DETERMINING THE PREVALENCE AND SCOPE OF POLYPHARMACY IN GERIATRIC PATIENTS AT A PRIVATE HOSPITAL IN PIETERMARITZBURG, KWAZULU-NATAL

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Discipline of Pharmaceutical Sciences
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DECLARATION

In fulfilment of the requirements of the degree of Masters in Pharmacy (Pharmacy Practice) in the Discipline of Pharmaceutical Sciences, School of Health Sciences, University of KwaZulu-Natal, Durban, South Africa, I, Arti Hemraj declare that:

i. The research reported in this dissertation, except where referenced, is my original work.

ii. This dissertation has not been submitted for any degree or examination at any other university.

iii. This dissertation does not contain other person's data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

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    a. their words have been re-written but the general information attributed to them has been referenced:

    b. where their exact words have been used, their writing has been placed inside quotation marks, and referenced.

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Date_____

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Abstract

Background: Polypharmacy can be defined as the use of multiple medicines by a single patient and includes inappropriate medicine use. This is common among the elderly, especially in patients 60 years and older. The use of multiple medicines has been shown to predispose patients to adverse medicine reactions.

Objective: The goal of this study was to determine if polypharmacy is prevalent in geriatric patients in a private hospital in KwaZulu-Natal, Pietermaritzburg, and if so to determine the extent of the problem.

Methods: A cross sectional descriptive study involving chart review of geriatric patients was carried out in a hospital. Prescriptions were reviewed for concomitant use of five or more medicines, adverse medicine reactions, therapeutic duplication, contraindications and inappropriate use of medicines. Demographic data e.g. age, sex, and medical aid membership were reviewed. Diagnosis, allergies and number of chronic disease states were also analysed.

Results: The majority of the patients reviewed had between one to two chronic diseases. The youngest age group 60-69 years age had the most number of patients with between 1-2 chronic diseases. Females outnumbered males in all three age categories reviewed. The most common chronic disease was hypertension. The 120 study patients were prescribed a combined total of 859 medicines. The average number of medicines per patient was 7.2 (used to determine the degree of polypharmacy) ranging from two to twenty one. A total of 75 % (n=90) of the study patients received 5 and more medicines. Prescription medicine use was assessed according to gender of the study population. Polypharmacy was more prevalent in females when compared to the males. Polypharmacy was prevalent in each age category with the 60-69 years age group having the highest prevalence. Polypharmacy was evident from the results obtained.

Conclusion: Prescribing trends in geriatric patients together with inappropriate medicine use were identified. The results of this study can be used by healthcare professionals to be aware of the prevalence of polypharmacy in their settings. Health care professionals can adopt an informed approach to address the needs of the geriatric population regarding polypharmacy. Strategies for pharmacists to manage polypharmacy can include medicine

review, communication with the prescriber and patient, reduction in a geriatrics regimen to the fewest possible essential medicines. Prescribers and dispensers can utilize the information to decide whether the medicine is essential and if the geriatric can tolerate possible interactions or adverse effects.

Key Words: Polypharmacy, geriatric, pharmacists

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Abbreviations

AMRs	Adverse Medicine Reactions
ATC	Anatomical Therapeutic Chemical
NCDs	Chronic Non-communicable Diseases
CVD	Cardiovascular Disease
CNS	Central Nervous System
COPD	Chronic Obstructive Pulmonary Disease
CGA	Comprehensive Geriatric Assessment
DM	Diabetes Mellitus
DVT	Deep Vein Thrombosis
GIT	Gastro-intestinal Disorders
HAT	Hyperpharmacotherapy Assessment Tool
HPT	Hypertension
IMU	Inappropriate Medicine Use
MDS	Minimum Data Set
MIMS	Monthly Index of Medical Specialities
NDP	National Drug Policy
NHS	National Health System
PIMs	Potentially Inappropriate Medicines
SAMF	South African Medicines Formulary
UK	United Kingdom
UN	United Nations
WAO	World Allergy Association
WHO	World Health Organisation

Chapter 1: Introduction and Background to the Study

1.1 Introduction

John J. Castellani (PhRMA, 2013) who is the President and Chief Executive Officer of Pharmaceutical Research and Manufacturers of America, stated that there are daunting health care challenges, with a higher incidence of chronic diseases, and these are becoming more of a burden due to the cost implications of therapy. Rare conditions like cancer, Alzheimer's disease, and Parkinson's disease are also on the increase. The medical needs of a population that is getting older is a unique challenge that requires addressing. Research and the development of new medicines are important in addressing the needs of an ageing population. The discovery of new medicines offers many ill individuals around the world hope for a cure or chronic treatment that will help them live a longer and healthier life (PhRMA, 2013). There is a greater demand for the treatment of chronic conditions as individuals grow older. Declining physiological, physical, mental and cognitive functional capacities in these ageing persons leads to an increase in the prevalence of chronic disease. This results in an increasing number of older individuals who need greater health and related care which places rising demands on the health care system (Joubert & Bradshaw, 2005).

Rational use of medicines is defined to ensure that patients receive medicines "appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, at the lowest cost to them and their community". Irrational use of medicines continues to be a major problem worldwide in terms of the use of too many medicines per patient (polypharmacy); inappropriate use of antimicrobials, inadequate dosages of medicines for non-bacterial infections; over-use of injections when oral formulations would be more appropriate; failure to prescribe in accordance with clinical guidelines; inappropriate self-medication of prescription-only medicines, and non-adherence to dosing regimens (WHO, 1985).

The rational use of medicines in an appropriate and effective way is very important in order to optimise the function of these medicines and to avoid adverse health outcomes. This is essential in older patients (Hilmer, 2008).

1.2 Background to the Study

According to The National Drug Policy (NDP) for South Africa in 1994, "the health care of the South African population is characterized by

a two-tier system consisting of private healthcare funded by medical aid and the public sector which is known for fragmentation (no less than 10 health authorities). This is largely inefficient due to a shortage of staff, a shortage of medication, inefficient use of resources, poor working conditions and inadequate infrastructure" (National Drug Policy for South Africa, 1994).

The private sector health care expenditure in 1992/93 comprised of 48.5 % of total health care expenditure that was responsible for 80 % of the country's total expenditure on medicines, although 60-70 % of the total volume of pharmaceuticals was consumed in the public sector. This resulted in a lack of equity in access to essential medicines. Consequently there was a negative impact on quality of care. The increasing cost of medicines, irrational use of medicines, major loss through malpractice and inefficient security systems, ineffective cost procurement and logistic practices became a huge concern. The South African government decided to tackle the disparities through the development and implementation of a National Drug Policy that would be consonant with and an integral part of the new National Health Policy, which aims at equity in the provision of health care for all. The goal of the National Drug Policy is to ensure an adequate and reliable supply of safe, cost-effective medicines of acceptable quality to all citizens of South Africa and the rational use of medicines by doctors, pharmacists and patients (National Drug Policy for South Africa, 1994).

The percentage of the population aged 60 years and above in South Africa rose from 7.1 % in 1996 to 8 % in 2011, constituting an increase from 2, 8 million to 4, 1 million individuals. The report, which is based on the three population censuses of 1996, 2001 and 2011, provides valuable information on the demographic and socio-economic profiles of the elderly population (Statistics South Africa, Census, 2011).

The common characteristics of old age are frailty, multiple morbidities and disabilities. This leads to an inability to perform various functions that many take for granted, e.g. walking, hearing, vision, memory, concentration and self-care. These become increasingly difficult with age. According to the Census results elderly women experience far higher levels of severe difficulty in a number of functional domains compared to elderly men. Many geriatric persons increasingly rely on assistive devices and chronic medicines. In South Africa a substantial proportion of elderly persons use chronic medicines (38 %) by age 60–64 (Statistics South Africa, Census, 2011).

Polypharmacy (the use of multiple medicines or the administration of more medicines than are clinically indicated) is common among the elderly (Viktil *et al*., 2008). Evidence based guidelines recommend several medicines in the treatment or the prevention of a single medical condition. This is relevant to the treatment of heart failure, diabetes mellitus, prevention of new cardiovascular events after myocardial infarction, and prevention of the progression of rheumatoid arthritis. An ageing population implies more co-morbidity. Consequently, many people are in need of several medicines, which can result in polypharmacy.

Geriatric persons often have limited regenerative abilities. They are more prone to chronic disease and other ailments than younger adults. The use of prescription medicines in geriatric patients has increased considerably in United States of America. Geriatric persons, 65 years and older use one third of all medicines prescribed. This is disproportionate to the percentage of the population they represent (Basca, 2008).

Cognitive and physical impairment are common adverse effects of different medicines. Geriatric patients are at risk for falls, motor vehicle accidents or unable to care for day to day needs when using these medicines. Geriatric persons often experience a mixture of social-emotional, physical and functional changes. Multiple chronic diseases, metabolic changes (medicine potency is affected), hormonal changes (e.g. change in melatonin levels resulting in altered sleep/wake cycles, menopause) and psychiatric problems worsen their health problems. Depression is not a geriatric problem but does affect many geriatric patients. Arthritis and osteoporosis affects the mobility and dexterity of geriatric persons slowing them down (Basca, 2008).

Normal physiological changes that occur with ageing place geriatric patients at a greater risk of adverse effects. They visit multiple doctors. One doctor is not aware of knowing the exact doses or the medicines that a patient has been prescribed by another doctor. Accurate record- keeping is hampered by impaired cognitive functions and communication problems of the geriatric patient. The risk/benefit ratio of a treatment that can be used in geriatric patients is difficult to assess as they are often excluded from medicines trials. This creates uncertainty for the clinician attempting to make a decision regarding how to treat an older adult with a new illness, recent discharge from a hospital, or exacerbation of a chronic illness (Halloran, 2013). Geriatric patients are often confused about using medicines. This is compounded by any hospital admission during which additions or changes are often made to medicines for reasons patients do not understand (Johnson, 2009).

It is of utmost importance that healthcare providers understand the pharmacodynamic and pharmacokinetic changes that occur with aging and their clinical importance on medicine metabolism. Metabolic changes have a clinical significance. They may increase the concentration and half-life of medicines resulting in adverse effects. Elimination changes should be considered, e.g. there might be an increase in the concentration of a medicine that is eliminated renally. These and other factors discussed below must be considered by a physician when choosing a medicine for the geriatric patient (Halloran, 2013).

Many of the prescribing guidelines are not for multiple chronic conditions. However, most geriatric patients have more than one chronic condition. This places them at a greater risk of medicine-medicine interactions. A new medicine added to the treatment plan may result in an adverse reaction. This adverse reaction is often mistaken for a new health problem. A vicious circle of testing, more medicines, more medicine/medicine interactions, and more adverse events follows (Halloran, 2013). Medicines are becoming more available to patients by means of the internet and self-medication, worsening the existing problems experienced. (Viktil *et al*., 2008).

For decades physicians have been entirely responsible for managing their patient's chronic conditions and complicated treatment plans. In recent years, as the world of pharmacy evolves, pharmacists are becoming increasingly responsible for patients. They are more involved in managing patients' treatment plans. They conduct medicine utilization reviews of the treatment plan and counsel patients. They also provide patient and physician education on the treatment plans (Chumney & Robinson, 2006).

Hepler & Strand (1990), stated that a medicine related problem exists when a patient experiences or is likely to experience either a disease or symptom having an actual or suspected relationship with their medicine. The author also recommends categorization of medicine related problems that can allow for a systematic process for pharmacists to be developed in order to contribute significantly to positive patient outcomes. WHO defines an adverse medicine reaction as "a reaction that is noxious and unintended, and which occurs at dosages normally used in humans for prophylaxis, diagnosis or therapy" (WHO, 1985).

The importance of pharmacists in health care teams is increasingly being recognised. Medicine reviews by pharmacists lead to major reductions in morbidity and health care costs. High quality cost effective care for each geriatric patient is attainable by the safe, effective and efficient management of medicines (Gillespie, 2009).

Clinical pharmacy services have a positive impact on patient outcomes. This is recognised in the United Kingdom (UK) and other parts of the world. It is also becoming increasingly evident, especially during the last twenty years. The UK has acknowledged that pharmacists' clinical skills and expertise are an integral part of delivering better services to patients in the 2008 Pharmacy White Paper. This was reinforced in 2010, by identifying the role of pharmacists in optimising the use of medicines. Examples of the positive impact made by pharmacists include reductions in medicine-related adverse events, reductions in the cost of medicine therapy, improved patient outcomes, reductions in duration of hospitalisation and reductions in readmission rates (Child *et al*., 2010).

The systematic review of a patient's treatment plan may help to determine how to improve inappropriate prescribing in older people. Inappropriate prescribing is often interlinked with polypharmacy. Interventions that are effective in managing disease with appropriate polypharmacy must be identified and put into practice (Patterson, 2012).

Polypharmacy includes inappropriate medicine use which includes the use of prescription or non-prescription (over the counter) medicines that have no legitimate indication, simultaneous use of interacting medicines, inappropriate medicines or dosage and the use of medicines to counteract the side effects of another medicine. Risks associated with polypharmacy include, non-compliance with medicine therapy, over/under dosage of medicine, therapeutic duplications, off-label use of medicines, contra-indicated use of medicines, medicine-medicine interactions, adverse medicine reactions, increasing medicine expenses, and excessive use of vitamins and herbal preparations (Hill, 2012).

Pharmacists can reduce or avoid polypharmacy in prescriptions in numerous ways. These include: reviewing of patient medicines, assessing effects of multi-morbidity and reviewing potential medicine-medicine interactions (Terrie, 2004). The most commonly used medicines associated with adverse effects are nonsteroidal anti-inflammatory medicines

(NSAIDS), antipsychotics, antihypertensives, and antibiotics. It is imperative that each medicine and its indication are reviewed (Terrie, 2004).

