A Community Pharmacy perspective on the epidemiology of antimicrobial drugs in the Kuilsriver urban area

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ABSTRACT

The epidemiology of drugs is 'defined as the manner in which drugs are used by doctors, nurses, pharmacists and patients. As such epidemiology of antimicrobial drugs is the manner in which this class of drugs is used by healthcare professional, patients or caregivers. Antimicrobial drugs have a pivotal role worldwide in preventing infections and treating infectious diseases. The challenge that lies in the health sector is to maintain antimicrobials' effectiveness by using them appropriately to avoid toxicity, adverse reactions and resistance among other problems. The world faces a future in which ten million people could die annually due to infections that are resistant to available antibiotics. Despite people already dying of drug-resistant infections in private and public hospitals, doctors are still prescribing antibiotics for viral infections, for which they have no effect. The aim of this research is to study the epidemiology of antimicrobial drugs and factors that lead to the inappropriate use of antimicrobials, which is resulting in a steep rise of antimicrobial resistance in the private sector from a community pharmacy perspective.

This was a cross-sectional study design where questionnaires were used to collect data for analysis. Correlation analysis was done using Graph Pad Prism. Three different questionnaires were used in this study, one for patients which aimed at collecting data on their health history, antimicrobial knowledge and psychosocial factors. The second and third questionnaires aimed at collecting data on patients' information, prescribers' information, the prescribed antimicrobial drugs data and prescribers' perceptions.

Results of this study showed that on average, 65.9% of the respondents received antimicrobial agents without a prior diagnostic test done to conclude presence of an infection. Only 24.2% of the respondents knew what antimicrobial agents t had been prescribed, while an alarming 75.8% had no idea of the identity of the antimicrobial agent that had been prescribed for them. When asked on what they do with left over antimicrobial agents, 33.3% reported on keeping antimicrobial drugs for future use on the same ailment, 61.7% throwing away leftover antimicrobials while 5% of the patients keep for other ailments.

The results obtained from the Unisolve data collection instrument included 503 patients and the results showed that dentist, general practitioners and specialist prescribed antimicrobial drugs inappropriately in (17.2%, 42.9% and 34.1%) per prescriptions respectively. A total of only 33% of the prescriptions had ICD10 codes and 40.2% of all prescriptions were deemed

inappropriate. General practitioners accounted for the greatest proportion of inappropriate prescriptions.

In conclusion Epidemiology studies prove to be useful tools that can be used to determine factors affecting inappropriate use of antimicrobial drugs amongst practitioners and patients and/or caregivers. This study showed that both patients and prescribers use antimicrobial drugs inappropriately.

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KEYWORDS

Epidemiology; Antimicrobial; Resistance; private sector

   Health care

DECLARATION

I declare that the thesis, *a Community Pharmacy perspective on the epidemiology of antimicrobial drugs in the Kuilsriver urban area,* is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full name: **Mhlanga Miriam Rufaro**

Signed: _____

Date: **15 November 2017**

DEDICATION

Dedicated ….

To God who is forever faithful and fulfilling his plans for my life, to my dearly departed mom for her hard work,

To my Father,

To Monalisa, Munyaradzi, Grace, Gift, Jeffrey, Hamufari, To my Fiancé Gerald

To my sons Junior and Amogelang.

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I am grateful to my supervisor, Doctor Obikeze for all his guidance and support that saw me completing this work.

Mr. Franklin Pedro for his guidance and all the Clicks Zevenwacht pharmacy staff members for their support;

Clicks Group for allowing me to do my research with them especially Selwyn Vonwillingh the regional manager for his continuous support;

My family and friends for their unwavering support throughout;

My dear fiancé Gerald and my two sons for putting up with me throughout and God for the strength

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LIST OF ABBREVIATIONS

WHO - world health organization

IDSA - Infectious Disease Society of America STD - Sexually transmitted diseases

CBD - Central business district

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CHAPTER ONE

Introduction

The epidemiology of drugs is 'defined as the manner in which drugs are used by doctors, nurses, pharmacists and patients (Buckalew and Sallis 1986). As such epidemiology of antimicrobial drugs is the manner in which this class of drugs is used by healthcare professional and patients or caregivers. Antimicrobial drugs have a pivotal role worldwide in preventing infections and treating infectious diseases. The challenge that lies in the health sector is to maintain antimicrobial effectiveness by using them appropriately to avoid toxicity, adverse reactions and resistance among other problems (Mendelson, 2015). The world faces a future in which ten million people could die annually due to infections that are resistant to available antibiotics (WHO, 2015). Despite people already dying of drug-resistant infections in private and public hospitals, doctors are still prescribing antibiotics for viral infections, for which they have no effect (Mendelson and Matsoso 2015). The aim of this research is to study the epidemiology of antimicrobial drugs and factors that lead to the inappropriate use of antimicrobials, which is resulting in a steep rise of antimicrobial resistance in the private sector from a community pharmacy perspective. This study will focus on studying the prescribing trends of doctors and patients' knowledge on the appropriate use of antimicrobial drugs in pursuit of finding the sources of antimicrobial resistance in private sectors in Kuilsriver. This would allow for recommendations and possible solutions thereof since that depends on the unique causes of resistance in certain setups.

1.1 : Antimicrobial resistance

Antimicrobial resistance at present is a crisis that calls for involvement of healthcare workers, patients and the community at large. Antimicrobial resistance is a natural biological process whereby microorganisms are able to multiply in the presence of drug concentrations *in vitro* higher than the concentrations of the same drug in human receiving therapeutic doses (James *et al*., 2008).

Mechanisms of drug resistance can be broadly divided into three groups:

1. Inactivation of the antimicrobial agent either by disruption of its chemical structure (e.g. penicillinase) or by addition of a modifying group that inactivates the drug (e.g. chloramphenicol, inactivated by acetylation);

2. Restriction of entry of the drug into the bacterium by altered permeability or efflux pump (e.g. sulphonamides, tetracycline) and by;

3. Modification of the bacterial target – this may take the form of an enzyme with reduced affinity for an inhibitor, or an altered organelle with reduced drug-binding properties (e.g. erythromycin and bacterial ribosomes) (James *et al*., 2008).

Antimicrobial resistance is considered a public health crisis in South Africa and the world at large (Wise *et al*., 1998.). Such resistance poses a huge threat to the nation as it has a great impact on the cost of health care which is associated with increased human suffering, loss of productivity and even death (Buckalew and Sallis 1986). Antimicrobial resistance is usually irreversible which can be a threat to the community and individual as well. This can be fatal in cases of co-infection with HIV and tuberculosis (Buckalew and Sallis 1986). Resistance to antimicrobials may result in rapid disease progression in the infected individual. The main cause of antimicrobial resistance is inappropriate use from both patients or caregivers and healthcare personnel which includes both prescribers and dispensers.

1.2 : Antimicrobial stewardship

Resistance to antimicrobial drugs due to inappropriate use has led to a wide coalition of countries under the auspices of the World Health Organization [WHO], working together to fight resistance by introducing antimicrobial stewardship to their healthcare systems (WHO, 2014). The Infectious Disease Society of America's (IDSA) definition of antimicrobial stewardship includes: optimizing the indication, selection, dosing, route of administration and duration of antimicrobial therapy to maximize clinical cure or prevention of infection while limiting the collateral damage of antimicrobial use including toxicity, selection and emergence of resistance (Dellit *et al*., 2007). Antimicrobial stewardship takes into account the pharmacokinetics, pharmacodynamics, pharmacovigilance and also pharmaceutical care of drugs in one process (WHO, 2014).

Appropriate use of antimicrobial drugs can be defined as the cost-effective use of antimicrobials which maximizes clinical therapeutic effects while minimizing both drug-related toxicity and the development of antimicrobial resistance (Buckalew and Sallis 1986). Microorganisms of medical importance are classified into four categories: bacteria, virus, fungi and parasites. The first broad classification of antimicrobials follows this classification closely so that there are antibacterial, antiviral, antifungal, and anti-parasitic agents. Within each class, drugs are further categorized by their biological properties and this study will include these classes listed above. In order to come up with effective interventions to combat this rise in unjustified use of antimicrobials by both healthcare professionals and patients, it is essential to understand the sources of inappropriate use in that particular population.

1.3 : Sources of inappropriate use of antimicrobial drugs

Antimicrobial agents can be used inappropriately by prescribers in many ways including prescribing wrong doses, wrong choices of antimicrobial drugs, incorrect duration of antimicrobial course, prescribing antimicrobial drug combinations which interact and prescribing antimicrobials were they are not necessary (Bosu and Ofori-Adjei1997). Patients on the other hand use antimicrobials inappropriately when they take wrong doses, self-medicate with antimicrobials, not following the correct drug regime for instance not completing the antimicrobial course and not following instructions and by the incorrect storage of dispensed medication (Haak, 1988). Patients and caregivers in a study done in Nigeria showed no knowledge on whether antimicrobials must be taken with or without food as well as combining antimicrobial drugs with other medicines without consulting their physicians or pharmacists (Okeke *et al*., 1999). Inappropriate use of antimicrobials is influenced by several factors which are unique to a certain population and area of concern and this study aims to identify these factors in the Kuilsriver area

1.4 : Factors influencing inappropriate use of antimicrobial drugs

Several factors influence inappropriate antimicrobial use by both patients and prescribers.

Patient-related factors are said to be the major influence of inappropriate antimicrobial use and therefore contribute to the increasing prevalence of antimicrobial resistance (Haak, 1988). The perception of patients that most conditions and episodes of suspected infection

require antimicrobial therapy notably influences the prescribing practices of providers (Denno *et al.*, 1994). Other factors for instance the lack of knowledge, poor adherence, media and technology and self-medication contributes to the inappropriate use of antimicrobial drugs (Haak, 1988). Poverty and the inaccessibility of health care facilities also play a major role in the inappropriate use of antimicrobial drugs (WHO, 2014).

On the other hand, multiple factors influence prescribers in deciding when to use antimicrobial drugs. These factors tend to vary depending on social circumstances, geographical region and the prevailing health care system in that certain region and most of these factors are interlinked (Laing *et al.*, 2001). As such any intervention would mean considering several factors and not treating them independently. Some of the factors influencing inappropriate prescribing of antimicrobials include lack of knowledge, fear of poor therapeutic outcomes, economic incentives given to prescribers, availability of drugs, lack of regulations and implementation thereof and lack of diagnostic tools (Bosu and Ofori-Adjei 1997). Unfortunately these factors are interlinked and improvements in the rational use of antimicrobial drugs would rely on the continual training of both prescribers and dispensers so as to equip both healthcare professionals with knowledge that would help ensure proper use of antimicrobial drugs. The inappropriate use of antimicrobial drugs has been shown to directly contribute to antimicrobial resistance (Wise *et al.*, 1998; Van den Bogaard *et al.*, 2000).

PROJECT SIGNIFICANCE

Previous researchers revealed patterns of antimicrobials use by prescribers and patients around the world and a few in South Africa as well. Most studies have focused on hospital settings in the public sector. This study will focus on the private sector.

In order to design and implement successful interventions at the community level, details on the epidemiology of antimicrobials specific to that community is important. As such the aim of this study is to investigate the appropriateness of antimicrobial prescribing amongst the

prescribers in the Kuilsriver area of the City of Cape Town. It seeks to investigate patients' understanding of the dispensing instructions on how to use the prescribed antimicrobials and their attitudes towards the use of antimicrobials. The factors contributing to these will also be studied.

RESEARCH QUESTION

What is the manner in which antimicrobial drugs are used amongst patients and prescribers in the Kuilsriver area and what are the factors that influence the manner of use of antimicrobial drugs in the selected community pharmacy?

RESEARCH AIMS AND OBJECTIVES

The aims and objectives of this study were

1.   To investigate the appropriateness of antimicrobial prescribing amongst the prescribers in the Kuilsriver area of the City of Cape Town by analyzing antimicrobial prescriptions filled at a Clicks community pharmacy at Zevenwacht mall in Kuilsriver.

2.   To assess patients' understanding of the dispensing instructions on their prescribed medication.

3.   To determine patient's knowledge on the appropriate use of antimicrobials and their attitudes to antimicrobial use.
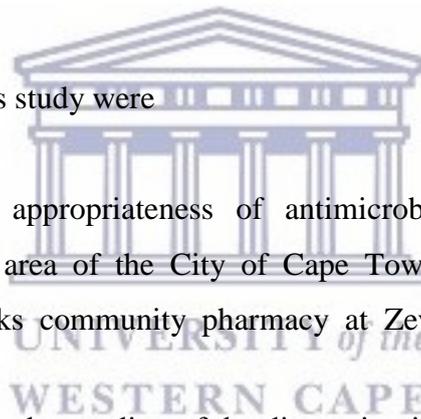
CHAPTER TWO

Literature Review

Antimicrobial drugs are an essential resource to the future of the human race in combating infections caused by microorganisms. It is important to preserve this important arsenal and there is the need for acquiring knowledge on the scale of antimicrobial misuse and managing any early warnings of the emergence of resistance. In developing countries laboratory diagnostic facilities are scarce and this has led to the introduction of empiric, pragmatic, and problem oriented management strategies for the administration of antimicrobials (Wise *et al*., 1998). This has however unfortunately led to cases of overtreatment which in turn has led to an increase in antimicrobial resistance (Wise *et al.,* 1998). This however emphasizes the need to discover the contributing factors to this misuse of antimicrobial drugs.
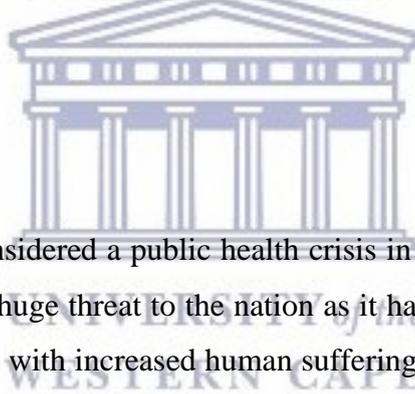
2.1: Antimicrobial resistance

Antimicrobial resistance is considered a public health crisis in South Africa and the world at large. Such resistance poses a huge threat to the nation as it has a great impact on the cost of health care which is associated with increased human suffering, loss of productivity and even death (WHO, 2014). Moreover there have been no new drugs developed since 1987. Penicillin was discovered by Alexander Fleming in 1928 and more than 100 compounds have been found since, but no new class of antimicrobials has been found since 1987 (Demain and Sanchez 2009). Preserving these available drugs is essential to reduce mortality caused by resistant strains of microorganisms. The result of inappropriate use of antimicrobials shown in several studies carried out across the globe include unwarranted drug toxicity and side effects, drug adverse reactions and much worse, antimicrobial resistance (Lipsitch *et al.,* 2000; Wilkes *et al*., 2000). The ultimate result is treatment failure which leads to death of the treated individual. Antimicrobial resistance is usually irreversible which can be a threat to the community and individual as well.

