Strand, L. 1998. Building a practice in pharmaceutical care. *Pharmaceutical Journal,* 260:874-876. Available at: http://www.pjonline.com/Editorial/19980163/forum/buildingapractice.html (Accessed: 14 August 2010).

Strang, I.W., Boddy, F.A. & Jennett, B. 1977. Patients in acute surgical wards: a survey in Glasgow. *British Medical journal*, 1(6060):545-548.

Talbert, R.L. 2008. Hyperlipidemia. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors). *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Van Mil, F. 2004. Proving the benefits of pharmaceutical care. *Pharmacy World and Science,* 26:123.

Verrue, C.L., Mehuys, E., Somers, A., Van Maele, G., Remon, J.P. & Petrovic, M. 2010. Medication Administration in Nursing Homes: Pharmacists' Contribution to Error Prevention. *Journal of American Medical Directors Association*, 11(4):275-283.

Weller, T.M.A. & Jamieson, C.E. 2004. The expanding role of the antibiotic pharmacist. *Journal of Antimicrobial Chemotherapy*, 54(2):295–298. Available at: http://jac.oxfordjournals.org/cgi/reprint/54/2/295 (Accessed: 17 June 2010).

Williams, D.B. & Schade, R.R. 2008. Gastroesophageal Reflux Disease. In: DiPiro, J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G. & Posey, L.M. (Editors). *Pharmacotherapy: A pathophysiologic approach*. Seventh Edition. New York: McGraw-Hill.

Zeind, C.S. & McCloskey, W.W. 2006. Pharmacists' Role in the Health Care System. *Harvard Health Policy Review*, 7(1):147-154. Available at: http://www.hcs.harvard.edu/~hhpr/publications/previous/06s/Zeind_and_McCloskey.pdf (Accessed: 22 July 2010).

Appendices

Appendix 1: Pharmacists' patient data base forms

PHARMACEUTICAL CARE FORMS
PHARMACIST PATIENT DATA BASE FORM

PHARMACIST NAME: DATE: (COMMENCEMENT OF PHARMACEUTICAL CARE)
DEMOGRAPHIC AND ADMINISTRATIVE INFORMATION
Patient study number:
Dr:
Date of birth/age: Gender: M / F
Height: Weight:
Admission date: Discharge date:

HISTORY OF PRESENT ILLNESS

VITAL SIGNS	
	O/A
WEIGHT	
TEMP	
BP	
PULSE	
RESPIRATION	

PAST MEDICAL HISTORY/SURGERY

MEDICATION PRIOR TO REVIEW DATE
Chronic:
Acute:

FAMILY AND SOCIAL HISTORY

LIFESTYLE

SOCIAL DRUG USE
ALCOHOL: Y / N
CAFFEINE: Y / N
TABACCO: Y / N

ACUTE AND CHRONIC MEDICAL PROBLEMS
1.
2.
3.
4.
5.

ALLERGIES	
NO KNOWN DRUG ALLERGIES	
ALLERGEN	REACTION

Patient study nr: _____ **PHARMACIST'S PATIENT DATA BASE FORMS**

Pharmacist: _____ Weight: _____

CURRENT DRUG THERAPY

Name/Dose/Route	**Start Date**	**Date of Pharmaceutical Care**											
Problem list, Clinical Response/Changes													

Patient study nr: _____ **PHARMACIST'S PATIENT DATA BASE FORMS**
Pharmacist: _____

LABORATORY DATA

	Reference Range	Date										
CRP												
NA												
K												
CL												
CO2												
UREA												
CREATININE												
GLUCOSE												
GLY HBG												
CA												
Mg												
PHOSPHATE												
TOTAL PROTEIN												
ALBUMIN												
HAEMOGLOBIN												
RBC												
WBC												
PLATELETS												
AST												
ALT												
LDH												
ALK.PHOS.												
TOTAL BILI												
DIRECT BILI												
GGT												
WEIGHT												
TEMP												
BP												
PULSE												
RESPIRATION												

OTHER MONITORING PARAMETERS

Patient study nr: _____

Pharmacist: _____

MICROBIOLOGY MONITORING WORKSHEET

Date	Diagnoses	Sample	Organism	Day cultured	Sensitivity	Antimicrobial agent prescribed	Intervention	Cost implication

Patient study nr: _____ **DRUG THERAPY ASSESMENT**
Pharmacist: _____ **WORKSHEET (DTAW)**

Category of Problem	**Type of Problem**	**Daily assessment**								
	Date:									
Correlation between drug therapy and medical problem	1. Are there drugs without medical indication?									
	2. Are there medication unidentified (not labeled or unknown)?									
	3. Are there untreated medical conditions? If "Yes", do they require drug therapy?									
	4. Are investigations indicated or outstanding?									
Appropriate drug selection	5. What is the comparative efficacy of the chosen medication?									
	6. What is the relative safety of the chosen medication(s)? Are there contraindications, precautions or warnings to consider?									
	7. Has the therapy been tailored to this individual patient?									
Drug regimen	8. Are the prescribed doses and dosing frequency appropriate (within the usual therapeutic range and/or modified for patient factors)?									
	9. Is the route/dosage form/mode of administration appropriate, considering efficacy, safety, convenience, patient limitations and cost?									
	10. Are doses scheduled to maximize therapeutic effect and compliance and to minimize adverse effects, drug interaction and regimen complexity									
	11. Is the length or course of therapy appropriate?									
Therapeutic duplication	12. Is there any therapeutic duplication?									
Drug allergy or intolerance	13. Is the patient allergic to or intolerant of any medicine (or chemically related medications currently being taken)?									
	14. Is the patient using any method to alert health care providers of the allergy/intolerance (or serious medical problem)									
Adverse drug events	15. Are there symptoms or medical problems that may be drug induced? What is the likehood that the problem is drug related?									
Interactions	16. Are there drug-drug interactions? Are they clinically significant?									
	17. Are any medications contraindicated given patient characteristics and current/past disease states?									
	18. Are there drug-nutrient interactions? Are they clinically significant?									
	19. Are there drug-laboratory test interactions? Are they clinically significant?									
Social or recreational drug use	20. Is the patient's current use of social drugs problematic?									
	21. Could sudden decrease or discontinuation of social drugs be related to patients symptoms?									
Failure to receive therapy	22. Has the patient failed to receive a medication due to system error or non-compliance?									
	23. Are there factors hindering the achievement of therapeutic efficacy?									
Financial impact	24. Is the chosen medication(s) cost effective?									
	25. Does the cost of the drug therapy represent a financial hardship for the patient?									
Patient knowledge of drug therapy	26. Does the patient (or carer) understand the purpose of his/her medication(s), how to take it, and the potential side effects of therapy?									
	27. Would the patient (or carer) benefit from education tools (written patient education sheets, wallet cards,or reminder packaging)?									