Pharmacists can recommend discontinuation of medicines used to treat adverse effects of other medicines. They can suggest alternative treatment. Pharmacists are able to identify unnecessary medicines in a patient's treatment plan. They can also suggest non-pharmacologic treatment. The solution may be difficult. However polypharmacy can be managed by multidisciplinary teamwork. The ideal pharmacologic treatment plan of patients is to treat all the chronic conditions, to prevent any complications from multiple morbidities and to stop or decrease any pain. Regular monitoring of treatment plans can assist in reaching these objectives (Terrie, 2004).

The greatest challenge for every health care professional is to ensure the most appropriate medicine is being given to each patient. Improvement in quality of life without affecting the geriatric patients' ability to function is a key factor. Any medicines prescribed and dispensed should also not place the patient at greater risk for adverse reactions (Terrie, 2004).
Various strategies for managing polypharmacy include (Woodruff, 2010):

- Information: Patients should be educated on keeping an up to date list of all medicines (this must include the generic and trade names), dosages and dosing frequency. They must be aware of the indication for each medicine. They must have a list of all the medical providers, including the pharmacist with their telephone numbers.

- Instruction: Patients should be educated about each medicine. They must be taught about its name, appearance, indication, adverse effects and medicine interactions. The importance of contacting the doctor or pharmacist with any medicine related queries must be emphasized. They must also be counselled on the importance of taking medicines exactly as directed. They should use one pharmacy to dispense their medicines.

- Organization: Patients should be educated on management of their medicines. This includes storage (safe, dry place away from sunlight, refrigerated items must be refrigerated), expiry date checks (dispose of expired medicines in a safe way) and encourage them not to share medicines. Due to a decrease in cognitive function, advise patients on the use of memory aids. This includes use of color-coded charts, automatic dispensers with bells, or voice-activated message services to remind them to take their doses.

All of the above information indicated a need to carry out this study. There are many challenges facing doctors and pharmacists regarding the prescribing and dispensing of appropriate medicines to the geriatric patient population. It is also important to ensure that the number of appropriate medicines does not lead to polypharmacy which can lead to many risk factors, especially in this patient population. In my own experiences as a pharmacist in the private sector, I found myself reviewing many geriatric prescriptions where polypharmacy was prevalent. This was a matter of enormous concern to me.

Polypharmacy is prevalent among the geriatric population because many different chronic diseases need to be treated as the patient grows older. The prevalence of polypharmacy leads to increased medicine costs, medicine interactions, non- compliance, adverse effects, decreased functional status and geriatric syndromes. More implementation studies are needed to show that practical application of the methods shown to improve polypharmacy issues can be disseminated to the various health care settings where geriatric patients are treated (Hajjar *et al*, 2014).

This study was therefore conducted to determine the burden of polypharmacy in the geriatric patient population in a private hospital setting in KwaZulu- Natal, South Africa, for which no evidence currently exists. The results of this study will be beneficial in

implementing suitable strategies to minimize polypharmacy not only at the study site but at other healthcare settings as well.

1.3 Aim and Objectives of Study

The aim and objectives of this study include the following:

1. To determine the prevalence of polypharmacy in geriatrics.
2. To determine the reasons for multiple medicine prescriptions based on the health status, chronic diseases and number of medicines.
3. To determine if appropriate management processes were followed.

1.4 Outline of Dissertation

1.4.1 Chapter One

Chapter one focuses on the reasons for the research. Included in this chapter are background information, research questions and objectives, aim of the study as well as the research problem.

1.4.2 Chapter Two

Chapter two focuses on the literature surrounding the research topic. The chapter reviews what other authors have discussed regarding polypharmacy in geriatric patients.

1.4.3 Chapter Three

Chapter three focuses on the methodology used in completing the research. This chapter provides an outline as to how the research instrument was designed as well as the method

used in sampling of the target population. Details surrounding reliability, validity and method used in administering the survey are elaborated in this chapter.

1.4.4 Chapter Four

Chapter four focuses on presenting the results of the study. The chapter provides analysis of data collected. Findings are tabulated.

1.4.5 Chapter Five

Chapter five focuses on a discussion of the results in relation to the research questions and objectives.

1.4.6 Chapter Six

Chapter six focuses on concluding the research questions as well as strategies for pharmacists to manage polypharmacy in geriatric patients.

1.5 Conclusion

The general idea and purpose of the study has been outlined in this chapter. The main aims, objectives and method have been presented. An overview of the different chapters in the study was also presented. The next chapter discusses the literature surrounding the topic.

Chapter 2: Literature Review

2.1 Introduction

A literature review is an evaluation of selected/related documents on a research topic. A critical review of various studies is explored in this chapter. This chapter will also discuss various aspects of polypharmacy in geriatric patients.

A Pub-Med search using the search string (polypharmacy in geriatrics, private hospital, South Africa) found no studies have been conducted in the private healthcare sector that dealt specifically with determining the prevalence of polypharmacy in geriatrics in South Africa as at November 2014. However similar studies have been conducted in other countries which will be covered in the literature review.

2.2 Geriatric Polypharmacy

A PubMed search on the term polypharmacy yielded 4852 hits on 7 November 2014. A review of the literature was conducted. English articles were searched for links between polypharmacy and geriatric patients from the age of sixty and over. A few articles that did not meet the age criterion (referred to the elderly from as young as 50) were reviewed if there was relevant information to be considered.

There are many definitions of the term polypharmacy. McGraw-Hill Concise Dictionary of Modern Medicine (2002) defines polypharmacy as the use of multiple medicines to treat one or a limited number of conditions; it is most common in elderly. Wikipedia defines polypharmacy as the use of multiple medicines by a patient, generally older adults (those aged over 65 years). More specifically, it is often defined as the use of four or more regular medicines. It sometimes alternatively refers to purportedly excessive or unnecessary prescriptions. The term polypharmacy lacks a universally consistent definition.

Polypharmacy is most common in the elderly, affecting about 40 % of older adults living in their own homes (Wikipedia, 2014).

Polypharmacy can be defined as the concurrent use of five or more medicines by the same patient. Polypharmacy involves more than the number of medicines that a patient takes. Clinically, the criteria utilized for identifying polypharmacy involve the following: Taking medicines that have no apparent indication, therapeutic duplication to treat the same illness, simultaneous usage of interacting medicines, under/over dosage, and utilizing other medicines to treat adverse medicine reactions (Terrie, 2004).

For this study polypharmacy is defined as the use of multiple medicines or the administration of more medicines than are clinically indicated, representing unnecessary medicine use (Viktil *et al.*, 2008).

2.3 Classes of Polypharmacy

Polypharmacy can be categorized into 2 major classes (Terrie, 2004):

- Therapeutic Polypharmacy: This type occurs when polypharmacy is carefully reviewed and monitored by health care teams. These medicines are needed for the treatment of conditions and for achieving a therapeutic goal. An example of therapeutic polypharmacy is the combination therapy of isoniazid, rifampicin, ethambutol, pyrazinamide, and pyridoxine in the initial treatment of tuberculosis. Another example of therapeutic polypharmacy is the numerous medicines used in the management of congestive heart failure, such as digoxin, angiotensin-converting enzyme inhibitors, and a diuretic.

- Contratherapeutic Polypharmacy: This type of polypharmacy occurs when a patient experiences adverse effects while he or she is on a treatment plan that is not reviewed and monitored. Polypharmacy has negative consequences when a patient takes numerous medicines, especially at high doses, and is not being monitored.

2.4 Risk Factors for Polypharmacy

Numerous risk factors for polypharmacy have been identified. These include: demographic characteristics (increasing age, white race, level of education), health status (declining health, depression, hypertension, incontinence, asthma, angina, diverticulosis, osteoarthritis, gout, diabetes mellitus, and use of 9 or more medicines) and healthcare characteristics (number of doctor visits, medical aid membership, multiple providers) (Hajjar *et al*., 2007).

Hovstadius & Petersson (2012), emphasize that the most prominent risk factors for polypharmacy are those associated with socio-demographics and the patients' conditions. Patient's self- medication with all types of medications, and risk factors related to physicians (the interaction between patient and physician, the large variation in physicians' individual prescribing practices, in terms of polypharmacy), are also problematic. Abdulraheem (2013) highlights that polypharmacy is a risk factor itself for geriatric syndrome, morbidity and mortality.

2.5 Consequences of Polypharmacy

The Department of Health and Human Services report Healthy People 2000 considers polypharmacy to be an enormous problem with far reaching consequences. It was listed as the principal medicine safety issue (Davis, 2010).

Polypharmacy may result in a variety of consequences. These include non-adherence, a very common problem in the geriatric persons (prevalence averaging 50 %), inappropriate prescribing (higher risk of inappropriate medicines as defined by the Beers criteria), increased risk of adverse medicine reactions (results in 12 % of hospital admissions in geriatrics), geriatric syndrome (higher risk of cognitive impairment, falls, hip fractures) and morbidity/ mortality (decline in physical and instrumental activities of daily living) (Hajjar *et al.*, 2007).

Geriatric patients with multimorbidity have an altered ability to metabolize and excrete medicines. Together with sensory and cognitive deficits and complex treatment plans, geriatric patients present a challenge to healthcare workers treating them. Polypharmacy is often linked to a higher risk of over the counter medicine errors, poor quality of life and unnecessary medicine expense (Hippisley-Cox *et al.,* 2004).

Hippisley- Cox *et al., (*2004) analysis of polypharmacy in geriatric patients found 11 % of people in 65-74 years age group, 15 % in the 75 years and over age group concurrently used five or more medicines. They also reviewed a health survey for England which revealed higher rates of polypharmacy in people over 75 years. Educated older women were more likely to engage in polypharmacy, and people over 65 years (unskilled or partly skilled) had an increased chance of polypharmacy. They also confirmed that geriatrics living in institutions and hospitalised patients were more likely to be exposed to polypharmacy (Hippisley-Cox *et al.,* 2004).

2.6 The Geriatric Age

WHO (2000) confirms that The Minimum Data Set (MDS) Project collaborators agreed at the 2000 Harare MDS Workshop to use the chronological age of 60 years as a guide for the working definition of "old". The western world accepts the chronological age of 65 years as a definition of 'elderly' or older person. However this does not apply in Africa. The geriatric age can also refer to the age a person begins to receive pension benefits. The United Nations has reached a consensus that 60 years and older is the geriatric age. In Africa, the geriatric age starts between 50-55 years of age. The more traditional African definitions of an elder or 'elderly' person correlate with the chronological ages of 50 to 65 years, depending on the setting, the region and the country. The age of 60 or 65 years, roughly equivalent to retirement ages in most developed countries is said to be the beginning of old age (WHO, 2000).

A prospective study to evaluate the use of percutaneous transluminal coronary angioplasty in elderly coronary artery disease patients aged 60 years and older by Forman *et al*., (1992) divided them into the young old (60 to 69 years), the middle old (70 to 79 years), and the very old (80 years and older) to clarify differences between the age groups. Subdivision by age resulted in the majority of patients being male aged 60-69 years. Procedure complications and a higher prevalence of multi vessel disease were found as patients' age increased. Older patients had a prolonged hospital stay. For this study the subjects were placed into the age categories 60-69 years, 70-79 years and 80 years and older (Forman *et al*., 1992).

2.7 Pharmaceutical Care

Hepler and Strand's (1990) definition of pharmaceutical care, "the responsible provision of medicine therapy for the purpose of achieving definite outcomes which improve the patient's quality of life", included pharmacist input in the design, implementation and monitoring of a therapeutic plan, in collaboration with the patient and other healthcare professionals, and helped to change the focus of clinical pharmacy activities from processes to achieving a therapeutic outcome. Pharmacy, by definition, is a clinical profession and thus clinical pharmacy is a patient-centred service where the pharmacist is a key member of the multidisciplinary clinical team (Gillespie, 2012).

The co-ordination of all medicine treatments for an individual patient, across sites, providers, and over time is greatly needed. Such a seamless continuum may represent the next stage in the evolution of geriatric pharmaceutical care (Nash *et al.,* 2000).

A clinical intervention can be defined as the process of identifying a medicine related problem and making a recommendation in an attempt to remedy or stop it. A pharmacist's suggestions to patients or doctors might not be taken into consideration or even used, but the provision of these recommendations would still be considered a clinical intervention (Pharmaceutical Society of Australia, 2011).

The newest medicines on the market often improve the health and quality of life of geriatric patients afflicted by multi-morbid conditions. The geriatric population is diverse with specialized healthcare needs. Pharmaceutical care for each geriatric patient must be individually tailored to each patient based on his or her specific health status. There is considerable variation from patient to patient. There is no one “best practice” for treating every patient. Physiological changes due to ageing, enormous variation in the properties of medicines used to treat geriatric patients and multi-morbid conditions create many complications in geriatric treatment (Nash *et al.,* 2000).

2.8 Medicine Related Problems in Geriatric Patients, South Africa

A South African intervention study was conducted in 2000 to determine medicine related problems among geriatric patients visiting the outpatient pharmacy at a public sector hospital. A sample size of 280 was considered sufficient to ensure 5 % tolerated error for this population size and the final selection of 281 geriatric patients was used in the study. This sample of 281 was representative of the study population at Addington Hospital in Durban.

Most geriatric subjects suffered from multiple chronic conditions which included: hypertension, ischaemic heart disease, musculoskeletal disorders (arthritis or gout), diabetes, chronic obstructive airways disease, hypercholesteremia and arrhythmias (atrial fibrillation). A shockingly high percentage of the geriatric patients were using from 7 to 9 medicines and a considerable percentage were using from 10 to 15 medicines (Moodley, 2000).

The antihypertensives were the most widely prescribed medicines followed by medicines acting on the central nervous system (CNS), coronary vasodilators, diuretics and medicines acting on the musculoskeletal system. Medicine related problems experienced by geriatric patients ranged from 1 to 11. The greater the number of prescribed medicines, the greater the actual medicine related problems experienced by geriatric patients. The most common

medicine related problems were those involved in medicine safety; effectiveness of the medicine therapy; compliance and indication of medicine therapy (Moodley, 2000).

