KNOWLEDGE AND PRACTICES TOWARDS ANTIBIOTICS USE IN THULAMELA MUNICIPALITY OF VHEMBE DISTRICT LIMPOPO PROVINCE

BY

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A dissertation submitted in fulfilment of the requirements for the degree

of

MASTERS OF PUBLIC HEALTH

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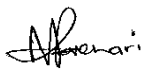
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DECLARATION

I Mpho Makhari, hereby declare that the research study titled - **"Knowledge, attitude and practices towards antibiotics use in Thulamela municipality, Limpopo province"** - submitted by me, has not been submitted previously for a degree at this or any other university, that it is my own work in design and in execution, and that all reference materials contained therein have been duly acknowledged.

Signature:  Date: 25/06/2025

Ms M Makhari

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PREFACE

There are three components to this dissertation, some of which are presented as articles. The study's overview, methodology, and ethical considerations are presented in Section A. Two manuscripts are presented in Section B along with the journal authors' guidelines. The study's conclusion, limitations, and recommendations are presented in Section C. The dissertation, thus, is structured in the manner described below:

Section A: Dissertation Overview

The background, problem statement, goal and objectives of the study, research design and methodology, and ethical considerations are all covered in detail in this section's summary. The dissertation does not include a separate literature review because a significant amount of the literature has been systematically reviewed for a systematic review that is underway to be published.

Section B: Paper/Article/Manuscript

This section has a manuscript:

- Manuscript 1 – Title of the manuscript: Knowledge, attitudes, and practices towards antibiotic use in South Africa: A systematic review - (Occupational Health Southern African Journal).

- The manuscript is titled – **Knowledge and Practices Towards Antibiotics Use in Thulamela Municipality of Vhembe District, Limpopo Province**" – Southern African Journal of infectious diseases

- **Section C: Conclusion, Recommendations and Limitations**

This dissertation's conclusions are presented in the final section, along with some relevant recommendations. The limitations are presented here; these have been identified in relation to all the sections of the study.

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- ✓ My mom and siblings for their unconditional love, all the sacrifices, and unwavering support.
- ✓ My partner who supported me and encouraged me throughout

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DEDICATION

- ✓ *This study is dedicated to all members of Limpopo province, Thulamela municipality who have been using antibiotics and those that participated in the study to learn more about their knowledge and practices towards antibiotics use in Thulamela municipality, Limpopo province*
- ✓ *This work is dedicated to my daughter Vhuthuhawe, whom I hope will be inspired to do greater than this.*

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Section A: Dissertation Overview

Abstract:

Antimicrobial resistance (AMR) is a health crisis that is found globally and it threatens the effective treatment of infectious diseases. It occurs when microorganisms develop resistance to the drugs that is used to treat them leaving the medication ineffective, microorganisms such as bacteria, fungi, viruses and parasite. The inappropriate use of antibiotics has been classified as major drivers of AMR, leading to multidrug-resistant strains of bacteria and reducing the effectiveness of existing treatment options. The World Health Organization (WHO) has recognized AMR as one of the biggest obstacles to public health in the 21st century not only is it increasing the morbidity and mortality rates associated with infectious diseases but also it leaves the economy in a hefty strain and negatively impacts the healthcare systems worldwide. This study aims to address the gap in knowledge by conducting a quantitative study to assess practices towards antibiotics and antimicrobial resistance among the communities. Simple random sampling was used to have 260 respondents who are males and females aged 18-65 residing in Thulamela Municipality. Data was collected using survey questionnaires, SPSS was used to analyse. Findings revealed adequate knowledge regarding antibiotics, The majority of respondents showed a good understanding of antibiotics, with 85% correctly identifying the difference between antibiotics and other medications. Ninety-four point six percent (94.6%) correctly identified that antibiotics are effective against bacteria, and 90.4% were aware that antibiotics can kill bacteria normally present on the skin and in the gut. The current study revealed that the community members are knowledgeable regarding antibiotics. However, some misconceptions were prevalent as evidence revealed that 50% believed that antibiotics speed up recovery from coughs and colds. The findings of this study provide valuable in-depth insights for the development of targeted interventions, campaigns, and policy measures to fight the AMR effectively. The findings highlight for the development of evidence-based strategies to fight against the AMR, promote responsible antibiotic use, and ensure safety of the public health on a global scale. Additionally, the study may serve as a benchmark for future research and policy development aimed at addressing this critical global health issue.

Keywords: Antibiotics, Attitude, Antimicrobial resistance, SA, Practices.

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1. OVERVIEW OF THE STUDY

INTRODUCTION AND BACKGROUND

1.1 Introduction

Antimicrobial resistance (AMR) has emerged as a significant global health concern, posing a threat to the effective treatment of infectious diseases. The misuse and overuse of antibiotics have been identified as major contributors to the development and spread of AMR, Understanding the practice of communities towards antibiotic use is crucial in addressing this issue and implementing effective interventions (Shatla, Althobaiti, Almqaiti, 2022). Antimicrobial resistance (AMR) is one of the major concerns for global health. Inappropriate use of antibiotics is speeding up the process of antimicrobial resistance.

Antimicrobials, including antibiotics, antivirals, antifungals, and antiparasitics, are used to prevent and treat infections in humans, animals and plants. Antimicrobials resistance occurs when microbes change over time, making antimicrobial ineffective, AMR is spreading creating microbes that cannot be treated with existing medications. Currently common organisations that cause different diseases such as tuberculosis (TB), HIV and AIDS, Malaria, sexually transmitted disease, urinary tract infections, lung infections, and blood infections can resist wide variety of microbics (Shatla, Althobaiti, Almqaiti, 2022)

Background

Antimicrobial resistance (AMR) is a global health matter that poses significant challenges to the effective treatment of bacterial infections (Shatla, Althobaiti, Almqaiti, 2022). Antibiotics were considered powerful drugs, but they are now losing their effectiveness due to the inappropriate use of these medications. which may result in common infections becoming untreatable, leading to prolonged illnesses, increase in the cost of healthcare, and even fatalities. The issue of AMR is broad and not limited to any specific region or country; it is a worldwide matter that goes beyond borders and is affecting people from all over the world. Therefore, it is critical to gain a comprehensive understanding of public knowledge and practices regarding antibiotic use and AMR on a global scale. This quantitative research study aims to provide valuable insights into these aspects, shedding light on the extent of the problem. Some international organizations, including the World Health Organization (WHO, 2023), the World Bank, and the United States (US), have recognized the importance of addressing AMR. They have set afloat global initiatives to fight AMR, promote responsible

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antibiotic use, and raise awareness. These initiatives focus on monitoring and locating the drug-resistant infections and their patterns of antibiotic use on a global scale. In addition, it enhances hygiene practices and infectious control measures to reduce the need for antibiotics; encourage healthcare professionals and the public to use antibiotics appropriately, only when needed and as prescribed and lastly support the development of new antibiotics and alternative treatments.

Antimicrobials play a critical role in preventing and treating infectious diseases across humans, animals, and plants, supporting health, food safety, and ecosystem integrity through a One Health framework (FAO/UNEP/WHO/WOAH, 2023). Antimicrobial resistance (AMR) threatens the ability to cure infectious diseases and contributes to the cult increased risk of death. AMR is estimated to cause at least 700,000 deaths each year globally and more than 35,000 people die each year in the United States making it an urgent public health problem. The problem of AMR is also common in low and middle-income countries, and is mainly caused by common bacterial pathogens, including *Escherichia coli*, *Salmonella spp*., or *Streptococcus pneumoniae*, *Mycobacterium* tuberculosis (Sumanth, Gerardo Alvarez-Uria, Jyoti Joshi, Direk Limmathurotsakul , Rogier van Doorn, 2020). In most developed countries, antibiotics can be obtained without a medical prescription. The prevalence of nonprescription use of antibiotics is estimated around 3% in developed countries and about 100% in developing countries. On April 17, 2018, the Saudi Ministry of Health (Saudi-MOH) mandated that all pharmacies must not dispense antibiotics without prescription. Consequently, any pharmacy that dispenses antibiotics without a prescription is subjected to a fine of up to 100,000 Saudi riyals (equivalent to the US$ 26,600), to revocation of the license and imprisonment for up to six months. Such regulations had resulted in a significant reduction in over-the-counter selling of antibiotics from 70.7% to 12.9% after law enforcement (Ali Hassan A. Alnasser, Jaffar A. Al-Tawfiq, Hana Ahmed A. Ahmed, 2021). According to a survey of twenty pharmacists conducted in Saudi Arabia's Eastern Province, most antibiotics are frequently sold over-the-counter (OTC). Also, two such studies found that 77.6-97.9% of community pharmacists dispense antibiotics without a prescription. Additionally, a study of antibiotics in the paediatric population showed a need for a better antimicrobial prescription. However, lack of awareness is a major factor in the misuse of antibiotics worldwide. Patients' knowledge, attitude, and practice (KAP) are considered important factors leading to such misuse. Few studies were conducted on the KAP towards antibiotics in Saudi Arabia, and most of such studies were confined to a specific region. Therefore, our study aims to assess knowledge and practices towards antibiotics use and AMR among the general public in Limpopo Province.

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A study in 2015 from Riyadh showed an increased reduction in the vulnerability of Acinetobacter baumannii (A. baumannii) to meropenem and imipenem, where the vulnerabilities were 64-81.2% in 2006 and 8.3-11% in 2012. Consequently, with carbapenem resistance, therapeutic options are extremely limited, making it a major epidemiological concern (Mokhtar, Fadi, Althobaiti,2022). In Saudi Arabia in 2014, national surveillance of AMR among gram-positive cocci represented a high resistance rate among Staphylococcus aureus (S. aureus), 32% were methicillin-resistant (MRSA), and among Streptococcus pneumoniae, 33% were resistant to penicillin G, and 26% were resistant to erythromycin (Hosam, Zowawi, 2016). Regarding multi-drug resistant bacteria in Saudi Arabia, there are many factors associated with its increase. It is well-established that inappropriate use of antibiotics is an important factor in the development of AMR. Over-the-counter antibiotics without a prescription is another factor leading to the inappropriate use of antibiotics, which contributes to more antimicrobial resistance. A study in 2001 was done in the Eastern province of Saudi Arabia and revealed that only one pharmacy out of 88 refused to dispense medication without a prescription for patients claiming to have a UTI. Another study in 2011 was done in Riyadh among 327 pharmacies and showed that 77.6% of pharmacies dispensed antibiotics without a prescription. Lack of awareness is another crucial component in the misuse of antibiotics worldwide (Shadi Ahmed Zakai, 2019). Patients' knowledge, attitude, and practice (KAP) are important factors contributing to the misuse of antibiotics. A study in the Hail region of 500 participants found that 26% got antibiotics without a prescription, only 34% finished the full antibiotic course, and 36.2% were unaware of antibiotic resistance and its rise (Imaan Benmerzouga, 2019). In addition, a recent study in 2021 to assess KAP towards antibiotic use and AMR among the general public in Saudi Arabia showed an insufficient attitude toward antibiotic use. It also suggests reducing antibiotic misuse by raising awareness. Low knowledge levels were also reported in a 2021 study in Jeddah, indicating the need to increase public knowledge and raise awareness. Globally, in Kuwait, a KAP study on antibiotic use in 2015. reported that 72.8% of the respondents had received an antibiotic prescription in the year before the survey; of those, 36% did not complete the course of treatment. Moreover, 27.5% were self-medicating primarily for cough, sore throat, and a common cold. A 2021 study conducted in Boyolali, Indonesia, revealed that most of the participants had insufficient knowledge about the proper usage, accessibility, and function of antibiotics. Male sex, low income, low educational levels, and residency in rural areas were associated with inappropriate use of antibiotics

The AMR challenge is further exacerbated by globalization and an increase in transnational travel and trade which inevitably create opportunities for the rapid spread of infectious pathogens (Macpherson, Hawkey, 2015). Recognizing the interconnectedness of health

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issues subsequently gave rise to the One Health (OH) approach which aims to promote cross-sectoral cooperation at the subnational, national and international levels (Travis, Sriramarao, Cardona, 2017).

The Global Health Security Agenda (GHSA) and its Joint External Evaluation (JEE) framework are international collaborations designed to enhance countries' abilities to prevent, detect, and respond to infectious disease threats (Antibiotic stewardship in Ghana, 2021). In Ghana's most recent JEE, the country scored just 1 out of 5 on three of the four AMR-related capacity indicators, reflecting a very limited national preparedness. This low score mirrors outcomes seen across West Africa, underscoring a regional challenge in AMR prevention and control

In Ghana, infectious diseases such as malaria, HIV/AIDS, tuberculosis, and lower respiratory infections remain among the top ten contributors to disability-adjusted life years (DALYs), highlighting a persistent public health burden. Recent clinical data further emphasize growing AMR concerns: a 2021 study at a district hospital reported that between 33–36% of outpatients received at least one antibiotic, a rate well above WHO recommendations. Moreover, a 2023 investigation into antibiotic dispensing practices revealed high usage of Watch- and Reserve-category antibiotics, pointing to problematic prescribing trends.

Surveillance data from national laboratory networks show that *Escherichia coli*, *Klebsiella pneumoniae*, and *Staphylococcus aureus* are consistently identified among the top AMR pathogens in Ghana, contributing to approximately 25,300 AMR-attributable deaths in 2023**.** Additionally, a laboratory-driven nationwide AMR report highlights widespread resistance, driven in part by gaps in culture and susceptibility testing infrastructure, especially in rural regions

While drug resistance is the product of multiple, systemic processes, one of the most common determinants is individuals' compliance to prescriptions and prudent use, and hence introduces a behaviour change requirement (Holmes, Moore, Karkey,2016). Studies on knowledge, attitudes, and practices (KAP) have been instrumental in understanding the underlying predictors of health behaviour (WHO,2017) (Demore, Tebano, Thilly,2017)]. For example, in a systematic review that included 26 antibiotic-related studies conducted among the general public worldwide, about one-third (34%) of those sampled were unaware of the efficacy of antibiotics for bacterial infections, or that resistance could result from misuse of medications (Gualano, Bert, Gili,2017). We therefore sought to determine whether these results were mirrored in the Ghanaian context. Despite the existence of guidelines restricting excessive levels of antibiotic dispensing in Ghana, poor enforcement has rendered guidelines ineffective, thereby resulting in misuse of antibiotics in communities. A few studies have shown

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high rates of antibiotic resistance in rural Ghana (Saba, Amenyona, Kpordze, 2017), which may be tied to the low level of educational attainment in these regions as reported in the Demographic and Health Survey (DHS) Hence, the imperative to closely examine within-country disparities. Particularly, study outcomes will be informative for the design of stewardship programs in line with the ongoing implementation of the country's AMR National Action Plan (NAP), which was developed based on the OH approach and has as a key objective awareness creation and public education on antibiotic resistance.

Despite existing research in this field, there remains a significant gap in our understanding of the public knowledge and practice towards antibiotic use and antimicrobial resistance. This gap in knowledge necessitates further investigation to assess antimicrobial resistance among communities, through determining the knowledge and practices towards antibiotics.

1.2 Problem statement

Antimicrobial resistance (AMR) is a wide global health crisis that threatens our ability to quickly treat infectious diseases (Antimicrobial Resistance Collaborators, 2022). It results from the microorganisms, such as bacteria, viruses, fungi, and parasites, developing resistance to the drugs designed to fight against them, such as antibiotics and antivirals. This resistance erodes the effectiveness of medical treatments, increasing the cost of healthcare, prolonging illnesses, and leading to higher mortality rates (Clin Lab Anal. 2022 Sep). The issue of AMR is not based on a specific region or nation; it is a global concern. Despite numerous initiatives and policies aimed at addressing AMR, the problem continues to escalate (WHO, 2023). In order to immediately fight AMR and preserve the efficacy of existing antimicrobial drugs, it is important to gain a comprehensive understanding of the knowledge and practices of the public toward antibiotic use and AMR on a global scale. Antimicrobial resistance (AMR) is one of the top global public health and development threats. It is estimated that bacterial AMR was directly responsible for 1.27 million global deaths in 2019 and contributed to 4.95 million deaths (WHO, Nov 2023). Despite the available strategies to raise awareness about the AMR, the AMR rate in South Africa is at 40% (knowledge hub 2021). The researcher discovered that many people are misusing antibiotics leading to antimicrobial resistance, however through observation the researcher has noticed that some of the studies have been conducted about AMR but still the rate of antimicrobial resistance is increasing. It is therefore the intention of this study to assess antimicrobial resistance amongst Thulamela community by determining the knowledge and practices towards antibiotics.

