THE EXTENT OF ANTIMICROBIAL STEWARDSHIP PRACTICES AMONG HOSPITAL PHARMACISTS IN NAMIBIA: A CROSS-SECTIONAL SURVEY

CHENAIMOYO MANDIMIKA-MUTUMBU

STUDENT NUMBER: 3706622

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Supervisor: Prof. Hanani Tabana
Co-supervisor: Dr. Martina Lembani

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Keywords: Antimicrobials, Antimicrobial Stewardship, Hospital pharmacist, Namibia, Antimicrobial Stewardship programme, Antimicrobial formulary, Antimicrobial Resistance, Online survey, Infection Control policies, Health Information Systems.

DECLARATION

I, Chenaimoyo Mandimika-Mutumbu, declare that the thesis entitled: ***"The extent of Antimicrobial Stewardship practices among hospital pharmacists in Namibia: A cross-sectional survey"*** is my own work, and it has not been submitted for any degree or examination in any other university. All the sources I have used or quoted have been indicated and acknowledged by complete references.

Name: Chenaimoyo Mandimika- Mutumbu

Signature: 

Date: 11 November 2021

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ABBREVIATIONS

AMR	Antimicrobial Resistance
AMS	Antimicrobial Stewardship
ASP	Antimicrobial Stewardship Programmes
DTC	Drug and Therapeutics Committee
EDL	Essential Drug List
HAI	Health-care Associated Infections
HCP	Healthcare professionals
ICP	Infection Control Programmes
LMICs	Low-to middle-income countries
NEMLIST	Namibian Essential Medicines List
PSN	Pharmaceutical Society of Namibia
SSA	Sub-Saharan Africa
STG	Standard Treatment Guidelines
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

OPERATIONAL DEFINITIONS

Antimicrobial Resistance (AMR): Phenomenon whereby some microbes become difficult to treat as they become resistant to the antimicrobial agent used to treat it.

Antimicrobial Stewardship (AMS): A set of interventions that are appropriately designed for the correct use of antibiotics.

Antimicrobial Stewardship Programme (ASP): Adoption of coordinated measures to optimize antimicrobial use while decreasing unnecessary antimicrobial exposure.

Drug and Therapeutics Committee: A committee that evaluates the clinical use of medicines, develops policies for managing pharmaceutical use and administration, and manages the formulary system of the hospital the committee belongs to.

Frontline Worker: Are workers who directly provide services where they are most needed. During the Covid-19 pandemic pharmacists were considered as frontline workers in Namibia and they provided the public with access to medicines.

Intermediate Hospital: Hospitals that deal with more complicated cases that are beyond the scope and capacity of the primary level hospital.

One Health Approach/Concept. Recognizes that human, animal and environmental health are closely related, therefore the overall health of humans, animals and the environment is in synergy thereby affecting each other positively or negatively.

Primary Hospital: Deals mainly with internal medicine, obstetrics and gynaecology, paediatrics and general surgery.

Quaternary/Specialist Hospital: Hospitals that are an extension of Tertiary Hospitals with advanced levels and highly specialised care

Responsible Pharmacist: A pharmacist who is responsible for the pharmacy practice complying with the regulations of the Namibian Pharmacy Act, 9 of 2004.

Tertiary Hospital: Hospitals that have highly specialized staff and technical equipment for example cardiology, intensive care units and specialised imaging units.

ABSTRACT

Background: Antimicrobial resistance (AMR) has become a major public health issue that threatens prevention and treatment of infections as microbes are no longer susceptible to antimicrobials. The concept of antimicrobial stewardship (AMS) was developed to help in the fight against AMR and is recognized as a strategy to reduce AMR. Pharmacists can play a role in developing AMS strategies both in community and hospital pharmacies. The main aim of this study was to determine the extent to which AMS is currently being practiced by pharmacists in Namibian hospitals.

Methodology: A quantitative descriptive cross-sectional study was conducted at all the 40 hospital pharmacies found across Namibia. An online survey was developed and emailed to 40 hospital pharmacists. The data was captured and coded using Microsoft Excel ® then imported for data analysis into IBM SPSS® version 25. Statistical tests were performed at a 5% level of significance. Opened ended questions were qualitatively analysed to determine recurring categories. Ethical approval was obtained from the University of the Western Cape's Biomedical Research Ethics Committee (Ref: BM20/8/17) and the Namibian Biomedical Research Management Committee (Ref: 17/3/3/CMM).

Results: A total of 21 (52.5%) hospitals responded to the survey of which 17 (81%) did not have AMS programmes in place with only 4 hospitals having AMS programmes. However, all hospitals practiced some form of AMS. All hospitals utilised established AMS techniques when antimicrobials had to be prescribed to patients. Nineteen of the hospitals did not have a pharmacist within their AMS teams/formulary restrictions group. Challenges hindering AMS activities included lack of human and financial resources, delayed microbiology laboratory results, perceived prescriber opposition and a lack of awareness with regards to AMR.

Conclusion: Hospital pharmacists practised some form of AMS whilst only a few hospital pharmacists had an ASP in place at their hospital. The study recommends the adequate allocation of human and financial resources to ensure the formation and adequate implementation of AMS programmes by pharmacists within the Namibian hospitals.

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CHAPTER 1: BACKGROUND

The increase in antimicrobial resistance has emerged due to decades of inappropriate use of antimicrobials coupled with the reduced discovery of new antimicrobials, and this has resulted in a serious growing public health threat (Trivedi & Pollack, 2014). The World Health Organization (WHO) recognizes that without global action, the world is heading towards a post-antibiotic era where people will die from common infections (Royal Pharmaceutical Society, 2017).

It is estimated that about 5.7 million people die every year from treatable infectious diseases of which most of these infections are susceptible to antimicrobials (Daulaire et al, 2015). The deaths mainly occur among populations residing in low-to middle-income countries. However, over 700 000 deaths are attributed to antimicrobial resistance (Daulaire et al, 2015). It is estimated that antimicrobial resistance will lead to 10 million deaths and a total GDP loss of over a 100 trillion by the year 2050 if no steps are taken to mitigate this (Chokshi, Sifri, Cennimo & Horng, 2019).

Inappropriate antimicrobial usage is one of the factors that has resulted in the emergence of antimicrobial resistance (Abubakar & Tangiisuran, 2020). Antimicrobial Stewardship (AMS) has been recognized as one of the strategies that can be used to help mitigate antimicrobial resistance (Abubakar & Tangiisuran, 2020). AMS can be defined as a set of interventions that are appropriately designed for the correct use of antimicrobials (selection, dosing, duration and route of administration) (Abubakar & Tangiisuran, 2020). Inappropriate use can be attributed to a lack of necessary laboratory tests leaving physicians to prescribe based on clinical experience rather than culture results (Owens, 2008). Other reasons include incentives from pharmaceutical representatives to physicians, over the counter sales and self-medication by consumers (Akpan, Isemin, Udoh & Ashiru-Oredope, 2020).

Pharmacists are perceived to have important roles in implementing AMS strategies as their responsibilities lie in the procurement and supply of antimicrobials as well as their expertise and knowledge (Lai et al, 2022). Recently in South Africa, the South African National Department of Health has recommended that AMS be included in the South African pharmacy degree curriculum (Khan et al, 2020). The impact of the proposed curriculum is to ensure that every pharmacist possesses the necessary skills and knowledge on AMS as per the country's national AMS policy (Khan et al, 2020). Most Namibian pharmacists have been trained in

South Africa and therefore have different AMS knowledge based on the curriculum they were taught. Consequently, each pharmacist in Namibia has a different view point on the importance of AMS as well as the measures that need to be undertaken to ensure the reduction of AR.

Pharmacists have the responsibility to have prominent roles in Antimicrobial stewardship programs (ASP) due to their knowledge on antimicrobials and influence in the healthcare system (Royal Pharmaceutical Society, 2017). Initially the role of the pharmacist was limited to a medication expert. However, there are now numerous specialized pharmacy postgraduate programs, training certificates and certifications for pharmacists (Fortin, 2018). Therefore, the pharmacist's role of being guardians of medicines and their proper use has evolved and greater responsibility lies within the profession (Royal Pharmaceutical Society, 2017).

Pharmacists must ensure that medicines are dispensed correctly and according to the law. Their role is also to ensure the rational use of medicines. Thus, improving the health outcomes of the patient, reduction of microbial resistance and the reduction of the spread of infections caused by multi-drug resistant organisms.

The consequence of antimicrobial misuse and, or overuse is that organisms adapt to these antimicrobials making these drugs ineffective. If these antimicrobial-resistant organisms infect a person, they are likely to spend more time hospitalized and more than likely to die as a result of the infection. This concern led to the endorsement of a Global Plan on Antimicrobial Resistance (AMR) in May 2015 at the World Health Assembly (Munkholm & Rubin, 2020). The declaration recognized that AMR was a global threat to public health (Munkholm & Rubin, 2020).

1.1 Problem statement

For decades, microbes have increasingly become resistant to antimicrobials and this has prompted the formation of AMS. The reduction of antimicrobial effectiveness is now a worldwide phenomenon driven by high antimicrobial use, increased use of medical procedures, hospital admissions and tertiary care (Laxminarayan et al, 2016). Rational use of antimicrobials is very important as inappropriate use can negatively affect patients, cause the emergence of resistance as well as an increase in health costs (Remesh, Gayathria, Singh & Retnavally, 2013).

Due to AMR, some microbes have become difficult to treat compared to a few years ago, for

example, the emergence of drug resistant Tuberculosis (Kurz, Furin & Bark, 2016) and drug resistant Gonorrhea (Bodie et al, 2019). In these cases, first line treatment no longer works and second or third line would have to be used to treat the disease (Palomino & Martin, 2014). This switch can unfortunately be more expensive and may require a longer period of treatment (Nachega & Chaisson, 2003).

As a result, it is imperative that surveillance and management of antimicrobial resistance is done. This provides necessary information which can be used to develop and monitor therapy guidelines, antibiotic formularies, antibiotic stewardship programs (ASP), public health interventions, and infection control policies (ICP). Active monitoring of AMR is vital for antimicrobial stewardship in supporting appropriate antibiotic use, while reducing adverse and toxic effects of antimicrobials and the development of resistance (Tacconelli et al, 2018).

In Namibia, AMR has increased in the past years (Pereko, Lubbe & Essack, 2015) and there is lack of evidence if ASP exists in the hospitals. A successful ASP is a multidisciplinary one which has a pharmacist at the core of the programme. Due to the lack of evidence of existence of ASP in Namibian hospitals (Pereko, Lubbe & Essack, 2015) it is imperative to investigate the current practices of AMS strategies that are employed at these facilities as well as to understand the role the pharmacist plays. Currently there are no regulations at a provincial or national level that prevent pharmacists from taking any role in an ASP. Namibian pharmacists are involved to a certain extent in Infection Control Programmes (ICPs) which function in synergy with ASPs (Brinkmann & Kibuule, 2020). A lack of human resources has been cited as the reason why pharmacists are not involved in ASPs (Pereko, Lubbe & Essack, 2015).

Hospitals in Namibia are divided into primary, secondary, tertiary and quaternary or specialist institutions. These levels are determined by the complexity of medical cases treated at the hospital. A primary hospital deals with mainly internal medicine, obstetrics and gynaecology, paediatrics and general surgery (Jamison et al, 2006). A secondary/intermediate hospital is highly differentiated by function with – clinical specialties and has between 200-800 beds (Jamison et al, 2006). Tertiary hospitals have highly specialised staff and technical equipment for example cardiology, intensive care units and specialised imaging units. Tertiary and Quaternary (Specialist) hospitals normally have between 300 to 1500 beds (Jamison et al, 2006). Therefore, the objective of this study was to determine the extent of antimicrobial stewardship in all levels of Namibian hospitals and in particular to understand the extent of involvement of the pharmacists in these programmes.

1.2 Study Purpose

The purpose of the research was to understand the level in which hospital pharmacists practice AMS strategies in Namibia. The collection of such information was considered to be of importance for various stakeholders within the public health arena. Information from this research can assist in the planning and formation of antimicrobial stewardship programs which in turn will help curb antimicrobial resistance in Namibia. The findings provided insight into the various attributes of AMS practices in Namibia as well as recommendations to address AMR.

1.3 Aims and Objectives

1.3.1 Aim

The aim of the study was to determine the extent to which AMS is currently being practiced in Namibian hospitals by hospital pharmacists.