The most common adverse medicine reactions (AMRs) were as follows: gastro-intestinal (GIT) ulceration, cough, diuretic side effects (dehydration, fatigue, hypotension, etc.), constipation, equilibrium problems and headaches. The most common prescription interventions were on problems involving medicine therapy monitoring, safety of medicine therapy, indication of medicine therapy, prescribing errors and prescription information omission (Moodley, 2000).

Even though the main aim of this study was to determine medicine related problems in geriatric patients a small section reviewed polypharmacy (Moodley, 2000).

2.9 Prevalence of Polypharmacy in Geriatric Patients Internationally

A cross-sectional study by Carvalho *et al*., (2011) was conducted on 440 medical records in Sao Paulo, Brazil to determine the prevalence of polypharmacy in geriatric patients. Associations were determined between polypharmacy and socio-demographic variables, clinical variables, access to health services and self-reported health conditions extracted from personal information, health status, medicines, and access to health services, work history and sources of income sections of the questionnaire. Medicines were classified based on the Anatomical Therapeutic Chemical (ATC) classification system, which is divided into five levels. The variables included gender, age, reasons for admission, comorbidities, and medicines used by the geriatric patients. Patients were predominantly male (51.6 %) (Carvalho *et al*., 2011).

The total number of medicines used was 5904, with an average of 13.4 per person. The three most commonly used medicines were dipyrone, omeprazole, and metoclopramide. The most frequently used medicines according to the ATC system were those of the alimentary tract and metabolism, nervous system, and cardiovascular system. Of the 255

types of medicines used, 42 (16.4 %) were included in the Beers list, and the three most often used were metoclopramide, ketoprofen, and aspirin (Carvalho *et al*., 2011).

Regarding diseases, 67.8 % had hypertension, 23.6 % had diabetes, 10.6 % had lung disease, 36.4 % had rheumatic disease and 25 % had heart disease. Thirty-six percent of the interviewees, representing 151 902 elderly individuals, reported taking five or more medicines. The multiple regression analysis revealed that the following factors remained positively associated with polypharmacy: female gender; age over 75 years; higher income; health self-rated as fair and poor/very poor; self-reported hypertension, diabetes, rheumatic disease and heart disease; and being currently employed (Carvalho *et al*., 2011). Exclusive use of the public healthcare system was associated with a lower number of medicines. Among the 20 medicines most often used by the individuals with polypharmacy, 10 (50 %) acted on the cardiovascular system. The second most frequent class was of medicines acting on the alimentary tract and metabolism. As these conditions are prevalent in the geriatric population, this is not a surprising finding (Carvalho *et al*., 2011).

Geriatric individuals often have several concomitant conditions, leading to the need for polypharmacy. The results of the study demonstrate that polypharmacy is highly prevalent among geriatric patients in the city of São Paulo, which may lead to serious consequences for this age group (Carvalho *et al*., 2011).

Considering the particularities of the geriatric population it is necessary to assess the suitability of what is being used in terms of both the choice of medicines and dosages. It should be stressed that individuals in the geriatric population come from very heterogeneous groups with regard to functional capacity, which is the result of a complex interaction of multiple factors, such as genetics, lifestyle, past illnesses, the quality of healthcare, etc. Thus, functional capacity can be very different between two individuals of the same age and gender. Likewise, the intensity of the pharmacokinetic and pharmacodynamic alterations that accompany the ageing process and the consequences of

polypharmacy can differ considerably between individuals. Prescribers need to consider this variability when selecting medicines and dosages so that the functional capacity of geriatric patients is not compromised (Carvalho *et al*., 2011).

Rational use of medicines in the growing geriatric population is an enormous challenge to public health. This complicated dilemma involves the responsibility of all links in the medicine chain – from the pharmaceutical industry, regulatory agencies and healthcare systems to health professionals and patients. Educational and administrative measures are needed to ensure quality medicine therapy for the geriatric population (Carvalho *et al*., 2011).

The study concluded that the number of medicines used per patient was large. The use of potentially inappropriate medicines according to the Beers Criteria was prevalent too. The results and conclusions of this study point out the shortcomings of the healthcare sector in South Africa especially with the geriatric patient population (Carvalho *et al*., 2011).

A prospective observational study was carried out in the medicine ward during from January 2013 to January 2014 by Maheshkumar & Dhanapal to determine the prevalence of polypharmacy in geriatric patients in a rural teaching hospital in India.

The study included 520 hospitalized geriatric patients. Polypharmacy was observed by number of medicines prescribed in each geriatric patient. An average of 6 -8 medicines were prescribed for most patients. The prescriptions were classified according to various therapeutic categories based on the disease systems identified. The top three conditions were cardiovascular, respiratory and hepatic system. The results also showed that major polypharmacy was prevalent in the cardiovascular and respiratory system diseases. Polypharmacy was more prevalent in the males than females. The duration of hospital stay of geriatric patients showed an increase in major polypharmacy. (Maheshkumar & Dhanapal, 2014).

They concluded that polypharmacy is prevalent among geriatric patients. Interventions by health care professionals regarding optimal use of medicines in geriatric patients may lead to reduced medicine related problems that are usually associated with polypharmacy (Maheshkumar & Dhanapal, 2014).

This study determined the prevalence of polypharmacy to various factors e.g. age, gender, hospital stays, therapeutic category and quantitative assessment. In assessing the results using these comparisons the study confirms that pharmacists can positively impact on polypharmacy by a number of interventions. These include: reduction in the total number of medicines, reduction in the number of doses, increasing patient compliance and prevention of adverse medicine reactions, thereby improving patients' quality of life and decreasing hospital and medicine expenditure (Maheshkumar & Dhanapal, 2014).

An observational study by accidental sampling to determine polypharmacy and inappropriate medicine use (IMU) in 100 geriatric hospitalised patients aged 65 years and above, in two Yogyakarta hospitals (internal medicine department), Indonesia was conducted by Rahmawati *et al*., (2007).

Inappropriate medicine use was identified through a discussion forum involving the clinical pharmacist and senior geriatric consultant. Comparisons were made between patients receiving five medicines or less per day (group A) with patients receiving more than five medicines per day (group B) during the hospital stay. Inappropriate medicine use occurred in 63 events. Total expense of inappropriate medicine use was substantial and equal to approximately 1.046, 11 US dollars. Of the 100 patients, 24% received more than five medicines per day during the duration of hospital stay (Ramhawati *et al.,* 2007).

Geriatrics are at higher risk of multiple chronic diseases. They tend to have more medicines prescribed than the other age groups. In addition, multiple complaints, atypical disease presentation and physician prescribing habits have resulted in the use of multiple medicines

in these people, particularly in hospitals, clinics, nursing homes. The study showed a total of 784 medicines were prescribed for geriatric patients while hospitalized, with a range of 2-20 medicines. There were 31 patients in total who were taking 10 or more medicines. Geriatric patients receive a higher number of prescriptions in hospital and in the community than do younger patients (Ramhawati *et al.,* 2007).

Polypharmacy was found to be the independent predictor of adverse medicine reactions. Earlier research, by Larson (2004) found the potential of adverse medicine reactions occurrence equal 6% among patient who got two kinds of medicines, 50% among the patient accepting five kinds of medicines and 100 % at the patient accepting eight or more kinds of medicines.

Inappropriate medicine use in patients with five medicines or less per day was lower than patients with more than five medicines per day during the hospital stay. The prevention of inappropriate medicine use can be minimised by reducing the number of medicines used (stop all medicines without therapeutic benefit, goal or indication). Elimination of inappropriate medicine use results in decreased medicine expenditure among geriatric patients. The above study identified inappropriate medicine use and the cost implications based on this wastage. The investigation of polypharmacy was a suitable indicator for inappropriate medicine use in this study (Ramhawati *et al.,* 2007).

A systematic review of polypharmacy and inappropriate medicine use among geriatric patients was carried out by Elmstahl and Linder in Sweden (2013). The aim of the study was to determine the frequency of polypharmacy and inappropriate medicine use among subjects ≥ 65 years. Fourteen studies fulfilled the criteria for polypharmacy and ten studies fulfilled the criteria for inappropriate medicine use.

Findings showed that five of the hospital studies reviewed had a higher polypharmacy prevalence (46 %-66 %) than that found in studies of the general population. This article shows that a significant number of geriatric patients treated with multiple medicines, and the prevalence of polypharmacy depended on the different care settings. The primary care setting had a lower prevalence of polypharmacy when compared to the hospital setting. They deduced that this could be due to hospital patients being frailer and having multimorbid conditions (Elmstahl & Linder, 2013).

They concluded that polypharmacy and inappropriate medicine use were common among the geriatric patients. The number of medicines prescribed increased over time. They also confirmed a need for more prospective studies on medicine use among geriatric patients as polypharmacy and inappropriate medicine use are recent concepts that have emerged over the past two decades. There are very few published papers on these important factors in geriatric medicine treatment (Elmstahl & Linder, 2013).

A recent single centre retrospective cohort study of 237 geriatric patients was conducted in a tertiary hospital in the United Arab Emirates by Al Ameri *et al*., (2014) to determine the prevalence of polypharmacy.

It was found that 89 % of the included patients were taking more than five medicines and were exposed to at least one polypharmacy episode. They concluded that there was significant prevalence of polypharmacy among geriatric patients. A clear relationship between polypharmacy and other factors such as age, gender, level of education, number of medicines, medicine-medicine interactions, interventions and co-morbidities was established (Al Ameri *et al*., 2014).

A step wise approach to decrease exposure of geriatric patients to polypharmacy should be developed in all hospitals. This will ensure safe, effective and appropriate use of medicines in these specific populations (Al Ameri *et al*., 2014).

They also concluded that strategies should be defined to closely monitor geriatric patients who are more likely to be exposed to polypharmacy to increase the awareness of the magnitude of the polypharmacy phenomenon, improve medicine therapy and minimize medicine intake in geriatric patients with a substantial decrease in the cost of medicines. This recommendation is consistent with The National Drug Policy of South Africa (Al Ameri *et al*., 2014).

2.10 Conclusion

All of the studies conducted overseas confirm that polypharmacy is prevalent in geriatric patients. The conclusions made by each study also emphasizes on the role of pharmacists in geriatric polypharmacy.

Based on all the articles reviewed, there needs to be a consensus on a universal definition of the term polypharmacy. Many authors had differing definitions of this term. The geriatric population age group should also have a common definition.

The use of single common definitions of these terms will assist in further research and studies being conducted to determine the prevalence of polypharmacy in geriatric patients. These can then lead to a universal standard treatment guidelines for the geriatric population.

South African studies did not address the prevalence of polypharmacy in geriatric patients as seen in the international research covered. There is a need for more studies to be

conducted in South Africa to replicate international studies. Based on all of the above, the aim of this study is to determine the prevalence of polypharmacy in a geriatric group at a private hospital.

Chapter 3: Methodology

3.1 Introduction

In this chapter, the methodology chosen for the research is discussed. The objectives of this study were addressed by following an exacting and thorough research methodology. This section provides information on the study population, study design, and the sample that was selected. The statistical techniques that were used to analyse the data and interpret the results are also discussed in this chapter.

3.2 Study Design

A cross sectional descriptive study involving geriatric patients was utilised in order to address the aim and objectives of this study.

Nedarc (2012) defines a descriptive cross-sectional study as a study in which the chronic disease or health condition and potentially related factors are measured at a specific point in time for a defined population. Cross-sectional studies are a "snapshot" of the frequency and characteristics of a health condition in a population at a particular point in time. This type of data can be used to assess the prevalence of certain conditions or characteristics in a population. In this study it was used to determine the prevalence of polypharmacy in geriatric patients in a private hospital.

3.3 Study Area

This was a private hospital in Pietermaritzburg in KwaZulu-Natal, South Africa. The name of the hospital will be kept anonymous to comply with the hospital rules and regulations regarding the study. It is a 225 bed hospital with an average of 85 % occupancy. The number

of patients seen in outpatients is an average of 350-400 per month. The catchment areas include, Umgungundlovu District, Kokstad, Ixopo, Mooi River and Northern Natal[1].

3.4 Study Population

These were selected from patients admitted to various wards in the hospital. From previous records (2013) at the hospital, an average of 180 patients from this age group is seen per month. The staff at casualty and admissions was informed about the data collection process to notify the researcher whenever a geriatric patient was admitted.

3.5 Study Sample and Size

Sample size was calculated using a sample-size calculator (see www.raosoft.com) with a 5 % margin of error, a 95 % confidence interval and a 50 % response distribution. A total of one hundred and twenty geriatric patient prescriptions were reviewed. Each prescription was given a code number from one to one hundred and twenty to keep patients 'names anonymous. Each photocopied prescription was reviewed. If it complied with the inclusion criteria, it was coded, reviewed and analysed using the data collection instrument.

3.6 Inclusion/Exclusion Criteria

3.6.1 Inclusion Criteria

- 60 years and older
- New hospital admissions from casualty department
- A doctor's referral letter for hospital admission
- First prescription only to avoid duplication

[1] This information has been provided by the Hospital and Pharmacy Manager.

3.6.2 Exclusion Criteria

- Patients not in this age category
- Those that were discharged immediately after being treated in casualty
- Patients who were admitted and had no medicine prescribed on admission

3.7 Data Collection Instrument

The prescription chart was used to extract data and a data extraction form (questionnaire) adapted from literature was used to extract the required variables (Annexure A). The hyper pharmacotherapy assessment tool (HAT) in Figure 5 (Annexure B) adapted from Bushardt *et al.,* (2008) was also used in the design of the data extraction form.