1. A problem exits
2. More information is needed for a determination
3. No problem exists or an intervention is not needed

Patient study nr: ________________

Pharmacist: ________________

DRUG THERAPY PROBLEM LIST (DTPL)

Date	Problem		Description of problem	Proposed Action / Intervention
	No.	Level		

Patient study nr: _____

Pharmacist: _____

PHARMACIST'S CARE PLAN MONITORING WORKSHEET (MW)

Date	Problem (Level 1) No.	Description of problem	Proposed action / Intervention / Monitoring Parameter(s)	Pharmacotherapeutic Goals and Desired Endpoints	Outcome(s) Achieved? Y / N	Explain How / Why Outcomes was Achieved / Not Achieved	Consultant with whom Intervention was Discussed	Cost implications

Appendix 2: Pharmacist's Time Spent in the Ward

Date: _____

Start time: _____

Number of patients present in ward: _____

Time spent per patient: _____min

Time spent per pharmaceutical care intervention: _____min

Time spent on other ward functions: _____min

List other ward functions time spent on:

- _____
- _____
- _____
- _____
- _____
- _____
- _____

End time: _____

Appendix 3: Doctor's information leaflet, consent and questionnaire

Researcher: Georgina Pretorius
Student Number: 201015277
Department of General Surgery
University of Pretoria

Dear Doctor

An assessment of the need for pharmaceutical care in a general surgical ward at Steve Biko Academic Hospital in Gauteng Province

I am a 2nd year Master's Degree student in Clinical Pharmacy at the University of Limpopo (Medunsa Campus) working in the Department of General Surgery. You are invited to volunteer to participate in my research project to determine the need for a clinical pharmacist in the general surgical wards at Steve Biko Academic Hospital.

This letter gives information to help you to decide if you want to take part in this study. Before you agree you should fully understand what is involved. If you do not understand the information or have any other questions, do not hesitate to ask me. You should not agree to take part unless you are completely happy about what we expect of you.

The purpose of the study is to determine if there is a need for a clinical pharmacist in the surgical wards of Steve Biko Academic Hospital in Gauteng. By doing this study the researcher will monitor all medication prescribed to the patient to see if it is the correct and appropriate selection, if the dosage is correct, to look at allergies, adverse effect and interactions, to monitor if the patient received the medication, if the patient understand the medication he/her is receiving and want the cost implication of the medication is. All interventions will be communicated to the prescribing doctor, who will decide if the intervention will

be made or not. The purpose of the questionnaires is to determine if the doctors feel that there is a need or a benefit in having a pharmacist providing pharmaceutical care by answering a few yes-no questions. The pharmacist will be working in the ward during the research period, and the research will be operational in nature.

We would like you to complete the questionnaire. This may take about ten minutes. The pharmacist will collect the questionnaire from you after you have completed the questionnaire. It will be kept in a safe place to ensure confidentiality. Please do not write your name on the questionnaire.

The Research Ethics Committee of the University of Pretoria, Faculty of Health Sciences granted written approval for this study. Approval has also been sought from the Medunsa Research and Ethics Committee from the University of Limpopo (Medunsa Campus). Your participation in this study is voluntary. You can refuse to participate or stop at any time without giving any reason. As you do not write your name on the questionnaire, you give us the information anonymously. Once you have given the questionnaire back to us, you cannot recall your consent. We will not be able to trace your information. Therefore, you will also not be identified as a participant in any publication that comes from this study. Note: The implication of completing the questionnaire is that informed consent has been obtained from you. Thus any information derived from your form (which will be totally anonymous) may be used for e.g. publication, by the researchers.

We sincerely appreciate your help.
Yours truly,
Georgina Pretorius
Researcher/Pharmacist
Telephone Number: 073 232 6129

Statement concerning participation in the Research Project

Name of Project
An assessment of the need for pharmaceutical care in a general surgical ward at Steve Biko Academic Hospital in Gauteng Province

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

I understand that participation in this study is completely voluntary and that I may withdraw from it at any time and without supplying reasons.

I agree to this, provided my privacy is guaranteed.
I hereby give consent to participate in this study.

.....
Name of volunteer

.....	.....	.....
Place	Date	Witness

Statement by the Researcher

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

.....	.....	.....	.....
Name of Researcher	Signature	Date	Place

Pharmaceutical care doctors' questionnaire

1. Do you feel there is a need for a pharmacist to routinely visit the surgical wards?
   Yes: □ No: □
   Comment: _____
   _____

2. Do you benefit from having the pharmacist present in the wards while you are conducting your ward rounds?
   Yes: □ No: □
   Comment: _____
   _____

3. Is the pharmacist able to provide you with adequate information to your information requests?
   Yes: □ No: □
   Comment: _____
   _____

4. Do you feel that interventions made by a pharmacist would improve the rational use of antimicrobials in your department?
   Yes: □ No: □
   Comment: _____
   _____

5. Do you feel that the provision of pharmaceutical care would decrease the expenditure of antimicrobials in your department?
   Yes: □ No: □
   Comment: _____
   _____

Appendix 4: Nurses' information leaflet, informed consent and questionnaire

Researcher: Georgina Pretorius
Student Number: 201015277
Department of General Surgery
University of Pretoria

Dear Participant
An assessment of the need for pharmaceutical care in a general surgical ward at Steve Biko Academic Hospital in Gauteng Province

I am a 2nd year Master's Degree student in Clinical Pharmacy working in the Department of General Surgery. You are invited to volunteer to participate in my research project to determine the need for a clinical pharmacist in the general surgical wards at Steve Biko Academic Hospital.

This letter gives information to help you to decide if you want to take part in this study. Before you agree you should fully understand what is involved. If you do not understand the information or have any other questions, do not hesitate to ask me. You should not agree to take part unless you are completely happy about what we expect of you.

The purpose of the study is to determine if there is a need for a clinical pharmacist in the surgical wards of Steve Biko Academic Hospital in Gauteng. By doing this study the researcher will monitor all medication prescribed to the patient to see if it is the correct and appropriate selection, if the dosage is correct, to look at allergies, adverse effect and interactions, to monitor if the patient received the medication, if the patient understand the medication he/her is receiving and want the cost implication of the medication is. If applicable, interventions will be communicated to the nursing staff. The purpose of the

questionnaires is to determine if the nursing staff feel that there is a need or a benefit in having a pharmacist providing pharmaceutical care by answering a few yes-no questions. The pharmacist will be working in the ward during the research period, and the research will be operational in nature.

We would like you to complete the questionnaire. This may take about ten minutes. The pharmacist will collect the questionnaire from you after you have completed the questionnaire. It will be kept in a safe place to ensure confidentiality. Please do not write your name on the questionnaire. The pharmacist will be available to help you with the questionnaire or to fill it in on your behalf.

The Research Ethics Committee of the University of Pretoria, Faculty of Health Sciences granted written approval for this study. Approval has also been sought from the Medunsa Research and Ethics Committee from the University of Limpopo (Medunsa Campus). Your participation in this study is voluntary. You can refuse to participate or stop at any time without giving any reason. As you do not write your name on the questionnaire, you give us the information anonymously. Once you have given the questionnaire back to us, you cannot recall your consent. We will not be able to trace your information. Therefore, you will also not be identified as a participant in any publication that comes from this study.

Note: The implication of completing the questionnaire is that informed consent has been obtained from you. Thus any information derived from your form (which will be totally anonymous) may be used for e.g. publication, by the researchers.

We sincerely appreciate your help.

Yours truly,

Georgina Pretorius
Researcher/Pharmacist
Telephone Number: 073 232 6129

Statement concerning participation in the Research Project

Name of Project
An assessment of the need for pharmaceutical care in a general surgical ward at Steve Biko Academic Hospital in Gauteng Province

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

I understand that participation in this study is completely voluntary and that I may withdraw from it at any time and without supplying reasons.

I agree to this, provided my privacy is guaranteed.
I hereby give consent to participate in this study.