1.3.2 Objectives

1. To ascertain whether any AMS principles are practiced by hospital pharmacists in hospitals across all the fourteen regions of Namibia
2. To identify any challenges and gaps associated with the formation and practicing of AMS in Namibian hospitals
3. To identify solutions that can lead to the strengthening of AMS in Namibian Hospitals

CHAPTER 2: LITERATURE REVIEW

2.1 Chapter Overview

This literature review seeks to contextualize antimicrobial resistance (AR) and antimicrobial stewardship (AMS) practices within different spheres in the world as well as to provide an overview of the different approaches undertaken whilst practicing AMS by pharmacists. Some of the factors that contribute to antimicrobial resistance are discussed and examples given. The literature review describes initiatives that some countries have undertaken and developed in order to decrease antimicrobial resistance. The review concludes by examining the role of pharmacists in AMS and their importance in this function.

The literature review has been compiled from a wide variety of sources. These include peer reviewed articles, official WHO documents, different pharmacy organization documents, as well as grey literature on the topic. While every attempt has been made to ensure that this literature review is the current and exhaustive literature, it must be acknowledged that there are not many documented examples on Antimicrobial stewardship in Africa. Therefore, making it difficult to contextualize this study within the current body of knowledge.

2.2 Aetiology of drug resistance

In Africa, antimicrobial resistance has become an issue due to an increase in resistance, notably in Mycobacterium tuberculosis, Staphylococcus aureus, Salmonella spp., pathogenic E. coli and Pseudomonas aeruginosa (Van, Yidanna, Smookera & Coloe, 2020). Resistance to antimicrobials can initially emerge in populations with a high frequency of infection due to either a patient's immunity status or interventions that compromise the host defences (Nicolle, 2001). WHO conducted a study on AMR and found that out of 194 countries, only 129 provided data. However, of these 129, only 22 countries could provide all the information required (WHO, 2018). The study also reported a high level of antimicrobial resistance with a lack of coordination in antimicrobial surveillance as well as significant surveillance gaps in developing countries which carry the highest burden of resistance (Chokshi et al, 2019). In May 2015 the WHO adopted a global action plan geared at increasing awareness and understanding of AR, strengthen knowledge through surveillance and research, reduce the incidence of infection, optimize the use of antimicrobial medicines in animals and humans ("One Health Approach"), and to develop sound economic goals to increase investment in fighting AR (WHO, 2015). This action plan provides the necessary framework for national

action plans (WHO, 2015).

In Sub-Saharan Africa (SSA), Southern Africa is reported to have the highest number of countries with training programmes and AMS (Elton et al, 2020). SSA was found to have a low mean score in AMR preparedness with the majority of the countries having not implemented the AMR National Action Plan, suggesting that AMR was not a priority (Elton et al, 2020).

The factors in the sections that follow have been noted in literature as drivers of antimicrobial resistance.

2.2.1 Irrational prescribing and over-the counter sales of antibiotics.

There has been an increase in antibiotic usage in low-to middle-income countries (LMICs) due to rapid economic expansion as well as increased access of antibiotics by previously disadvantaged populations (Van Boeckel et al, 2014). The causes of AMR in LMICs remains a challenge due to high prevalence of irrational use of antibiotics.

Irrational prescribing of antibiotics by physicians for minor ailments and or viral diseases can also be a driving factor for AMR. Some studies have shown that consumers can also pressurise doctors to prescribe antibiotics unnecessarily by demanding antimicrobials for ailments such as the common cold (WHO, 2018). There is an urgent need to educate the public on antibiotic uses in order to reduce AMR (Sakeena, Bennet & McLachlan, 2018). The Covid-19 pandemic may increase the burden of AMR due to the increased use of antibiotics for treatment of mild and moderate pneumonia (Majumder et al, 2020). The WHO has warned that use of antibiotics in mild disease may lead to strengthening of bacterial resistance leading to increased deaths during and beyond the crisis (Majumder et al, 2020).

Some pharmaceutical companies incentivise physicians to prescribe antibiotics to patients leading to irrational use of antimicrobials (Dadgostar, 2019). In some instances, patients might not complete their antimicrobials course potentially leading to AMR (Dadgostar, 2019). Purchasing of antimicrobials as over the counter medicines (OTC) in LMICs is extensive with much of the increased demand of antimicrobials occurring in LMICs (Pierce et al, 2020). It is expected that improved labelling of OTC medications can lead to a decrease in the over utilization of antimicrobials in Africa (Pierce et al, 2020). In Namibia all antimicrobials carry a higher scheduling status that requires that a doctor prescribes it in order for consumers to

have access to them (Pereko, Lubbe & Essack, 2015).

2.2.2 Increase in antimicrobial usage in animals for growth promotion resulting in a reservoir in the beast

In recent years an increase in usage of antimicrobials in animals by LMICs has been reported (Laxminarayan et al, 2016; Laxminarayan et al, 2020). Majority of the countries in the LMICs are found in the tropics where conditions are favourable for pathogen growth, which increases the likelihood of antibiotic overuse (Laxminarayan et al, 2016). Antimicrobials have over the years been used in food and animal production for treatment and disease prevention (Van et al, 2020). They have also been used for non-medicinal purposes as feed proficiency enhancers and growth promoters thereby increasing usage to allow the beast to grow quicker and healthier (Van et al, 2020). Usage of antimicrobials in animals may leave residues for example in milk, eggs, etc. which in turn may cause the transfer of antibiotic resistance to humans (Bacanl & Başaran, 2019). Usage of antimicrobials in animals has resulted in the conceptualization of the "One Health" approach in the early 2000's (Bonilla-Aldana, Dhama & Rodriguez-Morales, 2020). The One Health concept recognizes that human, animal and environmental health are closely related, therefore the overall health of humans, animals and the environment is in synergy (Bonilla-Aldana, Dhama & Rodriguez-Morales, 2020). The initiative is of significance to understand infectious disease ecology, where both animals and the environment have significant relationships and relevance in the occurrence of zoonotic diseases in animals and humans (Bonilla-Aldana, Dhama & Rodriguez-Morales, 2020). A study conducted by Shellack et al (2017) in South Africa recommended the development and implementation of a national strategic surveillance and reporting plan, collection and quantification of data for use of antimicrobials in animals and the empirical tailoring of antibiotic formularies against the national antibiotic guidelines (Shellack et al, 2017)

2.2.3 Poor access to clean water and sanitation.

Poor sanitation can be considered to be a major factor that contributes to infections within the community such as gastrointestinal and respiratory tract infections (Maillard et al, 2020). These infections require antibiotics for effective treatment. However, if sanitation is improved within communities and homes, rates of infection can be reduced and the need for antibiotics will also be reduced (Maillard et al, 2020). Therefore, consistent good hygiene will in turn reduce the spread of bacterial pathogens (Maillard et al, 2020).

LMICs' lack of access to both clean water and sanitation and waterborne infections are common (Cabral, 2010). According to the WHO, deaths due to water associated diseases exceed 5 million per year of which 50% are microbial intestinal infections such as cholera (Cabral, 2010). In 2013, WHO estimated that unsafe water and a lack of basic sanitation led to about 760 000 deaths per year in children under the age of 5 years (Griffiths, 2017).

Poor sewerage systems have been highlighted as a major environmental reservoir of AMR as it represents an ideal environment for AMR bacteria to persist (Fouz et al, 2020). It has been noted that poor sewerage systems can lead to a high likelihood of raw sewerage leaking into clean water reservoirs thereby contaminating clean water (Fouz et al, 2020). Generally, it has been observed that no matter how efficient the wastewater management system is, the final effluent can contain antimicrobial resistant bacteria at higher percentages than in the original wastewater (Novo et al, 2013).

2.3 Antimicrobial Stewardship Programs (ASPs) and Infection Control Programs (ICPs).

AMR is becoming a huge problem globally, with data suggesting very high rates in low to middle income countries (LMICs). However, the representative data remains scarce (Cox et al, 2017). AMS is aimed at various stakeholders including, prescribers, patients, pharmacists, policy makers and the general public (Cox et al, 2017). AMS in hospitals has had a positive impact with reduced length of stay, shorter treatment duration as well as a reduction in colonization and infection with resistant bacteria (Cox et al, 2017). In LMICs, it has been shown that while there are ASPs in some hospitals, other hospitals perform antibiotic stewardship interventions without a formal program in place (Akpan et al, 2020). ASPs have the potential to mitigate the emergence and spread of resistant pathogens (Drew, 2009).

ASPs can potentially reduce antimicrobial costs with limited use thereby reducing adverse events and emergence of resistance (Drew, 2009). Further, Drew (2009) reports that ASPs should potentially be run by a multi-disciplinary team consisting of two core members who are an infectious disease physician and a clinical pharmacist with infectious disease training. Other critical members of the team can consist of a clinical microbiologist, hospital epidemiologist, an infection control professional and an information system specialist (Drew, 2009). ASPs can provide vital education on antimicrobial use and adverse effects to healthcare professionals, patients and families (Kufel et al, 2018). In a study carried out by Howard et al. in 2015, they

concluded that in Africa, stewardship was delivered by infection control staff whilst the rest of the world utilised antimicrobial or infectious diseases pharmacists (Howard et al, 2015).

A key element in the fight against AMR is for hospitals to define what is considered to be appropriate antimicrobial use (MacDougall & Polk, 2005). Therefore, countries can provide guidelines on antimicrobial use which can be utilised as a resource during prescribing. An example of this is the standard treatment guidelines of Namibia (STG) as well as the essential drug list (EDL) authorized for use in public hospitals (Nemlist) (Klaas, Manetti, Amukugo, Panduleni & Shilunga, 2018). A similar strategy is employed in South African public hospitals, however for the private sector (South Africa and Namibia) the antimicrobial prescribed is determined by the consumer's financial capability (Schellack et al, 2017).

ASPs and Infection control Programs (ICPs) work in synergy within hospital settings whereby ICPs assist in the setting up of prudent guidelines on the appropriate use of antimicrobials within healthcare facilities (Alp et al, 2014). Infection Control Programmes (ICPs) are designed to decrease the incidence of infections in patients as well as staff (Nicolle, 2001). They are an effective way to control some outbreaks of colonization and infection with antibiotic resistant microbes in health care facilities (Nicolle, 2001). Health care-associated infections (HAIs) affect patient safety worldwide; and the burden of HAIs is greater in low-to middle-income countries (LMICs). Compared to high income countries, LMICs have at least 25% more patients admitted into hospital acquiring at least one HAI during their stay (Alp et al, 2014).

ICPs have been initiated in countries around the world from as early as the 1980's through to the 2000's. Countries with ICPs in place include Chile, Venezuela, Cambodia, Jamaica, Nepal, Kenya, South Africa, Democratic Republic of Congo and Egypt (Sastry et al, 2017). However, ICPs in these countries are hindered by a lack of funding, lack of appropriate laboratory capacity, under-utilised Health Information Systems as well as a lack of national policies on AMS (Sastry et al, 2017).

Pharmacists in Namibia are involved in ICPs to a certain extent. However, a study conducted in 2018 in primary health facilities in Windhoek, found that pharmacists are a necessary human resource that is unfortunately not available for their ICPs (Brinkmann & Kibuule, 2020). A lack of human capital in ICP programs in Namibia has been found to be detrimental and implementation of these programs is suboptimal (Brinkmann & Kibuule, 2020).

2.4 Antimicrobial Stewardship practices

Antimicrobial stewardship is the adoption of coordinated measures to optimize antimicrobial use whilst decreasing unnecessary antimicrobial exposure and reduction of the emergence of antimicrobial resistance (Pierce et al, 2020). The AMS approaches and techniques below can assist in optimizing antimicrobial selection, dosing, route and duration of therapy as well as limiting unintended consequences e.g. adverse events, emergence of resistance and cost (Leekha, Terrell and Edson, 2011).

2.4.1 Approaches

Antimicrobial stewardship can follow two approaches, front-end or prescription approach and back-end or post prescription approach. The front-end approach utilises the restrictive prescription authority and the back-end utilises the prospective review and feedback approach (Patterson, 2006). The front-end approach has the advantage of utilising specific antimicrobials for specific indications based on local resistance patterns and the hospital formulary (Doron and Davidson, 2011). The advantage of the backend approach is that it can focus on de-escalation, this is the modification of the initial regimen based on culture data, other laboratory tests and clinical status of the patient (Doron and Davidson, 2011). A combination of both approaches is often utilised.