3.8 Data Collection Process/Data Extraction Form

Data collection began once permission had been obtained from the hospital and by the Biomedical Research Ethics Committee of the University of KwaZulu-Natal. Data was collected over a period of six weeks from July 2014 to August 2014. Each prescription meeting the study requirements was photocopied. Data collected from each chart included the following aspects that are outlined below. The areas that were covered in the data extraction form included demographic information (age, gender, and medical scheme membership), diagnosis, chronic diseases, allergies, and prescription medicine on admission.

The conditions covered under diagnosis included: Cardiac conditions, hypertension (HPT), deep vein thrombosis (DVT), respiratory disorders, diabetes mellitus (DM), gastro-intestinal disorders (GIT), bleeding, epilepsy, psychotic disorders, orthopaedic conditions, allergies, groin pain, syncope, haemorrhoids, haematuria, chest pain, cholesterol, cellulitis, headaches, and laparoscopy. This was based on the hospital prescription chart and included a few extra diagnoses that was found on review.

Thirteen different chronic conditions were listed on the prescription chart as follows: cardiac conditions, hypertension, deep vein thrombosis, respiratory disorders, diabetes mellitus, hepatic disorders, thyroid, gastro-intestinal disorders, renal problems, blood disorders, epilepsy, psychotic and orthopaedic conditions.

Questions 9a to 9g included various questions to determine inappropriate medicine use. The Beers' Criteria for potentially inappropriate medicine (PIM) use in older adults was used to assess the medicines prescribed.

The "Beers Criteria" was first developed by Dr Mark Beers. In 1991, 13 nationally recognized experts in the geriatric field developed guidelines on criteria for certain medicines that may lead to adverse medicine events and were considered to be inappropriate for use in geriatric patients in nursing homes. These criteria were most recently updated in 2012. The use of medicines included in the criteria is based on the risk-benefit definition of appropriateness. The use of a medicine is considered to be appropriate if its use has potential benefits that outweigh potential risks. The Beers criteria has three categories of medicine use or selection that are considered inappropriate for geriatric patients. These include: inappropriate medicine choice (medicines to be avoided in the geriatrics), excess dose (medicines at a dose or duration of therapy not to be exceeded), medicine-disease interaction (medicines to be avoided for patients with specific co-morbid conditions) (The American Geriatrics Society, Beers Criteria, 2012).

With regards to generic or clone availability reference was made to the generics dictionary, the Monthly Index of Medical Specialities (MIMS), and the South African Medicines Formulary (SAMF). The Merck Manual and hospital formulary was also used to assess therapy. There were sections to determine and decrease inappropriate pharmacology. The side effect question was also accompanied by an action plan.

Medicine review is usually carried out by each pharmacist prior to dispensing to establish any discrepancies and make recommendations. Side effects are common in all medicines. The side effect action plan on question 10 was used to determine if positive changes were made to the treatment plan. The final section was on optimizing dosing regimen. The lowest effective dose as per the manufacturers package insert was used to determine the answer to question 19 in the questionnaire.

Bushardt & Jones (2005) further emphasize the principle of starting low and going slow. They encourage choice of dosages that are sensitive to a patient's age, health condition, renal and hepatic function, comorbid conditions, and concurrent medicine plan. As ageing often alters the pharmacokinetics and pharmacodynamics of most medicines, a doctor should consider what effects ageing has on a medicine being used on a patient rather than what the medicine may do to the same geriatric patient. A dosage that is lower than normal can be more beneficial to the patient initially. The medicine can be titrated to suit the patient's needs by regular monitoring. This is easy to do while the patient is hospitalised. Anticholinergic medicines, sedatives or hypnotics, hypoglycaemic medicines, and nonsteroidal anti-inflammatory medicines have an increased incidence of adverse effects at higher dosages and the above can be implemented when prescribing (Bushardt & Jones, 2005).

The percentage of encounters with an antimicrobial prescribed and the percentage of encounters with an injection prescribed was determined to measure the overall level of use of two important but commonly overused and costly forms of medicine therapy. All medicine prescribed was counted as a medicine. These included tablets, capsules, suppositories, nebulizing solutions, inhalers, ointments, creams, eye/ear/nose drops, nose sprays, injections, throat sprays, gargles, medicated shampoos and soaps.

3.9 Structure of the Data Extraction Form in Relation to Literature

Table 1 below provides a basic structural breakdown as to how the different questions in the questionnaire were developed so as to address the aims and objectives of the study, in collaboration with the relevant literature.

Table 1: Structure of Data Extraction Form in Relation to Literature

Questionnaire Questions	**Relevant Literature**
Questions: 1,2,3,4	Al Ameri *et al.,* (2014), Rozenfeld *et al.,* (2008), Rahmawati *et al.,* (2009), Maheshkumar and Dhanapal (2014), Trumic *et al.,* (2012)
Questions: 5,6,7,8	Al Ameri *et al.,* (2014), Rozenfeld *et al.,* (2008), Rahmawati *et al.,* (2009), Maheshkumar and Dhanapal (2014), Trumic *et al.,* (2012)
Questions: 9,10,11,1213,14, 15,16,17,18,19,20	Bushardt *et al.,* (2008), World Health Organization (1993)

3.10 Data Management

All prescriptions were locked away. They will be destroyed once the study is completed and according to UKZN study data requirements.

3.11 Data Analysis

All information collected on the questionnaire was entered onto a computerized spreadsheet, using Microsoft Excel. Once entered into the spreadsheet, descriptive analysis was used to calculate mean and percentage differences. Beers Criteria was used to determine appropriateness of medicines prescribed. The frequency and percentage differences of each component in the questionnaire were then entered into a table for comparison.

Statistical analyses were conducted to determine if there were significant differences in health status, chronic conditions, gender and age. These were done by means of Chi Square tests. P values were also determined. The website: http://www.socscistatistics.com/tests/chisquare2/Default2.aspx was used to determine values. The South Africa Medicines Formulary and the Monthly Index of Medical Specialities were also used as references to answer medicine related questions.

3.12 Ethical Considerations and Confidentiality

The aim, objectives and the protocol of this study was explained and discussed with the pharmacy manager. Ethics approval was obtained from the pharmacy manager of the private hospital in January 2014. The protocol was given full ethics approval by the Biomedical Research Ethics Committee, University of KwaZulu-Natal, South Africa (BREC Ref.: BE237/14) (Annexure C) in July 2014.

3.13 Reliability and Validity

The tool has been validated in other international studies that were discussed in the literature review. Some of these studies include those by Al Ameri *et al.,* (2014), Rahmawati *et al.,* (2009), Maheshkumar & Dhanapal (2014). The face validity was conducted with staff at the Discipline of Health Sciences at the University of KwaZulu-Natal. Data collected was also systematically checked before and after being captured onto the data collection instrument and spreadsheet. The reliability of the study was confirmed by comparisons to numerous international studies on the prevalence of polypharmacy in geriatric patients. The study however was limited to one private sector hospital and did not include data collections and comparisons with other private or public sector hospitals in the area. The data collection and subsequent results and analyses are limited to one study site and could only be compared to similar national and international studies only. Prescribing patterns in the public sector maybe different to the private sector due to the use of the Essential Drugs List and Standard Treatment Guidelines. The study site makes use of the hospital formulary as recommended by the buying group it belongs to.

3.14 Conclusion

This chapter has identified the method in which the research was conducted. The next chapter contains all the results of the research as well as a descriptive analysis of the results which are tabulated.

Chapter 4: Results

4.1 Introduction

This chapter presents all results on the study. It covers all the information captured from each prescription used and the correlating data based on the chart review questionnaire. Data collection spanned a period of 6 weeks between July and August 2014.

4.2 Demographics of the Geriatric Patients

In terms of demographic data (shown in Table 2), only patients aged 60 years and older were used in the chart review questionnaire. Patient age, gender and medical scheme membership were reviewed. Other demographic data regarding race, income, employment, education, marital and health status could not be determined as there was no direct patient contact and the prescription chart did not include this information.

Table 2 Demographic information of participants in the study (N=120)

Variable	Frequency	Percentage
Age (Years)	**(N=120)**	
60-69	89	74.2
70-79	24	20
80+	7	5.8
Gender	**(N=120)**	
Male	53	44.2
Female	67	55.8
Medical Scheme Membership	**(N=120)**	
Member	118	98.3
Non Member	2	1.7

4.2.1 Age of the Geriatric Patients

The majority (74.2 %; n=89) of the study group were in the age category 60-69 years, while 19. 2 % (n=24) were in the age category 70-79 years; and 5.8% (n=7) were in the age category 80 years and more. Table 2 represents the distribution of patients in the different age categories.

4.2.2 Gender of the Geriatric Patients

The study population consisted of 44.7 % (n=53) male and 55.8 % (n=67) female patients represented in Table 2. The majority of the study population were female. As can be seen from Figure 1, which is a comparison of the gender and age of participants in the study, all three age categories had more female patients. There was no significant difference ($p>0.05$) between males and females in the 60-69 years age group. The age groups 70-79 and 80 and over had significant differences in gender distribution ($p<0.05$).

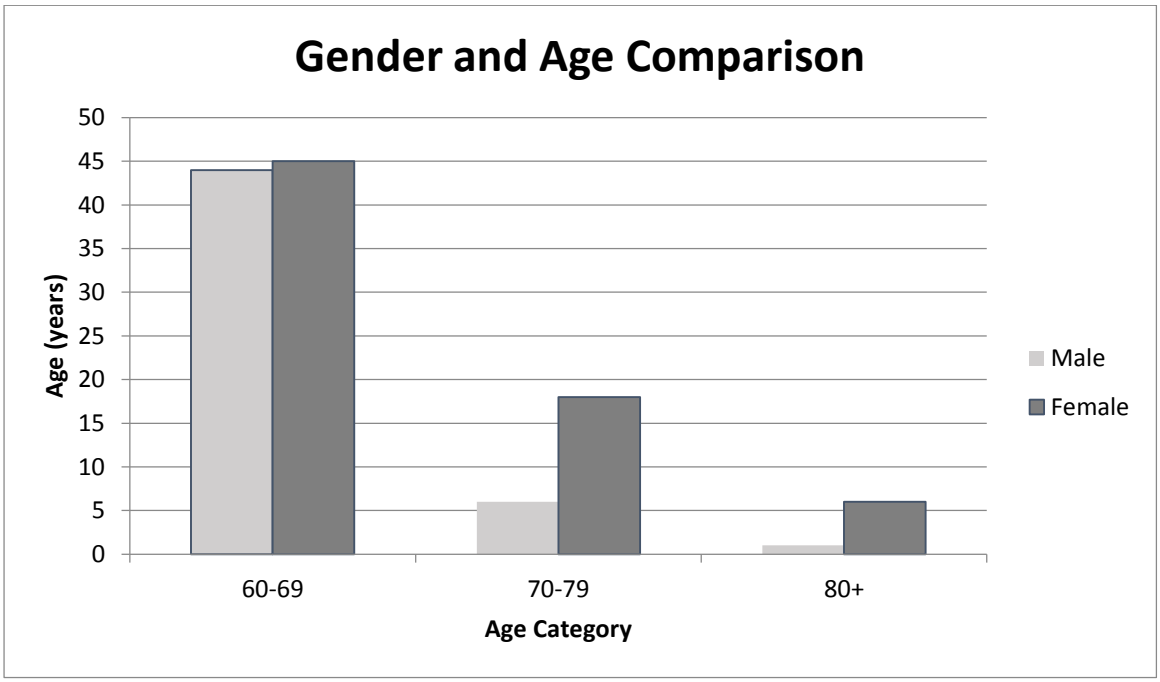

Figure 1: Gender and Age Comparison of Geriatric Participants in the Study

4.2.3 Medical Aid Membership of Geriatric Patients

Table 2 indicates medical scheme membership of the patients in study. Only two of the patients were cash patients.

Table 3 presents the descriptive results of the variables collected in this study. Each aspect will be described in more detail in the sections to follow.

Table 3: Information on diagnoses, chronic diseases, allergies and medicine prescribed to participants in the study.