The widespread availability and inappropriate use of antimicrobials by patients and healthcare providers has led to a steady increase in drug resistance, particularly to key

antibiotics (cotrimoxazole, erythromycin and tetracycline, ampicillin and chloramphenicol) which are used in the treatment of high prevalence diseases (NDoH, 2014). In the meantime hospitals and clinics in South Africa however depend on these mentioned drugs. Buckalew asserts that resistance to antimicrobials results in rapid disease progression in the infected individual, which can be fatal in cases of co-infection with HIV and tuberculosis (Buckalew and Sallis 1986).

Studies done on antimicrobial use in most developing countries showed that respiratory tract infections, diarrhoea, sexually transmitted infections, nosocomial infections and meningitis which were quite common in developing countries were treated empirically because of lack of laboratory facilities to carry out diagnostic tests (Wise *et a*l., 1998). Evidence of an association at the individual patient level between the prescribing of antibiotics in primary care and antimicrobial resistance by bacteria at different sites, including the urinary and respiratory tracts and skin has been identified in the same study. An association between resistance and antibiotics prescribed within overlapping time periods has also been reported (Hart and Kariuki 1998). This kind of resistance in developing countries is disturbing since there is a limited availability of antimicrobial drugs. Taking a closer look at South Africa, Africa surveillance data in South Africa showed resistance changes that occurred from 2012 to 2014. (NDoH, 2014). The table below summarizes the antimicrobial resistance in South Africa.

Table 1: Antimicrobial resistance in South Africa (NDoH , 2014)

Bacterium	Year 2012	Year 2014
Staphylococcus aureus	35 %	28%
methicillin resistance	30%	30%
Klebsiella pneumoniae carbapenems	2.9 %	4.2 %

Antimicrobial resistance is a major problem in developed countries as well. In the United States of America (USA), resistance to antibiotics in children rose by up to 50%, mostly attributed to an increased proportion of children diagnosed with otitis media (Finkelstein .*et al.*, 2003). Nosocomial prevalence of vancomycin-resistant enterococci increased from 0.3% in 1989 to 12% in 1997. The overall increase was a 16% hike which saw an increase in hospital population with the greater use of the third generation cephalosporin.

This widespread antimicrobial resistance was caused by many factors, inappropriate use being a prominent factor (Coque *et al.*, 1996).

Drug use and prescribing behaviors tend to be determined by a complex and multi-layered mix of medical, psychosocial, cultural, economic and even geopolitical factors (WHO, 2000). In order to come up with meaningful findings it is essential to explore all these factors. These worldwide statistics with high incidences of inappropriate use of antimicrobials highlight the importance of exploring the extent of inappropriate use of antimicrobials and the factors affecting the excessive use of this class of drugs. Resistance to antimicrobials is attained through several ways.
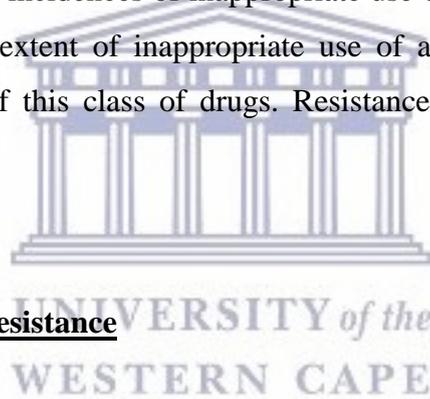
2.2: Sources of antimicrobial resistance

2.2.1: Unnecessary antimicrobial therapy:

Many infections do not require antimicrobials and the use of antimicrobial drugs in such instances cause resistance. In a study done in Netherlands in 2008 and 2009 in three hospitals, sixteen percent of antimicrobial therapy was deemed unnecessary (Willemsen et al., 2010). Treating patients with antimicrobials for conditions in which micro-organisms are not implicated directly causes antimicrobial resistance and unnecessary side effects in the treated patient, whilst indirectly causing a financial burden to the health system. The very high percentages of unnecessary use of this class of drugs reflect the depth of improper use and the urgent need to address this issue.

2.2.2: Inaccurate diagnosis:

Accuracy in the patient's diagnosis is essential for prescribing drugs rationally (Al-Shami *et*

al., 2011). Findings on a study done in Yemen in several government hospitals by, (Al-Shami *et al*., 2011) revealed that there was a deficiency in the profiling systems for patient information and that led to incorrect diagnosis therefore inefficient and wrong treatment were administered as a result. Poor decision making regarding patient's diagnosis is challenging and experience is needed to promote decision making skills since unnecessary treatment with antimicrobial drugs could lead to resistance. As such it is essential to have on-the-point diagnostic tools or to wait for culture results before initiating antimicrobial therapy with exceptions of severe life threatening infections for instances where pneumonia is suspected.

2.2.3: Irrational choice of antimicrobial drugs:

It is essential to choose correct therapy depending on known or likely infective organisms, site of infection and severity of infection in cases where on-the-point diagnostic tools are not available. A study done on analysis for rationality and other aspects of antimicrobial use showed that antimicrobial drugs were used in 95% or more of the admitted patients in one hospital which appears to be very high and cause for concern, (Shah and Shah 2004). Prescribers' trends on antimicrobial use in South Africa need to be investigated to find its association with the misuse of antimicrobial drugs in the country.

2.2.4: Duration of therapy and doses:

Long duration of antimicrobial therapy increases the risk of antimicrobial resistance as specified in (Dimitri *et al*., 2014) and as such prescribers as the initiators of antimicrobial drugs need to be extra vigilant when using this class of drugs. However, this is not always the case as a study done on antimicrobial use by the department of obstetrics and gynecology at a Tertiary Care Hospital in India, revealed the unjustified use of antimicrobials for prophylaxis against postoperative wound infection. Results showed the administration of more than one dose or continuation of therapy for more than 24 hours, with a mean duration of antimicrobial therapy of 6.06 days (Shah and Shah 2004). This duration of therapy was unreasonably high and cause for concern.

2.3: Inappropriate use of antimicrobials

Indiscriminate or poor use of antimicrobials is a global concern and according to (Hart and Kariuki 1998), antimicrobial usage is not regulated both in people and animals in most

developing countries. These antimicrobial drugs are used inappropriately in many different ways which include but not limited to such examples mentioned below.

2.3.1 : Inappropriate antimicrobial use by prescribers

Prescribers as the primary source of antimicrobials for patients are responsible for inappropriate use of these drugs. Overdosing and under-dosing have been identified as some of the ways by which inappropriate use occurs, with a study by (Mohammed and Tesfaye 1997) reporting a 14% and 18% prevalence of over- and under- dosing respectively in a private hospital. Under-dosing obviously increases the risks for the development of resistant strains while overdosing increases the adverse effects burden on the patient. Closely related to over- and under- dosing are prescriptions with incorrect strengths of antibiotics. A study by (Teka, 1998) revealed that 60% of antimicrobial prescriptions contained incorrect drug strengths. These very high incidences of incorrect drug strengths contribute largely to the prevalence of the inappropriate use of antimicrobials. Each year, millions of antibiotics are prescribed for colds, upper respiratory tract infections, and bronchitis (Gonzales et al., 1997). Antibiotics are only effective for treating bacterial or fungal infections and have little to no effect on these common ailments.

In Hungary in the 1980's, penicillin was cheap and overuse led to 50% of pneumococcal infections reported as penicillin resistant. By 1992, resistant infections were down by 16%. This occurred in part because physicians changed prescribing habits, relying on other classes of non- β-lactam antibiotics (Nowak, 1994). This suggests that rotational use of antibiotics could alleviate some resistance problems.

Despite people already dying of drug-resistant infections in private and public hospitals, doctors still prescribe antibiotics for viral infections, for which they have no effect.
According to Department of Health of South Africa documents on antimicrobial resistance released in 2016, "half of all antibiotics used globally were deemed unnecessary" (Mendelson, 2015).

Recent data from the Discovery Health Medical Scheme showed that in 59%   of claims for upper-respiratory-tract illnesses in children, such as a cold or blocked nose, doctors

diagnosed a viral infection but prescribed antibiotics instead (Mendelson, 2015).

The government together with the health department worked hand in glove in coming up with medicines formularies, essential drug lists, daily drug list and many other important guidelines to help guide prescribers on correct regimens.

2.3.2 : Inappropriate antimicrobial use by patients

2.3.2.1 : Poor adherence to drug regimens

Poor adherence to drug regimens has been noted to arise from a lack of understanding of the instructions on use of antimicrobial drugs by patients. This lack of understanding usually stems from the inability of prescribers and dispensers to effectively communicate the instructions of use to patients (Haak and Kariuki 1988). Several studies have identified different aspects of poor adherence mainly related to incomplete dosing regimens and non-adherence to dosing instructions and as such this is an area of interest in this particular study.

According to (Yang *et al*., 1993), insufficient stock in pharmacies in China was one of the reasons why patients did not complete their antimicrobial dosage regimen. In India, patients believed that they can buy a small quantity of antimicrobial drugs to test if they are working, then purchase the rest when they start to feel better as a way of establishing the effectiveness of the antimicrobials (Haak and Radyowijati 2010). In addition patients stopped taking antimicrobials as soon as they felt better, and in most cases these leftover antimicrobial drugs were used to self- medicate when they experienced the same symptoms again or to treat others presenting the same symptoms. Patients decided not to complete their antimicrobial drugs according to the course of drugs prescribed because they believed that antimicrobial drugs can cause severe side effects and they had doubts about the drugs necessity (Haak and Radyowijati 2010). On the other hand poor adherence to drug regimens has been noted to rise from lack of patient understanding or ineffective communication of instructions from prescribers on the use of antimicrobial drugs (Haak 1988). Therefore it is essential to identify the source of this lack of patients understanding whether it stems from patients' lack of understanding or prescribers' lack of effective communication and suggesting an intervention strategy that would be beneficial in improving adherence to drug regimens. Patients had no

knowledge on whether antimicrobial must be taken with or without food as well as combining antimicrobial drugs with other medication without consulting their physicians or pharmacists. These two factors affect the bioavailability of antimicrobial drugs directly and as a result negatively affecting the minimum inhibitory concentration of the antimicrobial drugs (Okeke *et al.*, 1999, Eddershaw, 2000).

2.3.2.2 : Self-medicating with antimicrobials

Antimicrobial drugs were the most common type of drugs used in self-medication. There is no guarantee that a patient that purchased antimicrobials without a prescription will take the medicine in the correct way. In a study conducted by (Haak 1988), one of the most common drugs used in self-medication was tetracycline, Ambra-Sinto® and was regarded the best medicine for teething in young children. Factors influencing patients' behavior unique to South African population need to be investigated so as to minimize the misuse of antimicrobial drugs.
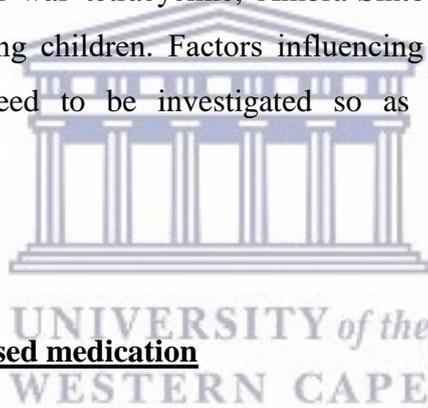
2.3.2.3 : Incorrect storage of dispensed medication

Effective communication between healthcare professionals and patients is important in improving patients' health. Foroutan (2014) concluded that more than 90% of patients in a study done in the Islamic Republic of Iran, patients did not read package inserts and this alone shows the importance of effective communication from the prescriber's part. Only 6.8% of the householders reported that they had read the instructions on the manufacturer's patient information leaflets and 93.2% did not read with some participants admitting that they threw away the leaflet (Foroutan, 2014). In the same study patients reported that they kept medicines in the refrigerator, kitchen cupboard and in the bedroom. It is essential to store medication correctly to keep the medication potent. Medline plus suggest storing in a cool dry place as a general rule of the thumb but others specified to follow the specifics for instance reconstituted antimicrobials to be kept in a fridge (Martin, 2016)

2.4: Factors influencing inappropriate use of antimicrobial drugs

2.4.1 : Patient-related factors

2.4.1.1 Patients' misperceptions and demands

In a study done by Macfarlane and colleagues, (1997), 85% of patients believed that most infections are treated by antimicrobials and one fifth of the patients requested antimicrobials from their doctors. Many patients believed that expensive and newer antimicrobials work better than cheap and traditional ones. In the same study 87% of the patients also believed that as long as they felt better they could stop taking antimicrobials.

Mangione-Smith and colleagues in 1999 discovered that parents in Indonesia demanded physicians to prescribe potent drugs like antibiotics to their children from their private practitioners. That has been reported as one of the factors that led private doctors and health centre practitioners to prescribe antibiotics to children. However it is essential to investigate if this factor is because of patients' expectations or it is merely because of prescribers' behavior. Furthermore, it might be an interaction between patients' expectation and prescribers' behavior, thus an investigation of this factor would be beneficial in answering the question of what factors are affecting inappropriate use of antimicrobial drugs in the country.

2.4.1.2 : Self-medicating with antimicrobials

Self-medication is defined as the selection of medicines by individuals to treat self-recognized illnesses and symptoms (Kumar *et al*., 2013). It is seen as an important factor that led people to use antimicrobial drugs inappropriately in countries like Nigeria and Cameroon. In Nigeria according to Okeke, (1999), oral or injectable antibiotics were the most frequent treatment sold over the counter without a prescription for diarrhoea and dysentery. In these cases one particular antibiotic would be popular for instance, in Cameroon tetracycline and cotrimoxazole were frequently used for respiratory tract infections (Radyowijati and Haak 2002).

The motive for self-medication according to (Radyowijati and Haak 2002) was the need to save money and patients believed that they had experience from previous illness with the

same symptoms so they treated either from left-over antimicrobials or bought the same antimicrobial from their previous illness, without a prescription. Therefore, it is essential to explore the effect of self-medicating when studying the factors influencing inappropriate use of antimicrobial drugs.

2.4.1.3 : Advertisement and promotion through media and social media

Direct to consumer advertising, media and the internet has exposed people to information on drugs and has led patients to request for drugs they have seen on these information platforms. Prescription drugs including antimicrobial drugs could be purchased from the internet by the public (Wilkes *et al*., 2000). It is necessary to consider the problem of advertisement and promotions through media since it exposes people to information which they may not comprehend medically.

2.4.1.4 : Economic consideration

The decision to buy medication is highly based on the availability of funds and the price of medication thereof. Patients with a medical aid were most likely to purchase all the drugs prescribed to them by the doctor whilst private patients were most likely to buy the cheaper drug on the prescription and in most cases it was antipyretic drugs and the antimicrobial drug was not bought (Foster, 1991).

Poverty and lack of access to appropriate health care were also factors that influenced inappropriate use of antimicrobial drugs. This study focuses on private patients and as such it is essential to consider the economic factor when exploring these contributing factors to inappropriate use of antimicrobial drugs.

2.4.1.5 : Lack of continuity of care

Evidence gathered from a study on patients' compliance when discharged from hospital showed the problem of poor compliance by patients when discharged from hospitals. The

change from hospital where nurses administer drugs to patients, to a general practitioner-derived drug regime in which the patient is responsible for taking his/her medication saw patients not using drugs properly. The study showed that 51% deviated from therapy to some extent and most of them due to lack of understanding of the prescribing instruction (Parins *et al*., 1976). In a general-practitioner setup, patients are responsible for their own care and as such it is essential especially to explore the extent of patients' understanding of instructions on how to use their medication correctly to prevent resistance which arises from improper use.