2.4.2 Techniques

It is critical that the pathogen responsible for the infection be determined and the correct antimicrobial administered. Techniques used in AMS include; following an antimicrobial formulary e.g. the standard treatment guidelines (STG) and or the Nemlist, dose optimization, IV-Oral Switch, surgical antimicrobial prophylaxis and separate antimicrobial drug charts / order forms.

2.4.2.1 Antimicrobial formulary

Generally, broad-spectrum antimicrobial therapy should be initiated, and samples collected for testing in the laboratory (Leekha, Terrell and Edson, 2011). Broad-spectrum antimicrobials are antimicrobials whose spectrum of treatment covers gram-positive and gram-negative bacteria. Gram-positive bacteria have a thicker peptidoglycan cell wall compared to gram negative bacteria (Sizar and Unakal, 2021). Upon testing with a dye to differentiate the two bacteria, the gram-negative thinner peptidoglycan layer does not hold the dye whilst the gram-positive bacteria do (Sizar and Unakal, 2021). Once the sample results are obtained and the pathogen identified or susceptibility data obtained, an attempt to narrow the antibiotic spectrum by using

antimicrobials that target specific bacteria should be done (Leekha, Terrell and Edson, 2011; Majumder et al, 2020).

2.4.2.2 Dose optimization

Dose optimization is the use of pharmacodynamics and pharmacokinetic principles to ensure that the patient receives the optimum dose to treat the patient's infection (Owens, 2008; Hoo, Liew and Kwa, 2017; Majumder et al, 2020). This technique is useful in patients with excess body mass indices and for closed-space or otherwise difficult to penetrate sites of infection (e.g. meningitis, endocarditis, pneumonia, bone and joint infections) (Hoo, Liew and Kwa, 2017). This technique would be especially useful in the clinically obese and critically ill patients (Hoo, Liew and Kwa, 2017).

2.4.2.3 IV-Oral switch

The IV-Oral switch technique is used in switching patients from IV formulations to therapeutically equivalent oral formulations as soon as the patient is clinically stable (Becker, 2013). As opposed to oral formulations, IV medicines are normally more expensive and carry significant toxicity therefore, shortening the length of IV therapy is thought to potentially shorten length of stay in hospital, reduce the likelihood of adverse events as well as the decreased cost associated with the preparation and administration of IV medicines (Paskovaty et al, 2005; Owens, 2008).

2.4.2.4 Surgical antimicrobial prophylaxis

The surgical antimicrobial prophylaxis technique is used to reduce surgical-site infections by prescribing antimicrobials before surgery is initiated (Becker, 2013). Although this technique can be a source of resistance emergence, it has been determined that approximately 15% of all antibiotics in hospitals are prescribed specifically for surgical antimicrobial prophylaxis (Tiri et al, 2020).

2.4.2.5 Separate antimicrobial drug charts

Separate antimicrobial drug charts/ order forms can play a significant role in reducing irrational prescribing as well as allowing for effective antimicrobial utilization reviews for each patient (Echols and Kowalsky, 1984).

2.5 The role of Pharmacists

Pharmacists play a crucial role in AMS as they are knowledgeable on appropriate drug dosing,

and drug interactions, making them an integral part for the provision of interdisciplinary patient care services (Baker et al, 2012). It is recommended that a pharmacist be an integral part of the AMS team (Drew, 2009). Countries with pharmacists involved in AMS teams include the United States of America, England, South Africa, New Zealand and Australia (Sakeena et al, 2018; Chetty et al, 2019). In South Africa, several studies have shown that pharmacist interventions did improve patient care and pharmacists were instrumental in resolving medicines-related problems (Chetty et al, 2019). Pharmacists in this role in South African ASPs is to monitor choice of antimicrobial, duration, and indication of use (Chetty et al, 2019). However, little is known about pharmacist involvement in ASPs within the hospital setting in Namibia.

Pharmacists are uniquely positioned to promote optimal use of antibiotics through individualized patient dosing when intervening in medication issues (Fortin, 2018). According to Fortin (2018:26), "pharmacists are uniquely situated to intervene using prospective audits, as their workflow includes chart review for appropriateness and indication when approving inpatient orders, filling outpatient prescriptions, or doing medication reconciliation as part of their daily activities in their practice site." Pharmacists can also help in drug selection thereby, reducing drug duplication especially in patients receiving multiple drugs or suggesting appropriate drug substitution in times of drug shortages (Fortin, 2018; Drew, 2009).

2.5.1 Pharmacists in Namibia

2.5.1.1 Definition of a Pharmacist

A pharmacist in Namibia is defined as a person who is duly registered with the Health Professionals council of Namibia with the intention of practicing as a pharmacist. Registration is subject to completion of a 4-year Pharmaceutical degree and completion of a 1-year internship (Pharmacy Act 9, 2004). Pharmacists can further be registered with the council as a responsible pharmacist where they are responsible for the pharmacy practice complying with the regulations of the Pharmacy Act, 9 of 2004 (Pharmacy Act 9, 2004).

2.5.1.2 Pharmacist's role in Namibia

The main tasks for pharmacists in Namibia include compounding of medicines, supplying of medicines to the public, counselling of patients, storage and distribution of drugs, as well as rendering pharmaceutical care (Pharmacy Act 9, 2004).

The duties of pharmacists are further elaborated in the Medicines and Related substances Act of 2003. A pharmacist can be a responsible pharmacist, pharmacist manager or a pharmacist. A responsible pharmacist is a pharmacist who is tasked with the sale and effective running of a pharmacy (Medicines and Related Substances Act 13, 2003). It is in this law where medicines are defined as either over the counter or require a prescription. This law further defines how medicines should be dispensed, for example antibiotics by prescription from a doctor or a dentist (Medicines and Related Substances Act 13, 2003). Therefore, pharmacists in Namibia are expected to only dispense antibiotics with a prescription and failure to do so results in a contravention of the law.

2.6 Antimicrobial Stewardship Teams

An AMS team is a multidisciplinary team that consists of a pharmacist, hospital epidemiologist, infection control professionals, information system specialist, clinical microbiologist, and an infection disease physician (Drew, Fortin, Royal, Majumder et al, 2020). Multidisciplinary collaboration within the healthcare system can result in optimal patient outcomes (Royal Pharmaceutical Society, 2017). Pharmacists in AMS teams monitor the choice of antimicrobial, duration, indication of use as well as the analysing antimicrobial consumption at the hospital (Chetty et al, 2019).

It is imperative to have a microbiologist within the AMS team as they play an advisory and consultative role. Microbiological confirmation of infections is required, a microbiologist can advise on which antimicrobials can be useful in the eradication of the infections (antimicrobial susceptibility results) (MacDougall and Polk, 2005; Abbas, S and Stevens, M.P., 2018). Microbiologists are also important especially when there are high cases of hospital acquired infections (HAI's)-nosocomial infections within the hospital as they can determine the current burden of antimicrobial resistance at the hospital. They can assist in the swabbing of the hospital to ensure that HAI's are treated correctly as well as to help in the fight against MRSA (MacDougall and Polk, 2005).

Hospital epidemiologists' function is support for the AMS teams in sharing of surveillance data, sharing outbreak alerts, as well as in the development of treatment algorithms (Abbas, S and Stevens, M.P., 2018). There is a rapid increase in the use of electronic medical records and computerized physician order entry systems providing a critical opportunity for both electronic surveillance of antimicrobial-prescribing practices and the use of electronic systems to provide

guidance to clinicians (Doron and Davidson, 2011). An information system specialist can assist in maintenance of the electronic records as well as assisting in gathering of the surveillance data. They can assist in the integration of stewardship protocols into existing workflow i.e. embedding relevant information and protocols at point of care, implementing clinical decision support for antibiotic use, creating prompts for action to review antibiotics in key situations (CDC, 2014).

CHAPTER 3: METHODOLOGY

3.1 Chapter Overview

This chapter focuses on the research methodology providing an overview and description of the study population, study setting, sampling process, study procedures and tools for data collection.

3.2 Study Design

A descriptive cross-sectional online survey was administered to collect information on the extent, nature and scope of the different AMS practices in different hospitals across all the regions of Namibia. A cross-sectional design allows for research to be conducted at a given point in time. The study can be descriptive or analytical where the former describes what already exists in a setting (Levin, 2006). On the other hand, analytical cross-sectional studies allow associations to be made between an outcome and possible explanatory factors. Cross-sectional studies are simple and inexpensive to perform. The survey consisted of a structured questionnaire which was used to collect the relevant information from the head of the pharmacy department or designated pharmacist.

The online questionnaire was divided into three sections. All participants were asked to answer the first section. Section two was addressed to those who had an established AMS program whilst section three was addressed to hospital pharmacists without established AMS programs at their facility. In addition to the structured questions, the questionnaire also consisted of a few open-ended questions. These questions allowed the interviewee to provide their own framework of meanings without the researcher's assumptions (Britten, 1995). The use of open-ended questions can be a powerful tool which can elicit unknown information which can be further explored (Britten, 1995).

3.3 Sampling

Sample size determination is a major step in designing and conducting research (Kumar et al, 2014). Therefore, adequate numbers need to be recruited to ensure that the research yields accurate results (Kumar et al, 2014). Sample size estimation for this survey was calculated as follows:

$$n = \frac{Nz^2pq}{E^2(N-1) + z^2pq}$$ (Formula Source: Rosner, 2000).

$$n = \frac{40(1.96^2 \times 0.5^2)}{[0.03^2(40-1) + (1.96^2 \times 0.5^2)]}$$

$$= 38.6$$
$$= 39$$

Where:

- n is the required sample size
- N is the population size
- p and q are the estimated population proportions set to 0.5
- z is level of confidence set at 1.96
- E sets the accuracy of your sample proportions set at plus or minus 3%, then E is set to 0.03.

Therefore, from the sample size calculation, 39 hospitals needed to participate in the online survey. However, there are 40 hospitals located in the study region, therefore all hospitals were included. Only one response per hospital was considered.

Inclusion and Exclusion criteria

At each hospital the head of the pharmacy department or designated pharmacist was requested to answer the survey. Any pharmacist who had taken part in the pilot study was excluded from the survey. Both the public and private hospitals were invited to take part in the survey.

3.4 Data Collection

The study questionnaire was adapted from Doron et al (2013). A pilot study was conducted before the study questionnaire was sent to the hospital pharmacists to ensure the validity and reliability of the questionnaire. The pilot study was administered to 5 hospital pharmacists who were currently employed in a hospital setting but were not heads of the pharmacy department. Thereafter the questionnaire was adjusted where necessary. The survey was designed and completed online via Google forms as this research was undertaken during the COVID-19 pandemic where face to face contact was restricted. The short online survey was administered in English to the hospital pharmacists and it was expected to take between 15 – 25 minutes to complete. In general, short questionnaires ensure that the majority of the participants respond (Sahlqvist et al, 2011).

The pharmaceutical society of Namibia (PSN) was approached to assist with the contact information (emails and telephone numbers) of the head pharmacists in the hospitals. The researcher sent out an email to the head pharmacists at the different hospitals. The PSN is the

professional body of pharmacists, pharmacist assistants and pharmacies in Namibia where all pharmacists and pharmacies must maintain a valid membership. Each head pharmacist was contacted via email which had a link to the letter for permission for research, consent form and questionnaire. The link to the questionnaire was valid for 4 weeks to allow the head pharmacist or designated pharmacist to respond. In the first week 19 hospitals responded to the online survey. An email reminder to complete the questionnaire was sent out in the third week. Following this, another 9 hospitals responded to the online survey. After deleting duplicate survey responses, a total of 21 hospitals responses were included and made the final sample, with a 52.5% response rate.

3.5 Data Analysis

The data obtained from the survey was entered into an Excel spreadsheet where the results were coded then exported and analysed using SPSS® version 25. Descriptive statistics (frequency, percentages, cross tabulation) were used to analyse demographic characteristics and hospital characteristics. The Chi-square test was used to test for any associations between different variables, for example the distribution between ASP establishment and Drug Therapeutic Committee. Statistical tests were performed at a 5% level of significance.

3.5.1 Categorical Analysis of the open-ended questions

Analysis of the open-ended questions in the questionnaire was done using thematic analysis. The content was elicited for recurring categories related to AMS through the formulation of recurring patterns across the data. The initial data obtained was used to generate codes by the researcher. Each code was assessed to determine if there were any themes. The themes obtained were then reviewed and renamed appropriately to categories related to AMS practices.

