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AN EVALUATION OF ANTIBIOTIC PRESCRIBING PRACTICES AMONG PATIENTS AT MARONDERA PROVINCIAL HOSPITAL, IN MARONDERA DISTRICT USING WHO-INRUD CORE DRUG INDICATORS

BY

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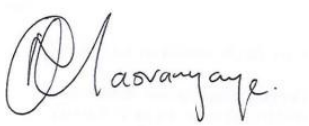
Abstract

Irrational prescribing of antibiotics in hospital settings, is one of the key drivers of the antimicrobial resistance (AMR) crisis globally. Studies conducted on the extent of antimicrobial use in Zimbabwe have shown considerable degree of resistance to commonly used first-line antibiotics. The objective of the study was to assess antibiotic prescribing practices at Marondera Provincial Hospital, in Marondera District, using the WHO-INRUD core drug indicators. The study also sought to evaluate the level of knowledge, attitude and practices (KAP) of health care workers towards antibiotic prescribing. A descriptive, cross-sectional study design was used. To investigate prescribing practices using prescribing indicators, 627 patient records were sampled out of 965 total patients' records using the random systematic technique from January to November 2023. To investigate prescribing practices using patient care indicators and facility-specific indicators, a total of 102 randomly selected outpatients and one pharmacy personnel were observed and interviewed respectively. Sixty-five (65) health care workers were randomly selected to participate in the KAP survey. The study revealed a mixed profile of compliance to WHO-INRUD recommended good prescribing practices. For the prescribing indicators, the average number of antibiotics per encounter was 1.90 (optimal range = 1.6–1.8), the drugs prescribed by the generic name were 81.2% (optimal value = 100.0%), the encounters with an antibiotic prescribed were 65.0% (optimal range = 20.0–26.8%), the encounters with an injection prescribed were 64.5% (optimal range = 13.4–24.1%) and the drugs prescribed from the Essential Drugs List (EDL) were 100.0% (optimal value = 100.0%). For patient-care indicators, the average consultation time was 8.31minutes (optimal value = ≥10 minutes) and average dispensing time was 81.1seconds (optimal value = ≥90 seconds). The hospital had a copy of the essential drug list and availability of key antibiotics was 63.0% (optimal value =100.0%). Forty-seven (72.3%) health care workers had good knowledge, fifty-one (78.5%) good attitudes, and thirty -seven (56.9%) reported good practice towards antibiotic prescribing. There was a statistically significant association between gender and level of practice with knowledge with p-values of 0.03 and 0.01 respectively. Irrational prescribing of antibiotics and non-compliance across most of the core drug indicators was observed at the hospital which was consistent with the appreciable level of practices observed. This invites further concerted efforts towards implementing relevant interventions to address the identified irrational prescribing practices. Collectively, these can help mitigate against unnecessary economic burden of cost of healthcare and drug-related adverse effects through, for example, drug-drug interactions The implementation of ASPs at all health facilities is crucial.

Key words: WHO/INRUD core drug indicators, rational antibiotic prescribing, Marondera.

Declaration page

I declare that this research is my original work except where sources have been cited and acknowledged. The work has never been submitted, nor will it ever be submitted to another university for the award of a degree



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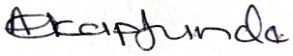

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Dedication

To my family, thank you for your unwavering support during the period of my studies. To my husband, Michael, thank you for your unwavering support. To my lovely children Connor and Ellie, this is for you to know, you can be and do anything you set your mind to.