2.4.1.6 : Lack of knowledge

Inappropriate use affects the bioavailability of the antimicrobial drugs either by lowering it or increasing it (Eddershaw *et al*., 2000). Oral bioavailability of a drug substance is defined as the degree of absorption across the gastrointestinal tract as determined by characteristics of the ingested source and environmental factors (Eddershaw *et al.*, 2000). It is affected by the environment at the point of drug absorption, pH at the absorbing surface, food and many other factors. The availability of the drug in the blood will ultimately affect the minimum inhibitory concentration of that drug; hence the bioavailability of a drug is of paramount importance and must not be affected negatively.

Bioavailability of any drug is important in achieving therapeutic success, this occurs when the drug reaches minimum inhibitory concentrations in the blood. Drug combinations and some foods taken together with antimicrobial drugs can reduce bioavailability of drugs and as a result the antimicrobials are not optimally absorbed. A Nigerian meal lowered the biologic availability of orally administered nitrofurantoin (Ogunbona and Oluwatudimu 1986; Okeke *et al.*, 1999). The chewing of Khat, a popular Yemeni stimulant adversely affected the bioavailability of ampicillin and amoxicillin (Okeke *et al.*, 1999).

Generally, drugs are better absorbed in the small intestine because of the larger surface area than in the stomach, therefore, the quicker the stomach emptying; the earlier and higher are the plasma drug concentrations. Eating stimulates production of gastric acid, penicillin G and penicillin V, which is unstable in gastric acid, are best administered in the fasting state. Amoxicillin is equally well absorbed with food or in the fasting state. However, when

amoxicillin is combined with clavulanate, absorption of clavulanate potassium is enhanced when it is administered at the start of a meal. The bioavailability of erythromycin and azithromycin is low (about 40%), and because their bioavailability is further lowered in the presence of food, these drugs should be administered in the fasting state, whereas clarithromycin has better bioavailability (50%) and can be administered with or without food (Levison, 2009). Food has no effect on the bioavailability of the fluoroquinolones, metronidazole, minocycline, doxycycline, linezolid, and trimethoprim-sulphamethoxazole. Food lowers the bioavailability of the first-generation cephalosporin cefaclor, second-generation loracarbef, and third-generation ceftibuten, but not that of the first-generation cephalosporins such as cephalexin and cefadroxil, second-generation cefprozil, and third-generation cefixime (Levison, 2009). Drug interactions can also alter absorption after oral administration. For instance, multivalent cations like aluminium, magnesium, and calcium in antacids can chelate the fluoroquinolones and tetracyclines, which may decrease the intestinal absorption of these antimicrobials after concurrent oral administration (Levison, 2009). It is of paramount importance for prescribers to be well informed in order to promote correct use of antimicrobial drugs and to prevent resistance. Patients on the other hand need to be well informed on how and when to take their medication. Therefore assessing the level of knowledge on patients' understanding of their mediation is essential.
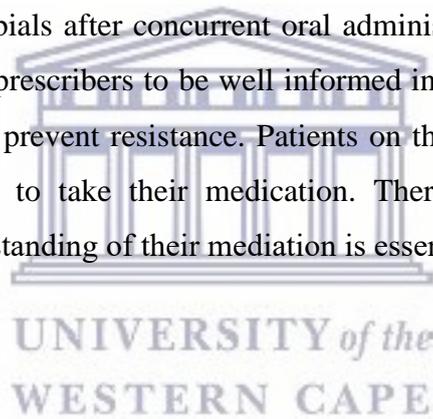
2.4.2 : Prescribers related factors

On the other hand prescribers-related factors also play a role in inappropriate use of antimicrobial drugs in communities. Prevention of infection should be the primary goal to improve health, but however where appropriate, prescribers and dispensers must use antimicrobials properly. There are multiple factors that influence prescribers to decide when to use antimicrobials and these factors interlink. Some of these factors include but not limited to:

2.4.2.1 : Lack of On-point-diagnostic tools

The lack of laboratory facilities or inability of patients to pay for microbiological tests resulted in prescribers using antimicrobials empirically (Rashid *et al.*, 1986). In most cases of

suspected infection illnesses, 90% of patients according to (Rashid *et al.*, 1986) in Bangladesh were treated with antibiotics with no tests done. Lack of access to appropriate diagnostic tools or slow diagnostic tools led prescribers to conclude diagnosis and treat infection even if in most cases there would be no infection at all, contributed to the inappropriate use of antimicrobials. The lack of accurate tests at point-of-care to achieve a rapid diagnosis is a huge problem in many diseases and this leads to prescribers prescribing irrationally.

2.4.2.2 : Fear of adverse therapeutic outcomes

Prescribing nurses in primary care clinics in Zimbabwe mentioned that fear of bad outcomes was a contributing factor in antimicrobial prescribing in patients presenting symptoms of pneumonia. They felt consequences of not treating a potential case of pneumonia were far greater than groundless use of antibiotics (Nyazema *et al.*, 1992). This behavior led to the unnecessary use of antimicrobials and as such it is essential to investigate if this can be a contributing factor in South Africa as well since Zimbabwe is South Africa's neighboring country with similar cultural beliefs.

2.4.2.3 : Prescribers' perceptions

Some focus group studies in Philippines revealed that prescribers expressed concern that, if they did not prescribe antimicrobials, patients would seek other sources of care where they could obtain antimicrobials (Radyowijati and Haak 2002). In addition, the physician offering the latest and often the most expensive and broad-spectrum antibiotic may be perceived to be the most informed and desirable source of care (Radyowijati and Haak 2002). Understanding prescribing patterns is essential to identifying areas for potential intervention to improve use of antimicrobial drugs.

2.4.2.4 : Financial incentives

Financial incentives were found to be an important factor in inappropriate use of antimicrobials in Zimbabwe. Higher profit margin in expensive antimicrobials led to inappropriate prescribing practices especially for patients with medical aid which pay full prescription costs and this was more common amongst prescribing doctors. (Trap *et al*., 2002). Fear of losing business and economic incentives given to prescribers were driving factors for the misuse of antimicrobials in a study by Cho and colleagues. Prescribers prescribed certain antimicrobial drugs based on that and as a way of keeping their reputation with such pharmaceutical companies (Cho *et al.,* 2004). This irrational prescribing behavior is of interest especially for this particular study as it focuses on private prescribers whose main or only source of income is from their patients.

2.4.2.5 : Factors among prescribers' working environment

In busy clinical practices, health care providers had no time to explain to patients why they chose to prescribe or not prescribe antimicrobial therapy. As a result prescribers in that situation believed it was simply most time-effective to prescribe an antimicrobial (Ellingson, 2002). The lack of opportunity for health care workers to follow up their patients to assess progress after treatment and poor continuity of care in general negatively influenced communication and the development of trust between the patient and health care provider. It is thus often easier for both prescriber and patient if an antimicrobial agent was prescribed on first contact since follow-up sessions were never guaranteed in the private sector (Ellingson, 2002).

2.4.2.6 : Lack of legislation and enforcement

Lack of legislation and enforcement has seen private physicians using antimicrobials inappropriately. According to (Hart and Kariuki 1998), antimicrobial usage was not regulated both in people and animals in most developing countries. These studies gave evidence that

antibiotics could be purchased from community pharmacies without a prescription. There was widespread and uncontrolled use of antimicrobial drugs by patients (Hart and Kariuki 1998) The introduction of guidelines and policies in Washington saw a decrease in the number of prescriptions for antimicrobials for patients for acute rhinosinusitis (Dimitri *et al.*, 2014). Implementing policies that would govern private practitioners' prescribing and policies for delaying antimicrobial use in private practices would depend on discovering the most influential factors associated with this antimicrobial drugs misuse in a certain area. It is therefore important to investigate the pattern of antimicrobial drugs usage in that particular area.

2.4.2.7 : Lack of appropriate antimicrobial drugs

Lack of appropriate drugs was a factor which led prescribers to inappropriate use of antimicrobials to treat patients in a study by Bosu in Ghana (Bosu and Ofori-Adjei 1997). Prescribers would be forced to prescribe available antimicrobial drugs on the market at that time. It is essential to investigate availability of medication in the country as well as the Western Cape for that matter to be able to come up with valued conclusions on whether availability of drugs plays a role in affecting prescribing patterns, as such this is an essential factor to investigate in this study.

2.4.2.8 : Lack of knowledge

Lack of knowledge about differential diagnosis, infectious diseases and microbiology and the appropriate choice of antimicrobials all played a vital role in inappropriate use of antimicrobials in some government hospitals in Ghana (Bosu and Ofori-Adjei 1997). According to Radyowijati and Haak (2002), physicians often used broad-spectrum antibiotics, believing that they would cover all possible etiologies and unusual pathogens because of the physician's failure to determine aetiology of the infections. Lack of up to date information resulted in inappropriate use of antimicrobials. Even well trained prescribers faced this challenge which led to the use of antimicrobials which were no longer effective or

excessive use of drugs (Grimshaw and Russell 1994).

2.5: Factors affecting both prescribers and patients

2.5.1: Cultural beliefs

In Brazil drug use was influenced by cultural preferences and beliefs both from patients and prescribers (Haak, 1988).There was an almost universal desire and demand for drugs in all countries. This behavior was noted to increase in developing countries as well. An often-quoted notion was that 'there is a pill for every ill' (Haak, 1988). The term 'antibiotic culture' was adopted and means that for every ill-defined symptom, antibiotics are indicated. This perception existed not only in the minds of lay people, but among health care professionals as well. This 'antibiotic culture' was responsible for the high use of this class of medicines (Wolff, 1993). Folk beliefs and traditions affected antibiotic use in many cultures. Dispensers and prescribers often belong to the same ethnic or geographical groups as their patients or customers, and they share perceptions on health, illness, and antibiotics. Appreciating the importance of cultural beliefs is especially important when discovering the factors affecting antimicrobial drug misuse and designing interventions to improve the appropriate use of antimicrobial drugs.

Antimicrobial drugs are a class of western medicine that was often perceived as 'strong' medicine especially in the African continent, capable of curing almost any kind of disease. In their classic study in West Africa, (Bledso and Goubaud 1985) reported that people had specific criteria for selecting medicines. Colour was one of the most important factors that determined perceived efficacy. Multi-coloured capsules were believed to be particularly effective because the different colours imply that several kinds of medicine were combined to make a very powerful drug.

Many cultures believed that antibiotics have the ability to prevent disease. For example, mothers in Ghana believed that antibiotics could be used to prevent cough and fever (Denno *et al.*, 1994). In the Philippines, taking an antibiotic was a common practice to prevent

diarrhoea especially after eating foods of suspicious hygienic status (Nichter, 2003) In Zimbabwe sexually-transmitted diseases (STDs) were believed to be preventable by taking an antibiotic immediately after visiting a prostitute. Any medicine in capsular form, including antibiotics, was considered good for preventing sexually-transmitted diseases STDs (Nyazema *et al.*, 1992.).

Rural populations in Brazil regard Ambra-Sinto® (Tetracycline-HCl) as the medicine of choice against measles. It was not used to treat measles, but rather to prevent the often serious respiratory tract infection that sometimes follows. Mothers believed that any fever in children may signify measles; most fevers were also treated with Ambra-Sinto® (Haak, 1988).

Literature indicates how complex the problem is of inappropriate use of antimicrobial drugs and antimicrobial resistance. It also shows the need to understand different concepts before deciding and concluding on certain facts as to what exactly are the major factors contributing to the misuse of this essential class of drugs, and devising interventions and implementations of such interventions.
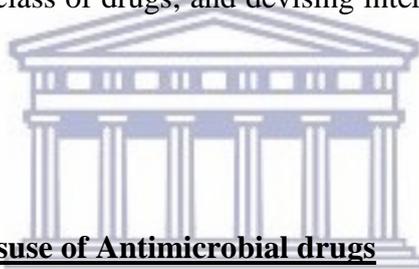
2.6 : Interventions to prevent misuse of Antimicrobial drugs

As part of its global strategy for containment of antimicrobial resistance in 2001, the World Health Organization (WHO) commissioned a study to come up with recommendations for interventions from community level up to dispensers and prescribers by determining the various causes of inappropriate prescribing.

The main aim was to educate patients and the general community on the appropriate use of antimicrobials and the importance of measures to prevent infection, such as immunization. Patients were encouraged on appropriate and informed health care seeking behavior as well as educating patients on suitable alternatives to antimicrobials for relief of symptoms and discourage patient self-initiation of treatment, except in specific circumstances.

Prescribers on the other hand would be educated on the importance of appropriate antimicrobial use and containment of antimicrobial resistance. This would be achieved by encouraging prescribers and dispensers to educate patients on antimicrobial use and the

importance of adherence to prescribed treatments. Educating all groups of prescribers and dispensers on factors that may strongly influence their prescribing habits, such as economic incentives, promotional activities and inducements by the pharmaceutical industry was also a focus point in the strategy. The strategy also involved training of medical and pharmacy students by promoting undergraduate and postgraduate educational programs on the accurate diagnosis, appropriate use of antimicrobials and management of common infections for all health care workers, veterinarians and prescribers included. Lastly introduction and monitoring guidelines on antimicrobial drug use was also a very important intervention area of focus (WHO, 2014). This leads to the important issue of antimicrobial stewardship.

2.7 : Antimicrobial stewardship

To date the health care organizations are working together to combat this rise in antimicrobial resistance brought about by inappropriate use by both patients and healthcare professionals. This has seen the introduction and continual growth of antimicrobial stewardship programs around the globe. The working goal is to administer an appropriate antimicrobial drug of sufficient dose and duration, to eradicate the pathogen and to prevent recurrence of the infection. If an inappropriate antimicrobial is administered or an appropriate antimicrobial is administered, but is of insufficient dose or inappropriate duration resistance will be inevitable (NDoH, 2014).

In providing pharmaceutical care, pharmacists can actively engage in this process by making sure the indication for commencement of antimicrobial therapy is documented in the patient's notes and if it is valid at all. There is need to check if empirical therapy targets the most likely pathogens and if it is based on knowledge of the antimicrobial resistance profiling. Pharmacist must check if antimicrobials are being given with the correct dosage, route of administration, time interval and duration, Clinical misuse of antibiotics may be more common among private practitioners than among public health personnel which render this study important.

CHAPTER THREE

Method

This was a cross-sectional descriptive study where questionnaires were used to collect data for analysis. Variables of the study population were developed from literature to ensure that they are relevant to the research question. A cross-sectional study design was used because they are the best way to determine prevalence and are useful at identifying variable associations (Mann, 2003).