Preliminary assessments suggest a lack of comprehensive understanding among the public regarding the appropriate use of antibiotics, the concept of antimicrobial resistance, and its

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implications for individual and community health. Reports indicate prevalent misconceptions and inappropriate practices related to antibiotic use, including self-medication, incomplete treatment courses, and sharing of antibiotics, contributing to the emergence and spread of antimicrobial resistance. Cultural beliefs and traditional healing practices prevalent in the region may influence attitudes and behaviours towards seeking healthcare services and adherence to prescribed antibiotic regimens, warranting further investigation and culturally sensitive interventions. Socio-economic factors, including limited access to healthcare facilities, financial constraints, and transportation barriers, may impact healthcare-seeking behaviours and adherence to prescribed antibiotic treatments, exacerbating the risk of antimicrobial resistance. Antimicrobial resistance has also become prevalent in South Africa. With a focus on Limpopo province, a study by Mthombeni et al. (2022) states that antibiotic consumption (ABC) is a critical component of the strategic priority response to the increasing antibiotic resistance threat. With over 5 million deaths globally associated with antibiotic resistance in 2019 (Murray et al., 2022), there is a need to improve the antibiotic use habits of individuals. Numerous studies explore this topic worldwide (Kahunde et al., 2023), but few focus on the state of affairs in South African communities (Farley et al., 2019), and even fewer in Limpopo province (Mthombeni et al., 2023).

Despite sporadic studies addressing aspects of antibiotic use and resistance in South Africa, there is a dearth of comprehensive data specifically focusing on Thulamela Municipality, necessitating localized research efforts to inform evidence-based interventions and policies tailored to the community's needs.

1.3 Rationale of the study

Global Health Crisis: Antimicrobial resistance (AMR) is a worldwide health crisis with many implications (WHO, 2023). It jeopardizes our ability to effectively treat infectious diseases, reverting medicine to a pre-antibiotic era. Gaining knowledge to the extent and nature of public knowledge and practices towards antibiotics is risky for devising strategies to mitigate AMR's impact. The general public plays a crucial role in fighting against AMR. The World Health Organization's awareness and behaviours regarding antibiotic use have direct influence on the development and the spread of resistance (WHO, 2023). This study recognizes the public as key stakeholders and seeks to study to enhance future studies that will empower people with knowledge for responsible antibiotic use. Antibiotic use and AMR awareness vary significantly across regions and populations. Developing effective interventions to combat AMR requires a solid evidence base. This study seeks to fill knowledge gaps by providing empirical data on public perceptions and behaviours related to antibiotics. Such data can

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inform the design of targeted awareness campaigns and educational initiatives., healthcare systems are facing prolonged illnesses, increased healthcare costs, and the need for more expensive treatments that strain healthcare resources. By gaining knowledge on public attitudes and practices, this study can contribute to the implementation of strategies that support healthcare sustainability. Policymakers rely on evidence to formulate effective policies. This study's results can inform the development of evidence-based policies and regulations that are aimed at identifying antibiotic misuse, promoting responsible use, and addressing AMR at the national and international levels. Anticipating and addressing AMR requires a long-term perspective. By understanding current knowledge and practices, this study contributes to future preparedness by identifying areas for targeted education and awareness efforts

1.4. Study purpose and objectives

1.4.1 Study purpose

The purpose of this study is to assess the knowledge and practices towards antibiotic use and antimicrobial resistance in the Vhembe district, Thulamela municipality.

1.4.2 Objectives

1 - Systematic Review

- To assess how much is known in SA related to awareness about antibiotics and antimicrobial resistance (AMR). - the systematic review is underway to be published).

2 – Data collected

- To determine Antibiotic Use Practices Among the Public including adherence to prescribed treatments and self-medication practices.
- To determine Knowledge Gaps and Misconceptions regarding antibiotics in Limpopo among community members.

1.5 Significance of the study.

The significance of the study is flexible as it has far-reaching implications for various stakeholders and global health. The Global Health Impact of Antimicrobial resistance (AMR) is a critical global health concern that poses a risk to the effectiveness of antibiotics, leading to treatment failures and increased morbidity and mortality rates. Understanding the public knowledge, attitudes, and practices toward antibiotics and AMR is important for addressing this health crisis in a beneficial way. The study's findings might inform targeted public health interventions and educational campaigns aimed at improving public knowledge and promoting

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appropriate antibiotic use. This may play a role in reducing the spread of AMR and improving health outcomes of the communities invloved. Inappropriate use of antibiotics strains healthcare resources and increases costs. By gaining insights and knowledge into public practices, healthcare systems might better allocate resources and optimize treatment plans, improving the efficiency of healthcare delivery. Prolonged illnesses and the need for more expensive treatments due to AMR can threaten the sustainability of healthcare systems.

The study might guide efforts to ensure that healthcare systems remain sustainable by addressing AMR-related challenges. The Policymakers rely on empirical data to formulate effective policies and regulations. The study's findings might serve as a foundation for evidence-based policymaking at the national and international levels, facilitating the development of strategies to combat AMR. Understanding public practicestowards antibiotics might be valuable for pharmaceutical companies and researchers working on new antibiotics. This insight might assist in aligning drug development efforts with the public's needs and expectations. The study goes hand in hand with the One Health approach, recognizing the interconnectedness of human health, animal health, and the environment in addressing AMR. Gaining knowledge of how the public interacts with antibiotics in various contexts supports a holistic approach to AMR mitigation. behaviour and changing initiatives and fighting against AMR are effective in awareness campaigns. The study's findings might help tailor these efforts to specific populations, addressing knowledge gaps and misconceptions. The study contributes to future preparedness by identifying areas for targeted education and awareness efforts, ensuring that the fight against AMR remains ongoing and proactive.

1.6 **Theoretical framework**

Theoretical Framework: Knowledge and Practices Towards Antibiotics Use in Thulamela Municipality, Limpopo Province

The Health Belief Model (HBM) is one of the most widely used frameworks in health behaviour research. It was initially developed in the 1950s by social psychologists Irwin M. Rosenstock and others to explain and predict health-related behaviours. The model is based on the premise that individuals are more likely to engage in health-promoting behaviours if they perceive that they are at risk for a health problem, believe the health issue is serious, and believe that taking a specific action would reduce their risk (Rosenstock, 1974).This study aims to gain the knowledge and practices towards antibiotic use in Thulamela Municipality, focusing on public awareness, adherence and compliance to treatment, self-medication practices, and knowledge gaps. The theoretical framework deals with health behaviour theories and

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knowledge translation concepts to provide a structured approach to understanding these dynamics (Janz & Becker, 1984; Kang & Kim, 2015).

1.6.1 Theoretical Foundations

A. Health Belief Model (HBM)- The Health Belief Model (HBM) is used to gain more insight as to why individuals take or avoid health actions based on their perceptions of threats and benefits. It provides a theoretical framework to understand health-related behaviours, mainly in the context of antibiotic use.

1.6.2 Health Belief Model (HBM)

The Health Belief Model is often used in health research to understand individual health behaviours. It focuses on beliefs of individuals regarding health-related behaviour.

Key components of HBM include:

Perceived Susceptibility: How vulnerable individuals feel to a health issue.

Perceived Severity: The seriousness of the health problem if it occurs.

Perceived Benefits: The positive outcomes of adopting a health behaviour.

Perceived Barriers: The obstacles or challenges that may prevent individuals from engaging in health-promoting behaviours.

Cues to Action: External factors or prompts that encourage individuals to act (e.g., media campaigns).

Self-Efficacy: The confidence in one's ability to perform the health behaviour.

The HBM helps to assess the knowledge and attitudes of individuals in relation to perceived threats and benefits, which can influence their practices.

1. 6.3 Application: HBM

In the current study the Health Belief Model will help to investigate how aware the public is of their susceptibility to infections that may require antibiotics; assess the perceived seriousness of antibiotic resistance (AMR) and improper use of antibiotics; evaluate the perceived benefits of adhering to prescribed antibiotic treatments and avoiding self-medication; Identify obstacles that hinder proper antibiotic use, such as misinformation or misconceptions.

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In addition it may be easy to determine factors that prompt individuals to seek proper antibiotic treatment or adhere to prescribed guidelines, including healthcare provider recommendations and public health campaigns. Futuref studies can then explore and develop targeted education programs to address knowledge gaps and misconceptions. Inform policies to improve antibiotic stewardship and address barriers to adherence. As well as to Involve community leaders to promote better practices and understanding of antibiotics and AMR.

1.7 Definitions

Antimicrobial Resistance (AMR): Antimicrobial resistance refers to the ability of microorganisms, such as bacteria, viruses, fungi, and parasites, to evolve and develop resistance to the drugs designed to treat them. This resistance reduces the effectiveness of antimicrobial drugs, including antibiotics and antivirals, leading to treatment failures and increased health risks (WHO,2021). In this study, antimicrobial resistance refers to when microorganisms change when they are exposed to antibiotics drugs.

Antibiotics: Antibiotics are a class of antimicrobial drugs used to treat bacterial infections. They work by inhibiting the growth or killing bacteria (National library of medicine 2020). In this study, it refers to a type of antimicrobial substance active against bacteria.

Public Awareness: Public awareness refers to the extent to which individuals in the general population are informed and knowledgeable about antibiotics, antimicrobial resistance, and related health issues. It encompasses the understanding of the risks associated with misuse and overuse of antibiotics (kemshall and Moulden, 2019). In this study, it refers to the public level of understanding about the importance and implications of antibiotic use and antimicrobial resistance.

Attitudes towards Antibiotics and AMR: Attitudes represent individuals' beliefs, feelings, and evaluations regarding antibiotics and antimicrobial resistance. These attitudes can influence behaviours, including antibiotic use and adherence to prescribed treatments (WHO, 2021). In this study, it refers to the way of thinking or feeling about the use of antibiotics and antimicrobial resistance.

Misconceptions: Misconceptions refer to inaccurate or false beliefs held by individuals regarding antibiotics and antimicrobial resistance. These misconceptions can contribute to inappropriate antibiotic use (Henderson, 2020). In this study, it refers to the opinion that is incorrect based on faulty thinking or behaviour.

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1. Methodology

This study was nested within a bigger project titled “Acquisition of antibiotic resistant gut bacteria and impact of microbiota” project no: FSEA/22/MBY/04/0302.

Research methodology is a systematic framework used to solve the research problem by using the best and most feasible methods to conduct the research while aligning with the aim and objectives of the research (Pamplona, 2022).

2.1 Research approach

The study employed a quantitative approach. Quantitative research has been defined as the systematic investigation of phenomena through the collection and analysis of numerical data using statistical, mathematical, or computational methods (Adedoyin, 2020). This approach was ideal for the study because it enabled the researcher to reach a larger number of participants within a short period (Mohajan, 2018). Recent literature further emphasizes that quantitative methods often involve structured tools such as surveys or polls, rely on large sample sizes for generalizability, and utilize statistical techniques to uncover patterns, relationships, or causal effects, enhancing objectivity, replicability, and reliability (The Wide Vision, 2025).

2.2 Study design

A study design serves as the foundational blueprint for any research project, guiding how data are collected, analyzed, and interpreted. For this study, a descriptive cross-sectional research design was employed to assess public knowledge and practices related to antibiotic use. This design is particularly useful for generating a clear snapshot of the current state of a population at a specific point in time (Aljofan et al., 2024). It allows researchers to systematically collect detailed data on what individuals know, believe, and how they behave regarding antibiotic use, without manipulating any variables (Nkhonjera et al., 2023). According to recent methodological literature, descriptive studies are valuable for estimating the prevalence of health-related behaviors and attitudes in the general population, especially in the context of antimicrobial resistance (Alghamdi et al., 2025). The cross-sectional nature of this design made it appropriate for identifying trends and gaps in public awareness within a limited timeframe, enabling timely public health insights.

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2.3 Study setting

Area of study refers to a specific area or place (location or sites) where data was collected. The decision regarding the setting depends on the nature of the research question in Limpopo Province, Vhembe district Thulamela municipality in areas around Thohoyandou, Maniini, and Maungani village.

The study was conducted in two of the communities in Limpopo Province.

Limpopo which is one of the nine Provinces in South Africa is located in the Northern part of South Africa. It consists of five districts namely Capricorn, Mopani, Sekhukhune, and Waterberg district. The study was conducted in Vhembe, one of the districts that consist of four municipalities namely Makhado, Musina, Thulamela, and Collins Chabane municipality. Vhembe district municipality is one of the districts that covers 21 407km2 and has a population of over 1.1 million living in 274 480 households. Data was gathered in a natural setting at Maniini and Maungani villages. To maximise validity, the data was collected in the participants' preferred language. Thohoyandou, Maniini and Maungani are situated in the Thulamela municipality, in the Vhembe region of the Limpopo province. Maniini village has a population of about 6023 households, with 67,8% being of age 18 to 65; and Maungani has about 7271 households, with 63,5% being of age 18 to 65. The settlement is centered in semi-rural areas and is inhabited by Venda ethnic group largely. Data was collected in a natural environment where participants were comfortable and free.

2.4 Study population

A study population represents the full set of individuals or objects that meet predefined eligibility criteria and are of interest to the researcher (Willie, 2023; Polit & Beck, 2021). In this study, the population consisted of individuals residing in Vhembe District's Thulamela Municipality, specifically from Thohoyandou, Maungani village, and Maniini. This clearly defined population delineation ensured that all eligible participants had a genuine chance of inclusion, enabling meaningful descriptive and inferential outcomes (Willie, 2023). By operating within these geographic boundaries, this research adhered to recommended practices for defining an accessible population in descriptive studies (Nkhonjera et al., 2023). Accurate specification of the study population enhances validity and generalizability of findings related to public knowledge and practices around antibiotic use.

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2.4.1 Target population

The population is the group of interest of the researcher (Mnedisi,2022). The target population for this study included both males and females aged 18 and above, the study focused on both genders, and respondents were assessed in the community.

2.5 Sampling

Sample is a portion, part, or fraction of the whole group and acts as a subset of the population used in a variety of settings where research is conducted (Kenton W,2023).

Sampling methods describe how participants are chosen from this population (McCombes, 2023). In this study, residents of Thohoyandou, Maungani, and Maniini in the Vhembe District were sampled. As Berndt (2020) explains, sampling involves identifying subgroups within the population that exhibit relevant behaviors or characteristics. To ensure representativeness, probability sampling was used, with simple random sampling, so that every household in the defined population had an equal and known chance of being selected (Elfil & Negida, 2017; Sambodhi, 2025; Researcher. Life, 2025).

Sample size, the number of respondents, must be sufficient to support reliable conclusions (Kotrlik & Higgins, 2022). This study used the Yamane formula ($N/(1 + N\,e^2)$) to calculate the required sample size, with an output of 250 participants to ensure representativeness and allow for generalizability (Tepping, 1968; Reddit insights, 2024). A target sample of 250 respondents was thus identified, balancing statistical rigor and practical constraints.

A sample of 260 was then recruited in case of a default or incomplete questionnaire.

2.3.3 **Inclusion criteria**

Inclusion criteria refer to characteristics that the respondents must have to be included in the research study (Jabuli, 2017; Patino & Ferreira, 2018). The respondents for this study had to meet the following criteria:

- Respondents were selected from a specific age range, such as adults aged 18 and above.
- Respondents needed to have a certain level of proficiency in Tshivenda or English language to complete the survey or questionnaire effectively.
- Individuals willing to provide informed consent to participate in the study were included.
- Respondents that had sought healthcare services within a certain timeframe, such as in the past year, to ascertain antibiotic use.

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- Respondents of both genders were allowed to participate.

Exclusion criteria

The following was the exclusion criteria in the study:

- Respondents below 18.
- Respondents who did not provide informed consent to participate in the study.
- Those who have never used antibiotics before.

2.6 Measurement instrument

(Leigh,2023) defines research instruments as the measurement tool designed to obtain data on the topic of interest from research subjects. The researcher used a survey questionnaire, questionnaire as the research instrument in this study.

Tool

Bhandari (2023) defines a questionnaire as a list of questions or items used to gather data from respondents about their attitudes, experiences, or opinions. Questionnaires were used as the measurement tool for the knowledgeand practices of community members towards antibiotic use in the Limpopo province consisting of 3 sections.