List of Acronyms and Abbreviations

AIDS	Acquired immunodeficiency syndrome
AMR	Antimicrobial Resistance
ANOVA	Analysis of variance
ASP	Antimicrobial Stewardship programme
AUREC	Africa University Research Ethics Committee
CDC	Centre for Diseases Control
EDLIZ	Essential Drug List in Zimbabwe
FAO	Food and Agriculture Organisation
HCWs	Health care workers
HIV	Human immunodeficiency virus
HMTC	Hospital Medicine and Therapeutics Committee
INRUD	International Network of Rational Use of Drugs
IRDP	Index of Rational Drug prescribing
IRDU	Index of Rational Drug use
IRFSDU	Index of Rational Facility-specific Drug Use
IRPCDU	Index of Patient Care Drug Use
LMIC	Low-middle income countries
MPH	Marondera Provincial Hospital
MoECTHI	Ministry of Environment, Climate, Tourism & Hospitality Industry
MoLAFWRD	Ministry of Lands, Agriculture, Fisheries, Water & Rural Development
NAP	National Action Plan
NATPHARM	National Pharmaceutical Company
NMS	National Medicines survey
OPD	Outpatient department
RDU	Rational Drug Use
SPSS	Statistical Packages for Social sciences
STG	Standard treatment guideline
STI	Sexually transmitted infections

TB	Tuberculosis
USD	United States Dollars
WHO	World Health Organisation

Definition of Terms

Antimicrobials- these are agents that destroy or inhibit the growth of microorganisms, especially pathogenic microorganisms

Antibiotics -these are a type of antimicrobial medicine used in the treatment and prevention of bacterial infections.

Antimicrobial resistance - the ability of a microorganism to stop the antibiotic from working against it or failure of the drug to inhibit the growth of a microorganism at clinically achievable concentration

Antimicrobial Stewardship programme -this is an organizational or system-wide health-care strategy to promote appropriate use of antimicrobials through the implementation of evidence-based interventions

Essential drug list - a compilation of key medicines that satisfy the priority health needs of the population. These are medicines to which people should always have access to, in sufficient amounts

Generic drugs – a term referring to any drug marketed under its chemical name without advertising. or branding the essential drug list of Zimbabwe will be used as a basis to determine drugs as generic or brand name.

Hospital medicines and therapeutic committee -A team of hospital personnel whose role is to optimize rational drug use, by evaluating the clinical use of drugs, developing policies for managing drug use, administration and formulary system.

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CHAPTER 1 INTRODUCTION

1.1 Introduction

The emergence of antibiotic-resistant pathogens is an imminent threat to global public health. In Zimbabwe, increasing antimicrobial resistance (AMR) is one of the many threats faced by the health care system. Poor clinical care, indiscriminate antibiotic use, lack of robust AMR surveillance programs, lack of proper regulations and the burden of communicable diseases are factors aggravating the problem of AMR in Zimbabwe. (Mudenda, et al., 2023)

Antibiotics are the most used medicines in healthcare facilities globally; and they are often misused, especially in developing countries (Wong, Blumberg, & Lowe, 2006). According to the World Health Organization (WHO) over 50% of medicines prescribed, administered or vended globally are done inappropriately (WHO, 2014). The association between an increased misuse of antibiotics and emergence and spread of antibiotic -resistant microorganisms has been confirmed by numerous studies (Shankar, et al., 2016) (Buul, et al., 2014) (Teferra & Getachew, 2021) (Tadesse, et al., 2012) (Cabral, 2010)

Inappropriate prescribing of antibiotics has been pointed out as one of the factors leading to the misuse of antibiotics. Globally, the inappropriate use of antibiotics in primary care and hospital settings is a major contributing factor to the spread of antimicrobial resistance (AMR). The Centre of Disease Control (CDC) has classified AMR as a public health threat of growing concern in need of immediate attention (CDC, 2018)

1.2 Background to the Study

Since the middle of the nineteenth century, humans have achieved unprecedented advances in their battle with pathogens. The success in the control of infections is largely attributed to improved public health systems, disease surveillance and control, the development of vaccines and the use of antibiotics to combat bacterial infections (Koji, et al., 2019). These advances underpinned an enormous reduction in the incidence of infectious diseases during the twentieth century, raising hope for a complete victory over infectious diseases.