Variable	Frequency	Percentage
Diagnosis	**(N=120)**	
Yes	117	97.5
No	3	2.5
Diagnosis on Admission	**(N=120)**	
Respiratory Disorders	53	44.2
Cardiac Problems	19	15.8
Diabetes Mellitus	19	15.8
Hypertension	13	10.8
Chest Pain	8	6.7
Other	33	27.5
Number of Chronic Diseases	**(N=120)**	
0	12	10
1-2	73	60.8
3-4	28	23.3
5+	7	5.8
Number of Chronic Diseases in age group 60-69	**(N=120)**	
0	12	10
1-2	55	45.8
3-4	18	15
5+	4	3.3
Number of Chronic Diseases in age group 70-79	**(N=120)**	
0	0	0
1-2	13	10.8
3-4	6	5
5+	3	2.5

Number of Chronic Diseases in age group 80+	**(N=120)**	
0	0	0
1-2	5	4.2
3-4	4	3.3
5+	0	0
Prevalence of Common Chronic Diseases	**(N=120)**	
Hypertension	68	56.7
Diabetes Mellitus	40	33.3
Respiratory Disorders	34	28.3
Cardiac problems	32	26.7
Orthopaedic Problems	14.2	17
Deep Vein Thrombosis	8	6.7
Other (Hepatic, GIT, Thyroid, Renal, Blood, Epilepsy, Psychotic)	40	33.4
Allergies	**(N=120)**	
Yes	12	10
No	108	90
Prescription Medicine	**(N=120)**	
1-2	2	1.7
3-4	28	23.3
5+	90	75
Average Number of Medicines Per Encounter Average Number of Medicines per Patient	**(N=120)** 7.2	
Antimicrobial Usage	**(N=859)**	
Total number of antimicrobials prescribed	98	11.4
Injectable Usage	**(N=859)**	
Total number of injections prescribed	373	43.4
Is Medicine Appropriate?	**(N=859)**	
Yes	758	88.24
Avoid	101	11.76
No	0	0
Availability of Generic/ Clone	**(N=859)**	
Yes	595	69.27
No	264	30.73
Is there a more effective medicine available?	**(N=859)**	
Yes	585	68.1
No	274	31.9
Is this medicine necessary?	**(N=859)**	
Yes	721	83.9
No	138	16.1
Decrease Inappropriate Pharmacology	**(N=859)**	

Side Effects		
Yes	859	100
No	0	0
Side Effect Action Plan: Stop Medicine		
Yes	95	11
No	764	89
Decrease Medicine Dose	**(N=859)**	
Yes	1	0.1
No	858	99.9
Change Medicine	**(N=859)**	
Yes	5	0.6
No	854	99.4
Other	158	18.3
Inappropriate Combination Medicines	**(N=859)**	
Yes	0	0
No	859	100
Number of Prescriptions with Medicine-Medicine Interactions	**(N=120)**	
Yes	51	42.5
No	69	57.5
Does diet interfere with pharmacological action?	**(N=859)**	
Yes	120	14
No	739	86
Risk of Addiction	**(N=859)**	
Yes	72	8.4
No	787	91.6
Same chemical class/pharmacological action	**(N=859)**	
Yes	66	7.7
No	793	92.3
Excessive Duration 1*	**N/A**	
Excessive Dosages	**(N=859)**	
Yes	11	1.3
No	848	98.7
Inappropriate Dosing Frequency	**(N=859)**	
Yes	5	0.6
No	854	99.4
Optimizing Dosing Regimen	**(N=859)**	
Is there lower effective dose of medicine?		
Yes	470	54.7
No	389	45.3
Medicine dosed more than twice daily	**(N=859)**	
Yes	373	43.4

No	486	56.6

Notes:

****1 Duration was not indicated on prescriptions. Prescriptions are usually reviewed at each dispensing to prevent excessive duration when medicine is reordered for the patient.***

4.3 Diagnosis in Geriatric Patients

The chart review included presence/absence of diagnosis. A few additions were made as per diagnosis indicated by the admitting doctor. The diagnosis included the following: cardiac conditions, hypertension, deep vein thrombosis, respiratory problems, diabetes mellitus, thyroid condition, gastro-intestinal disorders, blood disorders, epilepsy, psychotic disorders, and orthopaedic conditions. A few additions were made as per diagnosis indicated by the admitting doctor. The additional diagnoses were allergic reactions, groin pain, syncope, chest infections, cholesterol, haematuria, haemorrhoids, abdominal pain, chest pains, cellulitis, headaches and laparoscopy. Majority, viz. 97.5 % (n=117) patients were diagnosed on admission with 2.5 % (n=3) having no diagnosis.

Respiratory disorders resulted in 44.2 % (n=53) admissions. This was followed by cardiac conditions 15.8 % (n=19), diabetes mellitus 15.8 % (n=19), hypertension 10.8 % (n=13), chest pain 6.7 % (n=8), and other (gastro-intestinal disorders, deep vein thrombosis, headache, orthopaedic problems, haematuria, haemorrhoids, allergic reactions, cellulitis, laparoscopy, cholesterol, groin pain, syncope, psychotic disorders, epilepsy), 27.5 % (n=33). Chest pain was not included under cardiac conditions. Chest pain may not always be due to a cardiac condition and the doctor also indicated a diagnosis of chest pain rather than cardiac condition. Many of the patients had more than one diagnosis on admission.

4.4. Chronic Diseases in Geriatric Patients

Patients with no chronic diseases in the total study population included 10 % (n=12). The majority (60.8 %; n=73) of the study population reviewed had from1-2 chronic diseases. The study population having 3-4 chronic diseases was 23.3 % (n=28) and five or more chronic diseases was 5.8 % (n=7) respectively. A comparison of chronic diseases with age was done.

The 60- 69 years age group had 12 % (n=10) with no chronic diseases listed on admission. This age group of 60-69 years (for 1-2 chronic diseases) also had 45.8 % (n=55), (for 3-4 chronic diseases) 15 % (n=18) and (five or more chronic diseases) 3.3 % (n=4) out of the total study population respectively. The 70-79 years age group had the following: (1-2 chronic diseases) had zero patients, (2-3 chronic diseases) had 10.8 % (n=13) patients, (3-4 chronic diseases) had 15 % (n=18) and (five or more chronic diseases) had 2.5 % (n=3) patients respectively. The 80-89 years age group had the following: (1-2 chronic diseases) had zero patients, (2-3 chronic diseases) had 4.25 (n=5), (3-4 chronic diseases) had 3.3 % (n=4) and (five or more chronic diseases) had zero patients respectively.

In each age category reviewed in the comparison, the 1-2 chronic disease category had the highest number of patients from the study population. The 60-69 years of age category had the most number of patients with 1-2 chronic diseases. Chi square testing was done and Table 4 resulted in the following: The chi-square statistic is 9.5744. The P-Value is 0.143758. The result is not significant at $p < 0.05$.

Table 4: A Comparison of the number of chronic diseases in the three age groups:

	0	1-2	3-4	5+	*Row Totals*
60-69	12	55	18	4	89
70-79	0	13	6	3	22
80-80+	0	5	4	0	9
Column Totals	**12**	**73**	**28**	**7**	**120 (Grand Total)**

The number of chronic diseases was also compared to the gender of the study population. The female gender with 1-2 chronic diseases had the most number of patients. This was followed by males with 1-2 chronic diseases. A total of 60.8 (n=73) of the study population had from 1-2 chronic diseases.

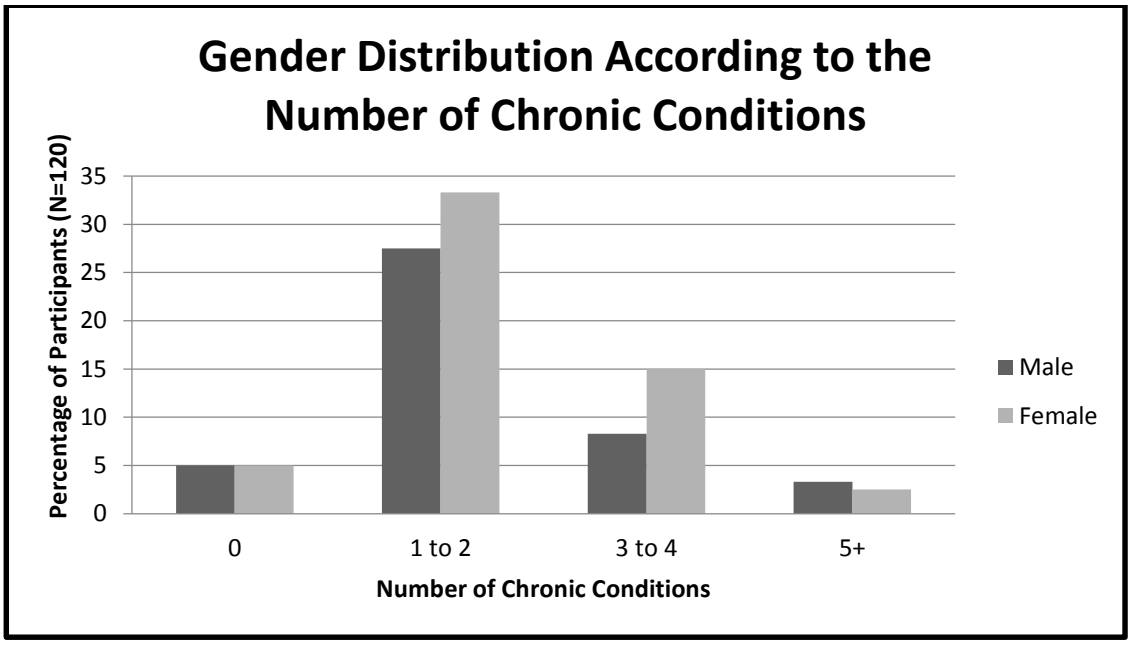

Figure 2: Gender and Chronic Diseases Distribution of Geriatric Participants in the Study

Chi square testing (Table 5) for the comparison of the number of chronic diseases and gender of the study population resulted in the following: The chi-square statistic is 1.4867. The P-Value is 0.685342. The result is not significant at $p < 0.05$.

Table 5: A Comparison of Gender with the Number of Chronic Diseases

	0	1-2	3-4	5+	*Row Totals*
Male	6	40	18	3	67
Female	6	33	10	4	53
Column Totals	12	73	28	7	120 (Grand Total)

An analysis of chronic diseases was done. The most common chronic condition in the study population was hypertension 56.7 % (n=68), followed by diabetes with 33, 3 % (n=40), respiratory disorders with 28.3 % (n=34) and cardiac conditions with 26.7 % (n=32) respectively.

4.5 Allergies in Geriatric Patients

An important aspect of any patient history is the presence or absence of allergies prior to dispensing any medicine. The prescription chart includes a section where presence/absence of allergies has to be documented. 10 % (n=12) of the patients had allergies listed on the prescription chart which included penicillin, pethidine Fresenius®, Mybulen®, codeine, Brufen®, and Bayer Aspirin® allergies. Penicillin allergies were the highest at 5.8 % (n=7) in the study population that had allergies listed on their prescription charts. Two patients were admitted due to an allergic reaction to penicillin. The dispensing pharmacist is required to double checks a prescription for allergies prior to dispensing. However, these cases illustrate that errors might be made.

4.6 Total Number of Prescription Medicines per Geriatric Patient

The 120 patients were prescribed a total of 859 medicines. The average number of medicines per patient was 7.2 (range of 2-21). The average number of medicines was calculated by dividing the total number of medicines by the total number of patients. This was also used to measure the degree of polypharmacy. These include medicines prescribed on admission, medicines transcribed from the admitting prescription and patient's chronic medicines listed on the prescription chart. Patient's chronic medicine was not always provided in the medicine history section of the prescription, so the average number could

be under-estimated. The majority of the study population, 75 % (n=90) received 5 and more medicines. Only 23.3 % (n=28) received 3-4 medicines. The lowest number of patients in the study population were those receiving 1-2 medicines, with a 1.7 % (n=2) record.

Prescription medicine use was assessed according to gender of the study population. Polypharmacy was more prevalent in females when compared to the males. Females had a prevalence of 41.7 % (n=50) when compared to the males having a prevalence of 34.2 % (n=41). There was no significant difference between males and females using 1-2 medicines ($p<0.05$). There was no significant difference between males and females using 3-4 medicines ($p<0.05$). There was a significant difference between males and females using five and more medicines ($p>0.05$).

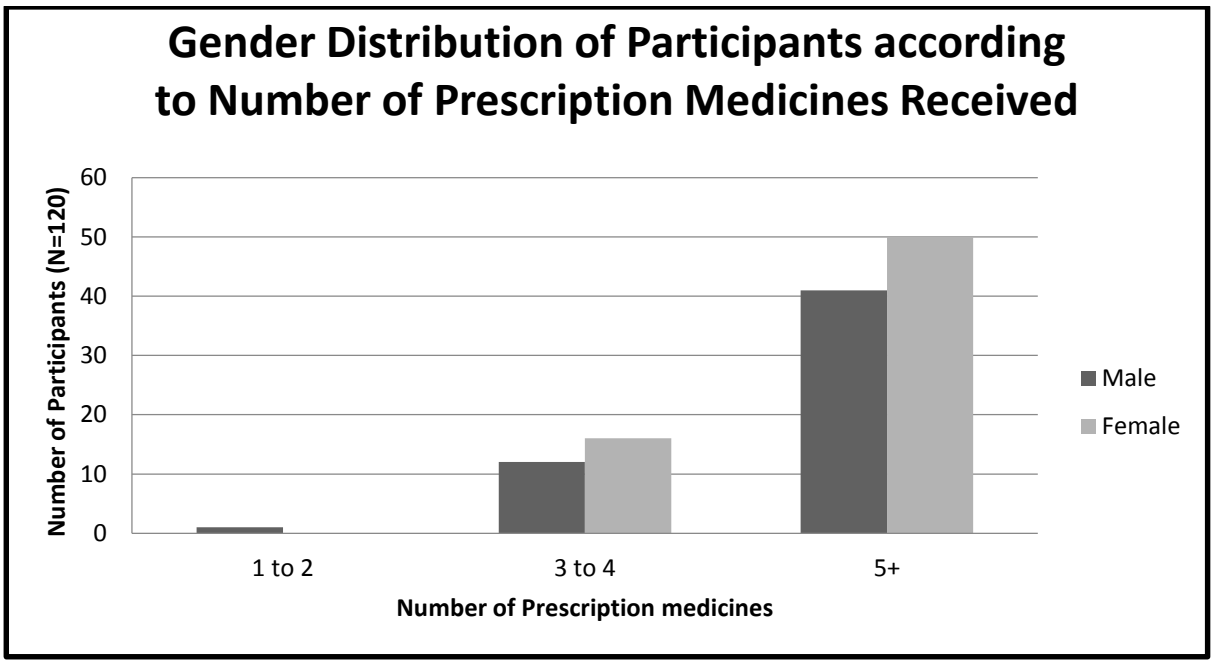

Figure 3: Prescription Medicines distribution by Gender of Geriatric Participants in the Study

Tables 6 and 7 which compared prescription medicine use to gender resulted in the following: The chi-square statistic is 1.2743. The P-Value is 0.528802. The result is *not* significant at $p < 0.05$.

Table 6: A Comparison of Prescription Medicines per Gender

	1-2	3-4	5+	*Row Totals*
Male	1	12	41	54
Female	0	16	50	66
Column Totals	1	28	91	120 (Grand Total)

Table 7: Chi- Square of Prescription Medicines per Gender

	1-2	3-4	5+	*Row Totals*
Male	1 (0.45) [0.67]	12 (12.60) [0.03]	41 (40.95) [0.00]	54
Female	0 (0.55) [0.55]	16 (15.40) [0.02]	50 (50.05) [0.00]	66
Column Totals	1	28	91	120 (Grand Total)

Prescription medicine use was assessed for each age category. The 60-69 years age group had the highest prevalence of polypharmacy with 55.8 % (n=67) of the total study population. Polypharmacy decreased with the 70-79 years age group to 14.2 (n=17). Polypharmacy was lowest for the eighty and over age group with a value of 5.8 % (n=7) of the total study population respectively. Polypharmacy was prevalent in each age category. Each age category had few patients using from 1-2 and 3-4 medicines when compared to use of 5 and more medicines. Polypharmacy was evident from the results obtained.