The questionnaires consisted of closed-ended questions in the form of a Linkert scale. The items on the questionnaire ensured that all the objectives were addressed. This enabled an expeditious data collection process such that many respondents were reached within a short span of time. The questionnaire was in English however, there was a soft copy and a few printed hard copies for the Tshivenda version for those who may not understand English and prefer vernacular language. The questionnaires had the following sections:

SECTION A: RESPONDENTS' DEMOGRAPHIC INFORMATION

This section comprised of respondent’s demographic characteristics, for example, age, education, marital status, ethnic group and etc.

SECTION B: RESPONDENTS' KNOWLEDGE REGARDING ANTIBIOTIC USE

This section comprised a Likert scale with the option to strongly disagree, disagree, strongly agree, or agree:

- Questions include general knowledge items such as whether respondents understand the difference between antibiotics and other medication.

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- Action and use, for example, “antibiotics speed up the recovery from most coughs and colds”.
- The side effects, for example, “if you get side effects during a course of antibiotics treatment you should stop taking them as soon as possible”.

SECTION C: THE USE OF ANTIBIOTICS, MEDICATION UNDERSTANDING AND USE SELF-EFFICACY

- This section includes the use of antibiotics.
- Items also address the correct way of taking medication.

2.5. Validity and Reliability

In this study, content validity was used to ensure that the research instrument appropriately and comprehensively covered the key aspects of the study’s objectives. Content validity is a crucial component of instrument development and refers to the degree to which the items on a questionnaire adequately represent the construct being measured. To establish this, the questionnaire items were mapped directly to the study’s research questions and objectives. Following best practices, the instrument underwent expert review by academic supervisors and faculty specialists in public health and epidemiology. This process ensured conceptual alignment, relevance, and comprehensiveness. According to a recent study conducted in Lebanon assessing knowledge, attitudes, and practices (KAP) toward antibiotic use, content validity was confirmed through item-level and scale-level Content Validity Indices with acceptable thresholds set at ≥0.78 and ≥0.90, respectively (Salameh et al., 2022).

The questionnaire used in the current study was adapted from several previously validated instruments employed in similar research on antibiotic use and resistance in various countries. This adaptation was guided by findings from the Antibiotic Knowledge and Consumption Tool which demonstrated robust content and construct validity in a multinational context (Nguyen et al., 2022). Adaptation steps included item refinement, language localization, and pre-testing to maintain structural integrity and cultural relevance.

To establish reliability, particularly internal consistency, the study employed Cronbach’s alpha as a statistical measure to assess the extent to which multiple items in the same section of the instrument were correlated and measured the same underlying concept. A Cronbach’s alpha value ≥0.70 is generally accepted as indicating acceptable reliability for psychological and behavioral measures (Nguyen et al., 2022). In the current study, the knowledge section

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yielded an alpha of 0.72, while the section measuring antibiotic use behaviours showed an alpha of 0.71. These values indicate that the instrument items were reliably capturing the intended constructs. Additional evidence from recent KAP studies, including one conducted among healthcare students in the Middle East, further supports the use of Cronbach's alpha alongside exploratory factor analysis for evaluating scale reliability and dimensionality (Hussein et al., 2023).

Taken together, these validation and reliability procedures ensured that the questionnaire used in this study was both scientifically sound and contextually appropriate for assessing public knowledge and practices related to antibiotic use.

Face validity: refers to whether the instrument appears to measure what it intended to measure, based on judgement, this was assessed through expert review and pilot testing. Experts in infectious diseases, and public health were asked to review the instrument, to assess whether the questions appeared to measure what was intended.

Content validity; this assessed whether the instrument covered all aspects of the construct being measured, it had been achieved by having a subject matter experts evaluated whether the instrument items represented the domain of the construct. Experts had rated the relevance of each item.

2.6. Pilot testing

In order to ascertain rigor, validity and reliability, pilot testing awas conducted on 20 individuals who possessed similar characteristics with the study respondents. The process was done to ensure clarity of the instructions, items on the questionnaire and also as an opportunity to identify potential issues so that such could be resolved. This process was done and based on feedback the questionnaire was user friendly. In the Tshivenda version various dialects had to be accommodated to ensure that local language was used in the questionnaire.

2.7 Data collection and method

Data collection methods are ways of directly measuring variables and gathering information. Thid process allows the researcher to gain first-hand knowledge and original insights into the research problem (McCombes,2023) primary data collection was done by the researcher.

The researcher submitted a research proposal for departmental review, Faculty Higher Degree Committee review and Faculty Executive review. Ethics approval was received from the University of Venda, research ethics committee, approval number FSEA/22/MBY/04/0302.

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Before data collection, study received ethical clearance and approval from Human and Clinical Trial Research Ethics Committee (HCTREC). The department of Health was also involved for the bigger project and approval was sought. Data collection methods in quantitative research involve systematically gathering numerical data to answer research questions. Quantitative data collection methods aim to provide structured and measurable information about the study's variables.

After negotiating entry, flyers were put up around the communities. Flyers with the aforementioned parameters for the respondents (people aged between 18 and 65 years old) were also putted up in these community areas. During the data collection process, the researcher approached respondents, a rapport was built with each respondent. The researcher presented themselves as a student from the University of Venda, conducting a study as a requirement for the completion of a Master's Degree. During this time, the purpose of the study was explained to the respondent.

After signing the consent form, a questionnaire was self-administered by respondents individually in English however, the researcher administered it for the illiterate respondents who were willing to participate. Respondents were instructed on how to complete the questionnaires to ensure completeness and it took about 25 minutes to complete each questionnaire. The researcher spent one to two months collecting data.

The researcher conducted a quality check when respondents had completed to fill the questionnaire and, in that way, errors were identified and rectified consequently leading to 100% completeness of all surveys. The data was transferred from hard copies that the respondent filled to Microsoft forms (online/ soft copies) of the questionnaire, after that data was then transferred to Excel Microsoft, and later transferred to SPSS for clearing and analysis.

2.8. Plan for data management and analysis

The purpose of data analysis was to extract useful information from data and communicate findings based on the data analysed (Johnson,2023). Effective data management is crucial for ensuring the quality, security, and accessibility of the quantitative data collected.

Data management

Data management in research refers to the systematic handling of data throughout its lifecycle from collection through documentation, storage, sharing, and long-term preservation

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(Cunha-Oliveira et al., 2024). It involves organizing data in structured formats, applying metadata for clarity, ensuring secure and ethical storage, and implementing preservation strategies that maintain data integrity and facilitate future reuse (SpringerLink, 2024). Proper data management is essential for ensuring transparency, reproducibility, and credibility in research and is a foundational best practice across disciplines.

The data was collected and entered into a computer database and checked for completeness and accuracy. The data was stored securely and confidentially, and access was restricted to the research team only. The data from the questionnaire's hardcopies was transferred to Google Forms, then to Excel sheets, and then conferred to SPSS software version 29 for analysis.

Data analysis

According to Arshia (2024), data analysis is the structured process of organizing, examining, and interpreting raw data to extract meaningful insights that support the study's objectives. In this study, data collected through questionnaires were analyzed using IBM SPSS Statistics, a software commonly used in social and health sciences for quantitative analysis. The analysis involved descriptive statistics such as frequencies, tables, and percentages to summarize and present participant responses clearly and concisely. To maintain data integrity, the research team implemented a multi-step quality assurance process: data were initially verified from hard copy questionnaires against entries in Google Forms, then cross-checked in Excel spreadsheets before final import into SPSS. Additionally, the entire analysis procedure was subjected to peer review within the research team to enhance accuracy and reliability.

To simplify data interpretation, Likert scale responses were recoded: participants selecting "strongly agree" or "agree" were grouped as "agreed," while those selecting "strongly disagree" or "disagree" were classified as "disagreed." For evaluating respondents' knowledge, scores were categorized into two levels: scores from 0 to 6 were defined as inadequate knowledge, and scores from 7 to 13 as adequate knowledge. This approach aligns with recommended practices for categorizing knowledge and using SPSS for analyzing survey data in applied research (Arshia, 2024; Bryman, 2021).

2.9. Ethical consideration

Ethical consideration in research is a set of principles that guide designs and practices. Ethics refers to the correct rules of conduct necessary when carrying out research. Researchers have a moral responsibility to protect research participants meaning that they must abide by certain

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moral principles and rules of conduct (Mcleod, 2023) the study adhered to the following ethical principles: proposal was submitted and presented to the Department of Public Health, Faculty of Health Sciences Degree Committee (FHDC) for evaluation and quality assurance, Executing Faculty of Health Degree Committee (EFHDC) for evaluation and quality assurance, Clinical Trails Research Ethics Committee (HCTREC) for ethical clearance , thereafter approval will be sought from University Higher Degree Committee (UHDC). The approval letter was used to seek permission to conduct the study from the communities and Department of Health.

2.9.1 Permission

In order to notify the chief of villages about the study, the researcher had to explain theaim , objectives and rationale. In this study, the researcher shared about the type of research being done, its purpose, and how the researcher will gather information. Respondents were requested to part in the study.

2.9.2 Informed consent

To abide by ethical consideration, the researcher needed to inform the participants about all the activities in the research and to enable respondents to make informed consent before starting research work. The researcher used preferred language to explain what the study entailed, the purpose, potential risks, benefits, rights as respondents and what they are required to complete. Informed consent can be in writing, verbalised or in audio recording (Brink et al,2018). In this study, the selected individuals were asked if they would want to participate in the study after it has been described, the purpose, risk and benefits, then obtain voluntary consent to participate and emphasise the right to withdraw at any time.

2.9.3 Written consent

These are a formal agreement document where respondents acknowledge and understand the study's details, risks, and benefits. The consent form should be written in clear, understandable language and include information about the study's purpose, procedures, potential risk, benefits, confidentiality measures, and the respondents right to withdraw. Participants had to sign the form voluntarily, without any coercion, receive a copy, and the researcher will also receive a copy. It is best to keep their identity a secret.

2.9.4 Confidentiality

It describes a situation in which a researcher is aware of the identification of respondents in a study project but takes precautions to prevent others from learning that identity. Keeping

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knowledge private requires maintaining secrecy, thus the researcher must be able to keep to him or herself in order to safeguard the source. The participant's identity in the study must bes kept confidential and real names must never be disclosed. In this study the researcher ensured protection of private information, the records were secured in a password protected file, and the researcher used a code only known by the research team and encrypt identifiable data and ensured the respondents identities were not linked to the data. The researcher will ensure proper disposal of study data or documents when the time comes according to the regulations stipulated.

2.9.5 Protection of participants from any harm

According to McLeod (2023) protection of participants from harm is that the researcher must not embarrass, frighten, offend or harm respondents, they should not be exposed to risks greater than or additional to that encounter in their normal lifestyles. In this study the researcher protected respondents from physical or mental health including stress by protecting any information provided to the study, the researcher never lied or deceive or hide any information from the respondents or misinterpret information provided during data collection. The researcher did not conduct the study in the environment that was to cause harm to the respondents and allowed the participant to have space to respond without others listening.

2.9.6 Privacy

The desire to limit others' access to oneself is referred to as privacy. The research proposal should describe privacy protection measures, such as how the investigator will obtain participants or participant information. Information provided by respondents was not shared. In this study the researcher encrypted computer-based files, store documents in locked file cabinet and remove personal identifiers study documents.

2.9.7 Rights to self determination

The respondents must also be informed that they are only required to participate voluntarily and that they are free to leave the study at any time with no repercussions. They must also be informed that leaving the study does not entail receiving any compensation. In this study respondents were given a free will to withdraw at any time and assurance that they will not be forced to participate.

2.9.8 Anonymity

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According to Hoft (2021) anonymity is a condition in which the identity of individual's subjects is not known to the researcher. In this research study the researcher did not collect identifying information of respondents (names, emails, address and cell phone numbers). The privacy of the respondents were protected by using pseudonyms and ensuring that their personal information and identities are kept confidential and not in one file to avoid linking of such files to the data.

2.9.9 Voluntary participation

Voluntary participation involves ensuring that individuals freely choose to participate in a study without any form of coercion or manipulation. This ensures autonomy and right to choose whether to participate or not. In this study the researcher provided clear information about the study, potential risk, benefits, and the option to withdraw at any time without consequences and voluntary participation was emphasised.

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SECTION B

JOURNAL ARTHORS GUIDES AND MANUSCRIPTS

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2.1 Manuscript 1

2.1.1 JOURNAL ARTHORS GUIDE

Occupational Health Southern Africa

Author Guidelines

Guidelinesforauthors.pdf

This section focused on the reviewed systematic literature on the knowledge, attitudes, and practices towards antibiotic use in South Africa

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Manuscript 1

Title of the manuscript: Knowledge, attitudes and practices towards antibiotic use in South Africa: A systematic review

(***Occupational Health Southern African Journal).***

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The Knowledge, Attitudes, and Practices towards antibiotic use in South Africa: A systematic literature review

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Abstract

Introduction: Antibiotics are a cornerstone of modern medicine, saving countless lives and revolutionizing the treatment of bacterial infections. However, the misuse and overuse of antibiotics have contributed to the emergence of antibiotic-resistant bacteria, posing a significant threat to global health. South Africa, with its high burden of infectious diseases, is particularly vulnerable to the consequences of antibiotic resistance.

Purpose: The purpose of this systematic literature review is to explore the knowledge, attitudes, and use of antibiotics in South Africa

Methodology: This systematic review adopted the framework explained by Arksey and O'Malley in (2005). The Arksey and O'Malley steps were adopted: Research question, Identification of applicable studies, selecting studies, Data charting, Collating, summarizing, and reporting of data

Results: 1754 articles were identified through the database search: Google Scholar, Science Direct, and PubMed, and the results ranged from 2015 to December 2024. A total of 1450 articles remained after removing the duplicated articles and screened for title. 304 articles were left after screening the research topics for abstract screening. In the final selection, 50 studies went for the full text review, which harvested 15 articles from the databases that were included as the studies met the criteria. Findings revealed the following themes: the attitude towards antibiotics in South Africa, the use of antibiotics in South Africa, the knowledge regarding antibiotics in South Africa. Variation of negative and positive attitudes were found with inadequate knowledge regarding certain aspect off antibiotics. Addressing these factors leading to misuse is critical to promoting responsible antibiotic use and reducing the development of antibiotic-resistant bacteria.

Key words: Antibiotics, Attitudes, Knowledge, Use, South Africa; Practices, AMR

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Introduction

Antibiotics are a cornerstone of modern medicine, saving countless lives and revolutionizing the treatment of bacterial infections. However, the misuse and overuse of antibiotics have contributed to the emergence of antibiotic-resistant bacteria, posing a significant threat to global health (World Health, 2020). The World Health Organization (2019) reported that AMR is estimated to cause at least 700,000 deaths each year globally with more than 35,000 people dying each year in the United States, alone (United States Centers for Disease Control and Prevention) making it an urgent public health problem; the problem of AMR, however, is also common in low and middle-income countries (Alnasser et al., 2021) It is estimated that by 2050, approximately 10 million people will die annually from uncontrollable infections due to antibiotic resistance (O' Neill 2016: 12). Studies from various countries, including Rwanda, South Africa, and Libya, highlight the urgency of assessing knowledge, attitudes, and practices (KAP) towards antibiotic use, among different populations.

South Africa, with its high burden of infectious diseases, is particularly vulnerable to the consequences of antibiotic resistance (National Institute for Communicable Diseases, 2020). South Africa has a complex healthcare system, with a mix of public and private sector providers. The country has made significant progress in improving access to healthcare, but challenges persist, particularly in rural and resource-poor areas (Coovadia, 2019). The use of antibiotics in South Africa is regulated by the National Department of Health, which has implemented guidelines and policies to promote responsible antibiotic use (National Department of Health, 2019).

Despite these efforts, studies have shown that antibiotic misuse and overuse remain widespread in South Africa. A study conducted in the Western Cape province found that 45% of patients received antibiotics for viral infections, highlighting the need for improved prescribing practices (Kredo, 2015). Another study conducted in KwaZulu-Natal province found that 70% of patients self-medicated with antibiotics, underscoring the importance of public education and awareness (Mabaso, 2018). Similarly, studies in South Africa explored patients' KAP regarding antibiotics and in Cape Town, the focused was on pregnant women (Bulabula et al., 2017). The significance of understanding patients' knowledge and attitudes is essential to develop interventions needed to encourage prudent antibiotic use (Farley et al. 2019: 1).