However, over the years, the overuse and misuse of antimicrobials have caused the emergence of AMR and its spread. The shocking news is that the proportion of infections due to antibiotic-resistant bacteria is growing and outpacing the rate at which new classes of antibiotics are discovered and synthesised (Buul, et al., 2014). As a result, the prospect of the world entering a 'post-antibiotic era' where common infections can no longer be cured is a real possibility (Chem & Anong, 2018)

Antibiotics are unique because they are the only pharmaceutical agents that have transmissible loss of efficacy over time. Because of the inevitable occurrence and transmission of antibiotic-resistant bacteria from patient to patient, every patient's use of antibiotics affects the future ability of every other patient to use those same antibiotics. Thus, antibiotics are a shared community property that health professionals, patients and the public should work together to protect from misuse (Copp, et al., 2011)

Inpatient antibiotic use in hospitals have also been seen to have a high point prevalence, which ranges from 71-87%. (Shankar, et al., 2013) (Akram, et al., 2017) (Alemu, et al., 2012) (Aldeyab, et al., 2011) Therefore, hospitals are a good starting place where information regarding antibiotic use in the community could be garnered

The ability to identify and stop inappropriate antimicrobial use is essential to slowing the emergence and spread of antimicrobial-resistant organisms. Research has shown that antibiotic use in hospitals is often characterized by prescription of more than one antibiotic, and prescribers are often inclined to prescribe medicines that may be less effective and carry more risk over the "first-line" medicines recommended by essential drug list (EDL) or standard treatment guidelines (STGs) (Rahman & Huda, 2014).

The critical step to limit the irrational use of medicines is to quantify the extent to which irrational use is occurring. The WHO in collaboration with the International Network of Rational Use of Drugs Use (INRUD) developed a group of indicators to assess the use of antibiotics in health facilities. The WHO-INRUD set of indicators have been used in numerous studies as yardsticks to assists in the introduction of antibiotic stewardship programs (ASPs) in different healthcare settings (Teferra, et al., 2020) (Nantongo, et al., 2022) (Al-Azazyih, et al., 2017) (Atif, et al., 2016)

The extent of antibiotic use is directly affected by the prescribing behaviour of physicians and other healthcare workers (e.g., nurses, pharmacy technicians,

community health workers and health assistants) who sometimes find themselves in the capacity of drug prescribers to patients (Atif, et al., 2016)

In 2017, Zimbabwe launched the One Health Antimicrobial Resistance National Action Plan. (NAP) 2017-2022. which was in line with the Global Action Plan and outlined strategic objectives to address the emerging problem of AMR. As Zimbabwe is setting out to document and implement its second NAP, it is important that more inquiry is made into the challenges of irrational medicine use and AMR. Furthermore, evaluation of the functionality of hospital medicines and therapeutics committee (HMTCs) that were established with the mandate of ensuring rational medicines use in hospitals should also be prioritized (Mudenda, et al., 2023)

The introduction of ASP requires the study of antibiotics prescribing patterns in health facilities and prescribing behaviour in health care workers as a benchmarking tool. It is the aim of this study to serve as a starter for a much broader study of antibiotic prescribing patterns and the nurturing of ASPs in Zimbabwean hospitals.

1.3 Statement of the Problem

Antibiotics are the most frequently prescribed drugs in hospitals. Studies conducted on the extent of antimicrobial use in Zimbabwe have shown considerable degree of resistance to commonly used first-line antibiotics (Mhondoro, et al., 2019)

Marondera Provincial Hospital is a referral health facility to the 25 health facilities in Marondera District. Unpublished pharmacy records for the hospital have shown a steady increase in number of medicines or antibiotics prescribed per year, The percentage of the medicines budget that is allocated to antibiotics for Marondera Provincial Hospital increased from an average of 46% in 2015 to an average 67% in 2022. The evidence shows an increase in antimicrobial use at the health facility. To the knowledge of the researcher, there are no published studies conducted at the hospital or the Mashonaland East province aimed at exploring the factors affecting antibiotic use and prescribing behaviours. This study is designed to contribute to the knowledge gap in this area and aimed designing interventions to improve the antibiotic prescribing and strengthen antibiotic stewardship programmes in public health facilities.