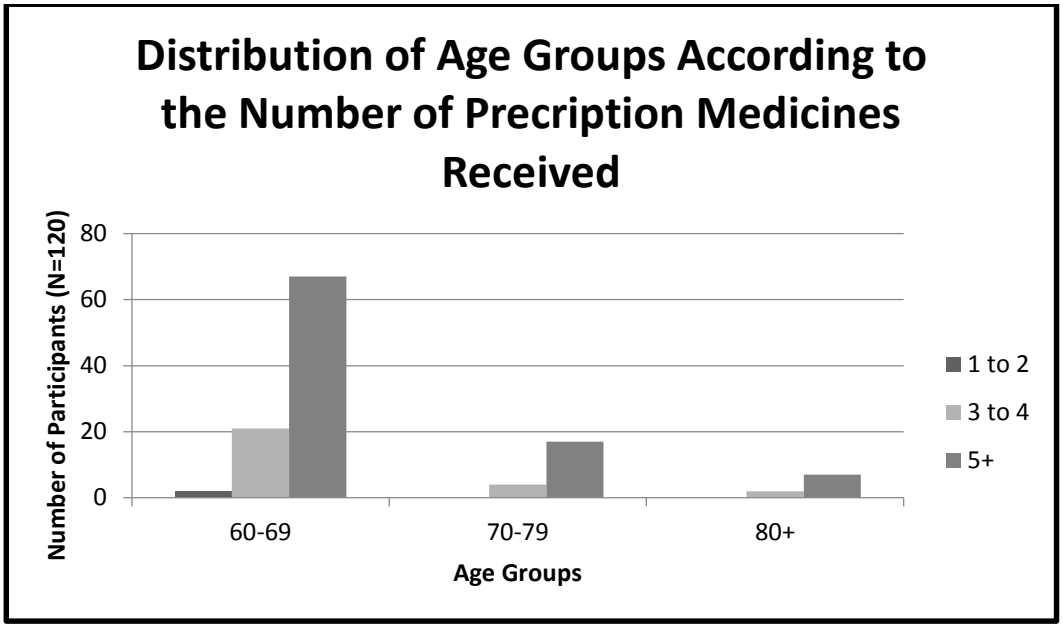

Figure 4 Prescription Medicines per Age Category of Geriatric Participants in the Study

Tables 8 and 9 which covered a comparison of prescription medicine use with the three age categories resulted in the following observations: The chi-square statistic is 0.9059. The P-Value is 0.923706. The result is *not* significant at $p < 0.05$.

Table 8: A Comparison of Prescription Medicines per Age Category

	60-69	**70-79**	**80-80+**	***Row Totals***
1-2	2	0	0	2
3-4	21	4	2	27
5+	67	17	7	91
Column Totals	**90**	**21**	**9**	**120 (Grand Total)**

Table 9: Chi-Square of Prescription Medicines per Age Category

	60-69	**70-79**	**80-80+**	***Row Totals***
1-2	2 (1.50) [0.17]	0 (0.35) [0.35]	0 (0.15) [0.15]	2
3-4	21 (20.25) [0.03]	4 (4.72) [0.11]	2 (2.02) [0.00]	27
5+	67 (68.25) [0.02]	17 (15.92) [0.07]	7 (6.82) [0.00]	91
Column Totals	**90**	**21**	**9**	**120 (Grand Total)**

4.7 Percentage of encounters with an antimicrobial prescribed in the study population

This was determined to measure the overall level of antimicrobials prescribed. Topical, oral and injectable antimicrobials were included. The hospital has an antimicrobial stewardship programme to minimize unintended consequences of antimicrobial use. The number of patient encounters during which an antimicrobial was prescribed was divided by the total number of medicines in the study, multiplied by 100. There were 11.4 % encounters (n=98). The appropriateness/inappropriateness of this fairly low value will be addressed in the discussion.

4.8 Percentage of encounters with an injection prescribed in the study population

This was determined to measure the overall level of use of injections which is a costly form of medicine therapy. The percentage use was calculated by dividing the number of patient encounters during which an injection was prescribed by the total number of medicines prescribed in the study, multiplied by 100. There were 43.4 % (n=373) encounters. This was close to 50 % of total medicine encounters and is considerably high. The appropriateness/inappropriateness of this value will be addressed in the discussion.

4.9 Appropriateness of Medicine in Geriatric Patients

All medicines were assessed using Beers Criteria. The options of a yes, no or avoid answer were available. Of the 859 medicines prescribed, 88. 24 % (n=758) were appropriate and 11.76 % (n=101) should be avoided as per Beers Criteria. The medicines prescribed, that should be avoided included, benzodiazepines (Ativan®, Azor®, Stilnox MR®, Dormonoct®, Imovane®, Ivedal®, Xanor SR®), Insulin, sliding scale (Novorapid®), Gastrointestinal (Maxolon®), NSAIDs (Rayzon® in cardiac patients, Toradol®), Tricyclic antidepressants (Trepilene®), calcium channel blockers (Amloc®, Felodipine®, Adalat XL 30mg®), diuretics (Spiractin®), benzothiazepine derivative (Zildem® in cardiac patients). Each medicine was assessed for availability of a generic or clone. Regarding the total number of medicines prescribed 69, 27 % (n=595) had a generic or clone option.

Each medicine was also assessed for effectiveness. Regarding the total number of medicines prescribed 68, 1 % (n=585) medicines were found to be effective while 31, 9 % (n=274) could be replaced with more effective medicine. Examples of more effective medicine recommendations include: Proton pump inhibitors instead of sucralfate to treat gastro oesophageal reflux disease and ulcers. The mechanism of actions differed but proton pump inhibitors worked faster and needed single or twice daily frequency as compared to sucralfate. Montelukast was recommended instead of older asthma oral medicine. No dosage adjustment is needed in geriatric patients as well as those with hepatic or renal insufficiency and it has the added benefit or being administered once daily at night. The use of celecoxib was recommended instead of Mybulen®. The patient was constipated and on a macrogol laxative. By stopping the Mybulen® and prescribing celecoxib (also a lower dosing frequency) the patient would still be using a nonsteroidal anti-inflammatory without the adverse effect of constipation. This would also result in discontinuation of the laxative.

Regarding the total number of medicines prescribed, 83, 9 % (n=721) were necessary and 16, 1 % (n=138) were unnecessary. Examples of interventions to assess appropriateness include the following: Nitepax® was prescribed in a patient with asthma. A recommendation was made to the doctor to discontinue it as it is not recommended in asthmatic patients.

Solphyllex® was prescribed for a diabetic patient, this was changed to Pholtex Forte®. One patient was prescribed Vimovo® and Arcoxia®, both are non- steroidal ant-inflammatory medicines. A recommendation was made to discontinue one agent. Ivedal® a benzodiazepine was often prescribed in the study population. The Beers Citeria does not recommend the use of this medicine in geriatric patients. The use of sliding scale insulin is not recommended in geriatric patients and doctors were informed of this. However this a common treatment plan for patients admitted to hospital with fluctuating and uncontrolled diabetes.

All medicines have side- effects. The intervention options were to stop the medicine, decrease the dose or change the medicine if it would be to the patients benefit. The medicines reviewed for this question included antimicrobials, benzodiazepines, analgesics, cough mixtures, multivitamins, medicines for nausea and vomiting, constipation, nonsteroidal anti- inflammatory medicines, topical applications and Venofer®. Regarding the total number of medicines prescribed, 11 % (n=95) were stopped and 0.6 % (n=5) were changed to alternative treatment. Recommendations were also documented on the patient chart in the event that the prescriber was unavailable. An example of a recommendation regarding the prescribing of ketorolac which is not recommended in geriatric patients. It is frequently prescribed by certain doctors and at a higher than normal dose per day as well. Doctors are always advised about the doing frequency and duration of use but this recommendation is often overlooked. The duration of treatment for ketorolac is 48 hours only. Stringent measures are in place for paracetamol and parecoxib injections. Paracetamol is stopped after 24 hours and parecoxib is stopped after 96 hours. However especially in the elderly a shorter duration of parecoxib is recommended due to possible negative effects on the cardiac system.

4.10 Decrease Inappropriate Pharmacology in Geriatric Patients

The appropriateness of each medicine prescribed was assessed with different questions. There was no inappropriate use of combination medicines that would have a negative effect on the patients. Of the 120 prescriptions reviewed, 42.5 % (n=51) had medicine-medicine interactions. Diet, which included alcohol intake was found to affect 14 % (n=120) was observed. There was a risk of addiction regarding 8.4 % (n=72) medicines prescribed. There was a 7.7 % (n=66) observation of two or more medicines of same pharmacological class or pharmacological action being used. Regarding excessive duration and excessive dosages, 1.3 % (n=11) was observed. There was a 0.6 % (n=5) observation of inappropriate dosing frequency. Excessive dosing frequencies were observed with nebulising solutions. It is commonplace to observe that they are prescribed to be used every two hours. Fluticasone which is recommended as a daily dose was sometimes prescribed to be used twice or three times a day. Recommendations were made to decrease the dosing frequency. Excessive

duration did not have a value as prescriptions did not have duration of treatment on them. A guide for sensible prescribing in older people has been included by Tidy (2014) (Annexure D).

4.11 Optimize Dosing Regimen in Geriatric Patients

Optimizing medicine therapy is an essential part of caring for a geriatric patient. The process of prescribing a medicine is complex. It includes: deciding that a medicine is needed according to the diagnosis, deciding on the most appropriate medicine, calculating a dose and dosing regimen suited to the patient's physiologic status, monitoring for effectiveness and toxicity, counselling the patient about potential side effects, and reasons for a doctor visit. Polypharmacy increases the frequency of non -compliance or confusion with dosing. Geriatric persons, especially those with low health literacy, are not able to efficiently consolidate prescription regimens to optimize a dosing schedule. The Institute of Medicine has proposed a standardized schedule for specifying medicine dosing (morning, noon, evening, bedtime), recognizing that 90 percent of prescriptions are taken four or fewer times daily (Rochon, 2014).

Two factors were used to optimize dosing regimen. A 54.7% (n=486) was observed in determining if there was a lower effective dose of the medicine. There was a 43.4 % (n=373) observation of patients having medicines dosed more than two times per day. Recommendations were made to change certain medicines to alternatives that needed once daily doses.

Chapter 5: Discussion

5.1 Introduction

The main objective of this study was to determine the prevalence of polypharmacy in a geriatric population group admitted to hospital. Other objectives were to determine the reasons for multiple medicine prescriptions based on the health status, chronic diseases and number of medicines, to determine an appropriate management process and to recommend strategies to pharmacists to assess geriatric patients with multiple medicine regimens and to make suggestions when necessary. One hundred and twenty prescription charts were reviewed, and 75 % (n=90) of the patients received 5 and more medicines. Polypharmacy was evident from the results obtained.

5.2 Demographics of the Geriatric Patients

5.2.1 Age of the Geriatric Patients

As discussed previously, age is one of the risk factors of polypharmacy. The largest portion of the study group was in the youngest age category between ages 60-69 years. A clear relationship was found between polypharmacy and age and gender on evaluation of the data analysis which will be discussed below.

The Al Ameri *et al*., study (2014) and the Maheshkumar and Dhanapal study (2014) also had the greatest number of participating patients in the 60-69 years age group and the lowest number of participating patients in the 80 and over age group which is consistent with this study.

Hong- Ah et al., (2013) prevalence and predictors of polypharmacy among Korean geriatric also had the most patients in the younger age category. Among the patients, 6.7 % were aged 85 years, 30.2 % were aged 75–84 years, and 63.1 % were aged 65–74 years.

5.2.2 Gender of the Geriatric Patients

A gender comparison of the study population confirmed that there were more females in the three different age categories. An article by Kirkwood (2010), an experimental gerontologist points out that women are more resilient than men from birth through to extreme old age. He reaffirms women outlive men by about five to six years. By age 85 there are approximately six women to every four men, at age 100 the ratio is more than two to one and by age 122, the current world record for human longevity, the score stands at one-nil in favour of women. On comparing the age category 70-79 years and 80 and over, the females outnumber the males by large percentage differences, which reaffirm Kirkwood's statements that women outlive men as they get older (Kirkwood, 2010).

Females constituted 60.0 % of the total study population in Korean geriatric patients. (Hong-Ah *et al*., 2013). This study was consistent with Hong-Ah *et al*., (2013) study as there were 55.8 % (n=67) females and 44.2 % (n=53) males in the study population.

5.2.3 Medical Aid Membership of Geriatric Patients

Critical illnesses are more common in geriatric patients than in younger people. Private healthcare in South Africa is very expensive. To get good quality treatment without medical aid is beyond the reach of most individuals. Many geriatric persons on a pension cannot afford medical aid and are assisted by family in payment of medical aid premiums. Fortunately medical aid is opened to any South African, irrespective of age (Medical Aids, 2015). The majority of the study population had medical aid membership. Notably, medical aid membership was associated with polypharmacy in the Hong- Ah and colleagues study (2013). This study also displayed the same pattern.

5.3 Diagnosis of the Geriatric Patients

The majority of the patients had a diagnosis, with only a small percentage having no diagnosis on admission. Many of the patients had more than one diagnosis. A diagnosis is

important so that a patient's treatment plan will target the underlying process rather than an isolated symptom (Hanger, 2012).