.....
Name of volunteer

....
Place Date Witness

Statement by the Researcher

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

.... ……. ……
Name of Researcher Signature Date Place

Pharmaceutical care nurses' questionnaire

1. Do you feel that there is a need for a pharmacist to routinely visit the surgical wards?

   Yes: ☐ No: ☐

   Comment: _____

   _____

2. What activities do you feel the pharmacist could fulfill within your department?

Patient counseling/education		Staff education	
Drug identification		Checking ward stock for expiries	
Prescription chart reviews		Dealing with pharmaceutical queries	
Drug ordering for patients		Schedule 5,6 & 7 Ordering	
Checking for drug interactions		Checking for adverse drug reactions	
Other:			

3. Do you feel that a pharmacist round would facilitate improved drug distribution to your department?

   Yes: ☐ No: ☐

   Comment: _____

   _____

4. Do you feel that there is a need for weekly education sessions with the pharmacist?

   Yes: ☐ No: ☐

   Comment: _____

   _____

Appendix 5: Patient information leaflet and informed consent for non-clinical research

TITLE OF STUDY: An assessment of the need for pharmaceutical care in a general surgical ward at Steve Biko Academic Hospital in Gauteng Province

Dear Patient

1) INTRODUCTION

We invite you to participate in a research study. This information leaflet will help you to decide if you want to participate. Before you agree to take part you should fully understand what is involved. If you have any questions that this leaflet does not fully explain, please do not hesitate to ask the investigator, Georgina Pretorius.

2) THE NATURE AND PURPOSE OF THIS STUDY

The role of the pharmacist has been expanding towards patient centered functions, in which the pharmacist assumes responsibility for treatment outcomes as part of the health care team. The aim of this study is to assess the need for the provision of these functions by the pharmacist to the patients in the surgical wards of Steve Biko Academic Hospital. You as a patient are a very important source of information to determine if there is need and if so, who the pharmacist play a role in resolving it.

3) EXPLANATION OF PROCEDURES TO BE FOLLOWED

By doing this study the researcher will monitor all medication prescribed to the patient to see if it is the correct and appropriate selection, if the dosage is correct, to look at allergies, adverse effect and interactions, to monitor if the patient received the medication, if the patient understand the medication he/her is receiving and want the cost of the medication is.

4) RISK AND DISCOMFORT INVOLVED

There are no risks in participating in the study as the pharmacist will only observe and communicate with the prescribing doctor if necessary.

5) POSSIBLE BENEFITS OF THIS STUDY

You may benefit directly by the study because by doing this study, the pharmacist want to improve your needs and medical treatment by working as a team with the doctors and nursing staff.

6) WHAT ARE YOUR RIGHTS AS A PARTICIPANT?

Your participation in this study is entirely voluntary. You can refuse to participate or stop at any time during the study without giving any reason. Your withdrawal will not affect you or your treatment in any way.

7) HAS THE STUDY RECEIVED ETHICAL APPROVAL?

This study has received written approval from the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria. A copy of the approval letter is available if you wish to have one. Approval from the University of Limpopo will also be obtained and a copy of approval would be available if you wish to have one.

8) INFORMATION AND CONTACT PERSON

The contact person for the study is Georgina Pretorius. If you have any questions about the study please contact her at cell 073 232 612.

9) COMPENSATION

Your participation is voluntary. No compensation will be given for your participation.

10) CONFIDENTIALITY

All information that you give will be kept strictly confidential. Once we have analyzed the information no one will be able to identify you. Research reports and articles in scientific journals will not include any information that may identify you or your hospital.

CONSENT TO PARTICIPATE IN THIS STUDY

I confirm that the person asking my consent to take part in this study has told me about nature, process, risks, discomforts and benefits of the study. I have also received, read and understood the above written information (Information Leaflet and Informed Consent) regarding the study. I am aware that the results of the study, including personal details, will be anonymously processed into research reports. I am participating willingly. I have had time to ask questions and have no objection to participate in the study. I understand that there is no penalty should I wish to discontinue with the study and my withdrawal will not affect any treatment in any way.

I have received a signed copy of this informed consent agreement.

Participant's name ……..... (Please print)
Participant's signature: .....……. Date.....

Surrogate's name …….. (Please print)
Surrogate's signature …… Date……....

Investigator's name .....…… (Please print)
Investigator's signature .....…….. Date.….....

Witness's Name .....……..... (Please print)
Witness's signature .....……..... Date.….....

VERBAL INFORMED CONSENT

I, the undersigned, have read and have fully explained the participant information leaflet, which explains the nature, process, risks, discomforts and benefits of the study to the participant whom I have asked to participate in the study.

The participant indicates that s/he understands that the results of the study, including personal details regarding the interview will be anonymously processed into are search report. The participant indicates that s/he has had time to ask questions and has no objection to participate in the interview. S/he understands that there is no penalty should s/he wish to discontinue with the study and his/her withdrawal will not affect any treatment in any way. I hereby certify that the client has agreed to participate in this study.

Participant's Name .....…….. (Please print)

Person seeking consent .....…..... (Please print)

Signature .....…….....Date.....

Witness's name….....……..... (Please print)

Signature .....……Date.….....

Appendix 6: Ethical approval was obtained from the University of Pretoria's ethical committee

The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.
* FWA 00002567, Approved dd 22 May 2002 and Expires 13 Jan 2012.
* IRB 0000 2235 IORG0001762 Approved dd Jan 2006 and Expires 13 Aug 2011.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences Research Ethics Committee
Fakulteit Gesondheidswetenskappe Navorsingsetiekkomitee

DATE: 27/01/2011

PROTOCOL NO.	**237/2010**
PROTOCOL TITLE	An assessment of the need for pharmaceutical care in a generalsurgica ward at Steve Biko Academic Hospital in Gauteng Province
INVESTIGATOR	**Principal Investigator:** Ms Georgina Pretorius
SUBINVESTIGATOR	None
SUPERVISOR	Prof JHR Becker **E-Mail:** hennie.becker@up.ac.za
DEPARTMENT	**Dept:** General Surgery **E-Mail:** georginarossouw@gemail.com **Cell:** 0732326129
STUDY DEGREE	MSc (Med) in Pharmacy
SPONSOR	None
MEETING DATE	**24/11/2010 – 26/01/2011**

The Protocol and Informed Consent Document were approved on 26/01/2011 by a properly constituted meeting of the Ethics Committee subject to the following conditions:

1. The approval is valid for 1 year period [till the end of December 2011] , and
2. The approval is conditional on the receipt of 6 monthly written Progress Reports, and
3. The approval is conditional on the research being conducted as stipulated by the details of the documents submitted to and approved by the Committee. In the event that a need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

Members of the Research Ethics Committee:

Prof M J Bester	(female)BSc (Chemistry and Biochemistry); BSc (Hons)(Biochemistry); MSc(Biochemistry); PhD (Medical Biochemistry)
Prof R Delport	(female)BA et Scien, B Curationis (Hons) (Intensive care Nursing), M Sc (Physiology), PhD (Medicine), M Ed Computer Assisted Education
Prof JA Ker	MBChB; MMed(Int); MD – Vice-Dean (ex officio)
Dr NK Likibi	MBBCh – Representing Gauteng Department of Health)
Prof TS Marcus	(female) BSc(LSE), PhD (University of Lodz, Poland) – Social scientist
Dr MP Mathebula	(female)Deputy CEO: Steve Biko Academic Hospital
Prof A Nienaber	(female) BA(Hons)(Wits); LLB; LLM(UP); PhD; Dipl.Datametrics (UNISA) – Legal advisor
Mrs MC Nzeku	(female) BSc(NUL); MSc(Biochem)(UCL, UK) – Community representative
Prof L M Ntlhe	MBChB(Natal); FCS(SA)
Snr Sr J Phatoli	(female) BCur(Eet-A); BTec(Oncology Nursing Science) – Nursing representative
Dr R Reynders	MBChB (Prét), FCPaed (CMSA) MRCPCH (Lon) Cert Med. Onc (CMSA)
Dr T Rossouw	(female) M.B.,Ch.B. (cum laude); M.Phil (Applied Ethics) (cum laude), MPH (Biostatistics and Epidemiology (cum laude), D.Phil
Dr L Schoeman	(female) B.Pharm, BA(Hons)(Psych), PhD – Chairperson: Subcommittee for students' research

MS: dd 2011/02/03: C:\Documents and Settings\User\My Documents\Protokolle\Grade briewe\Letters 2010\237.doc

Mr Y Sikweyiya	MPH; SARETI Fellowship in Research Ethics; SARETI ERCTP; BSc(Health Promotion) Postgraduate Dip (Health Promotion) – Community representative
Dr R Sommers	(female) MBChB; MMed(Int); MPharmMed – **Deputy Chairperson**
Prof TJP Swart	BChD, MSc (Odont), MChD (Oral Path), PGCHE – School of Dentistry representative
Prof C W van Staden	MBChB; MMed (Psych); MD; FCPsych; FTCL; UPLM - **Chairperson**

DR R SOMMERS; MBChB; MMed(Int); MPharmMed.
Deputy Chairperson of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

♦Tel:012-3541330 ♦Fax:012-3541367 / 0866515924 ♦E-Mail: manda@med.up.ac.za
♦Web: //www.healthethics-up.co.za ♦H W Snyman Bld (South) Level 2-34 ♦P.O.BOX 667, Pretoria, S.A., 0001

Appendix 7: Ethical approval was obtained from the University of Limpopo (Medunsa Campus)

UNIVERSITY OF LIMPOPO
Medunsa Campus

MEDUNSA RESEARCH & ETHICS COMMITTEE

CLEARANCE CERTIFICATE

P O Medunsa
Medunsa
0204
SOUTH AFRICA

Tel: 012 - 521 4000
Fax: 012 - 560 0086

MEETING: 02/2011

PROJECT NUMBER: MREC/H/24/2011: PG

PROJECT :

Title: An assessment of the need for pharmaceutical care in a general surgical ward at Steve Biko Academic Hospital in Gauteng Province

Researcher: Mrs G Pretorius
Supervisor: Dr N Schellack
Co-Supervisor: Prof JH Becker
Prof AGS Gous
Department: Pharmacy
School: Health Care Sciences
Degree: MSc (Med) Pharmacy

DECISION OF THE COMMITTEE:

MREC approved the project.

DATE: 10 March 2011

PROF GA OGUNBANJO
CHAIRPERSON MREC

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.

African Excellence - Global Leadership

Appendix 8: Permission to conduct the study

UNIVERSITY OF LIMPOPO
Medunsa Campus

Department of Pharmacy

P O Box 218
Medunsa
0204
Tel: (012) 521 5866
Fax: (012) 521 3992
Email: nschellack@ul.ac.za

Dr BJ Ribeiro
Steve Biko Academic Hospital

Dear Dr Ribeiro

Letter of intent to conduct an operational study

We are herby requesting for Georgina Pretorius to conduct a study in the general surgical ward at Steve Biko Academic Hospital. Mrs Pretorius is enrolled for an MSc (Med) in Pharmacy at the University of Limpopo. Attached please find the proposal for the study entitled: "An assessment of the need for pharmaceutical care in the surgical wards of Steve Biko Academic Hospital in Gauteng Province"

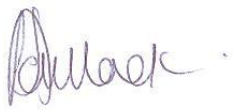
The study has been approved by Prof J.H. Becker who will also co-supervise the study. The proposal will be submitted to the School of Health Care Sciences and the Medunsa Research and Ethics Committee at the University of Limpopo (Medunsa Campus). The proposal will also be submitted to the University of Pretoria's Ethics Committee for approval.

The aim of the study is:
To determine the need for provision of pharmaceutical care from the pharmacist to the surgical wards of Steve Biko Academic Hospital.
The objectives are:

- To determine the role of the pharmacist in the general surgical wards
- To assist in the design and implementation of an antimicrobial ward protocol in the surgical wards

- To describe and categorize the interventions performed by a pharmacist during the provision of pharmaceutical care
- To identify factors which limit the provision of pharmaceutical care and provide recommendations for future undertakings
- To calculate the cost implications before and after pharmaceutical care interventions are made
- To assess the time spent on interventions performed by a pharmacist during the provision of pharmaceutical care
- To determine if the medical staff members in the surgical unit feel there is a need for the pharmacist providing pharmaceutical services to the wards

Kindest regards



Dr Natalie Schellack
Senior Lecturer/Clinical Pharmacist
Department of Pharmacy
Medunsa Campus
University of Limpopo
012 521 3286

Cc Prof JHR Becker; Prof AGS Gous

PROUDLY SOUTH AFRICAN

Appendix 9: Permission to access records / files / data base

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences
Department of Surgery

22 September 2010

PERMISSION TO ACCESS RECORDS / FILES / DATA BASE AT:

THE DEPARTMENT OF GENERAL SURGERY – STEVE BIKO ACADEMIC HOSPITAL

I, Prof JHR Becker Head of Department of General Surgery hereby give Mrs Georgina Pretorius permission to do the research study in this Department and to access the information as requested.

Yours sincerely

PROF JHR BECKER
Head of Department
General Surgery
Tel nr.: (012) 354-2099

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http://www.up.ac.za/academic/medicine

Appendix 10: Medication used in the surgical ward: number of study patients and the mean duration of use

System	ATC Code	International non-proprietary name	Number of patients (n=62)	Mean duration of use (days)
A Alimentary tract and metabolism	A02BA01	Cimetidine	5	4
	A02BC01	Omeprazole	10	2
	A02BC02	Pantoprazole	16	4
	A02BC05	Esomeprazole	3	1
	A02BX02	Sucralfate	8	4
	A03BB01	Hyoscine butylbromide	3	3
	A03FA01	Metoclopramide	22	4
	A04A01	Ondansetron	1	5
	A06AB02	Bisacodyl	2	1
	A06AD11	Lactulose	4	7
	A06AG01	Phosphate	2	1
	A07C	IV fluids	2	2
	A07DA03	Loperamide	1	3
	A07EC02	Mesalazine	1	2
	A10AA01	Insulin rapid acting	6	6
	A10AA02	Insulin long acting	3	10
	A10AA03	Insulin biphasic	1	25
	A10BA02	Metformin	4	6
	A10BB09	Gliclazide	2	5
	A11EB	Vitamin B complex	1	9
	A12AA03	Calcium gluconate	1	3
	A12BA01	Potassium chloride	13	4
B Blood and blood forming organs	B01AA03	Warfarin	2	5
	B01AB01	Heparin calcium	2	5
	B01AB04	Dalteparin	7	2
	B01AB06	Enoxaparin sodium	24	5
	B02AA02	Tranexamic acid	1	5
	B02BA01	Vitamin K1	4	2
	B02BD04	Factor IX complex	1	1
	B03AA07	Ferrous sulphate	2	7
	B05B	Total Parenteral Nutrition	2	16
	B05C	Ringer-Lactate	1	1
	B05XA06	Potassium phosphate	2	2