3.1   : Site

Clicks pharmacy Zevenwacht is a community pharmacy that is located in a public mall, Zevenwacht mall in the Kuilsriver area. This mall is the central mall to several residential locations for instance Stellenbosch, Eerste River, Mfuleni, Blue Downs and Kuilsriver community as well. The population that this mall caters for basically is people from different social backgrounds since it is central from Stellenbosch farm areas to the Mfuleni Township up to the Kuilsriver central business district (CBD) area. A total of 71.4% of Kuilsriver's population is adults from 19 years and older. The majority of the population in Kuilsriver speaks Africans and English with a smaller percentage of Xhosa and other foreign language speakers, (60.2%, 33.2%, 3.2% and 1.6% respectively) (Statistics South Africa 2016). This study was conducted in the Western Cape province of South Africa and this province and Kuilsriver especially consists of a heterogeneous population for representing a diversity of South Africa's cultures and beliefs and as such providing a suitable study group that can represent South African population. The population and population distribution of this area is shown in the table below:

Table 2: population and population distribution of Kuilsriver 2016 (Statistic South Africa 2016).

	Ethnic group			
Suburb	**Black**	**White**	**Colored**	**Other**
Kuilsriver	5,337	15,211	24,802	904
Mfuleni	50,143	111	1,566	405
Stellenbosch	43,716	28,742	81,361	1290
Eesteriver	6,282	90	32,070	599

3.2: Sample

1. The sample included all willing patients aged eighteen years and above with valid prescriptions containing one or more antimicrobial agent.

2. Questionnaires were distributed by the researcher to patients as they wait for their medicine in the dispensary. 150 patients completed the questionnaires from May to July 2016. Completed questionnaires were collected by the researcher and kept under lock. Structured information sheets were used to collect information on patients' prescriptions from all valid prescriptions containing one or more antimicrobial agent. A total of 503 patient's prescriptions were analyzed from August 2015 to June 2016.

3. The study also aimed to identify factors influencing the prescribing of antimicrobial agents from the prescribers' perspective. For this semi-structured questionnaires were used to collect data from five prescribers from practices in Kuilsriver where most of the patient's prescriptions analyzed originated.

The exclusion criteria for the study were the following:

a) All patients with invalid prescriptions (prescriptions with omitted information and expired

prescriptions)

b) All patients with prescriptions for which the antimicrobial agent(s) were antiretroviral agents only.

c) All patients with prescriptions without an antimicrobial agent.

With a population of 292 629, a 95% confidence level and a confidence interval of 9, a sample size of 119 respondents was needed for this study. With the expectation of a 60% response rate, 230 patients meeting the inclusion criteria were sampled using purposive sampling between August 2015 to June 2016. Only prescriptions from the patients who completed the questionnaire were included in the study.

3.3: Data collection

1) Data was collected from patients in the form of semi-structured questionnaire that the researcher handed over to consenting patients as they came into the community pharmacy.

Information like patient's educational level, age, knowledge on proper antimicrobial use, storage and disposal as well as attitudes towards antimicrobial use was collected.
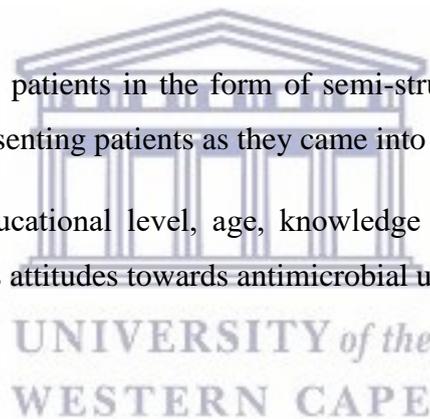
2) Data was collected from the Unisolve database that clicks pharmacies use, using a structured information sheet.

Information like the drugs name, dose, frequency, duration, directions and diagnosis supplied was collected. A unique code was generated for each prescriber so as to protect the prescriber's identity and confidentiality. The information from the prescriptions was also kept confidentially and no patients' names or details were used in this project.

3) Data was collected from prescribers in the form of a semi-structured questionnaire that was handed over to consenting prescribers from practices where most of the patient's prescriptions analyzed originated.

Data collection instruments

Questionnaires

Instrument development and validation

Firstly, literature review was done and information was gathered on relevant studies to help the researcher to come up with relevant questions to include in the data collection instruments.

Questionnaires for patients and prescribers were generated as well as the Unisolve instrument to be used for data collection. These instruments were developed by the researcher and validation was done by performing a pilot study.

The pilot study reviewed that English was a preferred language and the thus the study instruments were developed in English.

The patients' questionnaire. [Appendix 1]

The questionnaire for patients was available in English, with a translator available for patients who spoke only Xhosa or Afrikaans. The questionnaire was mixed with a majority of close-ended questions. Open-ended questions were used where a respondent's own thoughts or ideas were sort. These questions included:

1) Demographic characteristics: it comprised questions which included the patient's' age, gender, residential place, and educational levels.

2) Patients' health related history: these questions included the number of times the patient had received antimicrobials in the previous year, and which conditions were being treated.

3) Patients' knowledge of antimicrobials: these questions included the knowledge of patients on antimicrobial frequency of use, storage and class and names of the prescribed antimicrobial agents.

4) Participants' psychosocial factors on antimicrobial use and it included patients' information seeking behavior, adherence behavior and behavior towards the need for antimicrobials on doctor's visits as well as questions that monitors when patients stopped taking antimicrobials:

Unisolve information tool: [Appendix 2]

Closed ended questions were used to formulate the Unisolve information tool to allow for quantitative data collection.

 Unisolve instrument included the following:

1) Patients' information: these questions included a unique code for patients with demographic characteristics of the patient.

2) Prescribing doctor's information: these included a unique code for the prescribing doctor and doctors' status.

3) Antimicrobial drugs information: these questions included the names of antimicrobial prescribed, dosages, frequencies of use, diagnosis and any special notes on a certain antimicrobial drug prescribed:

Prescribers' questionnaires: [Appendix 3]

Closed ended questions were used to formulate the prescriber's questionnaire as well as open ended questions. This would allow for both quantitative and qualitative data analysis to be possible.

Prescribers' questionnaire

1) Contain information of diagnostic tools and tests

2) Prescribers' perceptions on use of antimicrobial agents

3) Questions on patients factors that drive prescribers to prescribe antimicrobial agents.

3.4: Data analysis

Data collected from patients' questionnaires was presented as both quantitative and qualitative data. Quantitative data was analyzed using GraphPad Prism. Spearman's correlation between patient's knowledge and improper use of antimicrobial drugs, and between patients knowledge and prescribers appropriate or inappropriate use of antimicrobial drugs was determined.

Qualitative data was collected from the Unisolve database from the prescriptions that the patients brought in and from prescriptions dating from January 2015 to December 2016. This data was analyzed on the proper use of antimicrobial drugs by prescribers. Analysis on correct antimicrobial choice to diagnosis was the major area of analysis in this project. Appropriateness of antimicrobial drug choice, dosage, frequency, duration of treatment and

any other necessary information unique to certain antimicrobial drugs was also analyzed from the data collected from Unisolve data base. Data was analyzed from the hard copy prescriptions to verify the data that pharmacists would have captured onto the Unisolve database.

Appropriateness of the antimicrobial treatment was determined using a standardized method adapted from Gyssens et al 1992. The following classification was used in this particular study,

1) Appropriate antimicrobial therapy :

a) Appropriate choice of treatment according to standard treatment guidelines for prescriptions with ICD 10 codes.

b) Correct prescriptions in terms of, correct dose, frequency and duration of treatment with the certain antimicrobial according to South African Medicine Formulary (12th edition).

2) Inappropriate antimicrobial therapy:

a) Inappropriate choice of treatment according to standard treatment guidelines for prescriptions with ICD 10 codes.

b) Incorrect prescriptions in terms of incorrect dose, frequency and duration of treatment according to the South African Medicine Formulary (12th edition).

3.5: Ethics

Participation in this study was voluntary and a signed informed consent was obtained from all participating patients and prescribers aged eighteen (18) and older prior to the administration of the questionnaire. Participants were informed of their right to opt out at any point of the study. Patient and prescribers information was kept confidentially and unique codes were used to identify patients and the prescribers. Measures were put in place to ensure that all data collected will not be traced back to parties, individual patients and prescribers. Data collected was kept securely throughout. Ethics clearance (15/7/32) was obtained from the University of the Western Cape.

CHAPTER FOUR

Results

4.1 : Patients responses

A total of 200 questionnaires were distributed to respondents who had come to fill prescriptions at Clicks pharmacy, Zevenwacht mall. Of the 200 questionnaires, 50 were deemed invalid because the respondents had omitted important information. Of the 150 respondents, 18 did not return the completed questionnaire giving a response percentage of 88%. All respondents were over 18 years of age, literacy levels were high in this study sample with the majority of the participants (91.90%) having obtained a matric certificate or more. See table 3 below:

Table 3: Demographic details of participants n= 132.

Age			Education			Gender		
Group	percentage	freq	**Group**	percentage	freq	**Group**	percentage	freq
18-26 years	15.9%	21	< grade 8	9.1%	12	Male	44.7%	59
27-36years	35.6%	47	matric	27.3%	36	Female	55.3%	73
37-46years	23.5%	31	tertiary	44.7%	59			
47-56 years	15.9%	21	post graduate	18.9%	25			
above	9.1%	12						

4.1.1. Diagnostic tests

Diagnostic tests are essential in treating infections and ideally should be performed to conclude presence of infection as well as identify the causative organism. There are however instances where collection of specimen is not necessary for instance in cases of diagnosing ear infection, tonsillitis and pneumonia (Al-Shami *et al*., 2011). In this study, 65.9% of the respondents received antimicrobial agents without a prior diagnostic test done to conclude presence of an infection, while only forty five respondents (34.1%) reported that diagnostic tests were done before a prescription for an antimicrobial drug was issued. It is however important to note that not all conditions require a diagnostic test to conclude the presence of infection such as tonsillitis and ear infections. Due to the absence of ICD 10 codes for the majority of the prescriptions it was impossible to isolate the conditions that required a diagnostic test prior to diagnosis.

4.1.2. Lack of knowledge.

Haak (1988) and Haak and Radyowijati (2010) identified lack of understanding and lack of knowledge on antimicrobial drugs as a leading factor to poor adherence to treatment regimens in patients. Incomplete dosing and non adherence to dosing instructions were noted to be the main reasons to improper use of antimicrobial drugs. Similarly with respect to their knowledge of antimicrobial drugs, a very low percentage of the respondents knew the identity of their antimicrobial (See figure 1).
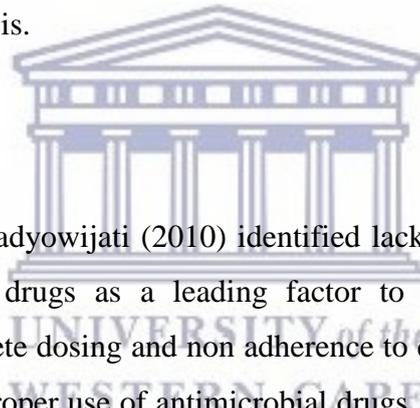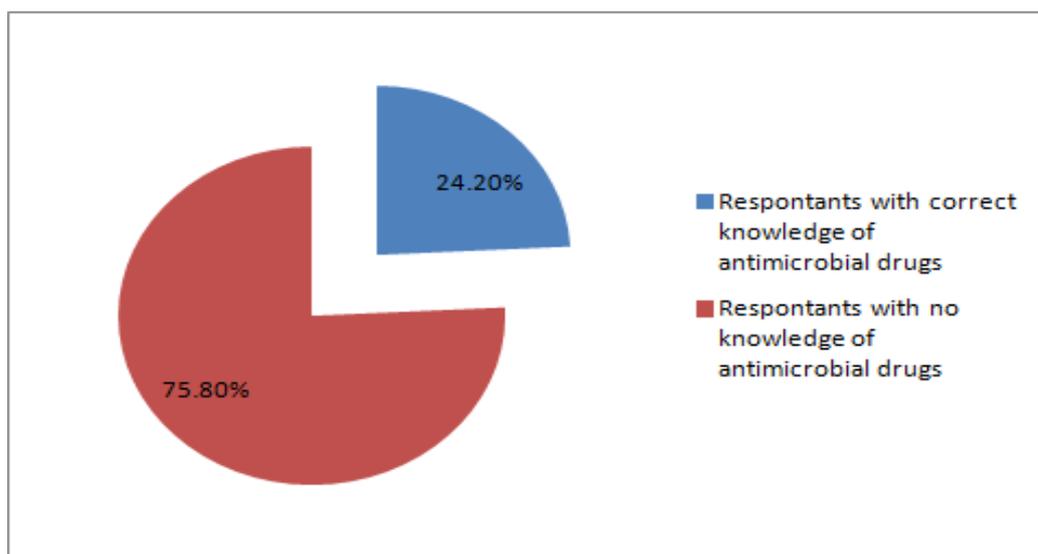
Figure 1: Respondents knowledge of the kind of antimicrobial drug they received. n = 132.

4.1.3. Poor communication

A total of 72.7% believed that all antimicrobials are taken after a meal. Of the 27.3% that did not believe that all antimicrobials must be taken after a meal, 61% had no idea when to take their antimicrobial drugs. Analysis of the data however indicated that there was no correlation between respondent's level of education and their knowledge of the medication ($p=0.788$). It is essential for patients to know the identity of their medication in order for them to follow correct treatment regimens. Certain foods taken with antimicrobials affect the drug's bioavailability and this could result in treatment failure and possible drug resistance.

Thus it is important to communicate effectively to patients on when to take certain antimicrobials (Okeke *et al*., 1999; Eddershaw *et al.*, 2000; Levison *et al.*, 2009). The results obtained from this study are indicative of a lack of knowledge on when to take antimicrobials by respondents due to lack of effective communication between patient and the health care providers. Foroutan (2014) went a step further in trying to understand why patients lack knowledge on their prescribed medicines and his findings revealed that 93.2% of participants did not read package inserts, which makes communication between patient and doctor

essential as this lack of effective communication directly affects patients' knowledge on prescribed medication. With a high literacy level of the respondents one would assume that the group would be knowledgeable on antimicrobials but the result obtained indicated a lack of knowledge. This would therefore mean that there is need for effective communication by health care practitioners regardless of educational levels or literacy level.
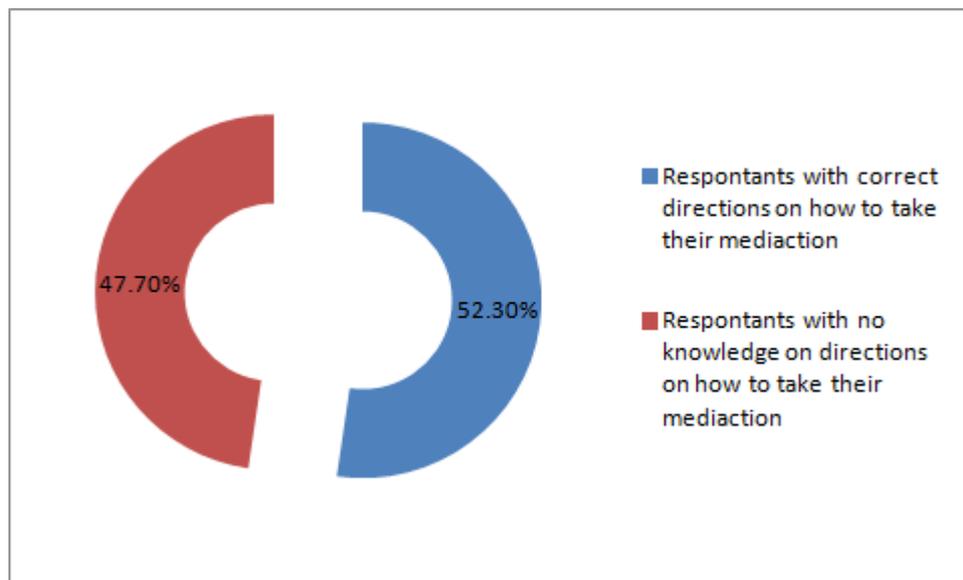
Figure 2: Respondents' knowledge on directions of use of antimicrobial drugs dispensed n= 132.