3.6 Validity and Reliability

3.6.1 Validity

Validity can be defined as the degree by which an instrument can measure what it is supposed to measure (Considine, Botti & Thomas, 2005). Therefore, validity questions the accuracy of the instrument. The pilot study was done to obtain the views of the pharmacists to ensure that the questionnaire reflected the concept that was being measured. The pharmacists who participated in the pilot study did not participate in the actual study. The pharmacists' views were used to revise the questionnaire appropriately thereby implying the questionnaire's

credibility.

In order to ensure validity of the study, measurement bias must be reduced i.e. data collection errors must be kept at a minimum to ensure that the true results of the study are obtained (Althubaiti, 2016). Data was captured twice to ensure accuracy and to give the researcher a chance to identify any errors and resolve them. To reduce further bias from the respondents, their identities remained anonymous to encourage the respondent to answer more honestly.

3.6.2 Reliability

Reliability can be defined as the measurement of something consistently producing the same results within different settings (Wilcken, 2010). Reliability of the study was addressed by ensuring that the questionnaire is administered in the same format and sequence of questions for each participant. Internal consistency of the responses from the questionnaire were assessed with the use of Cronbach's alpha test command in IBM SPSS®. There was good reliability of the survey (Cronbach alpha = 0.70).

3.7 Ethical Considerations

Ethical approval was obtained from the University of Western Cape's Biomedical Research Ethics Committee (BMREC) (Ref: BM20/8/17) as well as the Namibian Biomedical Research Management Committee (Ref: 17/3/3/CMM) before data collection began. An email was sent out to the head of the pharmacy departments with a link to the online survey. Once the participant accessed the online survey, another link with the information sheet, consent form and letter to hospitals requesting permission to conduct the survey was made available to them. The information sheet and consent form were made available in the official language of Namibia which is English. The information sheet detailed the study as well as the contact information of people to consult in case they had queries. All participants were informed about the purpose of the study and what was expected of them during the study.

The participants were also informed that their participation was voluntary and had the choice to withdraw from the study at any point without prejudice. No form of incentives was offered to any of the participants. The study participants were also informed that the information they provided would be treated as confidential. The names of the hospitals were recorded for administrative purposes, but no names or identifiers were used in the analysis or final reporting stages. Access and storage of the information collected during the research process was limited

to authorised persons (the researcher, and the research supervisor). All data obtained from the survey was password-protected.

The study did not involve the use of invasive procedures, and therefore it was not anticipated that any harm would be inflicted on any of the participants. However, the study involved the eliciting of information from the participants and therefore the possibility of evoking untoward emotions was anticipated. It was explained to the participants through the email that should the questionnaire evoke such emotions or should any participant suffer from psychological distress during or directly after the online survey they were encouraged to contact the Social Services Department within their hospital structures where they will be referred to a social worker for counselling.

CHAPTER 4: RESULTS

4.1 Chapter Overview

This chapter focuses on the results obtained from the online survey. The results presented in this chapter consist of the demographics of the respondents, characteristics of hospitals practising AMS with the use of an antimicrobial stewardship program and characteristics of hospitals that do not have an active antimicrobial stewardship program. Reasons for challenges that AMS initiatives face are also highlighted in the chapter and recommendations are provided. In addition, relationships between the variables are also presented in this chapter.

4.2 Demographics characteristics respondents and hospitals

A total of 21 hospital pharmacists successfully completed the online survey representing a response rate of 52.5%. Table 1 presents the demographic characteristics of the hospital pharmacists, indicating that 33.3% (n=7) were between the ages of 22 to 30 years old, 42.8% (n=9) were between the ages of 31 to 39 years old, 19% (n=4) were between the ages of 40 to 50 years. Only 4.8% (n=1) of the participants were above 50 years old. The majority of the respondents were male 52.4% (n=11). Of those who completed the online survey 47.6% (n=10) were pharmacists, 28.6% (n=6) were pharmacist managers and 19.0% (n=4) were responsible pharmacists.

Table 1: Demographic characteristics of the respondents

Characteristic	N (%)
Age (years)	
22-30	7 (33.3)
31-39	9 (42.8)
40-50	4 (19.0)
50+	1 (4.8)
Gender	
Female	10 (47.6)
Male	11 (52.4)
Employed as at the facility	
Pharmacist	10(47.6)
Pharmacist Manager	6(28.6)
Responsible Pharmacist	4(19.0)

The majority of the regions were represented in the online survey with 11 out of 14 regions (78.6%) having responded. Table 2 shows the demographics of the hospitals that participated in this study. The majority of the responses were received from regions D and I with 23.8% (n=5) and 14.3% (n=3) respectively. The proportion of public hospitals versus private institutions was 57.1% (n=12) and 42.9% (n=9) respectively.

Majority of the hospitals were intermediate (42.9%; n=9) in nature, whilst 19.0% (n =4) were primary health institutions, 19.0% (n=4) were specialist hospitals, 14.3% (n=3) were tertiary institutions and 4.8% (n=1) were private hospitals that were not categorised. Ten of the hospitals (47.6%) have between 101 and 300 beds whilst eight (38.1%) hospitals have less than 100 beds and only 1 (4.8%) of the hospital has more than 500 beds.

Majority (76.2%; n=16) of the hospitals have less than five pharmacists whilst 23.8% (n=5) of the hospitals have more than five pharmacists employed at the pharmacy. Of the pharmacists' assistants employed at the hospitals, 66.7% (n=16) have less than five pharmacist assistants whilst 33.3% (n=5) have more than five pharmacist assistants.

Seventeen (81%) of the hospitals have no Antimicrobial stewardship program (ASP) whilst only four (19%) of the hospitals have an ASP. Of the hospitals that participated in the survey, private hospitals were more likely to have ASP than a hospital from the public sector.

The majority of the hospitals (95.2%; n=20) did not have a pharmacist with a postgraduate qualification in infectious diseases. Only 1(4.8%) of the hospitals have at least one pharmacist with a postgraduate qualification. There is no antimicrobial pharmacist nor do they have an antimicrobial stewardship program in place in the majority of the hospitals (81%), only 4 (19%) of the hospitals have an antimicrobial pharmacist and an antimicrobial stewardship programme.

Table 2: Demographic characteristics of the hospitals

Region	**N (%)**
A	1 (4.8)
B	1 (4.8)
C	1 4.8)
D	5 (23.8)
E	1 (4.8)
F	2 (9.5)
G	2 (9.5)
H	2 (9.5)
I	3 (14.3)
J	2 (9.5)
K	1 (4.8)
Type of facility	
Private	9 (42.9)
Public	12 (57.1)
Hospital category	
Primary	4 (19.0)
Intermediate	9 (42.9)
Tertiary	3 (14.3)
Specialist	4 (19.0)
Other (Private Hospital not categorised)	1 (4.8)
Number of beds	
Fewer than 100	8 (38.1)
Between 101 and 300	10 (47.6)
Between 301 and 500	2 (9.5)
More than 500	1 (4.8)
Number of pharmacists	
Fewer than 5	16 (76.2)
More than 5	5 (23.8)
Number of pharmacist assistants	
Fewer than 5	14 (66.7)
More than 5	7 (33.3)
Pharmacists with a postgraduate qualification	
Yes	1 (4.8)
No	20 (95.2)
Antimicrobial pharmacist*	
Yes	4 (19.0)
No	17 (81.0)
Antimicrobial Stewardship Program	
Yes	4 (19.0)
No	17 (81.0)

*Antimicrobial pharmacist monitors antimicrobial prescribing, formulary development and appraisal of new antibiotics (Weller & Jamieson, 2004).

4.2.1 Bivariate Analysis

Chi-squared analysis was computed to ascertain if there was an association between the type of facility and Antimicrobial stewardship programs at the facility. Significant associations were reported between the type of facility and Antimicrobial stewardship programs at the facility (χ^2=6.588, df=1, p=0.010). Of the hospitals that participated in the survey, private hospitals are more likely to have ASP than a hospital from the public sector. All the public hospitals have no ASP and no established Drug Therapeutics committee.

4.3 Hospitals with operational Antimicrobial Stewardship Programmes

A total of four hospitals had an Antimicrobial stewardship program (ASP) therefore, only 19% of the hospitals had an ASP.

Table 3 represents the distribution of ASP by region. Half of the hospitals (50%; n=2) with ASP are located in the D regions whilst 25% (n=1) of the hospitals are found in region H and region K. No association between a hospital having ASP and the region in which the hospital is located was found (χ^2=9.975, df =10, p=0.443).

Table 3: Distribution of ASP by Region

		ASP		**Results on association**
		Yes (N, %)	**No (N, %)**	χ^2, p-value
Region	A	0	1(5.88)	
	B	0	1(5.88)	
	C	0	1(5.88)	
	D	2 (50)	3 (17.65)	
	E	0	1(5.88)	χ^2=9.975
	F	0	2 (11.76)	p=0.443
	G	0	2 (11.76)	
	H	1 (25)	1(5.88)	
	I	0	3 (17.65)	
	J	0	2 (11.76)	
	K	1(25)	0	
Total		4(19)	17(81)	

Table 4 represents the characteristics of the hospitals that have ASP within Namibia. Majority (75%) have an ASP that has been established for more than three years whilst 25% was established between one to three years ago. All hospitals practised AMS in all wards of the hospital. Of the hospitals with ASP, 50% (n=2) had a Drug Therapeutic Committee, with 75%

(n=3) having a pharmacist working within the DTC. Half of the DTC's consisted of more than 4 pharmacists whilst 50% (n=2) had no pharmacist in the DTC.

All hospitals conduct a form of educational intervention to the healthcare professionals with 50% of these interventions implemented via email and 50% via meetings. Majority of the hospitals (75%) conducted educational training Ad hoc whilst 25 % did the training monthly. All the hospitals conduct antimicrobial education sessions specifically for nurses, pharmacists and doctors.

Table 4: Characteristics of hospitals with Antimicrobial Stewardship Programs

Establishment of ASP	**N (%)**
1-3 years	1 (25)
more than 3 years	3 (75)
Wards with AMS	
Both Adults and Paediatrics wards	4 (100)
DTC	
Yes	2 (50)
No	2 (50)
Pharmacist in DTC	
Yes	1 (25)
No	3 (75)
Number of pharmacists in DTC	
0	1 (50)
More than 4	1 (50)
Educational intervention	
Yes	4 (100)
Educational intervention transmitted by	
Email	2 (50)
Other (meetings)	2 (50)
Transmission of educational techniques	
Monthly	1 (25)
Adhoc	3 (75)
Antimicrobial education to other HCPs	
Yes	4 (100)
Which HCPs	
Nurses, Pharmacists, Doctors	4 (100)

Figure 1 shows that 23.5% of the 4 hospitals have an Information system specialist and a hospital epidemiologist in the ASP team while 17.6% have an anti-infectious disease

pharmacist and 5.9% consists of an infection disease physician, clinical microbiologist and an infection control professional.

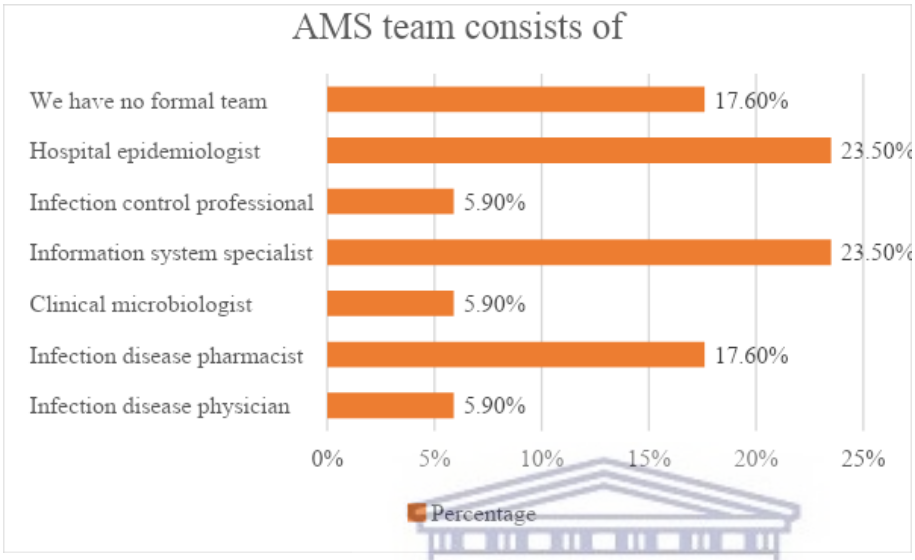

Figure 1: Professional Composition of an AMS team in Hospitals with ASP

Figure 2 shows the techniques utilised by the hospitals with an ASP. Overall only 42.9% utilise the dose optimization technique for their AMS techniques. About 28.6% utilise an antimicrobial formulary as an AMS technique. Whilst 14.3% utilise the reserved antimicrobial list and the separate antimicrobial drug chart/section.