1.4 Research Objectives

1.4.1 General objectives

The broad objective was to study prescribing practices of antibiotics among patients at Marondera Provincial Hospital in Marondera District, Zimbabwe.

1.4.2 Specific Objectives

The specific objectives of the study were to: -

1. Assess antibiotic prescribing practices and use among inpatients at Marondera Provincial hospital using WHO-INRUD core drug prescribing indicators from 01 January 2023 to 30 November 2023.

2. Assess patient care indicators among outpatients at Marondera Provincial hospital using WHO-INRUD core drug indicators from 01 January 2023 to 30 November 2023.
3. Assess health facility indicators at Marondera Provincial hospital using WHO-INRUD core drug indicators from 01 January 2023 to 30 November 2023.
4. Assess knowledge and attitudes regarding antibiotic prescribing, antimicrobial resistance, and antibiotic stewardship programmes among health care workers at Marondera Provincial Hospital from 01 January 2023 to 30 November 2023.

1.5 Research Questions

1. How does the antibiotic prescribing practices and use among inpatients at Marondera Provincial Hospital compared to WHO-INRDU prescribing indicators from 01 January 2023 to 30 November 2023?
2. What are the patient care indicators at Marondera Provincial hospital using WHO-INRDU core drug indicators from 01 January 2023 to 30 November 2023?
3. Which health facility indicators at Marondera Provincial Hospital match the WHO -INRDU from 01 January 2023 -30 November 2023.
4. What is the level of knowledge, attitudes regarding antibiotic use, prescribing and antibiotic stewardship programmes, among health care workers at Marondera Provincial Hospital from 01 January 2023 and 30 November 2023?

1.6 Significance of the Study

Inappropriate use of antibiotics is a global public health challenge and has been associated with antibiotic resistance According to a study on AMR burden and antimicrobial use and consumption, Zimbabwe scored a drug resistance index (DRI) of 66%. The score is twice the benchmark of 25%. (African Union, 2021)

According to Africa Society of Laboratory Medicine, (2019) efforts to promote rational antibiotic use in developing countries are poor. With the growing number of infections with antibiotic resistant bacteria, rational drug use becomes imperative and studies that promote rational drug use are highly necessary (African Society of Laboratory Medicine, 2020)

A study by Chitungo, et al., (2022) reported a prevalence 34.4% methicillin resistant Staphylococcus aureus pathogens in nosocomial infections reported in Zimbabwe in 2020. It is evident that there is paucity of information on antibiotic prescribing patterns in Zimbabwean health facilities, thus studying the prescribing practices and assessing knowledge and attitudes of health care workers will help in paving a way towards the introduction and implementation of Antimicrobial Stewardship Programmes (ASP) in Zimbabwean hospital

According to Nantongo, et al. (2022) most studies investigating the magnitude and determinants of antibiotic use have focused on high income countries, leaving several unanswered questions about current practices in LMICs particularly primary and secondary healthcare level where the bulk of antibiotic use takes place.

Poor prescribing habit of antibiotics may significantly affect hospitalized patients and treatment outcome for infectious diseases. This is particularly important for Zimbabwe which still faces significant and growing burden of infections such as TB, malaria, HIV/AIDS, respiratory infections, sexually transmitted infections (STIs) and diarrhoeal diseases (Mhondoro, et al., 2019). The spread of AMR, through irrational antibiotic prescribing threatens the effective prevention and treatment of these infections.

Despite the pressing need for conservative antibiotic use, overuse of antibiotics across human and animal healthcare and agriculture is increasing (African Union, 2021). Subsequently, this irrational and excessive use of antibiotics has contributed significantly to the development of antibiotic resistance . According to the World Health Organization (2019), the world urgently needs to change the way it prescribes and uses antibiotics. WHO has stressed on the need to preserve the efficacy of existing antibiotics through the implementation of measures aimed at minimising the development and spread of resistance. This requires an understanding of the social and behavioural drivers of antibiotic overuse to inform the design and implementation of interventions that can optimise antibiotic prescribing practices. (CDC, 2018).