Antimicrobial resistance is a result of inappropriate use and it poses a health crisis in the world and South Africa as well (Wise R *et al*., 1998; Mendelson and Matsoso 2015). Antimicrobial drugs need to be completed for effective treatment. A major cause of resistance to antimicrobials is patients not completing the course of antimicrobials. With respect to completion of the antimicrobial course, 85.6% of respondents reported completing their courses of antimicrobials while 11.4% stopped taking their medication when they felt better, 3% reported that they stopped taking their medication when they experienced side effects

.

With respect to what they did with leftover antimicrobials, figure 3 shows the different ways in which patients and care givers use leftover antimicrobial drugs. In a similar study done by Macfarlane 1997, 87% of patients stopped taking antimicrobials when they felt better. This study reported a low percentage of patients that stopped taking their medication after feeling better, with another 3% that stopped after experiencing side effects. Prescribers and other health care practitioners need to inform patients and caregivers of their responsibility to complete their courses of antimicrobial drugs and their right to return to the prescriber or pharmacy after experiencing side effects. With a high percentage of patients completing their course of antimicrobial drugs in this particular study one can conclude that respondents are aware of the need to complete their medication for effective treatment and intervention would be targeted on educating them on their right to report side effects if and when they experience them.
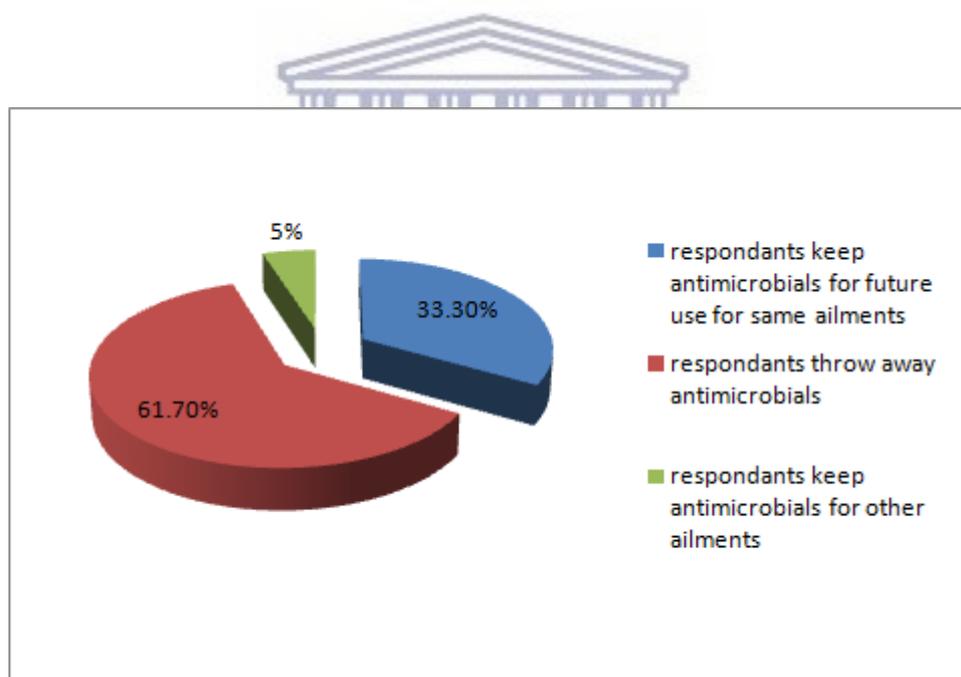
Figure 3: Left over antimicrobial drugs usage by patients. n = 132.

4.1.4. Storage.

The efficacy of any drug including antimicrobial agents can be adversely affected by the conditions in which they are stored. This in turn could lead to treatment failure and even

resistance (Martin, 2016). With respect to the storage of medication, only 57.6% of the respondents knew how to store general medication correctly (Figure 4) and there was also no correlation between the respondents knowledge of drugs and their knowledge of correct storage of medication ($p = 0.9640$). Given the significantly high percentage of respondents that stored medicine incorrectly this can result in treatment failure due to affected efficacy of the drugs.
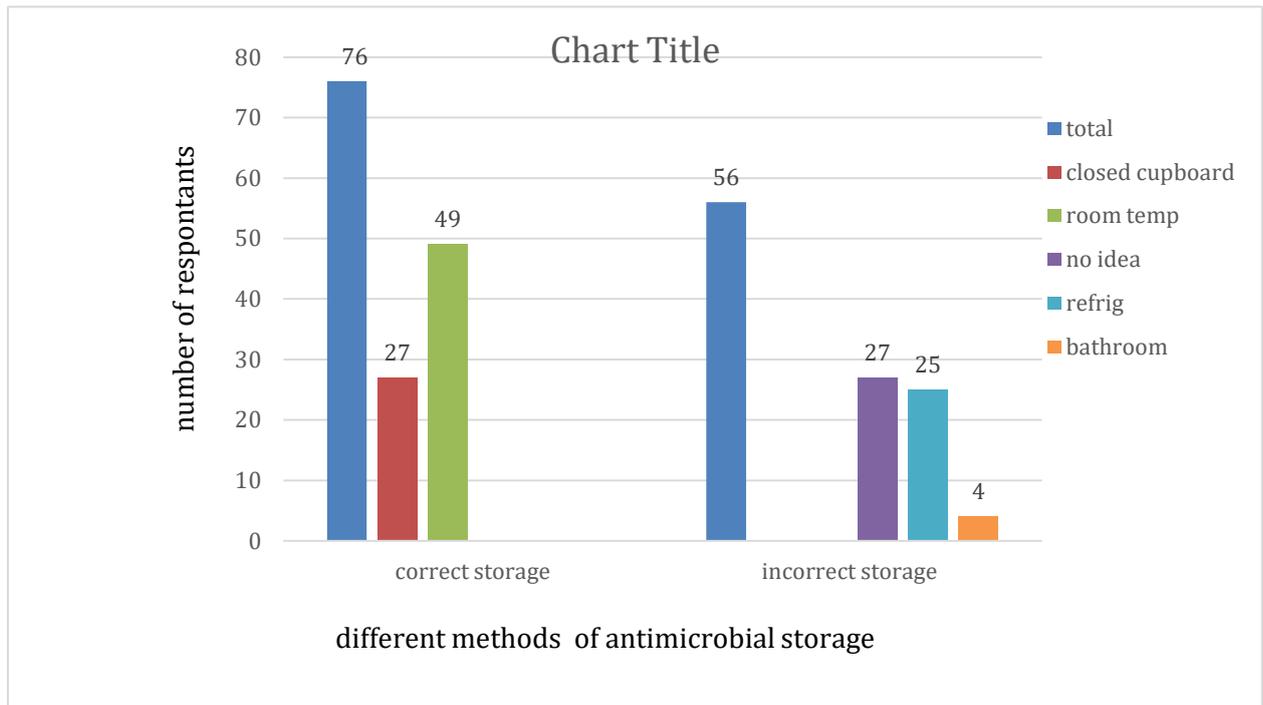
Figure 4: Storage of medications .n = 132.

4.1.5. Patient perceptions and demand.

Radyowijati and Haak, (2002) reported that patient's expectations play an important role in the prescriber's choice of treatment and Macfarlane and co-workers (1997) discovered that a fifth of the patients he investigated requested antimicrobials from their private doctors and that led physicians to prescribe antimicrobial agents. This study showed that when consulting with a doctor, 66.7% of patients did not expect to get antimicrobials each time while 33.3% expected to receive antimicrobials. Furthermore figure 5 shows that 80.3% of respondents reported that they would be satisfied even if they did not receive antimicrobials while 13.60% and 6.10% would not be satisfied and visit a different doctor respectively. Given the

significant percentage of patients expecting antimicrobials from physicians this may be a contributory factor to physicians prescribing antimicrobials inordinately to their patients. Interventions therefore need to target educating the public that not all conditions require antimicrobial drugs. The significant reduction in patients demanding antimicrobials as a result of patient education as reported by one of the practices interviewed indicates that educating patients continuously on appropriate antimicrobial use would impact positively on reducing the misuse of antimicrobial drugs.
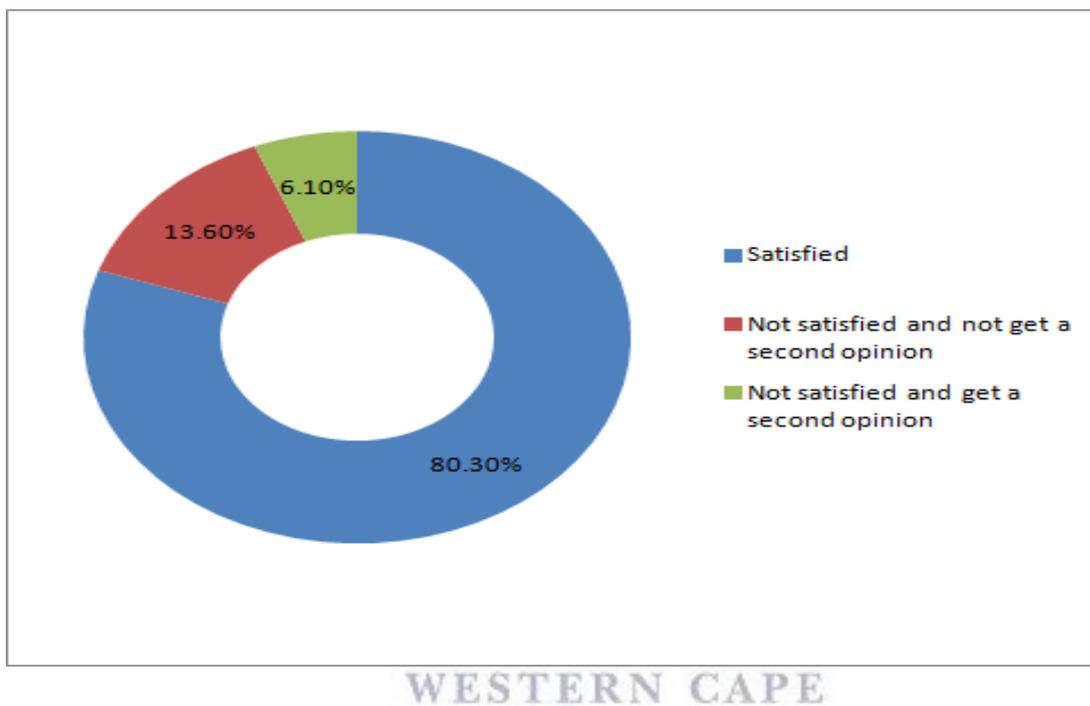
Figure 5: Patients' perceptions on receiving antimicrobials from prescribers. n = 132.

Wilkes and co-workers (2000) examined the effect of media and the internet on patients' perceptions on medicine demand and he discovered that patient used these information platforms and requested antimicrobial agents using that acquired information. Study participants admitted to seeking health information from the media and internet as sources of information on symptoms and treatments before consulting a doctor. A total of 58.30% did use these information platforms while 41.70 % did not. Thirty six (46.80%) of those that used the internet highly trust the information they find while 40.30% and 12.90% have some trust and very little trust in the information they find respectively. This directly affects the demand

of antimicrobial agents from physicians by patients.

4.2 : Unisolve instrument

Data was captured from the Unisolve system software that all Clicks pharmacies use to capture and store patients' information. This collected data was compared to the information on the hard copy prescriptions to prevent capturing mistakes made by the dispensers and also to allow for capturing the original prescriptions before any alterations done by the dispensers. A total amount of five hundred and nine prescriptions were captured with six deemed invalid since they did not have adequate information, three did not have the patient unique code, the other two had no doctor's codes and on one the prescribed antimicrobial drugs were omitted during capturing, giving a total of five hundred and three prescriptions captured all together.

With respect to the appropriateness of antimicrobial prescriptions, prescriptions with ICD 10 codes were evaluated for appropriateness of dose, frequency and duration using the South African Medicine Formulary (12th edition).

Figure 6 shows the distribution of use of various antimicrobial drugs with co-amoxiclav, being the most commonly used antimicrobial followed by amoxicillin and azithromycin.