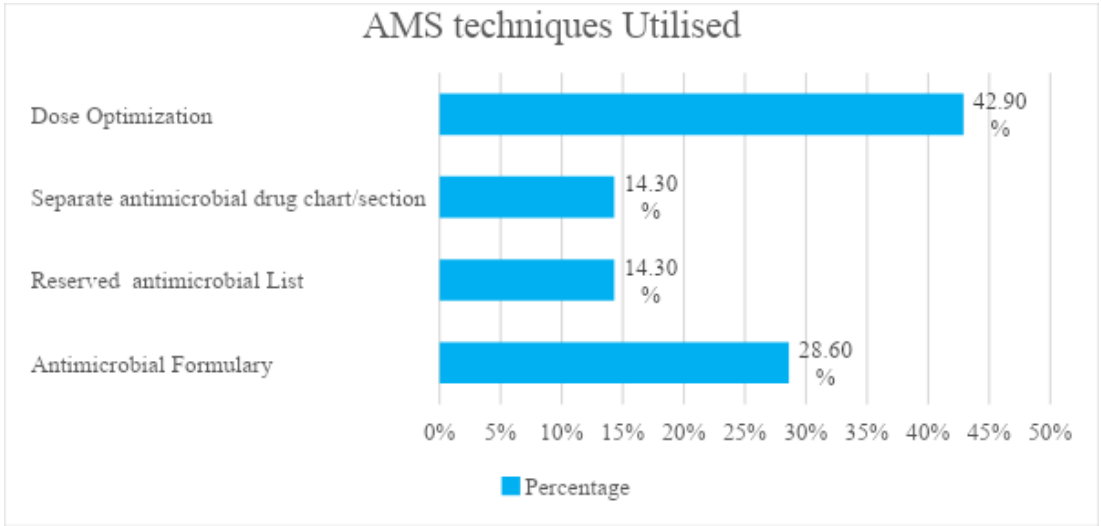

Figure 2: AMS techniques utilised at hospitals with ASP

Figure 3 shows the role the head pharmacist takes in a hospital with ASP. The head pharmacist role includes performing antimicrobial prescribing in primary care (26.7%), attending to ward rounds on specialities of high antibiotic use (20%), attending to bench rounds in microbiology laboratory (13.3%), performing the following anti-infective formulary decisions (6.7%); writing antimicrobial guidelines/policies(6.7%), horizon-scanning documents for antimicrobials (6.7%), maintaining an awareness of local resistance patterns(6.7%), attending a multi-disciplinary antibiotic review/steering group(6.7%), being available by phone/pager for referral of complex cases(6.7%).

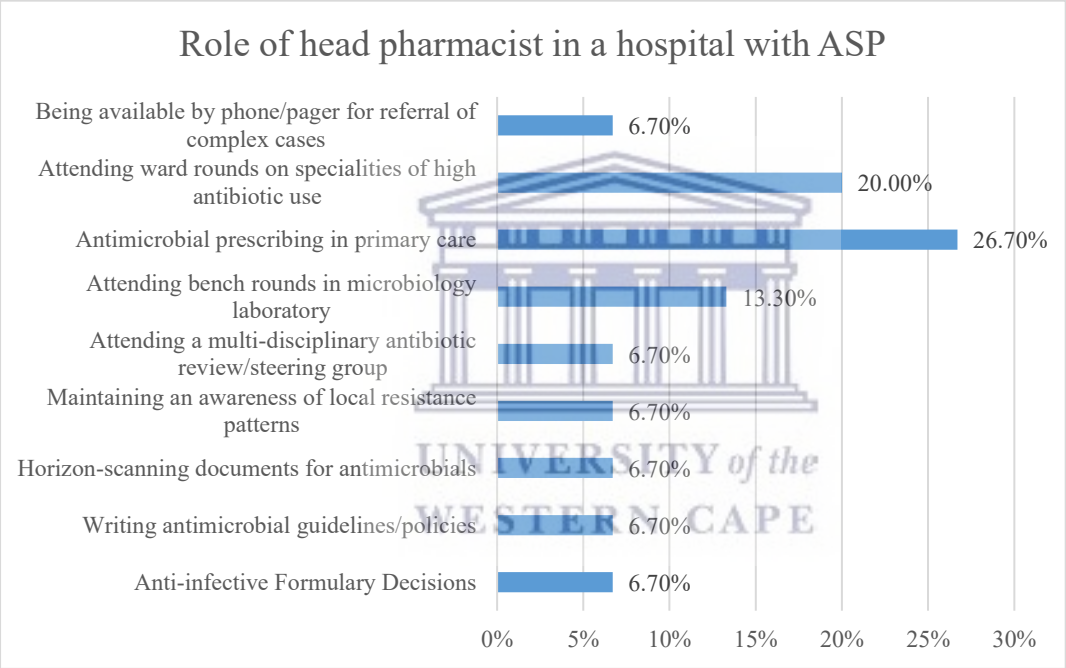

Figure 3: Head pharmacist role in hospitals with ASP

Table 5: The distribution of the period of establishment of ASP by DTC and the period of establishment of ASP by Pharmacist in DTC

		DTC		p-value	Pharmacist in DTC		p-value
		Yes (n, %)	No (n, %)		Yes (n, %)	No (n, %)	
Period of establishment of ASP	1-3 years	1 (25)	0 (0.0)	p=0.248	0 (0.0)	1 (25)	p=0.505
	more than 3 years	1 (25)	2 (50)		1 (25)	2 (50)	

*DTC = Drug and Therapeutics Committee *N=4 Hospitals

Table 5 shows the distribution of the period of establishment of an ASP by DTC and the period of establishment of an ASP by pharmacists in DTC. About 50% (n=2) of the hospitals have a DTC committee with an ASP that was established for more than 1 year. There was no association between the period of ASP establishment and the hospital having a DTC (p=0.248). Majority (50%; n=2) of the hospitals have no pharmacist in DTC however their ASP has been established for more than 3 years. Of the hospitals with an ASP established less than 3 years ago 25% (n=1) have no pharmacist in the DTC. Only 25% (n=1) have a pharmacist in the DTC with an ASP established more than 3 years ago. There was no association between the establishment of an ASP and a pharmacist in the DTC (p=0.505).

4.4 Hospitals operating without Antimicrobial Stewardship Programmes

Figure 4 depicts the reasons for non-consideration of AMS. Insufficient Medical Staff buy in 22.2% was identified as one of the reasons, whilst 16.7% of the pharmacists stated the following reasons; funding not high on the list of priorities, too many other things on the table, organised program has not yet been proposed. Some hospitals stated staffing constraints (11.1%) was stated as a reason for a lack of AMS.

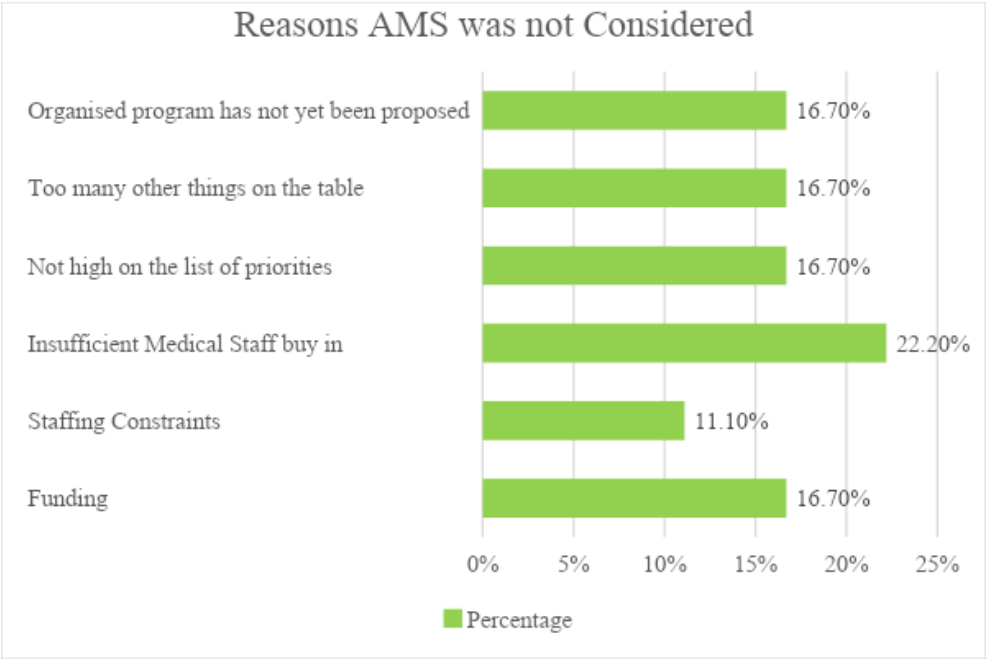

Figure 4: Reasons for non-consideration of AMS

Figure 5 below represents the reasons why AMS was not implemented even though it was considered. The reasons for lack of implementation was due to insufficient medical staff buy in (27.5%), AMS not being high on the list of priorities (25%), an organised program has not yet been proposed (12.5%), staffing constraints (15%) and 10% stated too many other things on the table and funding concerns (10%).

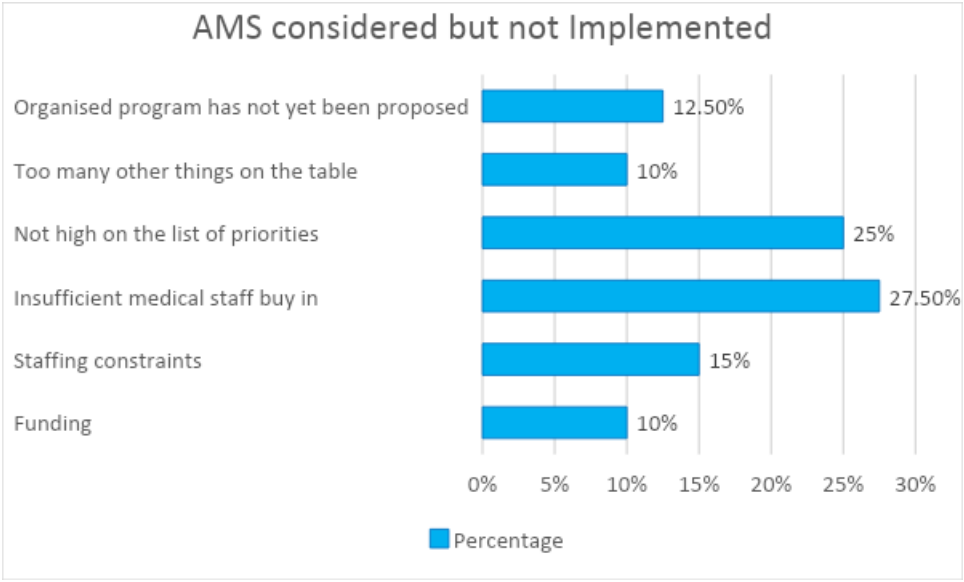

Figure 5: Factors affecting AMS implementation.

AMS techniques involve the use of formulary restrictions by controlling which antimicrobials are utilised and in which situation. Therefore, a formulary restrictions group exists to ensure reduced irrational prescribing. All the hospitals had a formulary restrictions group, 50% of the hospital formulary group consists of a Head nurse and 50% of the hospital formulary group consists of a Clinical microbiologist.

Figure 6 represents the AMS techniques that are utilised in hospitals without ASP. Majority (43.3%) of the hospitals utilise antimicrobial order forms, 36.7% utilise dose optimization, 13.3% utilise antimicrobial formulary and 6.7% utilise IV-oral switch.