This systematic review aims to explore the attitude, knowledge, and use of antibiotics in South Africa, with a focus on identifying areas for improvement and informing strategies to promote responsible antibiotic use. The objectives aimed at determining the knowledge of

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antibiotics in South Africa, the attitudes towards antibiotics in South Africa and to investigate the use of antibiotics in South Africa

Objectives of the study

To determine the knowledge of antibiotics in South Africa.

To explore the attitudes towards antibiotics in South Africa.

To investigate the use of antibiotics in South Africa.

Methodology

This systematic review adopted the framework explained by Arksey and O'Malley in (2005). The following steps were adopted as explained by Arksey and O'Malley: which included

Research question identification; Identification of applicable studies; Selecting studies; Data charting; Collating, summarizing, and reporting of data.

Identifying research question

The literature search was done to identify the available scientific information about the knowledge, attitudes, and the use of antibiotics in South Africa to answer the following research question:

- How much is known regarding the level of knowledge, the attitudes and practice towards antibiotics in South Africa?

Search strategy

Literature research was conducted using databases: Google Scholar, Science Direct, and PubMed. These databases were selected to cover a wide range of disciplines regarding the knowledge, attitudes, and the use of antibiotics in South Africa. The keywords used to search for information in various databases: knowledge, attitudes, use, antibiotics, and South Africa. The search yielded a total of 1754 studies; 1146 studies remained after excluding duplicates to screen titles and a total of 1450 studies were screened for and abstracts, out of 1146 studies retrieved only 304 studies were reviewed for full text from the search conducted. A total of 15 studies were then selected and reviewed as they were found to be most relevant to the aim of the review. The searched databases and keywords for the review are indicated in Table 1.

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Table 1: List of the databases used and search key terms, and index terms

Database	Key search words
PubMed, Science Direct, and Google Schoolar	Knowledge, attitudes, use, antibiotics and South Africa and practices and antibiotics;

Eligibility criteria

The eligibility of the included studies was based on the concept context framework. The main aim is to explore the knowledge, attitudes, and use of antibiotics in South Africa. The articles that were published between January 2015 and December 2024 were included. Studies considered were conducted in South Africa, published in English in peer reviewed journals The articles that were not written in English were excluded. All studies that could not be accessed for free as full text; qualitative study designs and unpublished data were excluded.

Charting the data

The charting form was designed by the researcher to select relevant studies based on the characteristics, which included, year of publication, the type of publication, study area, the type of information included, challenges and limitations. The materials collected for the literature review contained information on the author, publication date, the purpose, aim and research question the geographical location of the study, the total population and sample, study approach and design. The collected data was organized to respond to each research question.

Quality appraisal

The critical appraisal skills program tool (CASP) was used to evaluate the quality of the studies that are included. The questions were designed to modify the CASP quantitative checklist tool. Every question contained a comment box to indicate the reasons for the given responses. The quality was assessed by the reviews, and the final scores were determined for consensus. The checklist consists of ten questions, each measuring various methodological aspects of research. According to Long et al. (2020), the CASP tool was devised for use with health-related research and was therefore deemed appropriate for the current review. Table 2 shows how the chosen studies were critically appraised using CASP

Collecting, summarizing, and reporting the data

The thematic analysis approach was used to analyze the results of this literature review. The codes were initiated. The information discussed was based on the created themes. The data

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was reviewed and defined to answer each question of the study. The findings were discussed and finalized by three independent individuals. The study findings were checked on how they relate with the aim of the study and other researchers in the field. The collected data was categorized into subheadings. The reporting and analyzing of the findings were guided by the identified research questions

Results

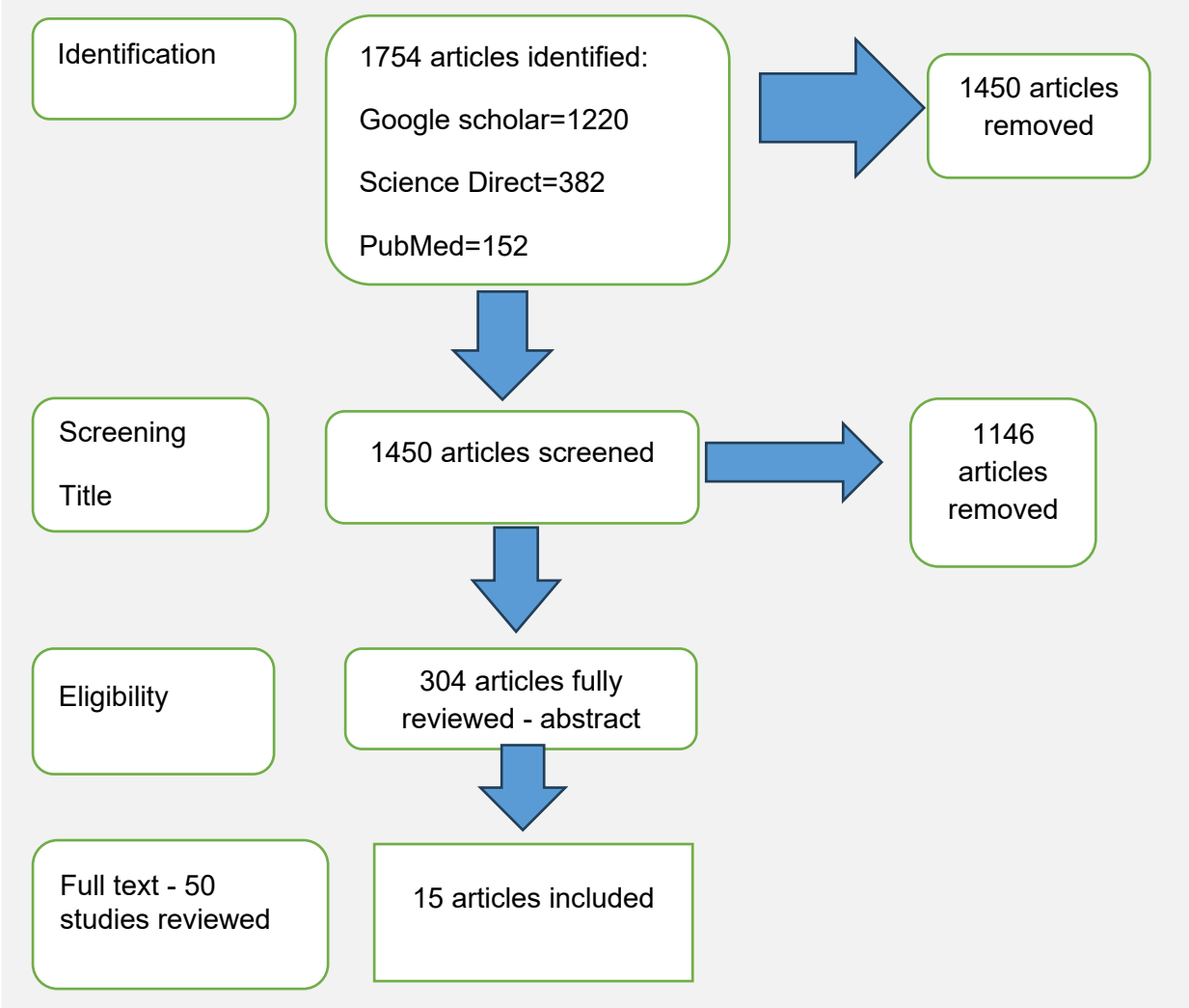


Fig. (1). Adapted Flow chart of the literature search for the included and excluded studies.Wu & Lin, Moher D, Liberati A, Tetzlaff J, Altman DG,The PRISMA Group (2009).

1754 articles were identified through the database search. A total of 1146 articles remained after removing the duplicated articles and screening for titles. 304 articles were screened focusing on the abstracts. 50 studies were reviewed full text where 15 articles from the

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databases were included for the review. Studies excluded focused on antibiotics and other diseases while some where clinical in nature.

Table 2: CASP for selected studies

Study authors & year	Title	Study Appraisal
Balliram. 2021	Knowledge, attitudes and practices of doctors, pharmacists and nurses on antimicrobials, antimicrobial resistance and antimicrobial stewardship in South Africa.	80%
Chibabhai, V, 2024	ICU nurses' knowledge and practice on intravenous antibiotic administration in Gauteng hospitals.	70%
Farley E, et al., 2019	Knowledge, attitudes, and perceptions of antibiotic use and resistance among patients in South Africa	85%
Huttner B, 2015	Impact of a multidisciplinary antibiotic stewardship program on patient outcomes and antibiotic use.	85%
Kredo T, 2015	Antibiotic prescribing for acute respiratory tract infections in primary care in the Western Cape, South Africa.	83%
Kumar S, 2017	Healthcare professionals' knowledge, attitudes, and practices regarding antibiotic use and resistance	83%
Linder J.A, 2015	Antibiotic prescribing for acute respiratory tract infections in primary care	83%
Mabaso M.L, 2018	Antibiotic stewardship in South Africa: A qualitative study of healthcare professionals' knowledge, attitudes, and practices.	80%
Mabaso M.L, 2019	Public Knowledge and attitudes towards antibiotic use and resistance in South Africa.	81%
Maruve, M. T. 2022	KAP of veterinarians on antibiotic use, resistance, and containment in South Africa.	60%
Mokhele, K. 2025	Validation of the CAMUS tool to measure antibiotic knowledge and use in South African primary healthcare settings.	90%
Mokhutsoane, L., 2023.	Knowledge, attitudes and practices of farmers on antibiotic use, resistance and stewardship in food animal production systems in	70%

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	KwaZulu-Natal, South Africa.	
NDOH, 2019	National Department of Health (NDOH). (2019).	78%
Ramchurren k, 2017	Patients knowledge, attitudes and practices regarding antibiotic use at a regional hospital in KwaZulu natal, south Africa	70%
Sullivan, M.,2022	Knowledge and perceptions of final-year nursing students regarding antimicrobials, AMR, and antimicrobial stewardship in South Africa.	80%

Characteristics of included studies.

The study characteristics (Table 3) were found to further justify the studies included. The included studies were those published within the previous 10 years with the acceptance that the area of interest is less researched. The characteristics of the included studies involved the author, studies' year of publication, design, setting where the study was conducted, study sample, findings, and limitations (Table 3).

Table 3. characteristics of included studies

Authors	Country	Purpose of the study	Design	Sample	Findings	Limitation
Balliram. (2021)	South Africa	To assess the knowledge, attitudes, and practices (KAP) of doctors, pharmacists, and nurses on AMR and stewardship.	Quantitative cross-sectional	Healthcare professionals (doctors, nurses, pharmacists)	Moderate to high awareness of AMR among professionals; gaps in practice and inter-professional communication.	Limited generalizability due to sample being from selected hospitals; possible self-reporting bias.

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Chibabhai, (2024)	South Africa	To assess ICU nurses' knowledge and practices regarding IV antibiotic administration.	Quantitative observational	ICU nurses in Gauteng hospitals	Identified knowledge gaps in IV administration protocols; inconsistent adherence to best practices.	Limited to ICU settings in one province; results not generalizable to all nursing contexts.
Farley et al. (2019)	South Africa	To assess knowledge, attitudes, and perceptions of antibiotic use and resistance among patients	Cross-sectional study	Patients in South Africa	Many patients had limited knowledge of antibiotic resistance; misconceptions about antibiotic use were prevalent	Self-reported data may introduce bias
Huttner (2015)	Not specified	To evaluate the impact of a multidisciplinary antibiotic stewardship program on patient outcomes and antibiotic use	Observational study	Healthcare facilities implementing stewardship programs	Reduced antibiotic use and improved patient outcomes observed	The lack of a control group limits causal inference

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Kredo (2015)	South Africa	To investigate antibiotic prescribing patterns for acute respiratory tract infections in primary care	Retrospective study	Primary care physicians in Western Cape	High rates of inappropriate antibiotic prescribing for respiratory infections	Study limited to Western Cape, may not be generalizable
Kumar (2017)	Various countries	To review healthcare professionals' knowledge, attitudes, and practices regarding antibiotic use and resistance	Systematic review	Multiple studies across different healthcare settings	Knowledge gaps exist among healthcare professionals, and stewardship programs improve prescribing practices	Variability in study designs affects comparability
Linder (2015)	Not specified	To review antibiotic prescribing for acute respiratory tract infections in primary care	Systematic review	Multiple studies	Over prescription of antibiotics for respiratory infections is common	Studies included varied in quality and methodology
	South Africa	To explore healthcare professiona	Qualitative study	Healthcare professio	Awareness of stewardship is high, but	Small sample size,

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Mabaso (2018)		ls' knowledge, attitudes, and practices regarding antibiotic stewardship		nals in South Africa	implementation barriers exist	findings may not be generalizable
Mabaso (2019)	South Africa	To examine public knowledge and attitudes toward antibiotic use and resistance	Cross-sectional study	The general public in South Africa	Public knowledge is low, with misconceptions about antibiotic use prevalent	Self-reported data may introduce bias
Maruve, (2022)	South Africa	To investigate veterinarians' KAP on antibiotic use and resistance containment.	Quantitative survey	Registered veterinarians in South Africa	Moderate knowledge of AMR, but poor application of stewardship and lack of record-keeping practices.	Low response rate; lack of qualitative data for deeper insights.
Mokhele, (2025)	South Africa	To validate a tool (CAMUS) for measuring antibiotic knowledge and use in	Tool validation study	Patients in primary healthcare (PHC) settings	CAMUS tool found reliable and useful in identifying public misconceptions and	Tool needs further testing across more diverse regions and

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		PHC settings.			knowledge gaps.	demographics.
Mokhutsoane (2023)	South Africa	To examine farmers' KAP on antibiotic use, resistance, and stewardship in food animal systems.	Mixed-methods	Farmers in KwaZulu-Natal	Limited knowledge of AMR; antibiotics often used without veterinary oversight; economic motivations influence use.	Regional focus limits wider applicability; potential bias in self-reporting practices.
NDOH (2019)	South Africa	To provide national guidelines for antibiotic treatment	Guideline documents		Standardized recommendations for antibiotic use and stewardship	It may not reflect regional resistance patterns or emerging data.
Ramchurren, 2017	South Africa	To assess patients' KAP regarding antibiotic use at a regional hospital.	Cross-sectional survey	Hospital patients in KwaZulu-Natal	Found misconceptions about indications for antibiotic use; many patients discontinued antibiotics early.	Hospital-based sample may not reflect community-level understanding.

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Sullivan,(2022)	South Africa	To explore final-year nursing students' perceptions of antibiotics, AMR, and stewardship.	Descriptive qualitative	Final-year nursing students (n = ~30)	Students were aware of AMR concepts but lacked confidence and practical exposure to stewardship strategies.	Small sample size and limited to one university; findings may not reflect national trends.

Results and discussion

The attitude towards antibiotics in South Africa

The use of antibiotics has become a critical issue in public health, with the emergence of antibiotic-resistant bacteria posing a significant threat to global health (WHO, 2015). Attitudes towards antibiotics use play a crucial role in shaping prescribing behaviour and patient adherence. This review explored the attitudes towards antibiotics use among healthcare professionals and the general public, highlighting the factors that influence these attitudes and the implications for antibiotic stewardship.

Healthcare professionals' attitudes towards antibiotic use are influenced by various factors, including their knowledge and experience (Kumar, 2017). A study conducted in South Africa found that healthcare professionals who had received training on antibiotic use had more positive attitudes towards antibiotic stewardship (Mabaso, 2018). Balliram (2021) and Mabaso (2018) found that some professionals viewed stewardship policies as administrative burdens rather than necessary clinical tools. Similarly, Sullivan (2022) noted that final-year nursing students were hesitant to participate in stewardship discussions, citing a lack of confidence and experience. In contrast, a study conducted in the United States found that healthcare professionals who had practiced for longer periods had more negative attitudes towards antibiotic use, citing concerns about resistance and side effects (Linder, 2015).

Similarly, the general public's attitudes towards antibiotic use are also influenced by various factors, including their knowledge and experiences. A study conducted in the United Kingdom found that patients who had received education on antibiotic use had more positive attitudes

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towards antibiotic stewardship (Huttner, 2016). Studies such as those by Farley et al. (2019), Mabaso (2019), and Ramchurren (2017) revealed that many individuals in the general public expect antibiotics for non-bacterial illnesses, particularly viral respiratory infections. This expectation exerts pressure on healthcare providers and encourages unnecessary prescriptions. Additionally, there is a prevalent belief that it is acceptable to stop taking antibiotics once symptoms improve, indicating poor understanding of proper treatment adherence. In contrast, a study conducted in Australia found that patients who had experienced adverse effects from antibiotics had more negative attitudes towards antibiotic use (Weeks et al., 2018).