No one wants to go into a hospital for any reason. Foltz-Gray (2012) confirmed the common reasons that geriatric patients get admitted to the hospital. In 2009, 543 000 adults over the age of 65 years were hospitalized for an irregular heartbeat (cardiac arrhythmias). In 2009, 751 000 adults over 65 years entered the hospital for congestive heart failure. More people are living longer and this includes people with heart disease. With the passage of time, there is damage/weakening of the heart muscles. This may progress to heart failure. In 2008, 822 500 people with chronic obstructive pulmonary disease (COPD), age 40 years and over, were admitted to hospital. Smoking is the primary cause of COPD, which includes emphysema and chronic bronchitis. In 2009, 753 000 adults over 45 years were hospitalized for coronary atherosclerosis, or a blockage of blood flow to the heart from the build-up of fatty plaque (coronary atherosclerosis). In 2009, 655 000 adults were admitted to hospital because of diabetes. Obesity, lack of exercise and age 45 years and older are three prominent risk factors for type 2, or adult-onset, diabetes. Common reasons for hospitalization due to diabetes include strokes, heart attacks, ulcers and dehydration from increased blood sugar levels. Medicine problems and adverse medicine reactions resulted in 1.9 million hospital stays in 2008. Medicines most commonly leading to this included: corticosteroids, anticoagulants, sedatives and hypnotics. Pneumonia, resulted in 886 000 admissions in 2009. The ageing process weakens the immune system. Geriatric persons are more prone to bacterial and viral pneumonia. Other conditions like diabetes, stroke and flu can predispose you to pneumonia as well. In 2008, stroke resulted in 892 300 hospitalizations (Foltz-Gray, 2012).

Data from a four-year study of 11.5 million Medicare enrolees show that even limited exposure to fine particle air pollution from a motor vehicle exhaust and power plant emissions enormously increased the risk for cardiovascular and respiratory disease among people over 65 years of age (Dominici *et al*., 2006).

Ageing also affects the respiratory system. The maximum function sees a gradual decline. The age-related changes in the lungs include: decreased peak airflow and gas exchange, decreased measures of lung function such as vital capacity (the maximum amount of air breathed out following a maximum inhalation) and weakening of the respiratory muscles. (Merck Manual, 2013).

Acute and chronic pulmonary problems, pose a threat to the lives of the geriatric population more than diseases involving any other organ system. Pneumonia is the third most common cause of death in the geriatric population, affecting over one million Americans each year, often at the end of life. Many viral infections can prove to be fatal for older people. The comorbidities of age exacerbate the health of geriatrics with respiratory disorders. Common acute and chronic pulmonary problems are often misdiagnosed or overlooked in the geriatric (Buckner *et al.,* 2007).

Heart disease is very common in geriatric patients and is often the leading cause of death (Jackson & Wenger, 2011). The increase in the number of geriatric patients has led to an increase of patients with heart disease and hypertension (Virdis *et al.,* 2011). The geriatric population increasingly comprises a larger portion of newly diagnosed diabetic patients. In 1993, 41 % of the 7.8 million people diagnosed with diabetes were over 65 years of age (Chau & Edelman, 2001).

In this study, respiratory disorders were a leading cause of hospital admission. Respiratory disorders included asthma, bronchitis, pneumonia, tuberculosis and other lung diseases. This was followed by cardiac conditions (angina, congenital, rheumatic fever), diabetes mellitus (hyper/hypoglycaemia) and hypertension. On evaluating the top four diagnosis on admission it is apparent that these are in correlation with many of the articles as discussed above. The different diagnoses observed on admission are also an indication that patients' chronic conditions are not adequately controlled by their medicine treatment plans.

5.4 Chronic Diseases in Geriatric Patients

According to the American Society of Consultant Pharmacists, the most common chronic diseases afflicting the geriatric are: Adult onset diabetes, Arthritis, Kidney and bladder problems, Dementia, Parkinson's disease, Glaucoma, Lung disease, Cataracts, Osteoporosis, Enlarged prostate, Alzheimer's disease, Macular degeneration, Depression, Cardiovascular disease (Parentgiving, 2015). The prevalence of chronic conditions, based on pharmacy claims data, in those aged ≥70 years in Ireland is high, with a significant level of co-morbidity (Naughton *et al.,* 2015).

Cardiovascular disease (CVD), which included hypertension, was the most common at 72 %. Second was central nervous system (CNS) conditions at 37 %, musculo-skeletal conditions at 28 % was third, upper gastrointestinal (GI) at 24 % was fourth and respiratory at 14 % was fifth. Diabetes mellitus, thyroid disease and glaucoma occurred in 5–8 % of this population, and cancer therapy was received by 4 %. There was a high level of co-morbidity, with two chronic diseases experienced by 27 % (86,514), three conditions by 19 % (60,930) and four or more conditions by 14 % (44,035) of the population (Naughton *et al.,* 2015).

Research by Phaswana-Mafuya *et al.,* (2008) to determine the prevalence of chronic noncommunicable diseases (NCDS) and associated factors among older adults in South Africa confirmed that the prevalence of chronic NCDs was 51.8 %. The prevalence of multimorbidity (≥2 chronic conditions) was 22.5 %. They found that the most common chronic NCDs reported globally included cardiovascular diseases, DM, cancer, and chronic respiratory diseases. This is also the case in South Africa. The most prevalent chronic NCDs reported in this study were hypertension (30.3 %) and arthritis (24.7 %). The prevalence of hypertension was higher among women (63.8 %), African Blacks (71.8 %), wealthier individuals (47.1), married persons (47.7 %), and urban residents (69.7 %). The distribution of arthritis was similar to that of hypertension, being higher among women (66.6 %), African Blacks (64.1 %), wealthier individuals (47.3 %), married persons (43.6 %), and those residing in urban areas (69.5 %). Chronic lung infection and depression were the least reported NCDs

(2.9 %) (Phaswana-Mafuya *et al.,* 2008). Cardiovascular, respiratory and hepatic system conditions accounted for top three chronic diseases (Maheshkumar & Dhanapal, 2014).

The Moodley (2000) study had hypertension as the most common chronic disorder in 64.8 % of the study population. This study also had hypertension as the leading chronic condition in 56.7 % (n=68) patients in the study population. The youngest age group in this study, 60-69 years had the largest number of the study population. The results of this study are more or less consistent with the South African, Indian, United Arab Emirates, and Irish studies determining the most common chronic diseases. Hypertension, diabetes mellitus, respiratory disorders and cardiac problems were the top four most common chronic diseases observed in this study population. This study also had a prevalence of multimorbidity and only 10 % of the study group had no chronic conditions. The 60-79 years study group also had higher multimorbidity consistent with the study discussed below.

Al Ameri *et al.,* (2014) revealed in their study that multimorbidity was higher in the 60-79 years age category, which also showed a higher exposure to polypharmacy. A total of 56 % of patients were involved in polypharmacy and showed multimorbidity of hypertension, diabetes and dyslipidemia. A clear relationship was found between polypharmacy and multimorbidity.

5.5 Allergies of the Geriatric Patients

The World Allergy Organisation (WAO) describes a medicine allergy as a type of unpredictable reaction. The risk factors for medicine allergy include medicine factors (nature of medicine, degree of exposure- dose, duration, frequency, route of administration and cross sensitization. Host factors for medicine allergies are age, sex, genetic factors, previous medicine reaction, concurrent medical illness and multiple allergy syndrome. Many medicines are linked to the allergic reactions. Penicillins, aspirin, and sulfonamides are responsible for over 80 percent of allergic medicine reactions (WAO, 2014). The results of the study are consistent with WAO finding regarding penicillins being more frequently implicated in the allergy section of the questionnaire.

5.6 Total Number of Prescription Medicines per Geriatric Patient

In this study the likelihood of more than one product being used was very apparent, and the use of 5 and more medicines was prevalent. Each age category had a high prevalence of 5 and more medicines prescribed. Females also overtook the males in the 5 and more medicines category.

Al Ameri *et al*., (2014) revealed in their study a clear relationship between polypharmacy and age and the higher the number of medicines found, the greater the risk of polypharmacy. It was indicated that 89 % of geriatric patients, aged from 60-79 years old were taking more than five medicines and were exposed to at least one polypharmacy episode. In addition the same age group had the maximum number of incidences of consuming more than nine medicines (Al Ameri *et al.,* 2014). On combining these two age groups, 60-69 years and 70-79 years, as a comparison to the Al Ameri *et al.,* (2014) study, 70 % (n=84) of the study participants were taking 5 or more medicines also confirming the relationship between polypharmacy and age. The lowest polypharmacy was seen in the 80 and over age group in Al Ameri *et al.,* (2014) and in this study group.

The Maheshkumar and Dhanapal study (2014) also had the highest prevalence of polypharmacy in the age group 60-69 years. Their study also showed a decrease in polypharmacy as the patient went over the age of 70 years and the researcher found the same pattern in this study. Geriatric people receive a higher number of prescriptions in hospital and in the community than do younger patients. The sampled geriatric hospitalized patients had 36 patients taking more than five medicines per day (Rahmawati, *et al.,* 2009).

The Al Ameri *et al.* (2014) study showed that more males were exposed to polypharmacy than females. The Maheskumar and Dhanpal study (2014) had more females being exposed to polypharmacy. Granero and colleagues (2010), has shown that there is no association between polypharmacy and gender.

The average number of medicines per encounter to measure the degree of polypharmacy in this study was 7.2. On referring to the definition of polypharmacy for the purposes of this study, it is apparent that polypharmacy is prevalent.

5.7 Percentage of encounters with an antimicrobial prescribed in the study population

To promote rational medicine use in South Africa, which is a developing country, it is important to assess medicine use pattern. This can be done using WHO medicine use indicators, which has been done for the study population (WHO 1993). The percentage of encounters with antimicrobials was calculated to determine the overall use of a costly form of medicine therapy. An antibiotic stewardship programme is being run in the intensive care units in this hospital which may have contributed to a lower figure. Pharmacy also reviews all antibiotic prescriptions. Oral antibiotics are reviewed after a five day course is dispensed in the event of a reorder. In the intensive care units and high care, antibiotics are reviewed in pharmacy after forty eight hours when laboratory results are available. The Desalegn

(2013) study had 58.1 % encounters with an antimicrobial prescribed compared to 11.4 % in this study. The low percentage of antimicrobial encounters also highlights the importance of an antibiotic stewardship programme as this has resulted in a decrease in antimicrobial therapy. Future studies at the hospital can further assess and highlight the positive impact of antibiotic stewardship when comparisons are made of antimicrobial usage in wards not exposed to the programme.

5.8 Percentage of encounters with an injection prescribed in the study population

This percentage of encounters was calculated to determine the usage of another expensive form of medicine therapy (WHO 1993). The percentage of encounters was just under 50 % which is high and also included the use of antimicrobial injections. According to WHO (1993), an injection was prescribed in 37 % of all consultations. A study by Desalegn (2013) in Ethiopia had 38.1 % of encounters with an injection; this study however was not restricted to the geriatric population. Overprescribing is often caused by medicine therapy not being re-evaluated over time with the consequence that medicines continue to be prescribed even though the indication for their use is no longer present. Certain medicines in many hospital charts are reviewed daily to prevent excessive duration. The same was done on charts being reviewed for the study. E.g. Rayzon® duration is recommended for 96 hours, paracetamol injection is dispensed for 24 hours and a further two day supply is only allowed in the intensive care units after it is reordered by the prescriber. The high percentage of encounters with an injection highlights that pharmacist interventions need to be increased when suggesting changes from injections to oral dosage forms.

5.9 Appropriateness of Medicine in the Geriatric Patients

Polypharmacy places geriatric persons at a greater risk of inappropriate prescribing. (Hajjar *et al*., 2007). Beers Criteria was used to determine if the medicines prescribed were appropriate. The prevalence of potentially inappropriate medicines has been evaluated in numerous studies since 1990. This has been seen in long- term care, outpatient, acute care and community settings. Even though this problem has been highlighted, the use of potentially inappropriate medicines is prevalent in geriatric patients (American Geriatrics Society, 2012). Willcox *et al*., (1994) concluded in their study that physicians prescribe potentially inappropriate medicines for a large percentage of geriatric persons living in the community, increasing the risk of adverse medicine reactions. In their study, 79.6 % of all geriatrics over age 65 received potentially inappropriate medicines. The Delphi consensus technique was used as an outcome measure.

Aparasu and Mort (2000), reviewed literature using Beers Criteria for potentially inappropriate medicines (PIMs) in geriatrics. They reviewed each study regarding the methodology used. They also assessed the prevalence and the degree of inappropriate medicines prescribed. Differences in methodology were observed. However there were some consistent patterns in the various healthcare settings. They observed that researchers adjusted the Beers criteria to examine inappropriate medicine use in the geriatric in the various health care settings. Results showed that almost one out of four (23.5 %) and one out of seven (14.0 %) geriatric patients received a potentially inappropriate medicine according to the Beers list of 20 inappropriate medicines. Almost every patient received one potentially inappropriate medicine. Long-acting benzodiazepines, dipyridamole, and amitriptyline were the most commonly used inappropriate medicines.

Inappropriate medicine use was established by review of the medical records, a comparison of symptoms, diagnosis, laboratory findings and prescription medicines. Inappropriate medicine use was classified as follows: no medical diagnosis, additive/ recreational medicine

therapy, non-medicine treatment is more beneficial, therapeutic duplication, and treatment of an avoidable adverse medicine reaction. Inappropriate medicines were classified and encoded using the MIMS Indonesia 105th Edition. (Rahmawati *et al.,* 2009). The evaluation of inappropriate medicine use in this study did not have access to laboratory findings. There is also no clinical pharmacist or geriatric consultant available at the study site.

Inappropriate medicine use occurred in 63 cases (63 %) of the study population. Unnecessary medicine therapy accounted for 117 events. A 0-6 range of problems was a consequence of the high frequency of inappropriate medicines prescribed. Prior to prescribing any new medicine, the need for the medicine should be re- evaluated and a non-pharmacologic option should be considered (Rahmawati *et al.,* 2009). This study had a very small percentage of potentially inappropriate medicines when compared to the Aparasu and Mort (2000) and the Rahmawati and colleagues study (2009).