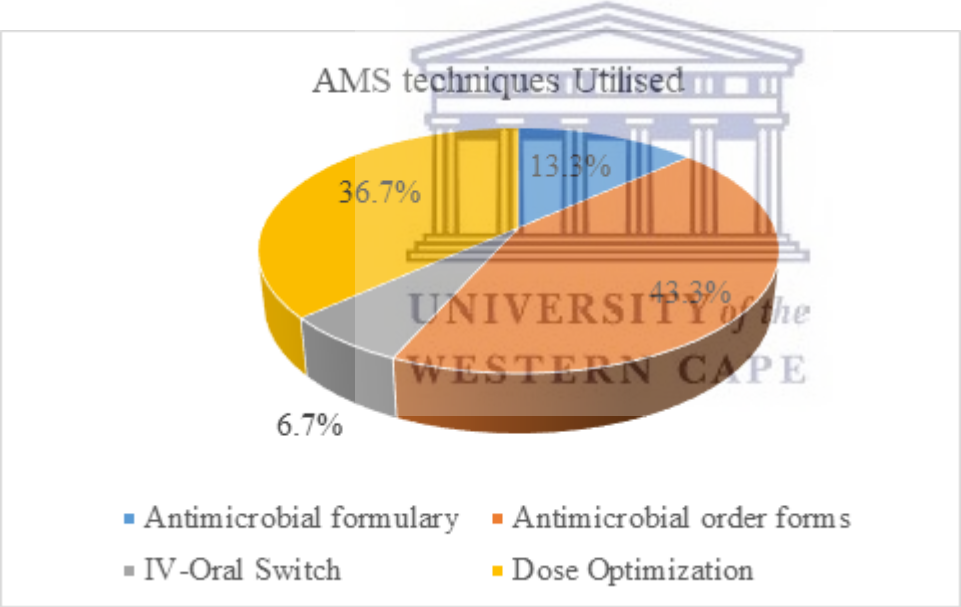

Figure 6: AMS techniques utilised in Hospitals without ASP

Table 6 represents any educational seminars offered by the hospital to health care professionals (HCP) as well as the type of educational interventions employed. Educational seminars are seminars whereby, HCPs can be taught on new techniques or new medicines available in the country. Educational interventions can be in the form of attending CPDs, emails, or webinars. Only 5 (29.4%) hospitals offer educational seminars, whilst 13 (81.3%) do not offer any form of educational seminars. Majority (88.2%) of the hospitals have no form of educational

intervention whilst 2 (11.8%) of the hospitals utilise Continuing Professional Development (CPD's) as a form of educational intervention.

Table 6: Educational seminars and educational interventions at hospitals

Responses	Educational Seminars	CPD's
Yes	5(29.4%)	2 (11.8%)
No	13(81.3 %)	15(88.2%)

4.5 Doctors perceptions based on pharmacist observations on antimicrobial restrictions

The survey tasked the respondent (pharmacist) to define the doctor's perceptions with regards to antimicrobial usage restrictions. The restriction of antimicrobials would be in the form of doctors having to use formularies to prescribe antimicrobials instead of just prescribing any antimicrobial they think works best. Table 7 represents the distribution of the hospitals category by doctor's perception based on pharmacist's observations of antimicrobial restriction. Primary and tertiary hospitals (11.8%), Intermediate hospitals and Specialist hospitals (5.9%) have doctors who are perceived to agree that antimicrobials must be restricted. Only 5.9% (primary hospital) of the hospitals perceive that the doctor's perception on antimicrobial restriction is neutral. The majority of the hospitals (Primary [5.9%], Intermediate [47.1%]) perceive that the doctors disagree with antimicrobial restrictions. 5.9% from a tertiary hospital do not know whether the doctors agree or disagree. Interestingly, no significant association was observed between the doctor's perception and hospital category (χ^2=16.580, df= 9, p=0.056).

Table 7: The distribution of hospital category by doctors' perceptions based on pharmacist observations on antimicrobial restrictions

		Doctors perceptions based on Pharmacist observations				
		The majority agree (N, %)	**Doctors are neutral (N, %)**	**The majority disagree (N, %)**	**I do not know (N, %)**	**Results on association**
Category	**Primary**	2(11.8)	1(5.9)	1(5.9)	0	χ^2, p-value
	Intermediate	1(5.9)	0	8(47.1)	0	χ^2=16.580
	Tertiary	2(11.8)	0	0	1(5.9)	p=0.056
	Specialist	1(5.9)	0	0	0	

4.6 Challenges faced by hospitals in AMS initiatives

The online survey consisted of open-ended questions in which the participants could give their understanding of the challenges they encountered in their hospitals with respect to AMS. Categories were identified on analysis of the answers the participants gave. Challenges with AMS initiatives were identified and categorised for both AMS practising hospitals and non AMS hospitals.

4.6.1 Challenges of AMS initiatives

The open-ended questions resulted in certain categories being observed as a result of how the questions were answered by the respondents. The respondents cited several reasons why AMS initiatives in their hospitals face challenges. Of note was a lack of teamwork between doctors and pharmacists with regards to treatment guidelines as well as a lack of appropriate skills within the pharmacy department. The respondents felt that the lack of a clinical pharmacist in their department hindered their work on AMS in their hospitals. Doctors were also cited as lacking professionalism towards pharmacists by disregarding the pharmacists' concerns with regards to their prescribing notes. A lack of teamwork between the HCPs was also cited as a hindrance in AMS as some HCPs opinions were considered more relevant as compared to others. A lack of stock was also believed to play a role in how antimicrobials are prescribed in the hospitals which would lead to irrational prescribing in some instances.

4.7 Recommendations suggested for the improvement of the Antimicrobial Stewardship Programme.

The respondents suggested that all healthcare professionals (HCPs) must be involved in ward rounds i.e. doctors, nurses, pharmacists and microbiologists. The respondents felt that this would ensure that the patients receive the best care possible especially with respect to antimicrobials. The respondents also believed that antimicrobial treatments must be based on evidence-based therapies through the use of standard treatment guidelines as well as ongoing research on the conditions.

The respondents cited that with increased teamwork more and more control on antimicrobials can be achieved thereby, reducing chances of antimicrobial resistance.

Increased teamwork mainly between the doctors and pharmacists would help to manage antimicrobials within the hospitals. It was also widely believed that all HCPs should attend CPDs so that they are kept abreast of new research on antimicrobials as well as antimicrobial therapies and antimicrobial resistance patterns.

Several of the respondents believed that if a clinical pharmacist was employed at their facility they would be able to mitigate AMR at their hospital. Clinical pharmacists have training especially in antimicrobial stewardship programs as well as how to monitor and evaluate hospital pharmaceutical programs.

Nearly all the respondents felt that laboratory results took too long to get back to the doctors and hence prolonged treatment with unsuitable antimicrobials. Therefore, it was suggested that if laboratory results were obtained faster the hospital's AMS practices would be in a position to help mitigate AMR at the hospital.

CHAPTER 5: DISCUSSION

5.1 Overview

This chapter discusses the findings of this research which aimed to understand the level and extent of AMS practices in Namibian hospitals by hospital pharmacists. The chapter further discusses the multi-disciplinary teams and measures that are undertaken to ensure that the activities of AMS are undertaken successfully. The chapter also discusses the challenges faced by HCPs with respect to AMS practices in the Namibian perspective.

5.2 Discussion of the findings

The most densely populated region in Namibia, Region D which has the most hospitals in the country (Pendeleton, Nikanor and Pomuti, 2012) represented almost a quarter of the respondents. More public compared to private hospitals participated in the survey, a reflection of the general distribution of public vs. private hospitals in Namibia (Pendeleton, Nikanor and Pomuti, 2012).

Antimicrobial stewardship interventions in most low-and middle-income countries are yet to align with global efforts to combat increasing AMR (Akpan et al, 2020). Majority (81%; n=17) of the hospitals in Namibia have no ASP in place. However similar to reports by Akpan et al (2020), it was established that all Namibian hospitals practice some form of antimicrobial stewardship initiatives without a formal program in place.

Other studies reported that only 14% of African hospitals had ASP in place (Abubakar & Tangiisuran, 2020), a finding similar to the current study where only 19% (n=4) of the hospitals had an ASP and these were all private hospitals. Interestingly, the private hospitals that reported to have an ASP in place are hospitals that are aligned to South African hospitals who have maintained their support of these Namibian hospitals. Previous studies have shown that South Africa has a National action plan on AMR and AMS activities have been identified in South African hospitals (Akpan et al, 2020). WHO member states adopted a Global Action Plan on AR which has subsequently led to formation of National Action Plans on AR (Schellack et al, 2017). Although some countries adopted this it has been found that in SSA some countries are in the process of writing an action plan or have one in place (Elton et al, 2020).

The low prevalence of ASP in Namibia could be attributed to a lack of funding, a lack of antimicrobial surveillance as well as significant surveillance gaps similar to Chokshi et al (2019) whose study attributed the lack of ASP in developed countries to a lack of antimicrobial surveillance and lack of funding. Public health authorities can play a vital role in ensuring the development of programs identifying key indicators to monitor and evaluate the complacency of each facility (Trivedi et al, 2014). Similar to Howard et al (2015) and Mushtaque et al (2019), the study revealed that the lack of ASP in hospitals was also due to staffing constraints, and ASP not being high enough on the list of priorities.

The study revealed a lack of correlation between the establishment of an ASP and the facility having a Drugs and Therapeutics Committee (DTC). The main objective of a DTC is to optimize the rational use of medicines through the development of policies, administration and management of the formulary system (Ramli et al, 2014). This result might suggest that there is inconsistent management of the pharmaceutical department within the facility. Areas that can be affected are the antimicrobial resistance surveillance reports, procurement, distribution, prescribing, dispensing and administration of drugs (Ramli et al, 2014). Management of antimicrobial sensitivities and resistance patterns in hospitals is a major function of the DTC, where their reports can assist in the management of HAI's (Nicole, 2001).

The major goal of ASP is to reduce antimicrobial resistance, through the use of different AMS approaches and techniques (Leekha, Terrell and Edson, 2011). Most of the hospitals practice a form of formulary restriction, dose optimization, IV-Oral switch in their AMS initiatives with various strategies being employed to determine how each patient is treated. The findings from this study are comparable to other studies done around the world where most hospitals had specific guidance on how to treat infections (Howard et al, 2015). It was apparent that some hospitals, especially those without ASPs, barely practiced dose optimization. This can potentially be attributed to the lack of clinical pharmacists within hospital settings as their specialist knowledge on drug pharmacodynamics and pharmacokinetics is required. Dose optimization of antimicrobial agents requires good knowledge of the distribution of the antibiotic (pharmacokinetics) in the body and how the antibiotic (pharmacodynamics) affects the pathogen (Hoo, Liew and Kwa, 2017). The pharmacists in the study mentioned the lack of clinical pharmacists employed at their facilities. They believed that this lack of a clinical pharmacist hampered their AMS

program as well as derailed any processes that they have in place. The pharmacists suggested that more clinical pharmacists needed to be employed to ensure improvement of their AMS programs. Intravenous formulations are normally more expensive and therefore it is not surprising that hospitals rely on the IV-Oral Switch technique. Similar to Paskovaty et al, (2005); Owens (2008), Leekha, Terrell and Edson (2011); Majumder et al (2020), shortening the length of IV therapy can result in a short hospital stay as well as decreased cost of IV preparation and administration. Success of AMS techniques is also dependent on antimicrobial availability within the hospitals. Poor inventory management, as well as stock outs of essential medicines can compromise the rational prescribing of antimicrobials and medicines in general (Ncube et al, 2020). Pharmacists highlighted the lack of stock as a challenge they face in AMS practices.

It is critical that the pathogen responsible for the infection is determined and the correct antimicrobial administered. In general, antimicrobial therapy should be initiated and samples collected for laboratory testing, once the pathogen is identified a narrow antibiotic spectrum agent is initiated (Leekha, Terrell and Edson, 2011). Similarly, the hospitals in Namibia should have laboratories that are in a position to perform this task fast and efficiently. However, it was noted that there is a delay in the delivery of laboratory results and this delays the prescribing and administering of the correct antibiotic to the patient (Abbas, S and Stevens, M. (2018). The study revealed the importance of a clinical microbiologist in the day to day identification of pathogens and possible antibiotics to treat them. In hospitals without ASP the clinical microbiologist was a part of the formulary group whilst in hospitals with ASP they are part of the AMS team.

None of the hospitals with ASP had a hospital epidemiologist nor did they have an information systems specialist. This can prove detrimental as the function of the AMS team is in the provision of data that can be utilized in the fight against resistance within the hospitals. This could lead to a lack of proper antimicrobial surveillance data and proper antimicrobial drug utilisation reviews (Doron and Davidson, 2011).