C Cardiovascular system	C01AA05	Digoxin	1	5
	C01DA14	Isosorbide mononitrate	2	9
	C03AA03	Hydrochlorothiazide	12	7
	C03CA01	Furosemide	7	9
	C03DA01	Spironolactone	7	5
	C07AA05	Propranolol	2	4
	C07AB03	Atenolol	1	7
	C07AG02	Carvedilol	3	6
	C08CA05	Nifedipine	16	5
	C09AA01	Captopril	1	5
	C09AA02	Enalapril	2	7
	C09AA04	Perindopril	14	7
	C09CA01	Losartan	1	7
	C10AA01	Simvastatin	7	7
D Dermatologicals	D01AA01	Nystatin	1	3
	D01AC02	Miconazole topical	1	4
G Genitourinary system and sex hormones	G01AF02	Clotrimazole	3	1
	G04AC01	Nitrofurantoin	1	1
H Systemic hormonal preparations	H01CB02	Octreotide	1	21
	H02AB04	Methylprednisolone	1	10
	H02AB07	Prednisone	1	2
	H03AA01	Levothyroxine sodium	3	1
	H03BB01	Carbimazole	1	11
J Anti-infective for systemic use	J01CA01	Ampicillin	4	5
	J01CA04	Amoxicillin	3	2
	J01CA12	Tazobactam/piperacillin	4	5
	J01CR02	Co-amoxiclav	21	5
	J01DA04	Cefazolin	9	4
	J01DH02	Meropenem	1	6
	J01EE01	Co-trimoxazole	1	1
	J01FA01	Erythromycin	5	5
	J01FA09	Clarithromycin	2	3
	J01FF01	Clindamycin	1	2
	J01GB03	Gentamicin	6	4
	J01MA02	Ciprofloxacin	9	4
	J02AC01	Fluconazole	2	1
	J04BA02	Dapsone	1	1
	J05AF05	Lamivudine (3TC)	1	3
	J05AF07	Tenofovir	1	3
	J05AG03	Efavirenz	1	3

M Musculo-skeletal system	M01AB01	Indomethacin	5	6
	M01AB05	Diclofenac	3	3
	M01AE01	Ibuprofen	17	4
N Nervous system	N02AA01	Morphine	3	3
	N02AG01	Morphine/papaverine/codeine	41	4
	N02AG03	Pethidine	2	5
	N02AX01	Tilidine	1	1
	N02BA01	Aspirin	7	7
	N02BE01	Paracetamol	53	5
	N03AB02	Phenytoin	1	11
	N03AE01	Clonazepam	1	4
	N03AF01	Carbamazepine	2	14
	N03AG01	Valproic acid	1	1
	N04BC01	Bromocriptine	1	5
	N05AB04	Prochlorperazine	3	2
	N05BA04	Oxazepam	4	3
	N05BB01	Hydroxyzine	1	1
	N06AA09	Amitriptyline	6	5
	N06AB03	Fluoxetine	2	4
	N06AB04	Citalopram	1	11
P Antiparasitic products	P01AB01	Metronidazole	15	4
R Respiratory system	R03AK03	Fenoterol	6	6
	R03BA01	Beclomethasone	3	8
	R03BB01	Ipratropium bromide	6	6
	R03DB04	Theophylline	1	9

Appendix 11: Ranking of medicines by total duration of use

Active ingredient	ATC code	Patients (n=62)	Rank	Patient-days	Rank
Paracetamol	N02BE01	53	1	277	1
Morphine/papaverine/codeine	N02AG01	41	2	155	2
Enoxaparin sodium	B01AB06	24	3	113	3
Co-amoxiclav	J01CR02	21	5	101	4
Perindopril	C09AA04	14	9	91	5
Metoclopramide	A03FA01	22	4	90	6
Hydrochlorothiazide	C03AA03	12	11	84	7
Nifedipine	C08CA05	16	7	84	7
Ibuprofen	M01AE01	17	6	66	8
Furosemide	C03CA01	7	15	63	9
Metronidazole	P01AB01	15	8	62	10
Pantoprazole	A02BC02	16	7	62	10
Potassium chloride	A12BA01	13	10	51	11
Simvastatin	C10AA01	7	15	50	12
Aspirin	N02BA01	7	15	50	12
Ciprofloxacin	J01MA02	9	13	36	13
Fenoterol	R03AK03	6	16	36	13
Ipratropium bromide	R03BB01	6	16	36	13
Insulin rapid acting	A10AA01	6	16	35	14
Sucralfate	A02BX02	8	14	34	15
Spironolactone	C03DA01	7	15	34	15
Cefazolin	J01DA04	9	13	32	16
Amitriptyline	N06AA09	6	16	32	16
Total Parenteral Nutrition	B05B	2	20	31	17
Lactulose	A06AD11	4	18	29	18
Insulin long acting	A10AA02	3	19	29	18
Carbamazepine	N03AF01	2	20	28	19
Indomethacin	M01AB01	5	17	28	19
Erythromycin	J01FA01	5	17	26	20
Gentamicin	J01GB03	6	16	25	21
Insulin biphasic	A10AA03	1	21	25	21
Metformin	A10BA02	4	18	25	21
Beclomethasone	R03BA01	3	19	23	23
Tazobactam/piperacillin	J01CA12	4	18	21	24
Omeprazole	A02BC01	10	12	21	24
Octreotide	H01CB02	1	21	21	24
Cimetidine	A02BA01	5	17	18	25
Isosorbide mononitrate	C01DA14	2	20	18	25

Carvedilol	C07AG02	3	19	18	25
Ampicillin	J01CA01	4	18	18	25
Dalteparin	B01AB04	7	15	14	26
Ferrous sulphate	B03AA07	2	20	14	26
Enalapril	C09AA02	2	20	13	27
Carbimazole	H03BB01	1	21	11	28
Phenytoin	N03AB02	1	21	11	28
Citalopram	N06AB04	1	21	11	28
Oxazepam	N05BA04	4	18	11	28
Gliclazide	A10BB09	2	20	10	29
Warfarin	B01AA03	2	20	10	29
Methylprednisolone	H02AB04	1	21	10	29
Pethidine	N02AG03	2	20	10	29
Hyoscine butylbromide	A03BB01	3	19	9	30
Vitamin B complex	A11EB	1	21	9	30
Heparin calcium	B01AB01	2	20	9	30
Vitamin K1	B02BA01	4	18	9	30
Diclofenac	M01AB05	3	19	9	30
Morphine	N02AA01	3	19	9	30
Theophylline	R03DB04	1	21	9	30
Propranolol	C07AA05	2	20	8	31
Atenolol	C07AB03	1	21	7	32
Losartan	C09CA01	1	21	7	32
Fluoxetine	N06AB03	2	20	7	32
Amoxicillin	J01CA04	3	19	6	33
Meropenem	J01DH02	1	21	6	33
Clarithromycin	J01FA09	2	20	6	33
Prochlorperazine	N05AB04	3	19	5	34
Ondansetron	A04A01	1	21	5	34
Tranexamic acid	B02AA02	1	21	5	34
Digoxin	C01AA05	1	21	5	34
Captopril	C09AA01	1	21	5	34
Bromocriptine	N04BC01	1	21	5	34
Potassium phosphate	B05XA06	2	20	4	35
Miconazole topical	D01AC02	1	21	4	35
Clonazepam	N03AE01	1	21	4	35
Clotrimazole	G01AF02	3	19	4	35
Esomeprazole	A02BC05	3	19	3	36
IV fluids	A07C	2	20	3	36
Loperamide	A07DA03	1	21	3	36
Calcium gluconate	A12AA03	1	21	3	36