The implications of these attitudes towards antibiotics use are significant. Healthcare professionals' attitudes can influence their prescribing behaviour, with those holding more positive attitudes towards antibiotic stewardship being more likely to prescribe antibiotics judiciously (Kumar, 2017). Similarly, the general public's attitudes can influence their adherence to antibiotic treatment, with those holding more positive attitudes towards antibiotic stewardship being more likely to complete their treatment (McNulty, 2017)

Attitudes towards antibiotics in South Africa have been a subject of interest in recent years. A systematic review of studies on knowledge, attitude, and practice of health practitioners towards antibiotic prescribing and resistance in developing countries, including South Africa, found that healthcare professionals' attitudes towards antibiotics were a major determinant of prescribing behaviour (Farley, Van den Bergh, Coetzee, Stewart & Boyles, 2019).

Veterinary and Agricultural Attitudes, Mokhutsoane (2023**)** and Maruve (2022) found that economic pressures often influenced the continued use of antibiotics for growth promotion and disease prevention. Many farmers and some veterinarians did not perceive AMR as an immediate risk to public health, and this minimized their motivation to change practices.

In South Africa, specifically, a scoping review of antimicrobial resistance, antibiotic prescribing practices, and antimicrobial stewardship in healthcare settings revealed that there is a need for improved prescribing practices, increased education, and awareness among healthcare workers and students (Porter, Owens & Breckons, 2021). The review highlighted that South Africa has measures in place to combat antimicrobial resistance, but inconsistencies were found between the private and public health sectors.

The knowledge regarding antibiotics in South Africa

Knowledge regarding antibiotics use is essential for healthcare professionals and the general public to promote responsible use and combat antibiotic resistance. This part of systematic

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literature review will explore the knowledge regarding antibiotics use in South Africa, highlighting the gaps and implications for antibiotic stewardship.

Healthcare professionals, particularly doctors and pharmacists, showed moderate to high levels of antibiotic-related knowledge, as reported by Kumar (2017**)** and Balliram (2021)**.** However, knowledge gaps were noted among nurses and allied health professionals, particularly regarding drug administration protocols, as highlighted by Chibabhai (2024) in ICU settings.

A study conducted in South Africa found that healthcare professionals had a good level of knowledge on antibiotic use, but gaps existed in their knowledge on local antibiotic resistance patterns (Kredo, 2015). Another study found that healthcare professionals' knowledge on antibiotic use was influenced by their training and experience (Mabaso, 2018). Healthcare Professional Knowledge.

The general public's knowledge regarding antibiotics use is also essential for promoting responsible use. A study conducted in South Africa found that the general public had limited knowledge on antibiotic use and resistance, highlighting the need for public education and awareness campaigns (Kumar, 2017). Studies by Farley et al. (2019)**,** Mabaso (2019)**,** and Mokhele (2025) revealed widespread gaps in public understanding of what antibiotics treat and how resistance develops. While awareness of the term "antibiotic resistance" was moderately high, there was poor comprehension of its causes and implications. The CAMUS tool validated by Mokhele, demonstrated varied results, indicating the need for tailored educational outreach.

The gaps in knowledge regarding antibiotic use in South Africa have significant implications for antibiotic stewardship. The lack of knowledge on local antibiotic resistance patterns among healthcare professionals can lead to inappropriate prescribing and use (Kredo, 2015). Similarly, the limited knowledge of antibiotic use and resistance among the general public can lead to misuse and overuse (Week, 2018).

The use of antibiotics in South Africa

The use of antibiotics in South Africa is a critical issue, with the emergence of antibiotic-resistant bacteria posing a significant threat to public health (WHO, 2015). Antibiotics are essential for treating bacterial infections, but misuse and overuse have contributed to the development of antibiotic-resistant bacteria (Kredo, 2015) and Linder, 2015). In South Africa, antibiotics are widely used in both the public and private healthcare sectors (Mabaso, 2018).

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However, studies have shown that antibiotics are often prescribed inappropriately, particularly for viral infections such as the common cold and flu (Kredo, 2015). This is concerning as antibiotics are ineffective against viral infections and can contribute to the development of antibiotic-resistant bacteria (WHO, 2015). Healthcare professionals' knowledge and attitudes towards antibiotic use are influential in shaping their prescribing behavior (Mabaso, 2018).

Studies have shown that healthcare professionals who have received training on antibiotic use and resistance are more likely to prescribe antibiotics judiciously (Kredo, 2015). However, a study conducted in South Africa found that many healthcare professionals lacked knowledge on local antibiotic resistance patterns, highlighting the need for ongoing education and training (Mabaso, 2018).

The general public's knowledge and attitudes towards antibiotic use are also important factors influencing antibiotic use in South Africa (Weeks, 2018). A study conducted in South Africa found that the general public had limited knowledge on antibiotic use and resistance, highlighting the need for public education and awareness campaigns (Mabaso, 2019).

Mokhutsoane (2023) found that many South African farmers used antibiotics without prescriptions, and often for non-therapeutic purposes such as growth promotion. Similarly, Maruve (2022) identified weak regulation and poor documentation practices among veterinarians, contributing to unmonitored and excessive use. These findings raise concerns about resistance transmission from animals to humans and call for integration of AMR policies across sectors

To address the challenges of antibiotic use in South Africa, the government has implemented various initiatives, including the development of national guidelines for antibiotic use and the establishment of antibiotic stewardship programs (NDOH, 2019). However, there is still more to be done to promote responsible antibiotic use and reduce the development of antibiotic-resistant bacteria.

Conclusion

In conclusion, the use of antibiotics in South Africa is a complex issue, influenced by various factors, including healthcare professionals' knowledge and attitudes, the general public's knowledge and attitudes, and government initiatives. Addressing these factors is critical to promoting responsible antibiotic use and reducing the development of antibiotic-resistant bacteria.

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Ethics approval and consent to participate

This study is part of my master's studies at the University of Venda. The permission to conduct this systematic literature review was granted by the University of Venda Research Ethics Committee (Ethics number: **FSEA/22/MBY/05/1804**)

Consent for publication

All authors give consent for publication; MM, TT and AM were involved in design and write up of the review.

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Conflict of interest

All authors declare no conflict of interest for this systematic review

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2.2 Manuscript 2

2.2.1 Authors guidelines

The manuscript was prepared based on the “Southern African journal of infectious diseases” as found in the following link below.

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Instructions to Authors – Southern African journal of infectious diseases.

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Knowledge and practices towards antibiotic use in Rural communities of Limpopo Province.

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ABSTRACT

Background: Antibiotics' resistance is a public health threat with about 700,000 deaths resulting from infections not responding to antibiotic therapies, every year.

Purpose: The study aimed to determine the knowledge and practices towards antibiotic use in the Vhembe district of Limpopo Province..

Methods: The study was quantitative in nature, data from 250 respondents were collected utilising a questionnaire and descriptive analysis was undertaken using the SPSS version 29 software**.**

Results: This study shows different levels of knowledge and misconceptions about antibiotics among respondents. While a majority (85%) correctly identified antibiotics as effective against bacteria, misconceptions persisted regarding their use for viral infections, with 41.9% believing antibiotics could treat colds and coughs. Over 60% of respondents recognized that antibiotic misuse contributes to resistance, yet 16.2% admitted to stopping antibiotics once they no longer feel any symptoms. Additionally, 23.5% acknowledged the impact of antibiotic use in animals on human resistance. The primary sources of antibiotic information were pharmacies (11.2%), clinics (5.8%), and doctors (3.1%), with minimal reliance on digital or media sources.

Conclusion: This study concludes that even though people know about antibiotics, misconceptions are still prevalent regarding proper use and effectiveness against viral infections. Knowledge gap seem to lead to the misuse of antibiotics and development of resistance. Educational interventions are needed to raise awareness, mostly through the healthcare practitioners to promote antibiotic use and limit the resistance risk.

Keywords: Antibiotics, Antimicrobial resistance, Attitude, Misconception, Practices, Public awareness, SA.

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Introduction

Antimicrobial resistance (AMR) has emerged as a significant global health concern, posing a threat to the effective treatment of infectious diseases. The World Health organisation reports 700,000 deaths resulting from infections not responding to antibiotic therapies every year. Antibiotics are the most prescribed medications in many industrialised and developing nations. Inappropriate use of antibiotics is a major contributor to the acquisition, development and spread of antibiotic resistance (Prestinaci et al, 2015). Studies show that one-third (33,7%) of the people in low- and middle-income countries lack knowledge about antibiotics (Awad & Aboud, 2015).The misuse and overuse of antibiotics have been identified as major contributors to the development and spread of AMR, and understanding the practice of communities toward antibiotic use is crucial in addressing this issue and implementing effective interventions (Shatla, Althobaiti, Almqaiti, 2022). Antimicrobial resistance (AMR) is one of the major concerns for global health.

Inappropriate use of antibiotics is a global challenge that arises from knowledge gaps, misconceptions, and improper practices among both the population at large and healthcare practitioners. A study that was conducted in Europe results in 57% of respondents that incorrectly believed that antibiotics are effective against viral infections such as the common cold and influenza (European Centre for Disease Prevention and Control [ECDC], 2019). In Asia, particularly in China and India**,** self-medication with antibiotics is prevalent, with over 50% of individuals reporting the use of leftover antibiotics, online purchase, or purchasing such without a prescription (Zhou et al., 2020; Sakeena et al., 2018). In the United States, while strict prescription regulations exist, misconceptions persist, with studies showing that one-third of Americans believe antibiotics are effective against viral infections (CDC, 2021).

Inappropriate use of antibiotics is speeding up the process of antimicrobial resistance. (Awad & Aboud, 2015). Antimicrobials, including antibiotics, antivirals, antifungals, and antiparasites, are used to prevent and treat infections in humans, animals, and plants. Antimicrobial resistance occurs when microbes change over time, making antimicrobials ineffective. AMR is spreading, creating microbes that cannot be treated with existing medications. Currently, common organizations that cause different diseases, such as tuberculosis (TB), HIV/AIDS, Malaria, sexually transmitted diseases, urinary tract infections, lung infections, and blood infections can resist a wide variety of microbes (Shatla, Althobaiti, Almqaiti, 2022).

Africa faces different challenges regarding to antibiotic use due to limited access to healthcare, high burden of infectious diseases, and weak regulatory frameworks (Okeke et al., 2007). Many studies in African countries report high rates of self-medication with antibiotics**,** primarily

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due to lack of awareness, easy availability of antibiotics over the counter, and inadequate healthcare infrastructure (Tufa et al., 2022; Mukokinya et al., 2018). Research in Nigeria and Ghana found that over 70% of respondents had used antibiotics without prescriptions, and nearly 60% believed antibiotics could cure viral infections (Awad & Aboud, 2015; Essack, 2017). Furthermore, substandard and counterfeit antibiotics are a growing concern in many parts of Africa, exacerbating resistance patterns (Nwokike et al., 2018).

South Africa is one of the leading antibiotic consumers in Sub-Saharan Africa, with studies showing widespread antibiotic misuse among both healthcare providers and the general public (National Department of Health [NDoH], 2018). A survey that was conducted in public hospitals and pharmacies in South Africa resulted in approximately 50% of prescribed antibiotics were unnecessary (Schellack et al., 2017). Additionally, misconceptions regarding antibiotic use remain prevalent, with studies indicating that over one-third of South Africans believe antibiotics are effective against viral infections (Gasson et al., 2018). The availability of antibiotics without prescriptions in informal markets also contributes to inappropriate usage patterns (Dlamini-Simelane & Bradley, 2017).

In response to these challenges, the South African government has implemented the National Antimicrobial Resistance Strategy Framework (2018-2024) to promote responsible antibiotic use, enhance public awareness, and strengthen antimicrobial stewardship programs (NDoH, 2018). However, gaps remain in public knowledge and attitudes, necessitating further educational interventions. The purpose of this study is to assess the knowledge, attitude, and practices towards antibiotic use and antimicrobial resistance in the Vhembe district, Thulamela municipality.

METHODS

Study design:

The research was quantitative with a cross-sectional descriptive approach. The setting was Maungani, Manini Villages and Thohoyandou located in Thulamela Municipality, Vhembe District, Limpopo Province. Maungani and Manini village comprised of low-income households and has a population of approximately 7271, and most of the people speak

Tshivenda. The unemployment rate is very high with community members also having low education levels.

Population and sampling strategy

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The study population comprised of community members who had recently taken antibiotics or have previously used antibiotics. A sample size of 260 respondents was used, community members were randomly selected, both males and females between the ages of 18 to 65. To begin the process of sampling, poster/flyers were distributed and some pasted around the settings. Respondents were randomly selected from households and approached.

Data collection

Tools

The questionnaire was adapted from other studies linked to the current project (Cameron et al, 2010; Kalichman et al., 2000; Roh et al., 2021). Supervisors and executive faculty members reviewed the adapted instrument to ensure that the content of current study is covered thoroughly. Reliability refers to the extent to which a measurement gives consistent results and validity refers to the degree to which a questionnaire measures what it is intended to measure (Roopa & Rani, 2012; Ahmed & Ishtiaq, 2021). To measure reliability, internal consistency was measured, by the Cronbach's α test to gauge the association between various items in each instrument that were projected to evaluate the same construct, for a better consistency (Viladrich, Angulo-Brunet & Doval, 2017). The Cronbach's α test has been widely used in various countries (Cameron et al, 2010; Kalichman et al., 2000; Roh et al., 2021) and for this study it proved internal consistency of the sections to determine knowledge of and attitude towards use of antibiotics (Awad & Aboud, 2015). The test results were as follows: statements of knowledge about antibiotics, α 0.72. The tool was translated to Tshivenda and two independent translators verified with adjustment to accommodate different dialects within the local communities.

Method

The was reviewed in the Faculty Higher Degree Committee and Faculty Executive review. The ethics approval was received from the University of Venda's, Research Ethics Committee, approval number FSEA/22/MBY/04/0302. After negotiating entry, flyers were put up around communities with the parameters for the study Before the data collection process begin, the researchers approached respondents a list was then generated after which consent was obtained prior to data collection for those who were randomly selected. After signing the consent form, the questionnaires (in English or Tshivenda) were self-administered to the respondents, individually, by the researchers. Respondents were instructed on how to complete the questionnaires; the process took about 25 minutes for each questionnaire. The researchers spent two month collecting data. The researchers conducted quality checks on

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completed forms, any errors were drawn to the attention of the respondents and rectified consequently leading to 100% accurately completed questionnaires.

Data analysis

Data were entered into the Statistical Package for Social Sciences (SPSS, version 29) and descriptive analysis conducted. The results were reported as percentage (95% confidence interval). To simplify the results' presentation in the text, those who answered, "strongly agree" or "agree" were classified as "agreed", and those who answered "strongly disagree" or "disagree" as having disagreed. A scoring system was applied to measure the respondents' knowledge towards antibiotics. One point was awarded for each correct response (strongly agree or agree for correct statement and strongly disagree or disagree for incorrect statement), and zero for each wrong or uncertain response, with a maximum correct score of 13 for each respondent. The knowledge score was categorized into two levels indicated by (0–6), inadequate and (7–13) as adequate. Association of respondents' characteristics with antibiotic prescribing, self-medication with an antibiotic, knowledge of antibiotics towards antibiotic use was evaluated using the Chi square with Phi and Crammer to ascertain association and the effect size.

RESULTS

This section covers the results of the data collected and analysed from 260 participants who completed the questionnaire. The demographic information of the respondents is presented below.