Interestingly, the majority of the hospitals with ASPs did not have a pharmacist in the AMS team in contrast to Majumder et al (2020) where a pharmacist must be engaged within the programme. Pharmacists dispense medicines and can easily notice trends and can enforce change if need be (Majumder et al, 2020). Ourghanlian et al (2020) mentioned

that pharmacists' actions have been linked to the reduction in antimicrobial consumption as pharmacists were responsible for optimizing antibiotic use.

Optimal patient outcomes can be obtained through multidisciplinary collaboration within the healthcare system (Royal Pharmaceutical Society, 2017). The importance of a pharmacist's presence during ward rounds is underpinned in assisting physicians in reviewing appropriate antimicrobial therapy for patients (MacDougall and Polk, 2005), interestingly only 25% of the hospitals mentioned the head pharmacist attending ward rounds. The role of the pharmacist reflects the AMS techniques and approaches that the hospitals enforces (Royal Pharmaceutical Society, 2017).

Globally, Africa has significantly less pharmacists per capita as compared to other regions (Bates et al, 2016) this is reflected in the study as the majority (76.2%) of the hospitals have less than five pharmacists or pharmacists' assistants at their facilities. The pharmacy workforce also varies considerably between countries and generally correlates with population and country-level economic indicators (Bates et al, 2016). Similarly, it has been determined that there is an unequal distribution of healthcare workforce (HWF) in Namibia, as most healthcare workers work in the urban areas (Ministry of Health and Social Services, 2010). The lack of adequate pharmacy personnel has been shown to have an impact on the procurement and management of medicines (Ncube et al, 2020) as well as the amount of workload that each pharmacist must undertake. Interestingly, a study done in Namibia determined that high patient volumes resulted in high antimicrobial prescribing by physicians (Pereko et al, 2015) thereby, having a direct impact on the pharmacists' ability to undertake corrective actions to prevent the irrational use of medicines.

Namibia recently began to produce its own pool of pharmacists which has resulted in new and younger pharmacist graduates (Rennie et al, 2018) in line with the demographic profile of the respondents in this study where 57% of them were in the age category 35 years and younger and had eight years of experience on average. Before the inception of the pharmacy school, the majority of the pharmacists were educated in South Africa (Rennie et al, 2018). A recent study by Khan et al (2020) showed that within the South African Bachelors of Pharmacy degree, AMS is covered within the curriculum. The 10 pharmacy schools in South Africa confirmed that they had different contact hours in which AMS was

taught with an average of 5-9 contact hours (Khan et al, 2020). The study went on to recommend a proposed curriculum which reflected the national policy documents on AMS (Khan et al, 2020). South Africa is one of the few countries in Africa with an action plan on AMR and AMS activities in place (Akpan et al, 2020).

Pharmacists can be further trained in infectious diseases where their roles can include the promotion and rational use of antimicrobials (Drew, 2009; Fortin, 2018). It is possible that pharmacists do not feel comfortable to provide recommendations for complex cases as they do not possess these additional qualifications. In response to this, the University of Namibia began training clinical pharmacists in a three-year Master's degree as of 2016 with the first cohort expected to graduate in 2020 (Corkhill et al, 2020). The study reported a lack of clinical pharmacists within the hospital setting which could be as a result of the new cohort graduating in 2020 as well as the possibility of some of these pharmacists working in community pharmacies.

Continuous professional development (CPD) can be used as a strategy for AMS such interventions have been shown to be effective depending on the HCPs willingness to make and sustain behavioural change (Paskovaty et al, 2005; Owens, 2008). One of the cornerstones for ASP is education (Paskovaty et al, 2005) therefore it is not surprising that only the hospitals with ASP presented CPDs to their HCPs.

The study results suggest that pharmacists believed that doctors did not agree with the restriction of antimicrobials. However, a plausible explanation is that physicians undergo limited training in medical school on antimicrobials (Pulcini, Botelho-Nevers, Dyar and Harbarth, 2014). This could explain why most of the respondents believed doctors did not agree with antimicrobial restrictions. Doctors are tasked with ensuring that they prescribe medicines rationally to their patients, however literature has shown that irrational use of medicines can be due to prescriber-orientated factors (Ncube et al, 2020). These factors include insufficient prescriber knowledge, their personal beliefs and a fear that some medications can present with adverse effects in some of their patients (Ncube et al, 2020; WHO, 2018). Interestingly, the results showed a lack of correlation between hospital category and doctors' perception based on pharmacist's observations on antimicrobial restrictions. Therefore, the study showed that the pharmacists believe that doctors in general do not agree with the antimicrobial restrictions.

Most of the pharmacists believed that they face challenges with AMS due to lack of teamwork between themselves and doctors as well as a lack of interaction between the two professions. Of concern the participants pointed out that doctors sometimes do not listen to pharmacists' recommendations. Close collaboration between doctors and pharmacists is one of the cornerstones of a successful ASP (Pulcini, Botelho-Nevers, Dyar and Harbarth, 2014) and their combined knowledge could help in the fight against AMR. A reflection of this is found in a study by Broom et al (2015), where pharmacists were implored to stop "policing" doctors and to take up the role of stewards or advisors of medicines. Such a shift can assist in improving the inter-professional relationship between the two professions (Broom et al, 2015). Further exploratory investigation needs to be done to understand the power dynamics that exist between pharmacists and doctors in Namibia.

5.3 Limitations

It is possible that some questions in the survey were not answered which would have had a negative effect on the analysed data (Kang, 2013). It was found that two respondents did not answer a question but went on to answer the follow-up question leading to missing data. Missing data may cause data analysis to be biased leading to invalid conclusions (Kang, 2013). Depending on the extent of the missing data, a decision was taken to eliminate it from the analysis.

The study had a low response rate possibly due to some responders being too busy, non-cooperative and a lack of trust whilst the other responders were cooperative, trusting and perhaps valued academic research (Rindfuss et al, 2015). Low response rates can risk the generalizability of findings as the sample size is small and affects the power of the sample and statistical analysis of associations. The statistical power must be adequate in order to draw accurate conclusions about a population (Rosner, 2000). Therefore, the survey results must be cautiously interpreted within the study setting.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The purpose of the study was to determine the extent to which AMS is being practiced in Namibian hospitals by pharmacists. The study used data collected through an online survey which was analysed quantitatively. It is imperative that AMS should be planned and actioned for all hospitals to mitigate the emergency of AMR. It is more important now with the emergence of Covid-19 where a wide range of antimicrobials are being used to treat the virus and related illnesses.

The findings highlight that all of the hospitals that took part in the survey, the pharmacist practiced a form of antimicrobial stewardship within their facility. Problems with a lack of funding as well as a lack of appropriately trained personnel had a negative effect on how these practices were performed. Most of the facilities did not have in their employ a clinical pharmacist who is paramount for an ASP to function. Therefore, human and financial resources determined whether a hospital had a fully functioning ASP or whether the hospital performed some functions that an ASP would do.

Although 4 of the hospitals have ASPs most of these lacked a DTC and the pharmacists where not involved in the DTC. DTCs mainly function by optimizing the rational use of medicines. The lack of a DTC can potentially mean that the ASP within the facility is not run to its full potential.

Education and information on antimicrobials were found to be lacking especially amongst the healthcare professionals. Hospitals with ASPs in place held some form of educational intervention for their healthcare professionals with respect to antimicrobials whilst the other hospitals did not. More knowledge needs to be shared so that all HCPs are up to date and able to help their patients accordingly.

6.2 Recommendations

The following recommendations arise from the study's findings:

The study found a large number of hospitals without ASP. Interestingly, there are a number of resources available from the CDC, Royal Pharmaceutical Society, WHO and journal articles on how to build a successful ASP (CDC, 2014; WHO, 2019). It would be

imperative that hospital administrators fully understand what is required and build an ASP that suits their hospital's resources.

The study determined that most hospitals through their pharmacists practiced some form of AMS, however, there was a lack of sufficient workforce. It would be imperative that more clinical pharmacists, pharmacists and pharmacist's assistants are employed at these facilities. This can ensure that the workload is divided proportionally allowing for each pharmacist to ensure that medicines are being prescribed appropriately and at the correct doses. Secondly the facilities would be able to ensure that a pharmacist is able to facilitate the running of their ASP or AMS practices.

In addition, hospitals with ASPs in place can introduce a multidisciplinary DTC that includes pharmacists at their facilities to allow for the rationalisation of the use of medicines (antimicrobials) in their facility. Given the finding of the relationship between pharmacists and doctors, formation of such a committee can afford the opportunity for the two professions to understand and work together professionally.

As we learn more lessons from Covid-19 and the effect late results can have on a human being, it is imperative that facilities receive laboratory results on their specimens faster. More microbiologists need to be employed as part of the AMS program, as well as increasing the capacity of the microbiology laboratories at the hospitals. This will assist in ensuring that the results are received earlier and the appropriate antimicrobial regimen is started earlier. Early initiation of the appropriate antimicrobial means a reduced chance of antimicrobial resistance.

Pharmacists are in a unique position where they can flag prescriptions for review by infectious disease specialists if need be. However, depending on workload and broadening of responsibilities they may not be able to review prescriptions comprehensively. Nevertheless, the situation can be remedied with the employment of a clinical pharmacist who is adequately trained in infectious diseases. A clinical pharmacist with appropriate qualifications in infectious diseases can dedicate their time into the running of the antimicrobial stewardship program (MacDougall and Polk, 2005). The clinical pharmacist would be able to provide recommendations for complex cases. The pharmacy school at the

University of Namibia may need to look into how they can produce more clinical pharmacists who are primed to deal with the Namibian situation.

6.3 Recommendations for further research

A more comprehensive exploratory study should be conducted in a selection of hospitals in the country to determine the administration AMS practices at the hospitals. This is of importance as it will determine whether ASPs are managing to control AMR as well as to determine how cost-effective the ASPs are.

The study noted that in most hospitals without ASPs, the pharmacists cited that AMS was not a high priority or that funds were not allocated to the formation of an ASP. Therefore, such a study would allow for valuable information which can be useful for the formation of ASPs at these hospitals.

The study revealed the differences in education that pharmacists receive with regards to AMR, therefore it is paramount that policies within Namibia are in alignment with WHO and Namibian guidelines on AMR to ensure that the appropriate curricula is available to pharmacy students. This will ensure that the appropriate level of AMS is achieved and practised by Namibian pharmacists.

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APPENDICES

APPENDIX 1

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa
Tel: +27 21-959 2809 Fax: 27 21-959 2872
E-mail: soph-comm@uwc.ac.za

Request for Permission to conduct Research with Head Pharmacists in Hospitals in Namibia

Dear Head Pharmacist,

My name is Chenaimoyo Mandimika-Mutumbu, and I am a Masters student at the University of the Western Cape (UWC) in South Africa. As part of the academic requirements, I am Mini Thesis study on the topic of "The extent of Antimicrobial stewardship practices among hospital pharmacists in Namibia: a cross-sectional survey". This project will be conducted under the Supervision of Dr H. Tabana and Dr M. Lembani from UWC, South Africa.

I am hereby seeking your consent to approach and conduct research within your Hospital pharmacy. I have provided you with a copy of my research proposal which includes copies of the data collection tools, consent and assent forms to be used in the research process , as well as a copy of the approval letter which I received from the UWC Biomedical Research Ethics Committee and the Namibian Biomedical Research Ethics Committee.

Upon completion of the study, I undertake to provide the Hospital with a bound copy of the full research report. If you require any further information, please do not hesitate to contact me on 081 346 4427 or 3706622@myuwc.ac.za.

Thank you for your time and consideration in this matter.

Yours sincerely,

Chenaimoyo Mandimika-Mutumbu

APPENDIX 2

ETHICS APPROVAL LETTERS

UNIVERSITY *of the* WESTERN CAPE

60 YEARS *of hope, action & knowledge*

15 October 2020

Ms C Mandimika-Mutumbu
School of Public Health
Faculty of Community and Health Sciences

Ethics Reference Number: BM20/8/17

Project Title: The extent of Antimicrobial stewardship among hospital pharmacists in Namibia: a cross-sectional survey

Approval Period: 15 October 2020 – 15 October 2023

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report annually by 30 November for the duration of the project.