Nystatin	D01AA01	1	21	3	36
Levothyroxine sodium	H03AA01	3	19	3	36
Lamivudine (3TC)	J05AF05	1	21	3	36
Tenofovir	J05AF07	1	21	3	36
Efavirenz	J05AG03	1	21	3	36
Bisacodyl	A06AB02	2	20	2	37
Phosphate	A06AG01	2	20	2	37
Mesalazine	A07EC02	1	21	2	37
Prednisone	H02AB07	1	21	2	37
Clindamycin	J01FF01	1	21	2	37
Fluconazole	J02AC01	2	20	2	37
Factor IX complex	B02BD04	1	21	1	38
Ringer-Lactate	B05C	1	21	1	38
Nitrofurantoin	G04AC01	1	21	1	38
Co-trimoxazole	J01EE01	1	21	1	38
Dapsone	J04BA02	1	21	1	38
Tilidine	N02AX01	1	21	1	38
Valproic acid	N03AG01	1	21	1	38
Hydroxyzine	N05BB01	1	21	1	38

Appendix 12: Antibiotic policy recommendations

ANTIBIOTIC POLICY RECOMMENDATIONS

DEPARTMENT: SURGERY

UNIVERSITY OF PRETORIA
STEVE BIKO ACADEMIC HOSPITAL

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4. IV to oral switch 3
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1. Introduction

The majority of hospitalized patients receive antibiotics for therapy or prophylaxis during their inpatient stay. It has been estimated that patients receive antibiotics needlessly. Reasons include inappropriate prescribing for antibiotic prophylaxis, continuation of empiric therapy despite negative cultures in a stable patient and a lack of awareness of susceptibility patterns of common pathogens. Over prescribing not only increases the costs of health care, but may result in super infection due to antibiotic-resistant bacteria, as well as opportunistic fungi, and may increase the likelihood of an adverse drug reaction. On the other hand, not prescribing (when there is an urgent need at the bedside) may also lead to serious consequences.

This policy serves only as a guideline for prescribing patterns, the aim of which is to introduce rational drug prescribing for prophylactic antibiotic treatment and therapeutic antibiotic treatment of infection mostly seen in the surgical wards.

2. Septic screen

For suspected sepsis, do a full septic screen and when appropriate start on antibiotic treatment

- Full blood count
- Blood culture
- CSF analysis (chemical and microbiological)
- Suprapubic urine microscopy, culture and sensitivity
- Intravenous fluid culture taken near the cannula
- Gastric aspirate for microscopy, culture and sensitivity (in early sepsis)
- X rays

3. Duration of empiric antibiotic treatment

Treat for 7 days but, antibiotic treatment should be stopped beforehand if:

- Cultures are reported negative, or/and
- The patient is normothermic for 48 hours with decreasing infection markers:
  - White blood cell count
  - Procalcitonin
  - C-reactive protein (this could also be elevated due to inflammation and trauma)

4. IV to oral switch

As adapted from Antimicrobial Management Group. 2008. Available at http://www.nhstaysideadtc.scot.nhs.uk/tapg%20html/Section%2014/pdf%20docs/Section%2014IVOST%2008.pdf (Accessed on 29 March 2011)

Indications to continue with IV treatment:

- Continuing serious sepsis (2 or more of the following)
  - temp > 38°C or < 36°C
  - tachycardia > 90/min
  - tachypnoea > 20 breaths/min
  - WCC > 12 or < 4
- Febrile with neutropenia (WCC <1.0)
- Specific infections which require high dose IV therapy e.g. endocarditis, septic arthritis, osteomyelitis, meningitis, abscess, cystic fibrosis patients, prosthetic infection
- Oral route compromised
  - vomiting
  - nil by mouth
  - reduced absorption e.g. severe diarrhoea or steatorrhoea
  - mechanical swallowing disorder
  - unconscious
- Patient post-surgery not tolerating 1 litre of fluid orally
- No oral alternative

Table 1: IV to oral switch

Intravenous Infusion (IV)	Oral
Amoxicillin 500mg -1g tds	Amoxicillin 500mg -1g tds
Amoxicillin 1g tds + Metronidazole 500mg tds + Gentamicin 7 mg/kg	Co-amoxiclav 375mg tds + amoxicillin 250mg tds
Benzylpenicillin 1.2g qds	Penicillin V 1g bd or 500mg qds
Ciprofloxacin 400mg bd	Ciprofloxacin 500mg bd or 750mg bd if Pseudomonas *spp* isolated
Clindamycin 600mg qds	Clindamycin 300-450mg tds
Co-amoxiclav 1.2g tds	Co-amoxiclav 375mg tds + amoxicillin 250mg tds
Flucloxacillin 1g qds	Flucloxacillin 1g qds
Gentamicin 7mg/kg	Refer to lab sensitivity. Ciprofloxacin 500mg bd or 750mg bd if pseudomonas *spp* isolated may be an option if sensitive
Metronidazole 500mg tds	Metronidazole 400mg tds
Other antibiotics	Seek advice
Od: once a day; bd 12 hourly, tds:8 hourly, qds:6 hourly	

5. Choice of antibiotics

The choice of antibiotics may depend on the following factors:

- Antibiotic spectrum of activity

  This term refers to the range of microorganisms against which a particular antibiotic is effective. For concentration-dependent drugs, the ratio of area under the concentration (AUC) to minimum inhibitory concentration (MIC): AUC/MIC should be 100-125 for gram-negative and 30 for gram-positive pathogens. For time-dependent drugs, dosing to achieve T>MIC at least 40% of the dosing interval is required. To optimize therapy the dosing frequency should be increased.

- Tissue penetration

  Antibiotics that are effective against a microorganism in-vitro but unable to reach the site of infection are of little or no benefit to the host. Antibiotic tissue penetration depends on properties of both the antibiotic (e.g., lipid solubility,

molecular size) and the tissue (e.g., adequacy of blood supply, presence of inflammation).

- Safety
  Avoid antibiotics with serious or frequent side effect.
- Cost
  Switching early from IV to PO antibiotics is the single most important cost saving strategy in hospitalized patients.
- Antibiotic resistance
  Resistance implies that growth of bacteria continues in the presence of an antibiotic. There are 2 forms:
  Intrinsic resistance/natural resistance where the organism lacks the specific target for a drug or the target is present but not accessible to the drug.
  Acquired resistance where an organism that was initially susceptible to a drug has become resistant due to any of a number of mechanisms.

5.1. Surgical prophylactic antibiotic treatment

Prophylactic antibiotic treatment is defined as the use of antibiotics before, during, or after a diagnostic, therapeutic, or surgical procedure to prevent infectious.[1]

General:

- The need for prophylactic antibiotic therapy is based on the risk of wound contamination.[2] When the incidence of postoperative wound infection is less than 1%, the potential for reducing this low infection rate even further does not justify the expense and side effects of antibiotic administration.
- Antibiotic prophylaxis is not required for clean operations/procedures in immunocompetent patients, who have minimal risk of contamination. In all other situations, prophylaxis should be considered.[2]
- The drug chosen should be active against the pathogens most likely to be associated with wound infections.[1,2]
- Prophylaxis must be given within 30^{1} – 60^{2} minutes of the first incision, usually at induction. Antibiotics should be administered in theatre and given as a bolus injection where possible.