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1. DEMOGRAPHIC INFORMATION

Table 1: Demographic profile of the sample (n=260) respondence from Maniini, Maungani villages ans Thohoyandou, Thulamela municipality, Limpopo province

Characteristics	Proportion%
Gender	
Females	131(50.4)
Males	118 (45.4)
Not specific	11 (4.2)
Age	
18-20	23 (8.8)
21-30	180 (69.2)
31-40	47 (18.1)
40 and above	10 (3.8)
Employment status	
Employed	140 (53.8)
Not employed	120 (46.2)
Highest level of education attained	
Less than Grade 12	2(0.8)
Grade 12	50(19.2)
Tertiary level	208(80.0)
Gross monthly income	
Less than R10000	122 (49.9)
More than R10000	138 (53.1)
Religion	
Atheist	1 (0.4)
Christian	256 (98.5)
none	1 (0.4)
Traditional African	2 (0.8)
Race	
African	259 (99.6)
Does not specify	1 (0.4)
Ethnicity	
No specific	1 (0.4)
Pedi	6 (2.3)
Swati	1 (0.4)
Tsonga	24 (9.2)
Venda	227 (87.3)
Zulu	1 (0.4)

The respondents' demographic profile is shown in Table 1. Data was collected comprise of respondents from age 18-65 years. 21-30 of age had the most respondents with (180) 69.2%. 40 and above had the most respondents are Venda speaking with (227) 87.3% and majority belonging to the Christian religion, with variety of ethnic groups.

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Table 2. Knowledge checklist

Questions asked	Frequency - (n) & Percentage (%)			
	Agree	Strongly agree	Disagree	Strongly disagree
I know the difference between antibiotics and other medications	161(61.9)	60(23.1)	31(11.9)	8(3.1)
Different antibiotics are needed to cure different diseases	189(72.7)	58 (22.3)	10 (3.8)	3 (1.2)
Antibiotics are effective against bacteria	180(69.2)	66 (25.4)	8 (3.1)	6 (2.3)
Antibiotics can kill bacteria that normally live on skin and in the gut	190(73.1)	45 (17.3)	17 (6.5)	8 (3.1)
Antibiotics speed up recovery from most coughs and colds)	102 (39.2	28 (10.8)	108(41.5)	22 (8.5)
Antibiotics work on most colds and coughs	91 (35.0)	28 (10.8)	114(43.8)	27 (10.4)
Antibiotics are effective against viruses	86 (33.1)	23 (8.8)	111(42.7)	40 (15.4)
If you get side effects during a course of antibiotics treatment, you should stop taking them as soon as possible	157(60.4)	49 (18.8)	39 (15.0)	15 (5.8)
If you get some kind of skin reaction when using antibiotics you should not use the same antibiotic again	158(60.8)	49 (18.8)	46 (17.7)	7 (2.7)
Antibiotics can cause imbalance in the body's own bacteria flora	162(62.3)	60 (23.1)	23 (8.8)	15 (5.8)
The unnecessary use of antibiotics can increase the resistance of antibiotics to them	139(53.5)	88 (33.8)	24 (9.2)	9 (3.5)
Resistance to antibiotics is a worldwide problem	133 (51.2)	97 (37.3)	19 (7.3)	11 (4.2)
The use of antibiotics among animals can reduce the effect of antibiotics among humans	130 (50.0)	61 (23.5)	45 (17.3)	24 (9.2)

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Human can be resistant to antibiotics	142 (54.6)	24 (9.2)	75 (28.8)	19 (7.3)

Source of information about antibiotics(distribution sources)	
Clinic	15 (5.8)
Doctor	8 (3.1)
pharmacy	29 (11.2)
Radio	8 (3.1)
Internet	1 (0.4)
Family	1 (0.4)
Newspaper	1 (0.4)
Television	1 (0.4)

Table 2 presents the findings regarding knowledge towards antibiotics

General knowledge about antibiotics when it comes to understanding the difference between antibiotics and other medications, about 221 respondents (85%) agreed while only 15% disagreed or strongly disagreed. When it comes to understanding that different antibiotics are needed for different diseases about (95%) agreed while only5% disagreed. However, when it comes to the understanding that antibiotics are effective against bacteria about 246 (94.6%) agreed and 5.4% disagreed. Majority of 90.4% understand that antibiotics can kill bacteria that normally live on the skin and gut and 9.6%)disagreed.

Findings showed that the misconceptions about antibiotics still exists because 50% agreed with an incorrect statement about the speed recovery from coughs and colds.

Understanding antibiotic use and resistance, about 206 (79.2%) believed antibiotics should be stopped if side effects occur and while 20.8% disagree that antibiotics should not be stopped without consulting a doctor.

Majority of the respondents have knowledge of the antibiotics principles. Most of the respondents relied on pharmacies 29 (11.2%) rather than doctors 8 (3.1%) or online sources (0.4%), suggesting the need for better public awareness campaigns.

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Table 3: Practices towards antibiotics

Questions asked	Frequency - (n) & Percentage (%)			
	Agree	**Strongly agree**	**Disagree**	**Strongly disagree**
I buy medication based on the experiences of family and friends	46 (17.7)	15 (5.8)	142(54.6)	57 (21.9)
When I experience any unusual symptoms after using the medication, I suspect those symptoms might be side effects	189 (72.7)	38 (14.6)	22 (8.5)	11 (4.2)
If I suspect side effects of medications, I consult my doctor or pharmacist	136 (52.3)	63 (24.2)	48 (18.5)	13 (5.0)
I stop using the medication as soon as the symptoms of the illness are no longer present	42 (16.2)	24 (9.2)	153 (58.8)	41 (15.8)
I keep the medication with its explanatory index	157 (60.4)	41 (15.8)	54 (20.8)	8 (3.1)

Table 3 revealed that majority of respondents about 76.5% do not rely on the experiences of their friends and family when buying medication. 87.3% respondents are aware that having unusual symptoms after taking medication can be an indication of side effects, and majority of respondents consult a healthcare practitioner if they suspect side effects from medications or if they are reacting. The current study also shows that most of the respondents 74.6% do not stop using medication just because their symptoms have improved, they adhere, and most respondents keep their medications together with the leaflet and follow the instructions written.

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Table 4: Association between demographics and practices towards antibiotics in Limpopo

Demographics	Practices	df	χ^2	p-value	Effect Size ϕ
Age range	Experiences side effects	9	15.982	.067	
Gender	Consult doctor/ pharmacist for side effects	6	15.778	.015	,169
Gross monthly income	Buys medications based on the experience of family and friends	9	15.064	.089	
Ethnicity	Experiences side effects after using medication	15	30.469	.010	,173
Ethnicity	Keep medication with its explanatory insert	15	43.816	<.001	,411

Note: *Association – *indicates significance at 0.05 level*

Analysis for Chi-Square

		Total			
		Yes		No	
		N	%	N	%
Ethnic	No specific	1	2.4%	0	0,0%
	Pedi	6	12,8%	0	0,0%
	Swati	1	0,6%	0	0,0%
	Tsonga	19	30,1%	5	19,9%
	Venda	170	92,4%	57	92,6%
	Zule	1	0,6%	0	0,0%
Total		198	100,0%	62	100,0%

a. 0 cells (0,0%) have expected count of less than 5.

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,411	<,001
	Cramer's V	,237	<,001
N of Valid Cases		260	

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Table 4 states that the chi-square test of age and experience of side effects (χ^2=15.982, p=0.067) suggests that there is not statistical significance. There was a significant association between gender and consulting a Doctor/Pharmacist (χ^2=15.778, p=0.015), the effect size is small to moderate level at ,169. indicating gender differences in seeking medical advice for side effects. There was association between income and medication purchase based on experience of friends and family (χ^2=15.064, p=0.089), Surprisingly, ethnicity was significantly associated with experiencing side effects and keeping medication with its explanatory insert at (χ^2=30.469, p=0.010), and (χ^2=43.816, p<0.001).,The effect size is high at ϕ-,173 and ,411 respectively.

Discussion

The current study aimed to investigate knowledge and practices towards antibiotic use in Limpopo province. However, misconceptions persist across all education levels, suggesting that public health interventions must target not only those with lower education but also tertiary-educated individuals who may still hold the wrong beliefs/ ideas about antibiotic use (Suda et al., 2020).

The majority of respondents showed a good understanding of antibiotics, with 85% correctly identifying the difference between antibiotics and other medications. Similarly, 95% acknowledged that different antibiotics are needed to cure different diseases. Moreover, about 94.6% correctly identified that antibiotics are effective against bacteria, and 90.4% were aware that antibiotics can kill bacteria normally present on the skin and in the gut. The current study revealed that the community members are knowledgeable regarding antibiotics. On the contrary, various studies present inadequate knowledge among the sample.

However, some misconceptions were prevalent. About 50% believed that antibiotics speed up recovery from coughs and colds, while 54.2% disagreed with the statement that antibiotics work on most colds and coughs. On the contrary, a study in Bangladesh found that 84.76% of respondents believed that antibiotics speed up recovery from most coughs and colds (Sontakke et al, 2016). Furthermore, 58.1% correctly recognized that antibiotics are not effective against viruses. Similar misconceptions have been reported in other studies, such as one conducted in Nigeria, where 56% of respondents incorrectly believed antibiotics could treat viral infections (Adebisi et al., 2021).

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A significant misconception was observed regarding antibiotics' effectiveness against colds and coughs. While 39.2% agreed and 10.8% strongly agreed that antibiotics speed up recovery from most coughs and colds,. Similarly, 35% agreed and 10.8% strongly agreed that antibiotics work on most colds, whereas 54.2% disagreed.

Misconceptions persisted regarding antibiotics' effectiveness against viruses, as 33.1% agreed. These findings highlight a serious misconception, as antibiotics are ineffective against viral infections such as influenza and the common cold (World Health Organization [WHO], 2022). Inappropriate use of antibiotics can lead to misunderstanding leading to antibiotic resistance (O'Neill, 2016).

The awareness of antibiotic resistance was generally high, with 87.3% agreeing that the unnecessary use of antibiotics increases resistance. Additionally, 88.5% recognized antibiotic resistance as a worldwide problem. However, 73.5% acknowledged that antibiotic use in animals could reduce their effectiveness in humans, showing a need for further awareness campaigns on this issue.

The belief that humans can develop resistance to antibiotics was held by 63.8% while 36.2% disagreed. A study conducted in South Africa by Brink et al. (2020) similarly found that most individuals were aware of antibiotic resistance, misconceptions about human resistance to antibiotics remained common.

A substantial proportion of respondents recognized the risks of antibiotic misuse. About 53.5% agreed that unnecessary antibiotic use can lead to resistance. However, there was less certainty regarding antibiotic use in animals affecting humans, as only 50% agreed.

When respondents suspected side effects, 76.5%consulted a doctor or pharmacist, while 23.5% (n=61) did not seek professional advice. On the contrary, a study by Shehadeh et al. (2019) in Jordan found that 68% of respondents sought medical advice when experiencing medication-related side effects.

Regarding adherence, 74.6% disagreed with the statement that they stopped taking antibiotics once symptoms disappeared, which suggests that most participants understood the importance of completing their prescribed course. Nevertheless, 25.4% (n=66) agreed that they stop using antibiotics when symptoms subside, indicating the need for more education

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on proper antibiotic use. According to the World Health Organization (WHO, 2021), incomplete antibiotic courses contribute significantly to antibiotic resistance worldwide.

Medication storage habits were relatively good, with 76.2%) keeping medications with explanatory leaflets, while 23.8% did not. Proper medication storage is crucial to ensuring patients use antibiotics safely and according to instructions (Ocan et al., 2020).

The most common sources of antibiotic-related information were pharmacies (11.2%, n=29), clinics (5.8%, n=15), and doctors (3.1%, n=8). However, only 0.4% (n=1) relied on the internet, family, newspapers, or television. This indicates a strong reliance on healthcare professionals but a limited engagement with other sources of health education. Similar findings were observed in a study by Ahmed et al. (2022) in Kenya, where pharmacies were the most frequent source of information on antibiotics.

This study's findings reveal significant associations between demographic characteristics and antibiotic-related practices. The chi-square test (χ^2=15.982, p=0.067) suggested no statistical significance between age and the experience of side effects. However, 72.7% of respondents aged 18-30 years reported experiencing side effects, compared to only 19.2% of those aged 31 and above. This aligns with research showing that younger individuals tend to use more medications, increasing the likelihood of side effects (Jones et al., 2021). Previous studies suggest that medication side effects are more dependent on individual biological responses rather than age groups (Smith et al., 2019).

A significant association was found between gender and consulting a doctor or pharmacist for side effects (χ^2=15.778, p=0.015). Among respondents, 64.4% of females sought medical advice compared to 52.7% of males. This finding supports previous research that women are more likely to engage in health-seeking behaviours (Green & Harper, 2020). Increased awareness and more frequent healthcare interactions may contribute to this trend (Lee et al., 2018).

There was no statistical significance observed between gross monthly income and purchasing medications based on experience of friends and family (χ^2=15.064, p=0.089). However, 59.2% of individuals earning less than R10,000 relied on recommendations from family and friends, whereas only 43.1% of those earning above R10,000 followed the same practice. Economic constraints may encourage self-medication behaviours, as noted by Patel et al. (2021).

Ethnicity was significantly associated with experiencing side effects (χ^2=30.469, p=0.010). Among respondents, 87.7% of Venda participants reported experiencing side effects

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compared other ethnic groups. This may be due to genetic variations in drug metabolism (Williams et al., 2019) or cultural perceptions influencing medication adherence (Ngwenya & Moyo, 2020).

A strong relationship was found between ethnicity and keeping medication inserts (χ^2=43.816, p<0.001). Venda respondents were the more likely to keep medication inserts (79.7%), while other ethnic groups reported lower rates (47.3%). Higher health literacy levels among certain groups may contribute to this behaviour (Chowdhury et al., 2022), which can enhance proper medication use and safety.

STRENGTH OF THE STUDY

The strength begins with the survey research that used randomization which means that a systematic analysis of the data was possible without bias.

This study included a broad range of respondents in terms of age, gender, employment status, education level, and income, providing a well-rounded dataset giving a diverse representation. A significant proportion (80%) of respondents have a tertiary-level education, which may contribute to informed responses and enhance the validity of knowledge-related findings. This study highlighted awareness of antibiotic resistance as a global issue, providing insights into public perceptions and potential areas for intervention.

LIMITATIONS OF THE STUDY

There are numerous positive aspects to this study, however, it is necessary to note possible limitations so that findings can be interpreted in the context of the study: In this study, most of the data came from questionnaires where participants may not always accurately report their behaviours or beliefs and practices. The sample may also not represent a large population. This study was cross sectional hence, it captured knowledge and misconceptions at a single point in time, which would prevent changes in awareness over time. The study relies on self-reporting data, which may be subject to bias affecting the accuracy of the data. The study does not have any access to assess the roles of the healthcare practitioners. Therefore, this study only utilized descriptive data. findings must be interpreted with caution and align to population with similar characteristics.

RECOMMENDATIONS

Based on the gaps in knowledge, implementing educational campaigns to raise awareness about the dangers of antibiotic misuse, such as resistance development. These programs

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could be tailored to specific groups (e.g., age, education level) and delivered through multiple channels, such as schools, healthcare settings, and media. Healthcare providers should be encouraged to regularly educate patients about proper antibiotic use, adherence and compliance during consultations. This includes explaining when antibiotics are needed, how to complete a prescription, and why misuse is dangerous. Training healthcare workers in communication skills can also help ensure that patients fully understand the guidance provided.

Governments should strengthen regulations regarding the sale and distribution of antibiotics. This might involve limiting over-the-counter availability, especially in areas where self-medication is common, and promoting adherence to prescription-only antibiotic policies. To overcome the limitation of cross-sectional studies, future research should adopt longitudinal study designs to better understand how knowledge, attitudes, and practices have changed over time, especially in response to interventions or changes in healthcare policies. The use of interactive and multimedia educational tools (e.g., videos, mobile apps, online quizzes) can make learning about antibiotic use more engaging and accessible, especially for younger or tech-savvy audiences.

CONCLUSION

In conclusion, understanding the knowledge and practices toward antibiotic use is crucial for addressing the growing issue of antibiotic resistance and ensuring the responsible use of antibiotics across different populations. This study highlights the gaps and strengths in knowledge and practices towards antibiotics Even though there is awareness of antibiotic resistance, for people to improve antibiotic use, we need to have educational interventions, strengthen proper guidance from healthcare providers emphasizing the importance of adherence, and strengthen the use of public health policies. By addressing knowledge gaps, shaping positive attitudes, and encouraging appropriate practices, we can help limit the rise of antibiotic resistance and preserve the effectiveness of antibiotics for future generations. Given the increase of antimicrobial resistance globally, the efforts to promote antibiotic stewardship remain critical (WHO,2022).

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SECTION C: CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

3.1 INTRODUCTION

This section provides a comprehensive overview of the study by summarizing the article's conclusions, the study's contribution, and its limitations, recommendations, and a summary. The overall conclusion will demonstrate how the project successfully achieved its original objectives, while the study's strengths highlight the factors that contributed to this success. The limitations outlined indicate certain factors that could have improved the outcome of the study.