5.10 Decreasing Inappropriate Pharmacology in the Geriatric Patients

The study of polypharmacy in the geriatric showed that comprehensive geriatric assessment (CGA) is an efficient way to decrease polypharmacy. Inappropriate medicine use is also curtailed. Health care personnel benefit from this assessment by being able to prioritize the different chronic conditions. This culminates in positive pharmacological treatment in geriatric patients. The patient's prognosis is also important in the treatment process. The most appropriate medicine treatment plan should combine evidence-based clinical practice guidelines with data gathered from the comprehensive geriatric assessment. Socioeconomic factors should also be considered. A medicine review of each geriatric patient should be done quarterly and the frequency should be increased as the number of chronic diseases increases (Sergi *et al.*, 2011).

Guidelines for a medicine review for ailing, ageing patients, the Pill Pruner, has been developed in New Zealand. The guidelines utilise the STOPP/START criteria. A trial of the Pill

Pruner was carried out at Christchurch Hospital on two different groups of 500 hospitalised patients aged over 75 years. A total of 70 % of the patients experienced polypharmacy. Prior The Pill Pruner project led to a drop in the number of discharge medicines prescribed. The project resulted in discontinuation of over 1000 medicines. These included: loop diuretics, antiplatelet medicine, statins, ace inhibitors, beta-blockers and benzodiazepines. Patients' health was not compromised by this (Hanger, 2012).

A study to determine the benefits of pharmacists' interventions was conducted by Gillespie *et al.,* (2009). The very old age group of 80 years and over were the study population. For the intervention group, there was a 16 % reduction in hospital admissions and a 47 % reduction in emergency department visits. Readmissions due to adverse medicine reactions were greatly reduced by 80 %.

Growing older changes pharmacokinetics and pharmacodynamics. This increases the risk of adverse medicine reactions. It is also worth remembering that patients aged >65-70 years are seldom enrolled in clinical trials. Evidence from research in younger patients cannot be applied to geriatric patients (Tidy, 2014).

Side effects may present in older patients in nonspecific ways. Most medicines can lead to the side effect of confusion. Constipation, dizziness, dry mouth, blurred vision are very common side effects in the geriatric. Falls are also often associated with medicine in this age group. When assessing symptoms in the geriatric patient, pharmacists should always review their medicines. Establish whether or not this might be iatrogenic disease. A side effect of non-steroidal anti-inflammatory medicines is gastro-intestinal bleeding. This can have serious consequences for the geriatric patient. Heart failure and impaired renal function can be made worse. An assessment of side effects will assist in determining if a patient's admission is due to side effect of any medicine they are on (Tidy, 2014).

This study is to determine the prevalence of polypharmacy in geriatrics. The most consistent risk factor for adverse medicine reactions is the number of medicines being taken and the risk rises exponentially as the number of medicines increases (Tidy, 2014).

Many studies in the literature highlight that adverse medicine effects occur with geriatrics because of age-specific metabolic changes, non-compliance, and adherence. Therefore a well-designed interprofessional supervision and close monitoring is essential, for this group to reduce aspects of unnecessary prescribing, medicine- medicine interactions and negative results on health outcomes (Al Ameri *et al*., 2014).

5.11 Optimize Dosing Regimen in the Geriatric Patients

Al Ameri *et al.,* (2014) states that multiple medicines usage increase the chances of poor compliance or confusion with dosing. Caution must be taken in determining medicine doses as higher doses and decreased clearance usually prolong a medicines half-life (Al Ameri *et al.,* 2014).

Regarding question 20, ideally medicine should be dosed once or twice daily but this is almost impossible. Many medicines need to be given three times a day (Bushardt & Jones, 2005). Medicines' which are dosed more frequently often lead to non-compliance.

Chapter 6: Conclusion

6.1 Introduction

In this chapter, the researcher attempts to interpret the findings of chapter 4. Each aspect of the aims and objectives of the study will be addressed based on the findings of the study. Recommendations are then made whereby improvements can be made to decrease the prevalence of polypharmacy in geriatric patients. The final and concluding remarks are made as well.

6.2 Findings from the Study

6.2.1 Findings from the Literature Review

The results of the findings show that there is a prevalence of polypharmacy in geriatric patients in the private hospital setting. This is consistent with the various articles reviewed on studies around the world regarding the prevalence of polypharmacy in geriatrics in various care settings around the world. More research is needed to highlight the consequences associated with IMU use in geriatric patients. The results of the study reiterate Al Ameri *et al.,* (2014) and Hong- Ah *et al.,* (2013) studies confirming that the prevalence of polypharmacy is widespread among geriatric patients.

6.2.2 Findings from the Research

The results of the research surrounding polypharmacy in relation to age, sex, medical aid membership, diagnosis, chronic conditions, medicine doses, inappropriate pharmacology optimization of dosing regimen indicate that all are contributing factors to the prevalence of polypharmacy. The youngest age group in the 60-69 years age category had the most polypharmacy. Females had the most polypharmacy.

6.3 Study Limitations

The study was assessed from reviewing patient prescription charts and not from interviewing patients or healthcare professionals. It was difficult to ascertain whether the study population was using any over the counter medicines, this may have resulted in an underestimate of the prevalence of polypharmacy.

The full set of criteria was not applied (Beers Criteria) as most of the prescriptions reviewed did not have a duration of treatment and only the first prescription on admission was reviewed. Lack of clinical data which included laboratory results, blood pressure and glucose monitoring were also not available. This may have resulted in an under estimation of the full extent of the negative problems associated with polypharmacy in the geriatric patients.

6.4 Recommendations

Health care personnel can adopt an informed approach to address the needs of the geriatric population regarding polypharmacy. Health care professionals need to know about the risks associated with polypharmacy and thoroughly review all medicines at each patient encounter to prevent polypharmacy from occurring. Strategies for pharmacists to manage polypharmacy can include medicine review, communication with the prescriber and patient, reduction in a geriatrics regimen to the fewest possible essential medicines. Prescribers and dispensers can utilize the information to decide whether the medicine is essential and if the geriatric can tolerate possible interactions or adverse effects.

Pharmacy and Medical Schools should provide ongoing education to all health professionals regarding rational medicine therapy in geriatric patients. Pharmaceutical companies should also provide training to healthcare professionals regarding the most problematic medicines in geriatric therapy. Geriatric patients should also be exposed to educational programmes regarding their treatment.

6.5 Conclusion

This study allowed the researcher to determine that polypharmacy is prevalent in geriatric patients in South Africa. Clear, feasible recommendations have been made to decrease the prevalence of polypharmacy in geriatric patients. The results of this study can be used by healthcare professionals to be aware of the prevalence and scope of polypharmacy. The results can be used by the pharmacy team at the study site to put systems in place for interventions that will impact positively on polypharmacy. More research is needed to address prescribing trends across the country and the impact of inappropriate medicine use in the geriatric population. The scope for further research following this study is significant as the health care industry in South Africa is currently going through a transition to a National Health System (NHS).

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Annexure A: Data Extraction Form/Questionnaire

Demographics:

1. Age group

Table: 1		
Age-group		
60-69	70-79	≥80

2. Sex

Table:2	
Sex	
Male	Female

3. Medical aid

Table:3	
Medical Aid	
Yes	No

Diagnosis on Admission Day

4. Diagnosis

Table:4		
Diagnosis	Yes	No

Chronic Diseases

5. Number of chronic diseases

Table:5
Number of chronic diseases

1 or 2	3 or 4	≥5

6. Names of chronic diseases

Table: 6	
a.	e.
b.	f.
c.	
d.	

7. Allergies

Table:7	
Yes with Description	No

Monitor Number of Medicines

8. Total Number of prescription medicines:

Table:8		
Total Number of Prescription Medicines		
1 or 2	3 or 4	≥5

9. Names and Dosage of All Medicine

Table:9						
			*	*	*	*
A	B	C	D	E	F	G

Name of Medicine	Dosage	Indication	Is Medicine Appropriate for use in geriatric (YES or NO)	Is there a generic or clone available (YES or NO)	Is there a more effective medicine available (YES or NO)	Is this medicine necessary (YES or NO)

*- 9. d, e, f, g Indicates Inappropriate Medicine use

Table:10			
Decrease Inappropriate Pharmacology	**YES**	**NO**	**Name/s of Medicine**
10. a. Are there side effects to the Medicine/s?			
11. Are there combination medicines, in which one of the medicines is inappropriate?			
12. Are there medicine-medicine interactions?			
13. Does diet interfere with pharmacologic action?			
14. Is there risk of an addiction from medicine?			
15. Are two or more medicines of same chemical class or pharmacologic action being used?			
16. Excessive duration?			
17. Excessive dosages?			
18. Inappropriate dosing frequency?			

10 a. Side Effect Action Plan after Discussion with Doctor

Table:12		
Plan	Yes	No
Stop Medicine		
Decrease Medicine Dose		
Change Medicine		
Other		

Table:13		
Optimize Dosing Regimen	**YES**	**NO**
19. Is there a lower effective dose of the Medicine?		
20. Does the patient have any medicines dosed more than two times per day?		

Annexure B: Hyperpharmacotherapy Assessment Tool (HAT)

Figure 5

Hyperpharmacotherapy Assessment Tool (HAT)

Patient Name: _____

Instructions: Evaluate drug profile by using criteria below. The first two criteria require numbers. Otherwise, use Y = Yes, N = No. When question is answered "Yes," investigate ways to improve medication regimen. Drug discontinuation or tapering should generally be engaged with a single drug at the time. When choosing among multiple medications well suited for discontinuation, consider the underlying problem and review this series in descending order of priority: safety, tolerability, efficacy, tolerability, price, and simplicity of use.

	Visit 1 Date:	Visit 2 Date:	Visit 3 Date:	Visit 4 Date:	Visit 5 Date:	Visit 6 Date:
GOAL I: Monitor Number of Medications						
Total # of Prescription medications, OTC medications, vitamins or minerals, dietary supplements and herbs						
Total # of Meds systemically or gastrointestinally absorbed						
GOAL II: Decrease Inappropriate Drug Use						
Has the disease state resolved that the drug(s) was originally prescribed for?						
Is non-drug therapy an option?						
Is there another drug more effective for the disease?						
Is there an equally effective, lower-cost drug available?						
Is the patient taking another person's medication?						
Is the drug inappropriate for use in the elderly?						
Are treatment goals unachieved?						
GOAL III: Decrease Inappropriate Pharmacology						
Are there any adverse effects to the medication(s)?						
Is the patient using 2 or more drugs of the same chemical class or pharmacologic action?						
Is the patient taking combination pill(s) in which one of the medications is inappropriate?						
Are there any drug-drug interactions? (OTC, herbal supplements, prescription meds)						
Are there any adverse drug-disease interactions?						
Does the patient's diet interfere with pharmacologic action?						
Is there risk of addiction from the medication?						
Is the patient at risk for accumulation from long-term use?						
GOAL IV: Optimize dosing regimen						
Is there a lower effective dose of the medication?						
Does the patient have any medications dosed more than 2 times per day?						

Figure 5: HAT above was used in the development of the Data Extraction Form for the Research, (Bushardt *et al*., (2008)

Annexure C: Ethics Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

11 July 2014

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PROTOCOL: Determining the prevalence and scope of polypharmacy in geriatric patients at a private hospital in Pietermaritzburg, KwaZulu-Natal. REF: BE237/14

EXPEDITED APPLICATION

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application received on 01 May 2014.

The study was provisionally approved pending appropriate responses to queries raised. Your responses received on 02 July 2014 to queries raised on 18 June 2014 have been noted by a sub-committee of the Biomedical Research Ethics Committee. The conditions have now been met and the study is given full ethics approval and may begin as from 11 July 2014.

This approval is valid for one year from **11 July 2014.** To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2004), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at http://research.ukzn.ac.za/Research-Ethics/Biomedical-Research-Ethics.aspx.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be **RATIFIED** by a full Committee at its meeting taking place on **12 August 2014.**

We wish you well with this study. We would appreciate receiving copies of all publications arising out of this study.

Yours sincerely

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Chair: Biomedical Research Ethics Committee

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Annexure D: A Rubric for Sensible Prescribing in Older Patients

Is it needed? Consider this carefully in the context of the older patient, their medical problems, lifestyle and resources to cope with taking a medicine.

Limit the range of medicines you use in older patients: it's a good idea to have a small formulary for older patients and to be aware of the indications, contra-indications and potential side-effects of these medicines in this group.

Start low, go slow: initial dosage should be carefully considered and usually about half of the normal adult dose. Dose titration should be cautious and carried out in small increments, watching out for side-effects.

Keep it simple: use medicine treatment plans with the lowest number, with dosing intervals of once or twice daily. Avoid complicated or multiple dosing regimens where possible. Avoid polypharmacy.

Make it clear: avoid unclear prescribing e.g. as 'as directed', providing full dose, frequency and route, on first and repeat prescriptions. Use pictograms or other aids to help the patient take the medicine correctly.

Review regularly: review medicine after it has been started, assess whether it should be continued long-term. An Irish study found that the main contributors to potentially inappropriate prescribing were NSAIDs taken for more than three months, PPIs prescribed at maximum strength for more than eight weeks and long-acting benzodiazepines given for longer than one month. Put systems in place for the doctor to review treatment at appropriate intervals. Encourage patients to dispose of old, unused medicine via their GP or pharmacist.

Use teams and support: interdisciplinary approaches to prescribing, dispensing and monitoring of medicines are particularly useful in older patients. Liaise with colleagues to achieve the best for every patient. There is good evidence that involvement of a clinical pharmacist in the review of elderly patients' medicine improves safety and decreases expenditure in a community setting. (Tidy, 2014)