Permission to conduct the study must be submitted to BMREC for record-keeping.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: BMREC-130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 13198
Windhoek
Namibia

Ministerial Building
Harvey Street
Windhoek

Tel: 061 – 203 2537
Fax: 061 – 222558
E-mail: itashipu87@gmail.com

OFFICE OF THE EXECUTIVE DIRECTOR

Ref: 17/3/3/CMM
Enquiries: Mr. A. Shipanga

Date: 03 December 2020

Ms. Chenaimoyo Mutumbu
PO Box 26983
Windhoek
Namibia

Dear Ms. Mutumbu

***Re:* The extent of Antimicrobial stewardship practices among hospital pharmacists in Namibia: a cross-sectional survey.**

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**

3.1 The data to be collected must only be used for academic purpose;
3.2 No other data should be collected other than the data stated in the proposal;
3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
3.4 A quarterly report to be submitted to the Ministry's Research Unit;
3.5 Preliminary findings to be submitted upon completion of the study;
3.6 Final report to be submitted upon completion of the study;
3.7 Separate permission should be sought from the Ministry for the publication of the findings.

4. All the cost implications that will result from this study will be the responsibility of the applicant and **not** of the MoHSS.

Yours sincerely,

EXECUTIVE DIRECTOR
MINISTRY OF HEALTH AND SOCIAL SERVICES

BEN NANGOMBE
EXECUTIVE DIRECTOR

"Your Health Our Concern"

APPENDIX 3

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa
Tel: +27 21-959 2809, Fax: 27 21-959 2872
E-mail: soph-comm@uwc.ac.za

CONSENT FORM

Title of Research Project: The extent of Antimicrobial stewardship practices among hospital pharmacists in Namibia: a cross-sectional survey

The study has been described to me in language that I understand. My questions about the study have been answered. I understand what my participation will involve and I agree to participate of my own choice and free will. I understand that my identity will not be disclosed to anyone. I understand that I may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits.

Participant's name…….

Participant's signature……

Date……

Biomedical Research Ethics Committee
University of the Western Cape
Private Bag X17
Bellville
7535
Tel: 021 959 4111
E-mail: research-ethics@uwc.ac.

APPENDIX 4

UNIVERSITY OF THE WESTERN CAPE

Private Bag X 17, Bellville 7535, South Africa
Tel: +27 21 959 2809 Fax: 27 21 959 2872
E-mail: soph-comm@uwc.ac.za

INFORMATION SHEET

Project Title: The extent of Antimicrobial stewardship practices among hospital pharmacists in Namibia: a cross-sectional survey

What is this study about?
This is a research project being conducted by Chenaimoyo Mandimika-Mutumbu at the University of the Western Cape. We are inviting you to participate in this research project because you of your position as a pharmacist in a hospital in Namibia. *The* purpose of this research project is to determine the extent of antimicrobial stewardship in Namibia as well as the challenges faced

What will I be asked to do if I agree to participate?
You will be asked to answer questions in a questionnaire about antimicrobial stewardship at your hospital. The questions are short and answer options are given. The questionnaire includes questions that require short answers in which lay language can be used. The questionnaire will take 15 -25 minutes to complete.

Would my participation in this study be kept confidential?
The researchers undertake to protect your identity and the nature of your contribution. To ensure your anonymity, only the name of the hospital is required on filling in the questionnaire. Your name will not appear in the data collected. However, a code will be placed on the survey and other collected data. An identification key will be used to link questionnaire to identity the hospital and only the researcher will have access to the key.
To ensure your confidentiality, *identification codes will be used that define the hospitals on the data forms. Password- protected computer files will also be used to ensure no one has unauthorized access.*
If we write a report or article about this research project, your identity will be protected.

What are the risks of this research?
All human interactions and talking about self or others carry some amount of risks. We will nevertheless minimise such risks and act promptly to assist you if you experience any discomfort, psychological or otherwise during the process of your participation in this study. However, should any participant suffer from psychological distress during or directly after the online survey they will be encouraged to contact the Social Services Department within their hospital structures wherein they will be referred to a social worker

for counselling.

What are the benefits of this research?

This research is not designed to help you personally, but the results may help the investigator learn more about the current status of antimicrobial stewardship in Namibia. We hope that, in the future, other people might benefit from this study through improved understanding of the challenges that antimicrobial stewardship in Namibia faces.

Describe the anticipated benefits to science or society expected from the research, if any.

The benefits of this survey include the introspection into how well managed antibiotics are in Namibia at hospital level. As well as to determine what challenges are faced and if possible interventions exist.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify

What if I have questions?

This research is being conducted by *Chenaimoyo Mandimika-Mutumbu* at the University of the Western Cape. If you have any questions about the research study itself, please contact *Chenaimoyo Mandimika-Mutumbu* at 081 346 4427 and 3706622@myuwc.ac.za

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

Prof U Lehmann
Head of Department: School of Public Health
University of the Western Cape
Private Bag X17
Bellville 7535
ulehmann@uwc.ac.za

Prof Anthea Rhoda
Dean: Faculty of Community and Health Sciences
University of the Western Cape
Private Bag X17
Bellville 7535
chs-deansoffice@uwc.ac.za

This research has been approved by the University of the Western Cape's Humanities and Social Sciences Research Ethics Committee.

Humanities and Social Sciences Research Ethics Committee
University of the Western Cape
Private Bag X17
Bellville
7535
Tel: 021 959 4111
E-mail: research-ethics@uwc.ac.za

APPENDIX 5

Questionnaire

Section A
Demographics

1. Please check box that best describes your age

☐	22 - 30
☐	30 - 35
☐	35 - 39
☐	40 - 50
☐	50+

2. Please select your gender

☐	Male
☐	Female

3. How would you best describe your position at your facility

☐	Pharmacist
☐	Pharmacist Manager
☐	Responsible pharmacist
☐	Other please specify ……

4. Please State Name of Hospital Pharmacy……

5. Please check box of the Region in which the facility is in

☐	Erongo
☐	Hardap
☐	Karas
☐	Kavango East
☐	Kavango West
☐	Khomas
☐	Kunene
☐	Ohangwena
☐	Omaheke
☐	Omusati
☐	Oshana
☐	Oshikoto
☐	Otjozondjupa
☐	Zambezi

6. How many beds does your facility have?

- [ ] Fewer than 100
- [ ] Between 101 and 300
- [ ] between 301 and 500
- [ ] More than 500

7. In what category does your facility fall under?

- [ ] Primary
- [ ] Intermediate
- [ ] Tertiary
- [ ] Specialist
- [ ] Other specify……

8. How many pharmacist(s) are employed at facility?

- [ ] Fewer than 3
- [ ] Between 3 and 5
- [ ] More than 5
- [ ]

9. How many pharmacists' assistants are employed at facility?

- [ ] Fewer than 3
- [ ] Between 3 and 5
- [ ] More than 5

10. How many Pharmacists at your facility have a post graduate qualification in infectious diseases? …….

11. Is your facility a private or public institution?

- [ ] Private
- [ ] Public

12. Does your facility have a pharmacist dedicated to the management of antimicrobials?

- [ ] Yes
- [ ] No

13. Does your facility have an antimicrobial stewardship program?

- [ ] Yes
- [ ] No

If the answer to question 13 is "Yes" please proceed to Section B of questionnaire. If

answer to question 13 is "No" please proceed to Section C of questionnaire.

Section B
Facilities with an Antimicrobial Stewardship Program

1. If you have an antimicrobial stewardship team at your facility, who comprises it? Check all that apply

- ☐ Infectious Disease Physician (s)
- ☐ Infectious Disease Pharmacist (s)
- ☐ Clinical Microbiologist
- ☐ Information system specialist
- ☐ Infection control professional
- ☐ Hospital Epidemiologist
- ☐ We have no formal team
- ☐ other specify……

2. When was the stewardship program established?

- ☐ It is in development
- ☐ Less than 1 year ago
- ☐ 1-3 years ago
- ☐ More than 3 years ago

3. Is your program utilized for adult wards, paediatric wards, or both?

- ☐ Adults only wards
- ☐ Paediatrics only wards
- ☐ Both Adults and Paediatrics wards

4. Do you have a Drug Therapeutics Committee (DTC) at your hospital?

- ☐ Yes
- ☐ No

5. Is there a pharmacist in the DTC?

- ☐ Yes
- ☐ No

6. How many Pharmacists are in the DTC?

---

7. Does the hospital follow any educational techniques to educate the prescriber on appropriate antimicrobial prescription?

- ☐ Yes
- ☐ No
- ☐ Other please specify.

8. If the answer to question 7 is "Yes" how these educational techniques are transmitted to prescriber. Check all that apply.

- [ ] Newsletter
- [ ] Email
- [ ] None
- [ ] Other, specify……

9. Does the Pharmacy provide antimicrobial education to other healthcare professionals?

- [ ] Yes
- [ ] No

10. If Question 9 was answered "Yes" which health care professionals receive this education?

- [ ] Nurses
- [ ] Pharmacists
- [ ] Doctors
- [ ] Other, specify…….

11. If Question 10 was answered "Yes" how many times is the training sent out or conducted?

- [ ] Yearly
- [ ] Half yearly
- [ ] Quarterly
- [ ] Monthly
- [ ] Adhoc
- [ ] None

12. Which of the following Antimicrobial Stewardship techniques are utilized by your facility? Check all that apply.

- [ ] Antimicrobial Formulary
- [ ] Empiric usage guidance
- [ ] Reserved antimicrobial list
- [ ] IV-Oral switch
- [ ] Surgical antimicrobial prophylaxis
- [ ] Separate antimicrobial drug chart/section
- [ ] Dose optimization
- [ ] None

13. Does the head of pharmacy take an active role in the below? Please check all that apply.

	Anti-infective formulary decisions
	Writing antimicrobial guidelines/policies
	Horizon-scanning documents for antimicrobials
	Maintaining an awareness of local resistance patterns
	Attending a multi-disciplinary Antibiotic Review/Steering Group
	Attending Infection Prevention and Control Committee meetings
	Attending bench rounds in microbiology laboratory
	Antimicrobial prescribing in primary care
	Attending ward rounds on specialties of high antibiotic use
	Being available by phone/pager for referral of complex cases

14. Please list any challenges that you wish to share in regards to antimicrobial stewardship initiatives. ……

15. Please provide any suggestions that you believe can improve the antimicrobial stewardship initiatives at your Hospital…….

Section C
Facilities without Antimicrobial Stewardship Program

1. Has your facility ever considered having an antimicrobial stewardship program? If "Yes" continue to question 3, if "No" continue to question 2. If "I don't know" continue to question4.

	Yes
	No
	I don't know

2. If your facility has never considered having an antimicrobial stewardship program, what were the reasons? Check all that apply. If this question applies to you continue to question 4 after you complete the question.

	Funding
	Staffing constraints
	Insufficient medical staff buy-in
	Not high on the list of priorities
	Too many other things on the table
	Organised program has not yet been proposed
	Other, specify

3. If your facility has considered having an antimicrobial stewardship program, why has it not been implemented? Check all that apply

	Funding

- [ ] Staffing constraints
- [ ] Insufficient medical staff buy-in
- [ ] Not high on the list of priorities
- [ ] Too many other things on the table
- [ ] Organised program has not yet been proposed
- [ ] Other

4. Does the facility offer any formal educational program to educate prescribers about the appropriate prescription of antimicrobials?

- [ ] Yes
- [ ] No
- [ ] I don't know

5. If the answer to question 5 is "Yes" which of the following educational techniques is utilised? Check all that apply.

- [ ] Email
- [ ] Newsletter
- [ ] CPD's

6. Does your facility have a specific group that approves formulary restrictions?

- [ ] Yes
- [ ] No
- [ ] Other

7. If the answer to question 6 was "Yes" please can you elaborate on who the group consists of? Please check all that apply.

- [ ] Pharmacist
- [ ] Prescriber
- [ ] Head Nurse
- [ ] Clinical Microbiologist
- [ ] Other please specify

8. Please check any techniques that your institution uses with regards to antimicrobials.

- [ ] Antimicrobial Formulary
- [ ] Antimicrobial order forms
- [ ] IV-oral switch
- [ ] Dose optimization

9. What is your perception of the extent to which doctors at your facility agree with the idea of restricting antimicrobials?

- [ ] The majority agree

	Doctors are neutral
	The majority disagree
	I do not know

10. Please list challenges that you wish to share in regards to antimicrobial stewardship initiatives. ……

11. Please provide any suggestions that you believe can lead to the implementation of an antimicrobial stewardship program at your hospital…….