- The prophylactic dose is a single dose equal to the standard therapeutic dose.[1,2]
- Reason for antibiotic administration beyond one dose should be documented and comply with criteria below:
  - >1.5 liter intra-operative blood loss (re-dose following fluid replacement).[1]
  - Prolonged procedure, i.e. >4 hours for cefazolin OR > 8 hours for metronidazole.[1,2]
- Cefazolin is the preferred prophylactic agent for most surgical procedures where anaerobes are not encountered. For surgical procedures where anaerobes are encountered the preferred prophylactic agent are cefoxitin or cefazolin plus metronidazole. See table 2.

Table 2: Prophylaxis for Surgery

Type of surgery	**Usual pathogens**	**Therapy**	**Comment**
Oesophageal	Enteric gram (-) bacilli, gram (+) cocci	Cefazolin 1g x 1	High-risk patients only
Gastroduodenal	Enteric gram (-) bacilli, gram (+) cocci, oral anaerobes	Cefazolin 1g x 1	High-risk patients only (obstruction, haemorrhage, malignancy, acid suppression therapy, morbid obesity)
Biliary tract	Enteric gram (-) bacilli, gram (+) cocci, anaerobes	Cefazolin 1g × 1 for high-risk patients, Laparoscopic: None	High-risk patients only (acute cholecystitis, common duct stones, previous biliary surgery, jaundice, age >60, obesity, diabetes mellitus)
Appendectomy	Enteric gram (-) bacilli, anaerobes	Cefoxitin 1g x1 OR Cefazolin 1g plus Metronidazole 500mg x 1	A second intraoperative dose of cefoxitin may be required if procedure lasts longer than 3 hours. Complicated or perforated appendectomy is treat as peritonitis
Colorectal surgery	Enteric gram (-) bacilli, gram (+) cocci, anaerobes	Cefoxitin 1g x1 OR Cefazolin 1g plus Metronidazole 500mg x 1	

Hernia repair	Enteric gram (-) bacilli, gram (+) cocci, oral anaerobes	Uncomplicated: none Uncomplicated with mesh: Cefazolin 1g Complicated: Cefoxitin 1g OR Cefazolin 1g plus Metronidazole 500mg	
Penetrating abdominal trauma	Enteric gram (-) bacilli, gram (+) cocci, anaerobes	Cefoxitin 1g x1 OR Cefazolin 1g plus Metronidazole 500mg x1	
Lower limb amputation	*S. aureus, S. epidermidis*, enteric gram (-) bacilli, enterococcus	Cefoxitin 1g x1 OR Cefazolin 1g plus Metronidazole 500mg x1	

In the instance of severe β-lactam allergy:

Use in place of cefazolin and cefazolin plus metronidazole:

Clindamycin has good anaerobic cover

- Clindamycin, IV, 300 mg

Colorectal, biliary or pelvic surgery:

- Clindamycin, IV, 300 mg plus gentamicin, IV, 3 mg/kg

5.2. Therapeutic antibiotic treatment

Therapeutic antibiotic treatment is defined as the use of substances that reduce the growth or reproduction of bacteria, including eradication therapy. This term is used to describe antimicrobial therapy prescribed to clear infection by an organism or to clear an organism that is colonising a patient but is not causing infection.

Table 3: Treatment of infections

Infection	**Usual pathogens**	**Therapy**
Pancreatitis	Gram (-) bacilli, *B. fragilis*	Benzylpencillin, gentamycin + metronidazole OR Cefotaxime + metronidazole OR Piperacillin/tazobactam
Cellulitis	Group A streptococci, *S. aureus*; occasionally other gram (+) cocci, gram (-) bacilli ± anaerobes	Mild: Amoxicillin/clavulanate, Moderate-severe: Aminoglycoside + metronidazole OR Cefoxitin OR Piperacillin/tazobactam (10-14 days)

Wound sepsis: community acquired		Intra-abdominal: Piperacillin/tazobactam OR Ampicillin, metronidazole + gentamycin; Skin/soft tissue: cefazolin
Wound sepsis: hospital acquired		Intra-abdominal: Piperacillin/tazobactam + gentamycin OR Meropenem; Skin/soft tissue: Ceftriaxone ± vancomycin
Cirrhosis	*E.coli*, *Klebsiella*, pneumococci	Cefotaxime; add clindamycin or metronidazole if anaerobes is suspected
Perforated peptic ulcer		Cefazolin OR Cefoxitin
General abscess	*E.coli, Klebsiella,* enterococci, *Bacteroides, Clostridium,* anaerobic cocci	Piperacillin/tazobactam OR Gentamycin + clindamycin or metronidazole
Liver abscess	*E.coli*, *Klebsiella*, enterococci, *B. fragilis*	Piperacillin/tazobactam OR ampicillin, gentamycin + metronidazole (Add metronidazole if amoebic liver abscess is suspected)
Normal or inflamed appendicitis		Cefoxitin (discontinue immediately post operation) OR Gentamycin + metronidazole or clindamycin
Perforated addendicitis		Cefoxitin OR Piperacillin/tazobactam OR Gentamycin + metronidazole
Acute cholecystitis		Cefazolin, Severe: Ampicillin + gentamycin
Cholangitis		Gentamycin + ampicillin ± metronidazole, Penicillin allergy: Vancomycin instead of ampicillin
Acute contamination from abdominal trauma		Cefoxitin OR Gentamycin + metronidazole or clindamycin
Helicobacter pylori		Amoxicillin, Metronidazole + Omeprazole, Pen allergy: Clarithromycin, metronidazole + omeprazole
Diabetic foot infections	*S. aureus*, streptococci, *Enterobacteriaceae, Bacteroides, Peptostreptococcus, P. aeruginosa, E.coli, Klebsiella, Proteus*	Amoxicillin/clavulanate, To cover *P.Aeruginosa*: Fluoroquinolones + metronidazole or clindamycin (10-14 days)

6. Reference

1. Antibiotic prophylaxis in surgery. Scottish Intercollegiate Guidelines Network. Guideline No. 104. 2008. Available from: http://www.sign.ac.uk/guidelines/fulltext/104/index.html (Accessed 29 March 2011)

2. Department of Health. Standard Treatment Guidelines and Essential Drugs List: Hospital level adults. Pretoria: The National Department of Health. 2006.

3. Dipiro, J.T., Talbert, R.L., Yee, G.C., *et al.* Pharmacotherapy: A pathophysiologic approach. 7th edition. 2008. New York: McGraw-Hill. 2559p.