Without such behavioural change, antibiotic resistance will continue to remain a major threat, even if new medicines are developed. Evidence show that the greatest proportion of antibiotics for human use are prescribed in primary healthcare facilities. This highlights the need to focus research and action at this level of healthcare Because prescribers play a crucial role in the medicine use process, identifying the major problems in antibiotic prescribing at health care

facilities, especially in primary health care settings where most patients receive medical care, is an integral first step in developing effective interventions aimed at improving antibiotic use (Akram, et al., 2017).

Since every dose of antibiotic prescribed and used increases the likelihood of AMR, it is important to ensure that antibiotics are used appropriately

This study has contributed to filling the gap in the existing body of knowledge related to the rate and patterns of antibiotic prescribing at tertiary level health facilities in a low-middle income country. This study has also contributed to the existing body of knowledge on the knowledge, attitude and practices of health care workers towards antibiotic prescribing, AMR and ASPs. It was the aim of this study to provide evidence-based interventions that can be used to promote the rational prescribing of antibiotics at healthcare facilities in a developing setting. Findings of this study can serve as baseline data to evaluate further into the factors contributing to irrational antibiotic use and implement interventions to improve the prescribing of antibiotics in hospitals in Zimbabwe. and beyond.

1.7 Delimitations of the Study

The study was an institution-based survey and will only look at prescribing practices at Marondera Provincial Hospital among patients admitted to paediatric and medical wards and patients visiting the outpatient departments (OPDs). Due to limited data on core antibiotic prescribing indicators in Zimbabwe, the study findings were compared to data based on results from previous studies in the Southern African Region. The researcher selected studies that have a similar methodology and that were conducted in similar setting, to allow for inference and comparison, this therefore means the

prescribing practices described in the study can only be inferred to settings like which the study was conducted.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Introduction

An overview of the study was covered in Chapter 1. The chapter looked at the research problem, research objectives, research questions, and significance of the study. This chapter presents the literature review as related to the research topic. The aim of the literature review was to provide context for the study by understanding what is already known about the research topic and identification of the gaps in the area.

Available literatures on antibiotics use and resistance that mainly focuses on antibiotics prescribing, factors affecting antibiotic prescribing and interventions to improve antibiotic prescribing at healthcare facilities from developing settings were retrieved from different electronic sources using various search engines. Literatures that were found relevant for the research topic were identified, reviewed, collated and presented under the different sub-topics of this chapter.

Based on the literature review, the burden of antibiotic resistance, determinants and impact of AMR, antibiotics prescribing and its determinants, and strategies to promote the rational prescribing of antibiotics, including the use of antibiotics and the resistance situation in Zimbabwe, are discussed in this chapter. It also discusses the findings on research done to investigate antibiotic use using WHO/INRUD drug indicators in health care facilities. The chapter also reflects on knowledge, attitudes and practices regarding antibiotic prescribing, AMR and ASPs of health care workers.

2.2 Description of study variables and their importance to the conceptual framework

From literature review, it is evident that antibiotic prescribing is a process influenced by the interaction of patient related factors, physician related factors, antibiotic related factors and the social and physical environment in which the antibiotic prescribing is occurring (Murray, et al., 2020) Antibiotic related factors, such as its safety, efficacy, bioavailability, and affordability have a meaningful and positive relationship with doctors' prescription habits (Al-Azazyih, et al., 2017)

In this study the patients' factors, antibiotic factors and physician factors were the independent variables. The antibiotic prescribing practices was the study's dependent variable, and this was measured using the WHO- core drug indicators.

2.3 Conceptual framework

Atif, et al., (2016) described prescribing practices and behaviour as complex decision-making processes, whose intricacies are not yet fully understood. The conceptual framework (Figure 1) adapted from Sisay, et al., (2017) illustrates these complexities. The conceptual framework shows the casual relationship between prescribing patterns and explanatory variables, such patient, physician and antibiotic factors. These factors determine the prescribing practices observed at health facilities, which then can be measured using different measurement tools, such as the WHO-INRUD core drug indicators.