FREQUENCY OF USE OF ANTIMICROBIAL DRUGS
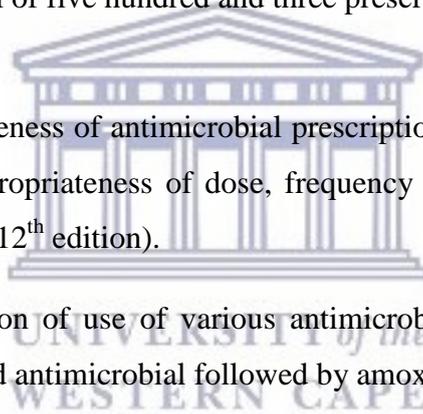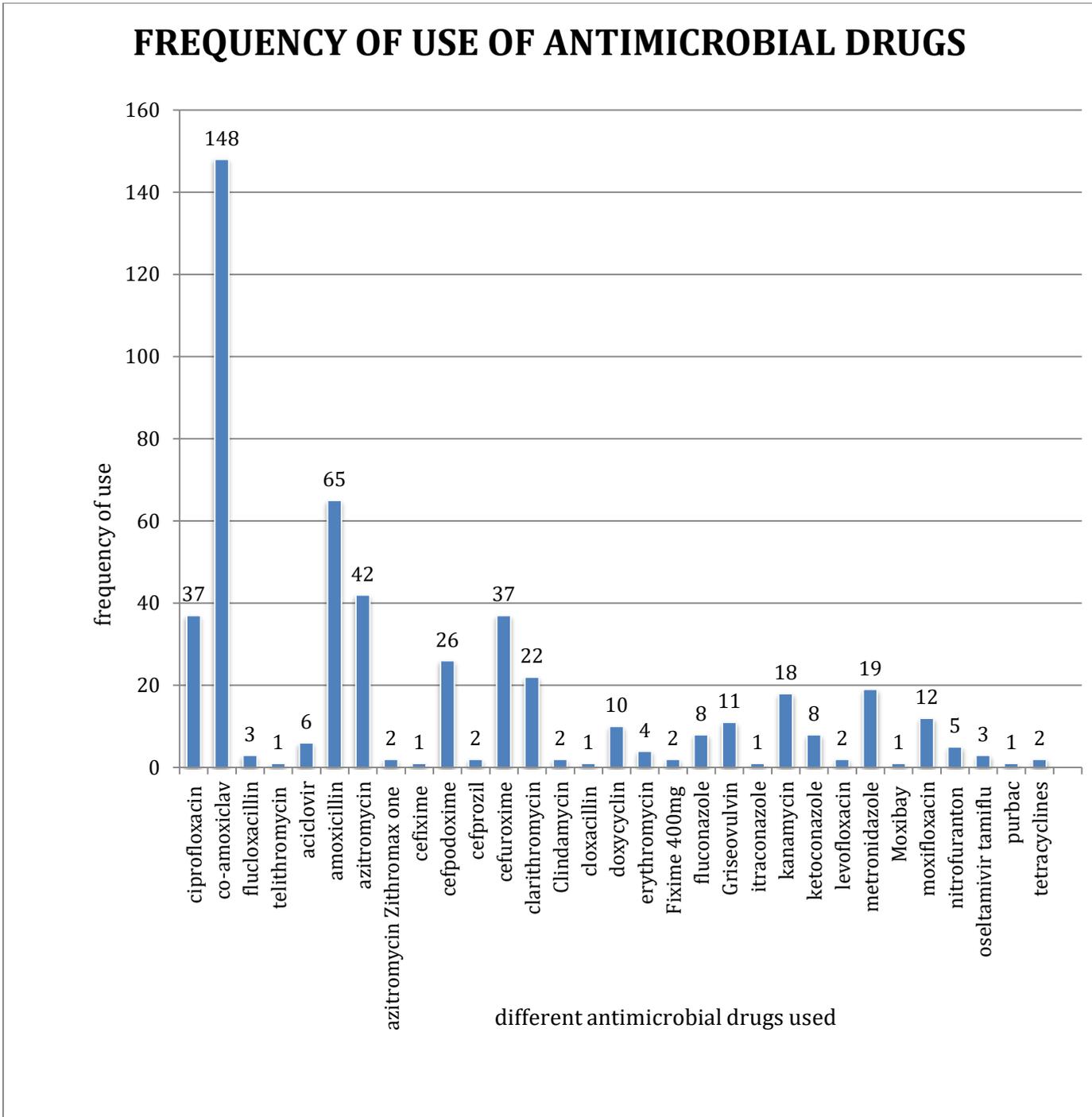
Figure 6: Frequency of use of antimicrobial drugs .n = 503.

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Prescriptions were captured for general practitioners, specialists and for dentist with 61.1%, 11.7% and 5.2% respectively. One hundred and sixty six prescriptions had ICD 10 codes, a total percentage of 33%, with a breakdown for the different types of prescribers given in (figure 7) below. It is essential to place an ICD 10 code on all prescriptions to allow for effective patient care from the dispensers as it gives a diagnosis. Pharmacists need to evaluate prescriptions for appropriateness of treatment and deficiency in patient profiling leads to incorrect diagnosis and inappropriate use of medication. In a retail pharmacy setting where there is no access to the patient's clinical notes, an ICD 10 code is necessary for the pharmacist to evaluate prescriptions for appropriateness of treatment (Al-Shami *et al*., 2011).
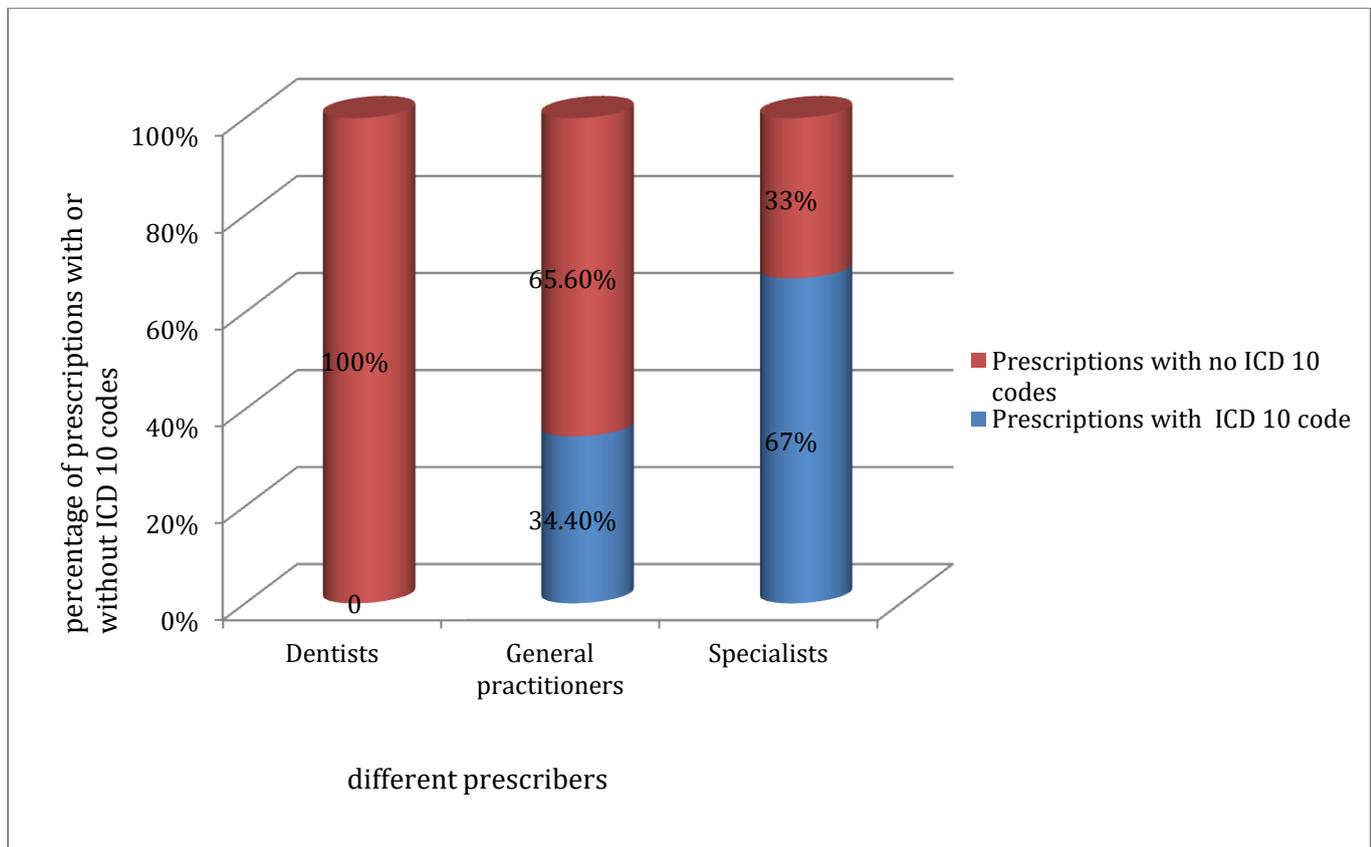
Figure 7: Prescriptions with or without ICD 10 codes. n = 503.

4.2.1. Inappropriate prescribing

Many studies done on accurate diagnosis and appropriate antimicrobial drugs dispensed showed alarmingly high percentages of inappropriate use by prescribers and as a result it is essential to study the trend of use in South Africa (Shah and Shah *e* 2004; Willemsen et al., 2010; Al-Sham *et al.*, 2011). Mendelson and Matsoso (2015) reported that 59% of the medical aid claims for the treatment of upper-respiratory-tract illnesses in children in 2015 were inappropriate. Similarly in this study a high percentage of antimicrobial misuse by prescribers was identified with 40.2% of all prescriptions deemed inappropriate (17.9% - prescriptions with ICD 10 codes and 22.3% -prescriptions without ICD 10 codes). Appropriate prescriptions accounted for 59.8% of all prescriptions reviewed (15.7% - prescriptions with ICD 10 codes and 44.1% - prescriptions without ICD 10 codes) (see figure 8).
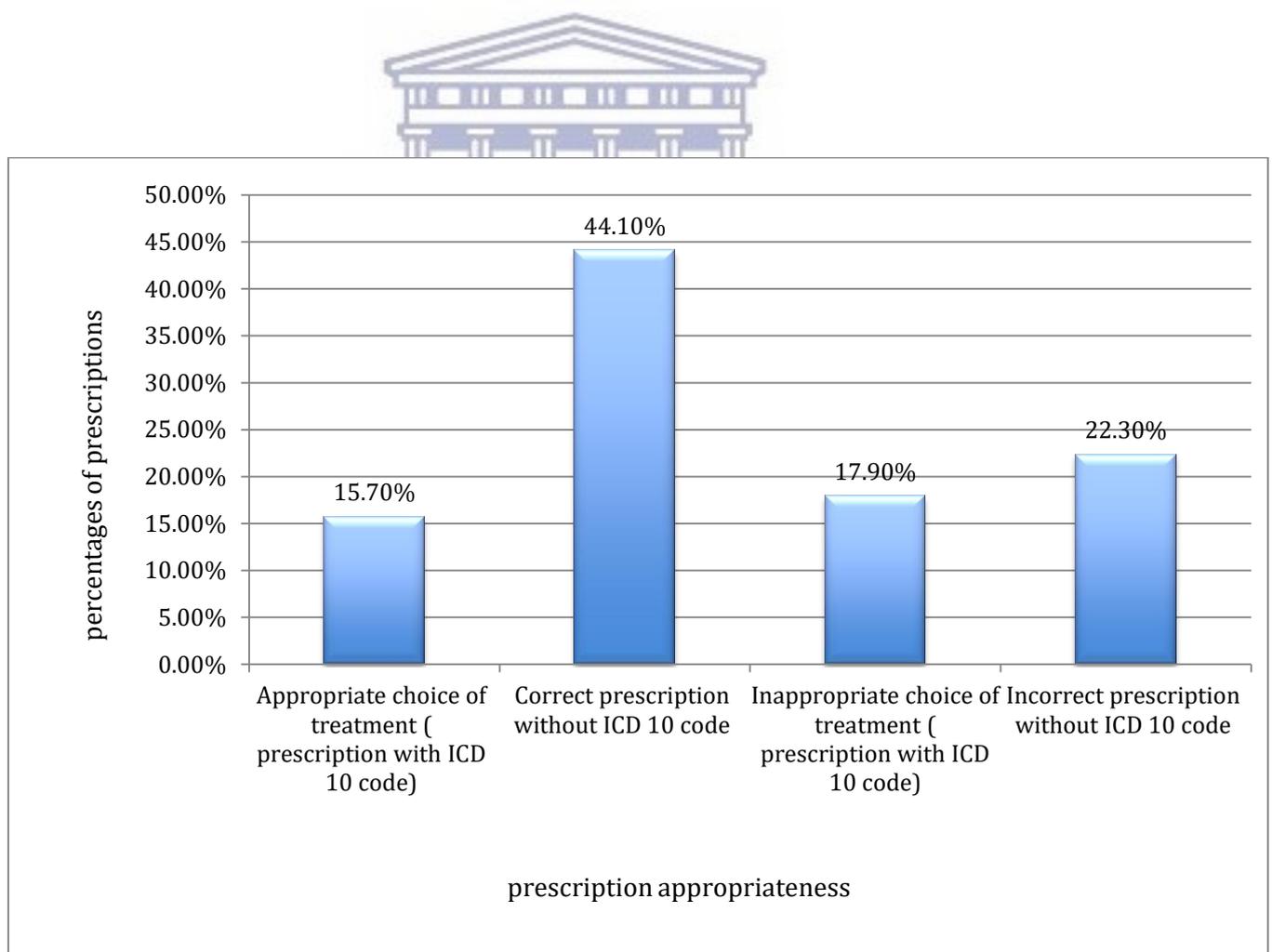
Figure 8: Appropriateness of antimicrobial therapy. n = 503.
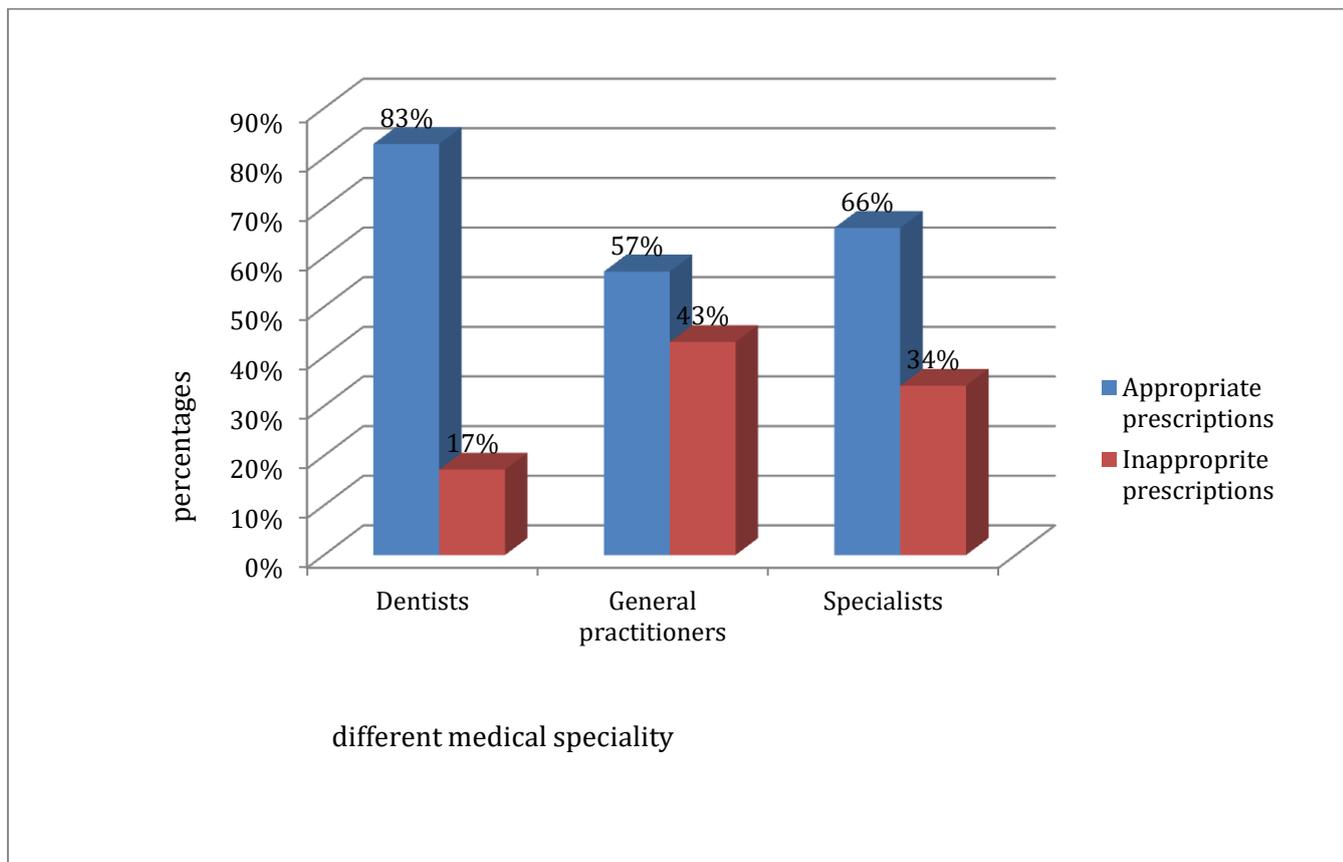
Figure 9: Appropriateness of prescriptions. n = 503.