3.2 ARTICLE CONCLUSIONS

The study aimed to understand the knowledge and practices (KAP) toward antibiotic use, which is crucial for addressing the growing issue of antibiotic resistance and ensuring the responsible use of antibiotics across different populations. This study highlights the gaps and strengths in knowledge and practices towards antibiotics. Even though there is awareness of antibiotic resistance, for us to improve antibiotic use, we need to have educational interventions, strengthen proper guidance from healthcare providers emphasizing the importance of adherence, and strengthen the use of public health policies. By addressing knowledge gaps, shaping positive attitudes, and encouraging appropriate practices, we can help limit the rise of antibiotic resistance and preserve the effectiveness of antibiotics for future generations. Given the increase of antimicrobial resistance globally, the efforts to promote antibiotic stewardship remain critical (WHO,2022).

The project articles were based on the study's objectives. The summary for each is detailed below:

Article 1

The review study focused on exploring the knowledge, attitudes, and use of antibiotics in South Africa to identify existing challenges, gaps, and areas for improvement. The review included five (5) databases, Google Scholar, Science Direct, and PubMed. These databases were selected to cover a wide range of disciplines regarding the knowledge, attitudes, and the

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use of antibiotics in South Africa. Studies included articles published between 2015 to 2024. The critical appraisal skills program tool (CASP) was used to evaluate the quality of the studies that are included. The questions were designed to modify the CASP quantitative checklist tool. In the final discussion, 08 articles from the databases were included as they met the eligibility criteria.

Findings indicate that while many individuals understand the role of antibiotics in treating bacterial infections, misconceptions persist, particularly regarding their effectiveness against viral illnesses. Several studies highlight inadequate differentiation between bacterial and viral infections, leading to unnecessary antibiotic use. The awareness of antibiotic resistance exists but is not widespread enough to significantly influence behaviours. And the public attitudes towards antibiotics show a reliance on self-medication, often influenced by previous experiences or advice from family and friends rather than healthcare professionals. Trust in antibiotics as a quick solution to illnesses contributes to inappropriate use. Additionally, many individuals believe that discontinuing antibiotics once symptoms improve is acceptable, which contradicts best practices and fosters antibiotic resistance.

Antibiotic usage trends reveal inconsistent adherence to prescribed treatments**,** with high rates of self-medication and accessibility issues. The misuse of antibiotics in treating common colds, flu, and other viral infections is a significant concern. Studies also show that healthcare provider prescribing practices contribute to antibiotic misuse, with unnecessary prescriptions for non-bacterial infections. Misuse and self-medication remain high due to a lack of awareness about antibiotic resistance. However, a lack of educational awareness tends to contribute to the belief that antibiotics cure all infections, including viral illnesses. Non-adherence and compliance reduce antibiotic effectiveness.

Article 2

1. Knowledge of the Public Towards Antibiotic Use

The study reveals that the public possesses a moderate to high level of knowledge about antibiotics. A significant proportion (61.9%, n=161) correctly identified the difference between antibiotics and other medications, with an additional 23.1% (n=60) strongly agreeing. Furthermore, 72.7% (n=189) recognized that different antibiotics are required to treat different diseases, and 69.2% (n=180) understood that antibiotics are specifically effective against bacterial infections.

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However, misconceptions persist, particularly regarding the role of antibiotics in treating viral infections. While 33.1% (n=86) agreed that antibiotics are effective against viruses, a notable 42.7% (n=111) correctly disagreed. Similarly, 39.2% (n=102) believed that antibiotics speed up recovery from colds and coughs, though 50% (n=130) correctly recognized that antibiotics are not effective for such illnesses. These findings highlight the need for further education on the appropriate use of antibiotics (World Health Organization, 2021).

2. Public Attitude Towards Antibiotic Use in Thulamela Municipality, Vhembe District

The general attitude towards antibiotic use in the municipality is varied. A large percentage of respondents demonstrated awareness of antibiotic resistance, with 53.5% (n=139) agreeing and 33.8% (n=88) strongly agreeing that unnecessary use contributes to resistance. Additionally, 51.2% (n=133) acknowledged that antibiotic resistance is a global problem, indicating a level of public concern.

However, attitudes towards antibiotic use in animals were less definitive. While 50% (n=130) agreed and 23.5% (n=61) strongly agreed that antibiotic use in animals can impact human antibiotic efficacy, a considerable proportion (26.5%, n=69) disagreed. This indicates a gap in awareness regarding the broader implications of antibiotic use (Ventola, 2015).

3. Practices of Antibiotic Use Among the Public and Adherence to Prescribed Treatments and Self-Medication

The study suggests that while many individuals follow prescribed antibiotic treatments, self-medication and early discontinuation remain concerns. Encouragingly, 58.8% (n=153) disagreed with stopping antibiotics once symptoms disappear, indicating an understanding of completing prescribed courses. However, 16.2% (n=42) agreed and 9.2% (n=24) strongly agreed that they stop taking antibiotics as soon as symptoms subside, demonstrating risky behaviours that could contribute to resistance (Llor & Bjerrum, 2014).

Additionally, 72.7% (n=189) of participants reported suspecting side effects if they experienced unusual symptoms during antibiotic treatment, and 52.3% (n=136) stated they would consult a doctor or pharmacist if side effects occur. However, 23.5% (n=61) admitted they would not seek medical advice, highlighting gaps in adherence to proper antibiotic use.

When it comes to purchasing antibiotics, only 17.7% (n=46) admitted to buying medication based on family or friends' recommendations, with 54.6% (n=142) strongly disagreeing with this practice. This suggests that while some individuals engage in self-medication, a majority rely on professional medical advice (Michael et al., 2014).

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4. Gaps and Misconceptions Regarding Antibiotics and Antimicrobial Resistance (AMR)

Despite a generally good level of knowledge, misconceptions about antibiotics and AMR persist. Some key gaps identified include effectiveness against viruses being 33.1% (n=86) believed antibiotics work on viruses, indicating a need for better education on the distinction between bacterial and viral infections. And the use for colds and coughs, resulting in 39.2% (n=102) agreed that antibiotics speed up recovery from colds and coughs, while 35% (n=91) thought antibiotics work on most colds. This misconception can contribute to unnecessary antibiotic prescriptions. Stopping antibiotics early, 16.2% (n=42) agreed and 9.2% (n=24) strongly agreed that antibiotics can be discontinued once symptoms disappear, which increases the risk of resistance. Antibiotic use in animals, Only 50% (n=130) agreed that antibiotic use in animals can reduce antibiotic effectiveness in humans, indicating a lack of understanding of AMR's broader implications (Centers for Disease Control and Prevention, 2022).

While the public in Thulamela Municipality exhibits moderate to high knowledge about antibiotics, gaps in understanding and misconceptions still exist. The attitudes toward antibiotic resistance suggested a general awareness of its dangers, but some uncertainties remain, particularly regarding antibiotic use in animals. While many people follow prescribed antibiotic courses, self-medication and early discontinuation are still practiced by some individuals. Addressing these knowledge gaps and misconceptions through public health campaigns and educational initiatives will be critical in promoting responsible antibiotic use and combating antimicrobial resistance.

3.3 CONCLUSIONS OF THE STUDY

In conclusion, this study addresses antibiotic resistance requiring a comprehensive understanding of knowledge and practices towards antibiotic use. This research highlights significant gaps in public awareness and factors contributing to misuse, such as insufficient knowledge, self-medication, and poor prescribing practices. To combat this growing issue, future research should focus on improving educational programs, implementing effective stewardship policies, and enforcing regulations on antibiotic use in both human and veterinary medicine. Additionally, targeted interventions, strengthened healthcare guidance, and community-based approaches are crucial. By fostering responsible antibiotic practices, we can reduce resistance and preserve antibiotic efficacy for future generations.

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3.4 LIMITATIONS

It is important to acknowledge the limitations of this study, including potential biases in self-reported data and the specific demographic characteristics of the sample population. Future research could benefit from a larger and more diverse sample size to generalize findings more broadly across the Thulamela Municipality. This study was reviewed as cross-sectional, meaning they only captured a snapshot of attitudes, knowledge, and practices at a single point in time. This limits the ability to draw causal inferences or track changes over time. A significant limitation to the study was the reliance on self-reported data, which can be subject to response bias. For instance, people might provide socially desirable answers or overstate their compliance with prescribed antibiotic regimens.

3.5 RECOMMENDATIONS

The following recommendations are made based on the findings of the study:
Research, policy, and practices

. Policy recommendation**:** There should be collaborative efforts between public health agencies**,** healthcare providers**,** pharmacists, and veterinarians to address antibiotic resistance in both human and animal health contexts. There should be educational campaigns that will implement targeted educational programs on antibiotics and resistance tailored to the community's needs. Regulatory measures should be implemented so that they can strengthen regulatory frameworks to control the distribution and sale of antibiotics. Also, access to healthcare should be improved towards the healthcare facilities in order to discourage the self-medication practices. Further research and surveillance should be conducted to monitor antibiotic use patterns and resistance trends over time. Future research should investigate the role of antibiotic use in animals and its contribution to antimicrobial resistance in human populations. This includes exploring how to balance the need for antibiotics in agriculture with public health goals

3.6 CONCLUDING REMARKS

In conclusion, this study aimed to investigate the knowledge and practices regarding antibiotic use among residents of Thulamela Municipality, Limpopo province. The findings shed light on several important aspects related to antibiotic use, healthcare-seeking behaviour, and awareness among the population.

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The study revealed a varied level of knowledge regarding antibiotics among participants. While a significant proportion demonstrated a basic understanding of antibiotics and their appropriate use, there were notable gaps in understanding antibiotic resistance and the consequences of misuse. This suggests a need for targeted educational campaigns to enhance public knowledge and awareness.

Participants exhibited diverse practices in antibiotic use, including self-medication, incomplete courses, and sharing antibiotics with family or friends. Such practices are concerning as they contribute to antibiotic resistance and can lead to ineffective treatment outcomes. Education on the proper use of antibiotics and the importance of completing prescribed courses is crucial in addressing these behaviours.

The study found that a large number of respondents prefer to obtain antibiotics from informal sources, such as pharmacies without prescriptions or from family members. This behaviour highlights the need for stringent enforcement of regulations governing antibiotic distribution and increased accessibility to healthcare facilities where appropriate diagnosis and prescription can occur.

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APPENDIX A: ETHICAL CLEARANCE

ETHICS APPROVAL CERTIFICATE

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Prof PO Bessong

STAFF NO:
2000101

PROJECT TITLE: Undisclosed Antiretroviral Exposure and HIV Drug Resistance.

PROJECT NO: FSEA/22/MBY/05/1804

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Prof PO Bessong	University of Venda	Principal Investigator Staff
C Mahapa	UNIVEN, Nutrition	Co- Investigator, Public health nutritionist
A Mophuda	UNIVEN, Psychology	Co- Investigator Clinical psychologist
T Apalata	Walter Sisulu University, Faculty of Health Sciences	Investigator, Clinician, Consultant clinical microbiologist
L.S Mavhandu Ramavenda	UNIVEN, SAMRC-UNIVEN AVR-GH Unit	Co- Investigator, Virologist
T Apalata	Walter Sisulu University, Faculty of Health Sciences	Co- Investigator: Clinician, Consultant, clinical microbiologist
G Bolokr	Sefako Makgatho Health Sciences University	Co- Investigator, Medical Virology Investigator, Virologis:
A Sanki	UNIVEN, Biochemistry and Microbiology	Co- Investigator Bacteriologist, biostatistician
H Sibuyaane	UNIVEN, Advanced Nursing	Co-Investigator, Nursing
P Nwitoho	UNIVEN, Biochemistry and Microbiology	PhD student/Virology
R Nakhwalhana	UNIVEN, Education	Co-Investigator, Education, and communication
M Makatu	UNIVEN, Psychology	Co-Investigator, psychologist
ET Rogawski McQuade	Emory University, Rollings School of Public Health	Investigator, Epidemiologist, biostatistician
R Gillingham	University of Virginia, Infectious Diseases and International Health	Investigator, Clinician, Infectious Diseases Specialist
W Garira	UNIVEN, Computational and Mathematical Sciences	Investigator, biomathematician
ND Mabuma	UNIVEN, SAMRC-UNIVEN AVR-GH Unit	Co-Investigator, Virologist
Mr Tinashe Vanaiza,	UNIVEN, Department of Biochemistry and Microbiology	Co-Investigator, Student
Ms Dakalo Precious Mbedzi	UNIVEN, Department of Biochemistry and Microbiology	Co-Investigator, Student
Prof Jason Farley	School o' Nursing, Johns Hopkins University	Collaborator
Prof Lufuno Nakhwilo	UNIVEN, Department of Public Health, UNIVEN	Collaborator
Dr Sharlene Govender	Nelson Mandela University	Co- Investigator, Student
Dr TG Nakhwilo	UNIVEN, Advanced Nursing Science	Co- Investigator
Ms TC Ntuna	UNIVEN, Public Health	Co- Investigator, Student
Ms KH Mbweni	UNIVEN, Public Health	Co- Investigator, Student
Ms N Madzari	UNIVEN, Psychology	Co- Investigator, Student

Type: Staff Research
Risk: Risk to humans, animals, environment, or a sensitive research area (Category 3)
Approval Period: October 2024 – October 2025

The Human and Clinical Trails Research Ethics Committee hereby approves Recertification and Amendments of your project as indicated above.

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE
Date Considered: October 2024

Name of the Chairperson of the Committee: Prof NS Mashau

Signature:

UNIVERSITY OF VENDA
OFFICE OF THE DIRECTOR
RESEARCH AND INNOVATION
2024 -10- 04
Private Bag X5050
Thohoyandou 0950

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APPENDIX B1: INFORMATION SHEET

Title of the research study: knowledge, attitude and practice towards antibiotics use Limpopo province, Vhembe district, Thulamela municipality.

Principal investigators/researchers: Makhari M (univen student)

Co-investigator/s/supervisor/s: Prof A Maphula A / DR TO Tshitimbi

Brief introduction and purpose of the study

Antimicrobial resistance (AMR) has emerged as a significant global health concern, posing a threat to the effective treatment of infectious disease. The misuse and overuse of antibiotics have been identified as major contributors to the development and spread of AMR, understanding the practice of communities towards antibiotic use is crucial in addressing this issue and implementing effective interventions (Shatla, Althobaiti, Almqaiti, 2022). Antimicrobial resistance (AMR) is one of the major concerns for glob al health. Inappropriate use of antibiotics is speeding up the process of antimicrobial resistance. Antimicrobials, including antibiotics, antivirals, antifungals, and antiparasitics, are used to prevent and treat infections in humans, animals and plants. Antimicrobials resistance occurs when microbes change over time, making antimicrobial ineffective, AMR is spreading creating microbes that cannot be treated with existing medications. Currently common organisations that cause different diseases such as tuberculosis (TB), HIV/AIDS, Malaria, sexually transmitted disease, urinary tract infections, lung infections, and blood infections can resist wide variety of microbics (Shatla , Althobaiti , Almqaiti, 2022)

The purpose of the study was to assess the knowledge, attitudes and practices towards antibiotic use, in Thulamela municipality.

Outline of the procedure

The researcher used questionnaire with the participants in a convenient place around Maniini and Maungani villages. Participants consented to individuals who are 18 years and older and are expected to provide full information about the study without omissions, they should remain confident at all costs, e.g. should there be any example they are to give they won't be expected to mention names. The research involved 260 participants from Maniini and Maunga villages. This research took place at Thulamela municipality's selected villages. To obtain data from participants, five structured questionnaires were employed. English was used to deliver the questions but the researcher also had few copies of Tshivenda translated questionnaires. Data was collected for a couple of days.

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Risks or Discomforts to the participant: participants may get tired of answering a lot of questions.

Benefits: people of Vhembe district may have an increased level of knowledge regarding antibiotic use and antimicrobial resistance and also promote responsible antibiotic use within the general population.

Cost of the study: participants will not be asked to contribute anything other than their knowledge and information they have about the topic.

Remuneration: Participants will not receive any form of remuneration after participating in the research.

Confidentiality: the researcher will undertake that all information accumulated will be used only for the study purpose, and no names will be disclosed. Participants will be assured that any information they provide will not be published or reported. And that no one will access the raw data of the research without authorization.