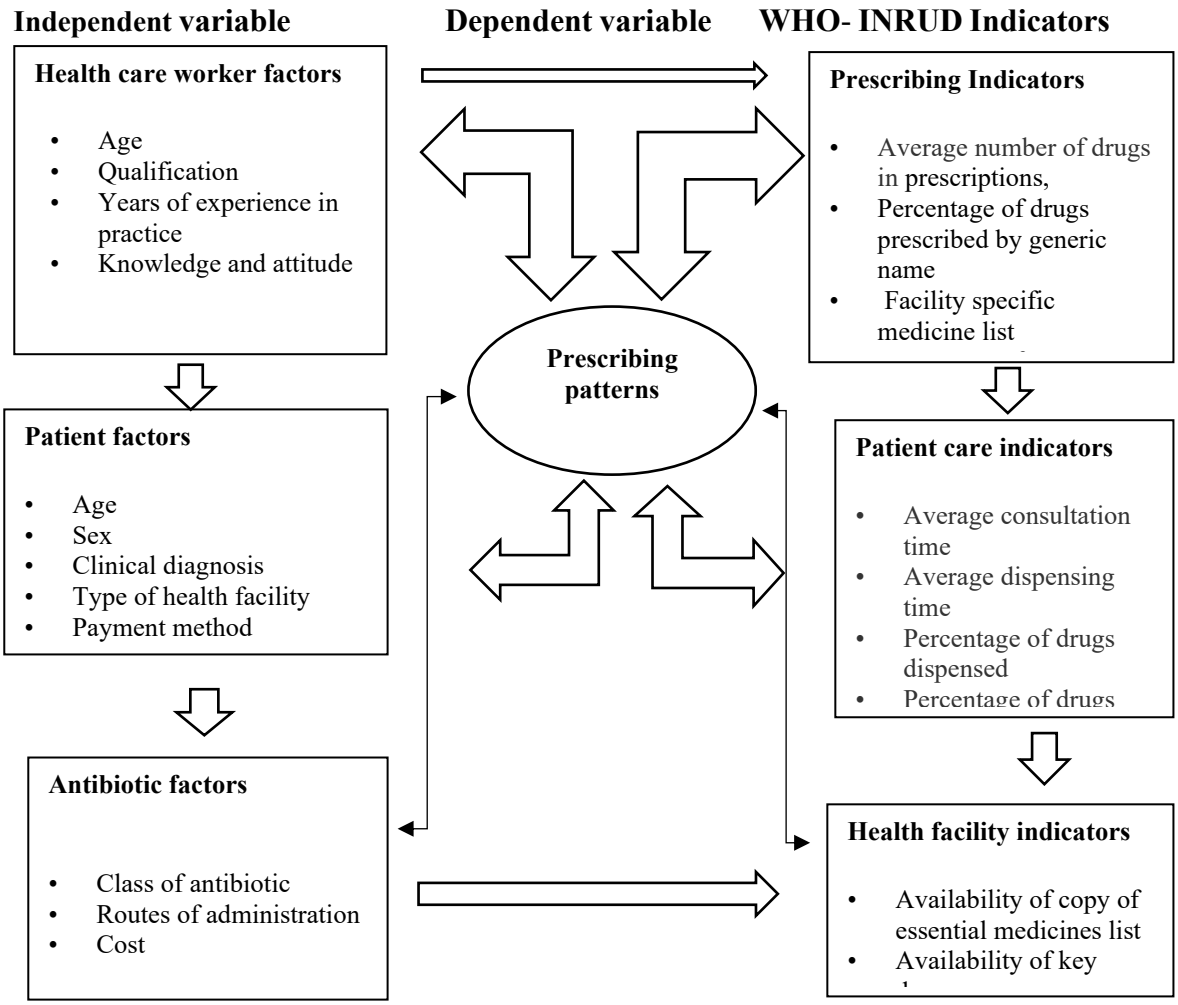

Figure 1: Conceptual framework for antibiotic prescribing patterns at Marondera Provincial Hospital adapted from Sisay et al (2017)