This study examined inappropriate prescribing patterns including prescriptions with wrong doses, incorrect frequencies and incorrect durations. General practitioners accounted for the greatest proportion of inappropriate prescriptions with 42.9% of prescriptions from general practitioners being inappropriate. Although general practitioners accounted for the majority of the prescriptions evaluated in this study, they however accounted for a disproportionately high percentage of the inappropriate prescriptions (83, 1% of all inappropriate prescriptions). With regards to incorrect doses, general practitioners had the highest amount of prescriptions amounting to 77% followed by specialists with 20% and lastly dentists with only 3% prescriptions with wrong doses. (Percentages derived from the total amount of prescriptions with wrong doses) Incorrect duration of therapy was also noted with general practitioners having 78% prescriptions with incorrect duration followed by specialist then dentists with 18% and 4% respectively. General practitioners had 93% prescriptions in total with incorrect

frequencies and specialists had 5%% prescriptions with incorrect frequencies and lastly dentists had only 2% from the total incorrect prescriptions with wrong frequencies (figure 10) With regards to duration of therapy, prescriptions were noted to have longer or shorter durations with general practitioners accounting for (40 % of total number of all incorrect prescriptions with wrong durations) of the prescriptions. Mohammed and Tesfaye (1997) reported 14% and 18% prevalence of over- and under- dosing respectively in a private hospital and closely related to this is prescribing for shorter durations and longer durations. Study results showed that general practitioners, dentists and specialists prescribed antimicrobial agents with shorter durations and longer duration in 43% and 57% respectively out of all the prescriptions that had incorrect durations. Under-dosing obviously increases the risks for the development of resistant strains while overdosing increases the adverse effect burden on the patient.
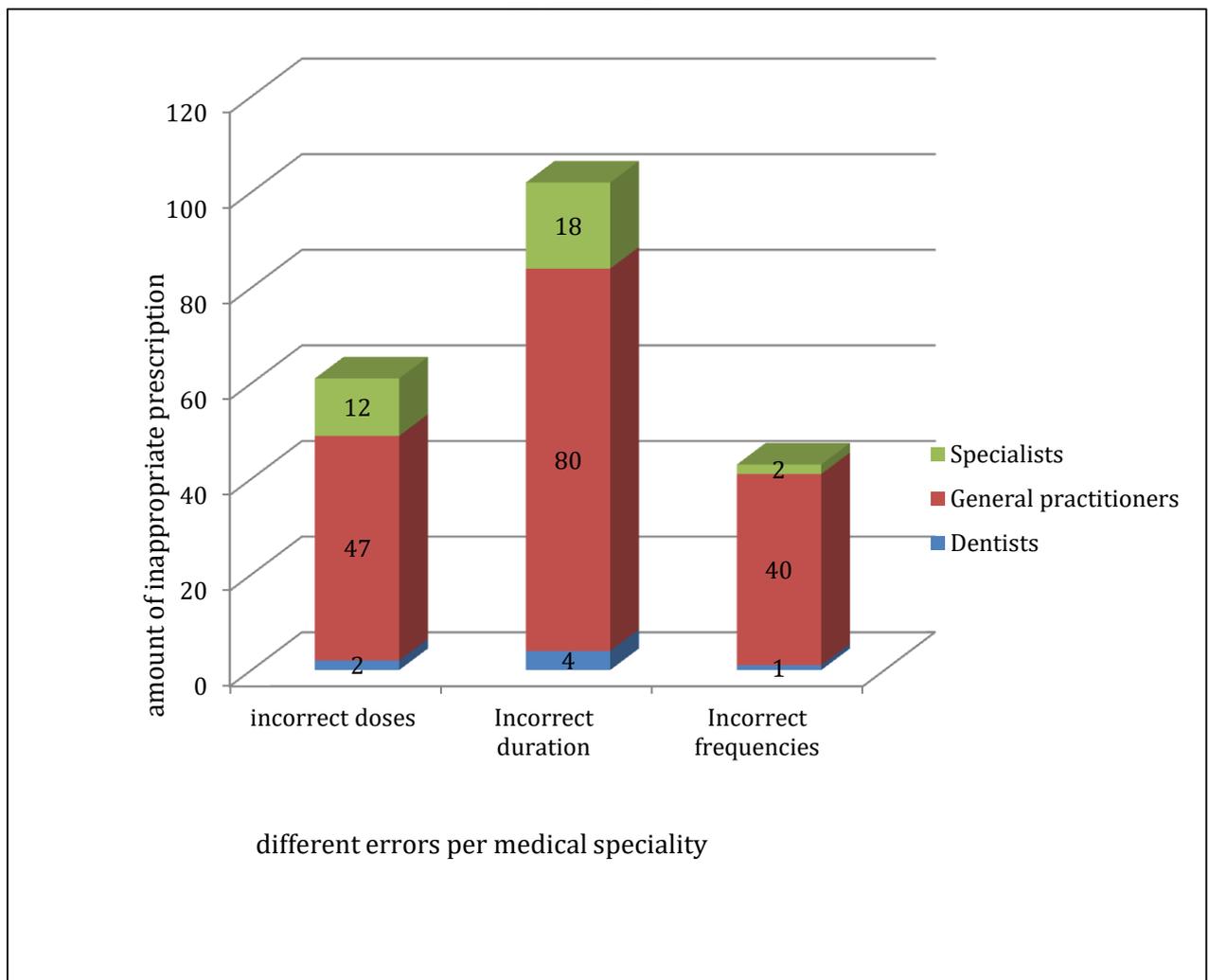
Figure 10: Different errors noted per Doctor's' status. n = **200.**

A total of two hundred prescriptions were inappropriate, with 89% of the inappropriate prescriptions containing antibacterial drugs, 8.5% containing antifungal drugs and 2% containing antiviral drugs. Co-amoxiclav was the most commonly inappropriately prescribed agent with 31% of the inappropriate prescriptions (see figure 11). Such high percentages of misuse of co-amoxiclav, a broad spectrum antibacterial drug indicate its use to treat infections where prescribers are not sure of the etiology of the infection. As a result resistance to this drug is inevitable.

Figure 11: shows percentages of different antimicrobial drugs used inappropriately.
n = **200**

4.3 : Prescriber's responses

4.3.1. Prescribers perspectives

This study also investigated the prescriber's perspective on the factors influencing the prescription of antimicrobial agents with semi-structured questionnaires administered to prescribers at four different practices in Kuilsriver. Results were collected from four out of five prescribers as one prescriber did not hand back the results giving a response rate of 80%. Three out of the four prescribers reported not performing diagnostic tests before prescribing an antimicrobial agent with some of their patients. Three of the prescribers reported on administering antimicrobial agents empirically in cases where a potentially dangerous infection is suspected. All prescribers also indicated that the inability of patients to pay for diagnostic tests influenced the empirical prescription of antimicrobial agents. The lack of laboratory facilities or the inability of patients to pay for microbiological tests was also reported as influencing the empirical prescription of antimicrobials in a study done by Rashid et al, (1986). Financial constraints on the patient's side also determined what antimicrobial drug was prescribed.
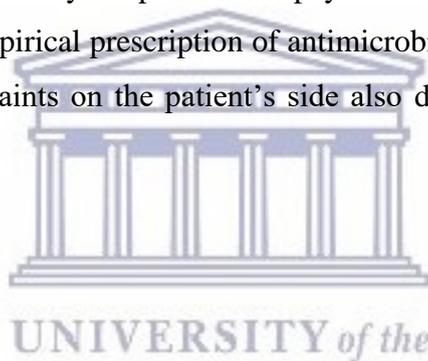
4.3.2. Continuity of care

Patient care is very essential and continuity of care must be a priority whether in private or public health centers. However results in this study revealed that there is no continuity of care in private practices and 50% of the prescribers agreed that the lack of continuity in patient care was the reason they prescribed antimicrobial drugs on patient's first visit as follow-up visits were never guaranteed. Prescribers also gave several reasons why continuity of care was never guaranteed and the reasons cited were:

1) Patients were not compliant

2) Patients were not able to afford costs that comes with follow-up visits

3) Patients were too busy for follow-up visits

4) Practitioners too busy to follow-up

5) Patients referred to hospitals if symptoms persisted.

4.3.3. Patients perspectives on demand of antibiotics

All prescribers indicated that a percentage of the patient's (5%, 80%, 60% and 70% for prescriber A to D respectively; average of 53.75%) demanded antimicrobials from them. One prescriber reported a very high percentage (80%) of patients demanding antimicrobial drugs, but also mentioned that after continuously educating his patients the percentage dropped to 50%. Prescriber C reported that parents demanded antimicrobial drugs for their children especially. This was similar to reports by Mangione-Smith et al, (1999) that parents in Indonesia demanded physicians to prescribe potent drugs like antibiotics to their children from their private practitioners.

4.3.4. Availability of medicines

Lack of appropriate drugs played a role in prescribers' misuse of antimicrobials to treat patients in a study by Bosu in Ghana (Bosu and Ofori-Adjei 1997). In this study half of the prescribers reported that availability or unavailability of certain drugs did not affect their choice of antimicrobial treatment while one prescriber agreed that it does and one reported that it does but not all the time.

4.4 : Discussion

This study researched on the epidemiology of antimicrobial agents in the Kuilsriver area, with data collected from patients or caregivers and prescribers. Questionnaires were used to collect data on patient's knowledge of the correct use and storage of antimicrobial agents. Results from this study indicate that patients have little knowledge on the correct use of antimicrobial agents, with 75.8% participants having no idea of the identity of the antimicrobial agent that had been prescribed, and a further 47.7% not having any knowledge of the correct directions of use of their medication. The knowledge of the nature and use of an antimicrobial agent is very important in helping prevent inappropriate use of this class of

drugs. Haak (1988) in a similar study reported that poor adherence was due to a lack of knowledge of the medication and that patients stopped taking medication due to side effects without informing their doctors or any healthcare provider (Haak and Radyowijati 2010). In this study, no correlation was found between educational level and the level of knowledge on antimicrobial drug use. With 91% of the study participants with a matriculation certificate or above, it was not possible to determine any effect of the lack of or lower educational levels on the knowledge of antimicrobial drugs. Given the high educational levels in the study group and the low levels of knowledge of their medication by the patients in this study, educational level alone does not play a role in determining appropriate use of antimicrobial agents. Effective communication between the patient and the prescribers is essential to promote appropriate use of antimicrobial agents to prevent resistance.

Resistance to antimicrobial drugs is as a result of inappropriate use of antimicrobial agents of which repurposing of leftover medication is one of the sources. In our study, 33.3% of the respondents kept antimicrobial drugs for future use on the same condition, while 5% kept them for future use on other ailments. This shows how complex the problem of controlling resistance in antimicrobial drugs is. Patients do not complete antimicrobial therapy and self-medicate with the leftovers which gives room for even further resistance in the future. Self-medication in some countries, Nigeria and Cameroon was due to patients purchasing antimicrobial drugs over the counter (Okeke *et al.*, 1999) but in this study it was due to self-medicating with leftover antimicrobial agents from a previous ailment. This makes it an even worse scenario because patients could be self-medicating with sub therapeutic doses each time unlike in the other study where they would purchase complete courses of antimicrobial agents. Interventions to reduce self-medication have to then take into consideration leftover medication as an important source of antimicrobial misuse.

Storage of medication is essential in maintaining efficacy of medication and improper storage of antimicrobial agents would reduce effectiveness of medication, and this directly gives room for resistance. In this study 42.4% of respondents stored their medication incorrectly. This was higher than expected considering the high literacy levels in this study. Information on correct medication storage can be found in the package insert and given the literacy levels of the respondents it could be expected that they read the package inserts to be able to store medication correctly but this was not the case. However a study by Foroutan (2014) showed

that 90% of patients threw away package inserts, and this could be the reason why participants in this study stored medication incorrectly. In this view it then becomes of paramount importance for prescribers and dispensers to inform patients on correct storage.

In a study done by Macfarlane et al, (1997), patient's expectations were reported as one of the factors driving inappropriate prescribing. In that study 85% of participants believed most infections are treated by antimicrobial drugs and one fifth of all participants in the same study requested antimicrobial drugs from their doctors. Similarly in this study patients expected antimicrobial drugs when they visited their private doctors and 13.6 % of all participants would not be satisfied with not receiving antimicrobial drugs with 6.1% consulting a different doctor. This demand of antimicrobial drugs will indirectly drive prescribers to prescribe antimicrobial drugs to their patients. A total of 19.7% of the total respondents needed their doctors to prescribe antimicrobial drugs for them and this suggests why private doctors prescribe antimicrobial agents.

Of all the patients, 58.3% used the Internet and media as platforms of gathering information on their conditions and treatment of these ailments before consulting with healthcare practitioners. With high levels of trust of these platforms (46.8% of those that use these platforms highly trusting the information they get), there is the problem of patients demanding treatment options they have learnt from these platforms from their practitioners.

In this study 40.2% of all prescriptions were deemed inappropriate. General practitioners accounted for the greatest proportion of inappropriate prescriptions. Although general practitioners accounted for the majority of the prescriptions evaluated in this study, they however accounted for the highest proportion of inappropriate prescriptions (42.9% of prescriptions from general practitioners were inappropriate). With regards to incorrect doses, frequencies and duration of therapy general practitioners also had the highest amount of inappropriate prescriptions. This study results showed that general practitioners, dentists and specialists prescribed antimicrobial agents with shorter durations and longer duration in 43% and 57% respectively. In a similar study by Mohammed and co-worker (1997), 14% and 18% prevalence of over- and under- dosing respectively was reported. Under-dosing and shorter duration would increase the risk of resistance while overdosing and longer duration of therapy would increase the side effect burden on the patient and indirectly increase the financial burden on the health care system. Such high percentages of wrong doses, incorrect frequencies and incorrect duration of treatment suggest that interventions should focus on

ensuring correct doses are dispensed with correct frequencies and correct duration of therapy as well.

In this study, 65.9% of the respondents received antimicrobial agents without a prior diagnostic test done to conclude presence of infection and etiology of the infection as well. In a similar study done in Bangladesh, 90% of patients were treated with antimicrobial drugs with no tests done (Rashid*et al.*, 1986). Although that study had a very high percentage of patients receiving antimicrobial drugs with no test done, 65.9% is also a very high percentage even though it includes other conditions such as ear infection, tonsillitis, infected nails and sinusitis that do not need a diagnostic test. These alarmingly high percentages shows that treatment with antimicrobial drugs is done empirically by prescribers and interventions need to focus on providing cost effective on-the-point diagnostic tests tools and awareness on delaying use of antimicrobial drugs until diagnostic tests results are received. However considering the resource-scarce nature of the South African healthcare system, improving the empirical diagnostic skills of doctors through training and retraining is essential.