Appendix 13: Medication containing penicillin

WARNING: Contains Penicillin

Generic name	Trade name	Dosage form
Benzylpenicillin	Novopen®, Benzyl Penicillin-Fresenius®	Injection
Benzathine benzylpenicillin	Penilente® LA, Benzathine Penicillin-Fresenius®	Injection
Procaine benzylpenicillin	Novocillin®, Procillin®	Injection
Phenoxymethyl penicillin	Betapen®, Len V.K®	Tablet and suspension
Ampicillin	Penbritin®, Ampicillin-Fresenius®, Ampipen®, Petercillin®, Be-ampicil ®	Injection
	In combination with Cloxacillin: Ampiclox®, Apen®, Cloxam®, Megamox®	Capsule
Amoxicillin	Amoxil®, Adco-Amoxycillin®, Amocllin®, Betamox®, Maxcil®, Moxan®, Moxypen®, Penmox®, Zoxil®	Capsule and suspension
	In combination with Flucloxacillin: Suprapen®, Macropen®, Megapen®	Capsule and suspension
	In combination with Clavulanic acid (Co-Amoxiclav): Augmentin®, Augmaxil®, Clamentin®, Clavumox®, Ranclav®	Injection, tablet and suspension
Piperacillin	In combination with Tazobactam: Tazocin®, Tazobax®	Injection
Cloxacillin	Cloxacillin-Fresenius®, Cloxin®	Injection and capsule
Flucloxacillin	Floxapen®	Capsule and syrup

Appendix 14: Information on generic names, trade names, indications, administration and the most common adverse effects on medication used the most in the wards during the study period

Generic name	Trade name	Indication	Administration	Most common adverse effects
Amoxycillin	Amoxil®, Moxypen®, Betamox®	Antibiotic	On an empty stomach, 1 hour before a meal or 3 hours after a meal	Skin rash
Ampicillin	Petercillin®, Ampicillin-Fresenius®	Antibiotic	Do not mix in the same infusion container as any other drug. Use within 30min of preparations to ensure stability	Skin rash, anaphylactic reactions
Aspirin	Disprin®	Prophylaxis of platelet aggregation (also pain, fever & inflammation)	Take with food	Gastric irritation and bleeding. Bronchospasm in asthmatic patients
Atenolol	Tenormin®, Ten-Bloka®	Hypertension (β-blocker)		
Captopril	Capoten®, Captomax®, Captohexal®	Hypertension (ACE-inhibitor)		Coughing, skin rash, taste disturbance
Carvedilol	Carloc®, Dilatrend®, Carvetrend®	Hypertension (β-blocker)		
Cimetidine	Tagamet®, Lenamet®, Sedacine®, Hexamet®	Peptic ulcer, reflux esophagitis, prevention of stress ulcers		

Generic name	Trade name	Indication	Administration	Most common adverse effects
Ciprofloxacin	Ciprobay®, Cifloc®	Antibiotic	Maintain adequate fluid intake, doses are best taken on an empty stomach, do not give with antacids like Ulsanic	Gastro-intestinal disturbances - diarrhea and vomiting
Co-Amoxiclav	Augmentin®, Augmaxil®, Ranclav®	Antibiotic	With meals (to decrease GI disturbances). Parenteral solutions should be used soon after mixing.	Gastro-intestinal disturbances - diarrhea and vomiting
Diclofenac	Voltaren®, Panamor®	Pain and inflammation	Administer with food	Peptic ulceration and bleeding, fluid and sodium retention
Enalapril	Renitec®, Enap®, Hypace®, Pharmapress®	Hypertension (ACE-inhibitor)		Coughing, skin rash, taste disturbance
Erythromycin	Erythrocin®, Purmycin®	Antibiotic and used for prokinetic effects	Mix only with water for injection, stable for 24 hours after reconstitution at room temperature and 2 weeks if refrigerated	Painful at site of injection, gastrointestinal disturbances and skin rash
Fluoxetine	Prozac®, Nuzak®, Lorien®	Depressive and anxiety disorders	Important to not miss any dosages	
Furosemide	Lasix®, Puresis®	Hypertension and edema	Take with meals. If prescribed as daily: take in the morning. If prescribed as twice daily, take in the morning and mid-afternoon.	Nocturia if given at night, electrolyte imbalances

Generic name	Trade name	Indication	Administration	Most common adverse effects
Gliclazide	Diamicron®, Diaglucide®, Glucomed®	Diabetes mellitus	Take in the morning with breakfast	
Hydrochlorthiazide	Ridaq®, Hexazide®	Hypertension and edema	Take in the morning	Electrolyte imbalances
Hyoscine	Buscopan®, Scopex®, Hyospasmol®	Stomach cramps		Dry mouth, visual disturbances
Ibuprofen	Brufen®, Inza®, Nurofen®	Pain and inflammation	Take with food. Maximum 6 (200mg) tablets per 24 hours	Peptic ulceration and bleeding, fluid and sodium retention
Indomethacin	Indocid®, Arthrexin®	Pain and inflammation	Capsules should be taken with meals. Suppositories should be given at night to avoid morning pain and stiffness (maximum 2 suppositories per 24 hours)	Peptic ulceration and bleeding, fluid and sodium retention
Insulin	Actrapid®, Humulin®, Actraphane®, NovoRapid®	Diabetes mellitus	Administer 30 minutes before meals. Never injection cold (fridge temperature) insulin. Can be stored at room temperature, from the first day of use, for 30 days. Avoid freezing of preparations.	
Metformin	Glucophage®	Diabetes mellitus	Take with meals.	Metallic taste in mouth
Metoclopramide	Maxolon®, Clopamon®, Contromet®, Setin®	Nausea & vomiting and as prokinetic	Take 30 minutes before meals (unless stat dose is needed)	Drowsiness and fatigue, convulsions

Generic name	Trade name	Indication	Administration	Most common adverse effects
Metronidazole	Flagyl®, Medazol®, Trichazole®	Antibiotic	Avoid alcohol during therapy. Take with half a glass of water or after meals	Dark coloration of urine, metallic taste in mouth
Nifedipine	Adalat®, Cardifen®, Nifedalat®	Hypertension (Calcium channel blocker)		Headaches, light-headedness, dizziness
Omeprazole	Losec®, Lokit®	Gastric and duodenal ulcers, reflux esophagitis	Take 30 minutes before meals	
Morphine/papaverine/codeine	Omnopon®	Pain	Administered IM or SC	Hypotension (less than pethidine and morphine), pain at injection site and itching
Pantoprazole	Pantoloc®, Topzole®	Gastric and duodenal ulcers, reflux esophagitis	Take 30 minutes before meals	
Paracetamol	Panado®, Painamol®	Pain and fever	Maximum 8 (500mg) tablets per 24 hours	
Perindopril	Coversyl®, Prexum®, Vectoryl®	Hypertension (ACE-inhibitor)		Coughing, skin rash, taste disturbance
Pethidine	Pethidine®	Pain	IM, SC or very slow IV	Hypotension
Potassium chloride	Slow K®, Plenish K®	Hypokalemia	Intravenous potassium is lethal if given in undiluted form. Rate of infusion should not exceed 10mmol/L. Tablets should be swallowed whole after a meal.	

Generic name	Trade name	Indication	Administration	Most common adverse effects
Prochlorperazine	Stemetil®, Mitil®	Nausea & vomiting		Drowsiness and impaired concentration
Simvastatin	Zocor®, Simvotin®	Hypercholesterolemia	Administer at night	Muscle weakness or stiffness
Spironolactone	Spiractin®, Aldactone®	Edema	Take with meals	Hyperkalemia
Sucralfate	Ulsanic®	Peptic ulcer, reflux esophagitis	Administer 1 hour before meals and at bedtime and at least 2 hours apart from other medication	
Warfarin	Warfarin®	Prevention and control of thrombo-embolism	Take at night	Hemorrhage