2.4 Antimicrobial resistance

Antimicrobial resistance is a natural phenomenon that occurs when microorganisms are exposed to antibiotics. Under selective pressure of antibiotics, susceptible bacteria are killed or inhibited, while bacteria that are naturally resistant or that have acquired antibiotic -resistant traits have a greater chance of surviving and multiplying (Prestinaci, Pezzotti, & Pantosti, 2013)

Antimicrobial resistance develops when bacteria adapt and grow in the presence of antibiotics. This occurs through a range of mechanisms, such as a modified antimicrobial target, enzymatic hydrolysis degradation, efflux and inhibition of permeability (Rabie & Kheder, 2020).

Mhondoro, et al., (2019) reported that despite immense advances, infectious diseases account for 25% of deaths worldwide and 45% of mortality in LMICs. In recent times, the benefits derived from use of antibiotics are facing a great threat due to the emergence of antimicrobial resistance.

Drug resistant bacteria can circulate in populations of human beings and animals, through food, water and the environment and transmission are influenced by trade, travel and both human and animal migration. (WHO, 2017). Figure 2 shows the interaction between the environment, animals, human population in the development of AMR.

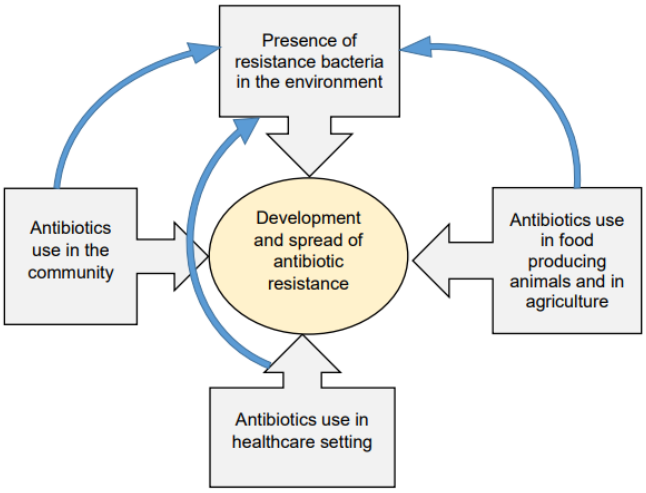

Figure 2: Factors involved in the development and spread of antibiotic resistance, adapted from (Prestinaci, Pezzotti, & Pantosti, 2013)

According to the African Union Framework for Antimicrobial Resistance Control 2020-2025 (Africa Union 2018), many factors contribute to the emergence, persistence and transmission of AMR. Although AMR strains arise naturally due to genetic changes in microorganisms, their emergence is accelerated by the inappropriate use of antimicrobial agents in humans, animals and environment. Inappropriate use of antibiotic which include self-treatment of illness by lay persons, non-indicated administration by health care providers and addition of antibiotics to animal feed and use in the prevention of illnesses in food animals also aggravate the rate of development and spread of AMR (Chitungo, et al., 2022)

The global burden associated with antibiotic resistant infections in 2019 was estimated to be 4.95 million deaths, of which 1.27 million deaths were directly attributed to drug resistance (Murray, et al., 2020). Resistance to fluoroquinolones and β-lactam antibiotics (i.e., carbapenems, cephalosporins and penicillin) which are the antibiotics often considered first line for empirical therapy for severe infections, accounted for more than 70% of the deaths attributable to AMR across pathogens (Murray et al., 2022).