Research-related injury: when an injury occurs as a result of participation in a research study it is called research-related injury, and these are sometimes inevitable. These injuries h

Reason/s why the participant may be withdrawn from the study: it can be personal reasons, health and safety, non-compliance, lost to follow-up, randomization, errors, and adverse reactions, as such there will be no adverse consequences for the participants if they choose to withdraw.

Persons to contact in the event of any problems or queries:

Makhari M 0712164305

(Supervisor and details) please contact the research (071 216 4305), my supervisor (015 962 8341)or the University Research Ethics Committee Secretariat on 015 962 9058. Complaints can be reported to the director: Research and Innovation, Prof GE Ekosse on 015 962 8313 or Georges Ivo.Ekosse@univen.ac.za

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APPENDIX B2: CONSENT FORM

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Makhari Mpho, about the nature, conduct, benefits, and risks of this study - Research Ethics Clearance Number: _,
- I have also received, read, and understood the above-written information (*Participant Letter of Information*) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials, and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

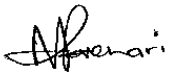
Full Name of Participant Date Time Signature

I, …….. …… …… ……..

Makhari Mpho here with confirms that the above participant has been fully

Informed about the nature, conduct, and risks of the above study.

Full Name of Researcher

Makhari Mpho…. Date**……** Signature**……** 

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APPENDIX B3: RESPONDENT INFORMATION SHEET

Title of the Research Study: knowledge, attitude and practices towards the use of antibiotics in the Thulamela Municipality of Vhembe district, Limpopo province.

Principal Investigator: Mpho Makhari,

Supervisor: Prof. Angelina Maphula, PhD in Psychology

Introduction and purpose of the study:

Antimicrobial resistance (AMR) has emerged as a significant global health concern, posing a threat to the effective treatment of infectious disease. The misuse and overuse of antibiotics have been identified as major contributors to the development and spread of AMR, understanding the practice of communities towards antibiotic use is crucial in addressing this issue and implementing effective interventions (Shatla, Althobaiti, Almqaiti, 2022). Antimicrobial resistance (AMR) is one of the major concerns for glob al health. Inappropriate use of antibiotics is speeding up the process of antimicrobial resistance. Antimicrobials, including antibiotics, antivirals, antifungals, and antiparasitics, are used to prevent and treat infections in humans, animals and plants. Antimicrobials resistance occurs when microbes change over time, making antimicrobial ineffective, AMR is spreading creating microbes that cannot be treated with existing medications. Currently common organisations that cause different diseases such as tuberculosis (TB), HIV/AIDS, Malaria, sexually transmitted disease, urinary tract infections, lung infections, and blood infections can resist wide variety of microbics (Shatla , Althobaiti , Almqaiti, 2022)

The purpose of the study was to assess the knowledge, attitude and practices towards antibiotics use, in Thulamela municipality.

Outline of the procedures: participants who decided to take part in this research project were asked to sign a permission form to confirm their willingness to participate. This research involved 260 participants from chosen villages in Thulamela Municipality. And the participants were of both genders aged 18 to 65. This research took place at Thulamela municipality's selected villages. To obtain data from participants, five structured questionnaires were employed. English was used to deliver the questionnaires. And data was collected for a couple of days.

Risks or discomforts to the respondent: participants may get tired of answering a lot of questions.

Benefits: people of Vhembe district may have an increased level of knowledge regarding antibiotic use and antimicrobial resistance and also promote responsible antibiotic use within the general population.

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Reason/s why the respondent may be withdrawn from the study: it can be personal reasons, health and safety, non-compliance, lost to follow-up, randomization, errors, and adverse reactions, as such there will be no adverse consequences for the participants if they choose to withdraw.

Remuneration: You will not receive any payment such as money or anything else for participating in this study.

Costs of the study: You will not be asked to pay for any cost for this study, but the researcher will be responsible for every cost of the study.

Confidentiality: The researcher will treat your information with privacy by appointing code names or numbers to you instead of using your real names on the survey questionnaire. The collected information will be kept in a safe place, and it will only be shared by the order of the law for reasons to protect you or someone else.

Persons to contact in the event of any problems or queries:

Please contact the researcher on 071 216 4305, my supervisor on 015 962 8341 or the University Research Ethics Committee Secretariat on 015 962 9058. Complaints can be reported to the Director: Research and Innovation, Prof GE Ekosse on 015 962 8313 or Georges Ivo.Ekosse@univen.ac.za.

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APPENDIX B4: RESPONDENT ASSENT FORM

- I hereby confirm that I have been informed by the researcher, Makhari Mpho, about the nature, conduct, benefits, and risks of this study - Research Ethics Clearance Number: _,
- I have also received, read, and understood the above-written information (*Participant Letter of Information*) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials, and diagnosis will be anonymously processed into a study report.
- Given the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant Date Time Signature

I, …….. …… …… ……..

Full Name of researcher

…….. Date…….. Signature……

Full Name of Witness (If applicable)

……... Date ……. Signature……...

Makhari Mpho here confirms that the above participant has been fully

Informed about the nature, conduct, and risks of the above study.

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APPENDIX B5: PERMISSION LETTER TO THE CHIEF

University of Venda
Faculty of Health Sciences
Department of Public Healt
Private bag x5050
Thohoyandou
0950

To the tribal authority
Thulamela municipality
Maniini village
0950

Dear Sir/Madam

Request for permission to conduct research

I am a master's student from the University of Venda, conducting a research about ‘’public knowledge, attitude and practice towards antibiotic use and antimicrobial, in Limpopo province’’ as an achievement of the requirements of my master’s in public health.

The purpose or main aim of the study is to assess the knowledge and practices towards antibiotic use, and antimicrobial resistance in Thulamela Municipality, Limpopo Province
The data will be collected by Makhari M at Maniini and Maungani village. Participants will be given questionnaires per person, people who feel uncomfortable in participating in the study can raise their concerns, and they will be answered accordingly.

Content

The University of Venda Ethics Committee will provide me with Ethical clearance. Permission to carry out the study will be asked from the chief from Maniini village. All the participants will be asked to sign a consent form that indicates their permission to take part in the study. However, if the participants give consent, the researcher will appreciate the participation and information obtained.

Confidentiality

will have access to it.I'll keep the details you provide with me private. I will make sure that all data provided is used solely for the study and that no names are mentioned in the interview transcription.

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Your private information will be treated as confidential, and nobody besides the researchers

My request for ethical approval will be granted by the University of Venda Ethics Committee. The head of Maniini and Maungani village will be consulted regarding permission to conduct the study. To confirm their agreement to take part in the study, each participant will be required to sign a consent form. Most essential, as the researcher i will value the participants' engagement and the data they contribute provided they give consent.

Benefits and risks of participation

Participation for this study will be voluntary and there will be no direct benefit to anyone who participated. If you want to withdraw from the study or you cannot answer some of the questions if you are not comfortable answering there will not be any penalties, however if you share your thoughts and feelings to question asked, I would really appreciate it.

Contact details

The researcher will be delighted to answer any questions or give clarity about issues the participant may encounter during this study. If there are any concerns in relation to the study, feel free to contact the researcher: Makhari M @ 0712164305

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APPENDIX C: INSTRUMENTS

Section 1: Demographic information

- Gender
- Age
- Educational level
- Geographic location
- Ethnicity or race
- Religion
- Income (Monthly)
- Occupation
- Marital status
- Ethnicity

Section 2: Research questions

Strongly disagree (SD), Disagree (D), Agree (A), Strongly agree (SA)

RESPONDENTS' KNOWLEDGE REGARDING ANTIBIOTICS **General Knowledge**	**SD**	**D**	**SA**	**A**
1. I know the difference between antibiotics and other medication				
2. Different antibiotics are needed to cure different diseases.				
3. Antibiotics are effective against bacteria				
4. Antibiotics can kill the bacteria that normally live on the skin and in the gut				
A. Action and use (incorrect statements)				
5. Antibiotics speed up the recovery from most coughs and colds				
6. Antibiotics work on most coughs and colds				
7. Antibiotics are effective against viruses				
B. Side effects				

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8. If you get side effects during a course of antibiotics treatment you should stop taking them as soon as possible				
9. If you get some kind of skin reaction when using an antibiotic, you should not use the same antibiotic again				
10. Antibiotics can cause imbalance in the body's own bacterial flora				
C. Resistance (correct statements)				
11. The unnecessarily use of antibiotics can increase the resistance of bacteria to them				
12. Resistance to antibiotics is a worldwide problem				
13. The use of antibiotics among animals can reduce the effect of antibiotics among humans				
Incorrect statement 14. Humans can be resistant to antibiotics				
15. Source of information about Antibiotic **(Tick all that apply)**	Radio = 01 Doctor = 02 TV = 03 Clinic =04 Pharmacy = 05 Friend = 06 Family = 07 Newspaper = 08 Other = 09			

MEDICATION UNDERSTANDING AND USE SELF-EFFICACY (MUSE) SCALE

Strongly Disagree; Disagree; Uncertain; Agree; Strongly agree

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ITEMS & OPTIONS	SD	D	SA	A
Practices 16. I have good knowledge of the safe use of medications.				
17. I ask the pharmacist in detail about the medication you have bought.				
18. I buy medications based on the experiences of family and friends.				
19. When I experience any unusual symptoms after using the medication, I suspect those symptoms might be side effects.				
20. If I suspect side effects of medications, I consult my doctor or pharmacist.				

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APPENDIX D: LANGUAGE EDITION CERTIFICATE

EDITOR'S LETTER

21 March 2025

Letter from the Editor for Ms Mpho Makhari

This serves to certify that I have edited Ms Makhari M **(STUDENT NUMBER: (18011659)** to proof-read her dissertation for Master in Public Health (MPH).

The title of his study is "KNOWLEDGE, ATTITUDE, AND PRACTICES TOWARDS ANTIBIOTICS USE IN THULAMELA MUNICIPALITY OF VHEMBE DISTRICT LIMPOPO PROVINCE**".** The document was thoroughly read, for consistency and facts. Language and flow of facts/logic were reviewed, and track changes were made, suggestions reflected through track changes software and highlighting general errors.

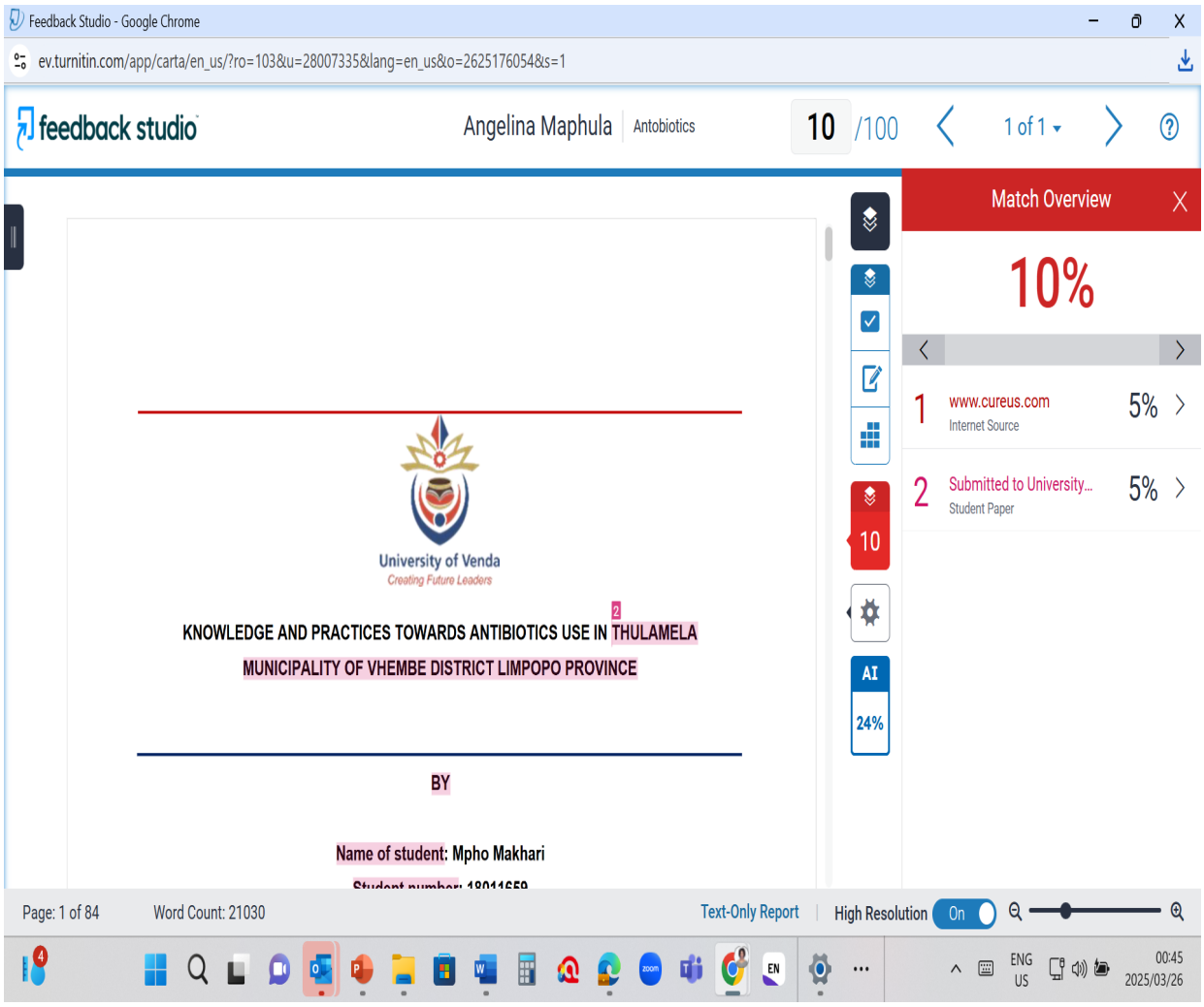
Yours Sincerely

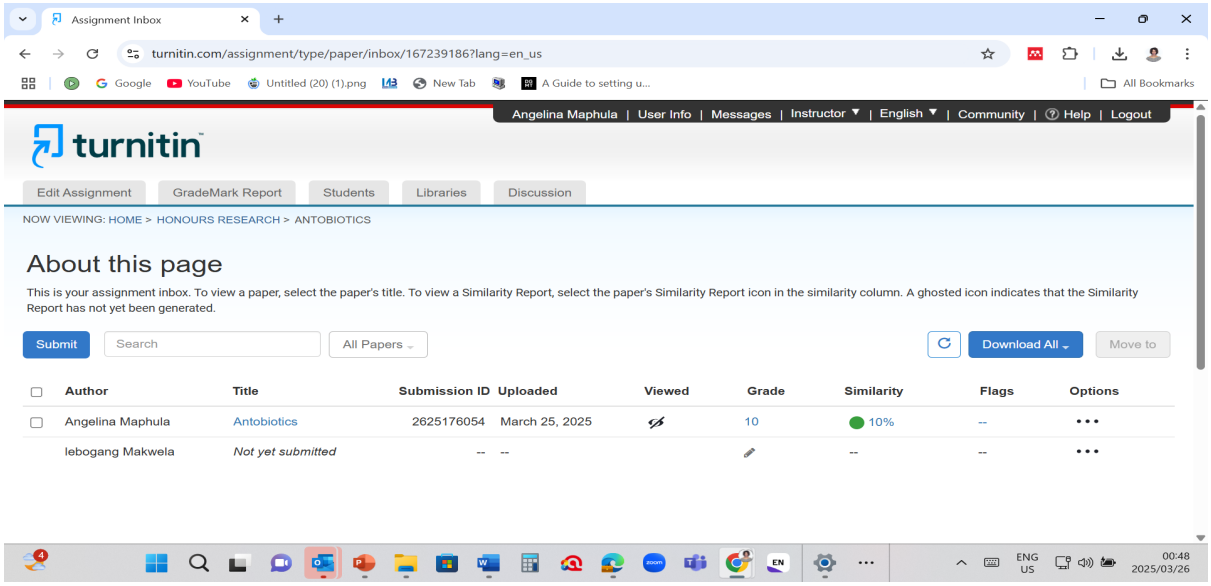
MN Nedzungani  Date: 21/03/2025

061 325 3627

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APPENDIX E: Turnitin report





© University of Venda

DIGITAL RECEIPT – TURNITIN

Makhari Turnitin Receipt.pdf

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