A total of 89% of the inappropriate prescriptions contained antibacterial drugs and Co-amoxiclav was the most commonly inappropriately prescribed agent with 31% of the inappropriate prescriptions. This study revealed a higher frequency in the inappropriate use of antibacterial agents when compared to the other antimicrobial agents (antifungal and antiviral agents, and excluding antiretroviral agents). This implies the importance of starting targeted interventions to reduce the inappropriate use of co-amoxiclav, with studies like this one providing data that is essential for these interventions.

The lack of continuity of care for most of the patients from the prescribers, coupled with the extensive practice of empirical prescribing are significant in the fight against resistance. The cost associated with diagnostic tests was identified as a factor limiting their use by prescribers. Similarly in a study by Rashid et al, (1986), patients could not afford diagnostic tests costs thus prescribers had to prescribe empirically. The lack of diagnostic tests to conclude presence of infections has been reported as a contributor to drug resistance (Rashid *et al*, 1986). As such any interventions to promote appropriate use of antimicrobial drugs and prevent resistance must also include the implementation of some form of continuity of care, with clear guidelines regarding empirical prescribing of antibiotics and a way to make diagnostic tests more affordable for patients.

A total of 53.75% of patients that visited these private health centers demanded antimicrobial

agents from their prescribers in this study; however prescribers from all four practices reported that they gave advice on the dangers of giving antimicrobial drugs to their patients for conditions that did not require any antimicrobials. This saw one practice having a decline in number of patients demanding antimicrobial agents from 80% to 50%, which indicates that with good communication between the patient and the prescribers this problem can be resolved and antimicrobial misuse can also be reduced. Although there is an improvement in one practice, there has been no improvement in the other practices on patient demand and a 53.75% of patients requiring antimicrobial agents is still very high and intervention therefore should not include educating patients only as a way of reducing the need for antimicrobials.

4.5. Limitations

The lack of ICD 10 codes on prescriptions limited the scope of this study. ICD 10 codes allows for the dispenser and researchers to know the diagnosis of the patients. That would in turn give the dispenser or researcher a better chance to investigate the prescription for correctness and appropriateness.

The scope of this study was also limited by the small sample size. A larger sample size would allow for better understanding of the trends in this area. The study included one community pharmacy only and including a number of community pharmacies would also allow for better understanding of the epidemiology of antimicrobial drugs in community pharmacies.

The research site covers only a small area of the Western Cape, Kuilsriver urban even though it caters for other areas around it like the Stellenbosch farm areas and Mfuleni townships, expanding the research area would improve the results as well.

CHAPTER FIVE

<u>Conclusion</u>

In conclusion, epidemiology studies prove to be useful tools that can be used to judge appropriateness of antimicrobial use amongst patients and prescribers and to determine the factors affecting inappropriate use. This study showed that both patients and prescribers use antimicrobial drugs inappropriately. It showed that in the Kuilsriver area patient related factors that drive inappropriate use of antimicrobial drugs are lack of knowledge on antimicrobial drugs, use of self-medication from left-over antimicrobial drugs, not following correct treatment regimens and incorrect storage of medication. Psychosocial factors like the use of media and the internet to search for treatment before visiting a doctor and the need for antimicrobial drugs by patients to treat infections was also a driving factor that led patients to shop around for second opinions until they received antimicrobial drugs from their private prescribers. On the other hand prescribers prescribed antimicrobial drugs inappropriately by prescribing wrong doses, prescriptions with wrong frequencies and duration of treatments. Antimicrobial drugs were prescribed with no diagnostic tests done. Private prescribers gave antimicrobial drugs for conditions that did not require any antimicrobial agent and prescribed antibacterial drugs for viral infections as well in this study. Prescribers also used broad spectrum antimicrobial agents, empirically, in most patients because patients could not afford diagnostic tests and a lack of follow-up visits. Availability of certain antimicrobial drugs did not play a role in affecting antimicrobial therapy chosen by prescribers in Kuilsriver. This epidemiologic study showed areas where interventions on improving antimicrobial agents can be directed to with the aim of preventing resistance in this class of drugs.

<u>Recommendations</u>

As most of the participants in this study had little knowledge on antimicrobial drugs, demanded antimicrobial drugs from their prescribers for themselves and for their children, educating patient on the dangers of the misuse of antimicrobial agents is highly recommended.

Antimicrobial agents are misused by prescribers in several ways and continuity of care for patients is never guaranteed due to especially lack of funds by patients, reduction of empirical

use of antimicrobial is recommended.

Further studies on recommendations and implementation of such recommendations on proper antimicrobial use in the private sector in South Africa are required.

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Appendix I

Patients' questionnaire

QUESTIONS   RESPONSES

                                                              133

Patient questionnaire

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TOPIC: Epidemiology of antimicrobial drugs and appropriate prescribing by doctors and other health care practitioners in the Kuilsriver area to treat infections.

PRINCIPAL INVESTIGATOR: OBIKEZE, KC School Of Pharmacy [University Of The Western Cape]

: MHLANGA, MR [Clicks Zevenwacht Pharmacy]

The above-mentioned project is an undertaking by a master's student at the School of Pharmacy, University of the Western Cape. The purpose is to determine the epidemiology of antimicrobial and appropriate prescribing by doctors and other health care practitioners in the Kuilsriver area to treat infections .Respondents would be given questionnaires with questions on how to use antibiotics to fill in whilst they wait in the queue to collect their medication from the dispensary.

Information gathered from these questionnaires would be kept confidential and individual

patients would not be identified but a specific identification code would be created for each patient taking part and would never be traced back to the individual.

Participation is voluntary not compulsory and the results would provide input to the metropole district health service directorate. Your signature indicates that you understand the above, and that your participation is voluntary.

Signature of participant...

PATIENTS DETAILS

Age

☐ 18-27

☐ 27-37

☐ 37-47

47-57 ☐

Patient's unique code

Short answer text

Gender

    MALE

    FEMALE

Educational Level

    LESS THAN GRADE 8

    GRADE 8

    MATRIC

    TERTIARY EDUCATION

    POST GRADUATION

    Other…

DRUG INFORMATION

    Do you know the type of antimicrobial drug the doctor has prescribed for you

    YES

    NO

If yes please indicate from the options below

ANTIBIOTIC

ANTIVIRAL

ANTIFUNGAL

DRUG INFORMATION

Do you know the name of the drug OR drugs the doctor has prescribed for you

YES

NO

If yes please indicate the name or names below

Long answer text

Is this your first time using antimicrobial drugs (antibacterials, antivirals, antifungals)

YES

NO

If NO how many times have you been treated with antibiotics in the past 1 year

ONCE

TWICE

THRICE

MORE THAN THREE TIMES

For which of the following conditions did the doctor prescribe your current treatment

COLDS

SINUSITIS

OTITIS MEDIA

TONSILITIS

SEPTIC WOUND

SKIN INFECTION

STOMACH

NO IDEA

Other…

UNDERSTANDING INSTRUCTIONS

Drug 1 ....

How many times must the medication be taken per day?

ONCE

TWICE

THREE TIMES

FOUR TIMES

FIVE TIMES

MORE THAN FIVE TIMES ....

Drug 2 ....

How many times must the medication be taken per day?

ONCE

TWICE

64
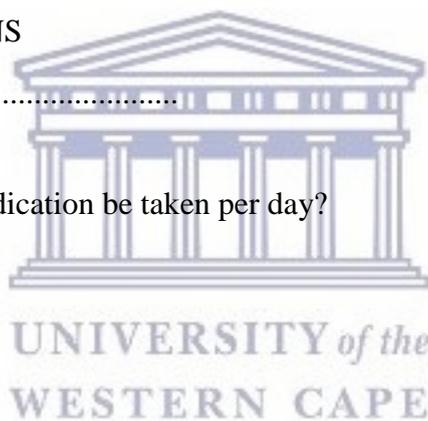
FOUR TIMES

FIVE TIMES

MORE THAN FIVE TIMES ....

Drug 3 ....

How many times must the medication be taken per day?

ONCE

TWICE

THREE TIMES

FOUR TIMES

FIVE TIMES

MORE THAN FIVE TIMES ....

Do you know the instructions of taking the above medication with/without food.

Yes

No

No Idea

The medication must be stored

   A. In the fridge

   B. In a closed cardboard

   C. Under room temperature

E. No idea

DISEASE DETAILS

Did the doctor perform any test to confirm diagnosis

YES

NO

IF YES PLEASE INDICATE

A. Blood test

B. Urine test

C. Feacal test

D. Saliva test

Other ....

PATIENTS' PERCEPTIONS

when do you stop taking your antimicrobial drugs (antifungals, antibacterials ,antivirals)

When I am feeling better

When I have completed the course

When I experience side effects

Do you keep left-over antimicrobials

YES

NO

☐ Throw away

☐ Keep for future use for self

☐   Keep for future use for others with similar symptoms

☐ Other..

When you visit the doctor do you expect to get antimicrobials (antibacterials, antifungals, antivirals)

☐ YES ☐ NO

If you do not receive antibiotics (antimicrobials) from your doctor

☐ You will still be satisfied ☐ Not satisfied

☐ Visit a different doctor

Do you use the media or internet to search for information on your condition and medication before you seek medical help?

☐ YES ☐ NO

IF YES, on a scale of 1-10, how much do you trust the information you get from these sources

1   2   3   4   5   6   7   8   9   10

Appendix II

Prescriber questionnaire

QUESTIONS   RESPONSES
                                                                      6

Prescriber questionnaire

                                                    University of the western Cape
School of Pharmacy   Private Bag X17, Bellville, 7535, South
                                            Africa
                                            Tel: 021 959 3666 Fax: 021 959 3407

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prescribers would not be identified but a specific identification code would be created for each prescriber taking part and would never be traced back to the individual. Participation is voluntary, not compulsory and the results would provide input to the metro-pole district health service directorate. Your signature indicates that you understand the above, and that your participation is voluntary.

Signature of participant...

1.   Do you perform diagnostic tests before administering or prescribing antimicrobial drugs to all your patients?

○ Yes ○ No

2.   What diagnostic tools do you have at your practice?

Long answer text
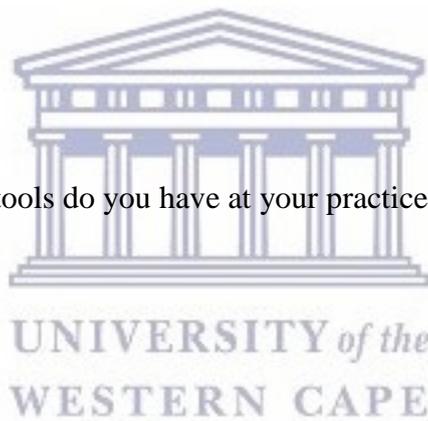
Yes

No

4.   In cases where a potentially dangerous infection is suspected do you prescribe antimicrobial agents empirically or do you wait for microbiological results before initiating treatment and why?

Yes

No

5.   Which treatment guidelines if any do you use when prescribing antimicrobial drugs for infections?

Long answer text

6.   What is your perception when it comes to the use of newer antimicrobials as compared to the older compounds?

Long answer text
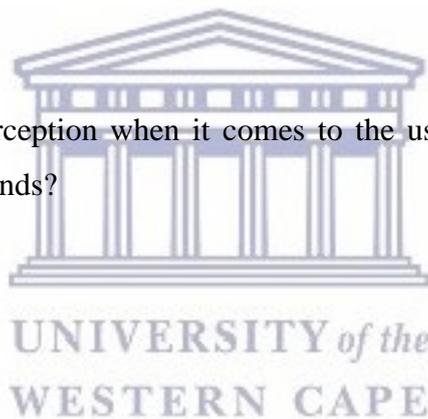
7.   Do you base your choice of antimicrobial on whether a patient can afford (comparing your patients on medical aid and private patients) the medicines?

Yes

No

Maybe

8.	What percentage (estimate) of your patients request antimicrobials from you and how do you respond to such demands?

Long answer text

10.	Research has shown that private practitioners do not follow up on their patients after the initial visit where an antimicrobial has been prescribed, what could be the reason for this failure in continuity of patient care?

Long answer text

Would that lack of follow-up be the reason to prescribe an antimicrobial anyways on the first visit since follow-up sessions are never guaranteed?

Yes◯ No
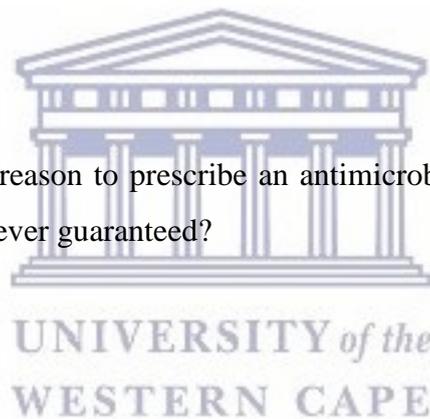
11.	Does availability of certain antimicrobials on the market influence the choice of antimicrobial drug you end up prescribing?

YesNo

Maybe

◯

UNISOLVE QUESTIONAAIRE

PATIENT'S UNIQUE CODE

[   ]

PATIENT'S AGE

[   ]

Doctor's status

○ General practitioner

○ Specialist

○ Dentist

DOCTOR'S UNIQUE CODE

[   ]

PATIENT'S GENDER

○ MALE

○ FEMALE

PATIENT'S RESIDENTIAL AREA

○ KUILSRIVER

○ STELLENBOSCH

○ MFULENI AND HAPPY VALLEY

○ EESTERIVER

PAYMENT METHOD

○ CASH

○ MEDICAL AID

DRUG 1 INFORMATION

NAME

Dose

○ CORECT

○ WRONG

Duration

○ correct duration

○ shorter duration

○ longer duration

Frequency

☐ right frequency

☐ wrong frequency

PRESCRIPTION HAS ICD10 CODE

☐ YES

☐ NO

Diagnosis from ICD10 CODE

Special precautions unique to certain antimicrobial drug

PRESCRIBER'S ERRORS NOTED ON PRESCRIPTION

DRUG 2 INFORMATION

NAME

Dose

- ⚪ CORECT
- ⚪ WRONG

Frequency

- ☐ right frequency
- ☐ wrong frequency

Duration

- ⚪ correct duration
- ⚪ shorter duration
- ⚪ longer duration

PRESCRIPTION HAS ICD10 CODE

- ☐ YES
- ☐ NO

Diagnosis from ICD10 CODE

Special precautions unique to drug

PRESCRIBER'S ERRORS NOTED ON PRESCRIPTION

DRUG 3 INFORMATION

NAME

Dose

○ CORECT

○ WRONG

Frequency

☐ right frequency

☐ wrong frequency

Duration

○   correct duration

○   shorter duration

○   longer duration

PRESCRIPTION HAS ICD10 CODE

☐   YES

☐   NO

Diagnosis from ICD10 CODE

[   ]

Special precautions unique to drug

PRESCRIBER'S ERRORS NOTED ON PRESCRIPTION

HOW MANY TIMES PATIENT HAS BEEN ON ANTIBIOTICS FROM JANUARY 2015

☐   ONCE

☐   TWICE

☐   THREE TIMES

☐   MORE THAN THREE TIMES

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WESTERN CAPE