The magnitude of the threat of AMR has been comparable to that of a pandemic (Pulcini, et al., 2013) In his Nobel Prize speech in 1945, Alexander Fleming, who discovered penicillin in 1928, predicted that the world would one day be facing the challenge of antibiotic resistance (WHO, 2017) As predicted, bacteria and other pathogens have continued to evolve such that many have developed resistance to the antibiotics that were normally used to combat them (Chunnilall, et al., 2015).

According to the report by Taxifulati, et al., (2018), there are various levels of drug resistance. Drug resistant is defined as non-susceptibility to at least one antimicrobial agent. Multi-drug resistant (MDR) is non-susceptibility to at least one agent in three or more antimicrobial categories. Extensively drug resistant (XDR) is defined as nonsusceptibility to at least one agent in all but two or fewer antimicrobial categories (i.e., bacterial isolates remain susceptible to only one or two categories). Possible pan-drug resistant (PDR) is defined as non-susceptibility to all agents in all antimicrobial 22 categories tested. (Tadesse, et al., 2012)

A review of studies conducted on antimicrobial resistance in Southern Africa from 2013 to 2016 reported high rates of AMR to commonly used antibiotics, including 50-100% resistance to ampicillin and cotrimoxazole, emerging resistance to gentamicin (20-47%) and relatively high levels of resistance to ceftriaxone (46-69%) among gram-negative bacteria. (Kalonga, et al., 2020) Much of the resistance was reported in Klebsiella species and E. coli. Among gram-positive infections, extensive resistance was reported to ampicillin (100%), gentamicin and ceftriaxone (50-100%).

A metanalysis of studies conducted from 2007-2017 to assess the prevalence of E. coli resistance in Ethiopia (Feleke, et al., 2018) indicated an overall resistance rate of 45.4% with level of resistance ranging from 62.6% in Addis Ababa to 27.5% in Tigray Region. The highest resistance was reported for ampicillin (83.8%) followed by amoxicillin (75.8%).

Another systematic review of studies conducted from 1999 to 2018 on the prevalence of Shigella species and its drug resistance pattern in Kenya, Shigella species were highly resistant to amoxicillin, erythromycin and ampicillin with pooled resistance

rates of 86.5%, 83.2% and 83.1%, respectively. On the other hand, 23 relatively low level of resistance was reported for ciprofloxacin (8.9%), ceftriaxone (9.3%), norfloxacin (8.2%) and gentamycin (17.3%) (Sisay, et al., 2017)

In Zimbabwe, Mhondoro, et al., (2019) described an increase in resistance rate to common antibiotics from data reviewed from a private laboratory in Harare.Antibiotic prescribing Resistance was highest to ampicillin followed by penicillin, both ranging between 70 and 100% over the six years. The study also revealed an increase in resistance to last-line antibiotics i.e., fluoroquinolone-resistant *Salmonella* spp. and carbapenem-resistant *Pseudomonas aeruginosa* and *Acinetobacter baumannii.*

2.5 Antibiotic prescribing patterns

The World Health Organisation (2014) described rational prescribing of antibiotics as the practice that ensures patients receive antibiotics appropriate to their clinical needs, in doses that meet their individual requirements, for an adequate period, and at the lowest cost to them and their community. Injudicious prescribing and use of antibiotics are considered as principal drivers of increasing resistance (Shankar, et al., 2016) .

Taxifulati et al. (2021) reported that excessive and improper use of antibiotics was more common in primary care settings than in secondary and tertiary hospitals although the types of antibiotics prescribed were similar. Inappropriate use of antibiotics includes, but is not limited to, treatment of conditions for which antibiotics are not clinically warranted, suboptimal dosage regimens, premature cessation of antibiotic treatment, lack of or poor-quality consultation with healthcare providers,

purchasing antibiotics without prescription and sharing antibiotics with others (Atif, et al., 2016)

2.6 Overview of antibiotic use and impact of irrational antibiotic prescribing

Inappropriate antibiotic prescription practices lead to ineffective and dangerous treatment, exacerbation or prolongation of the patient's disease, exaggerated costs and emergence of antibiotic resistant pathogens (Sanyal, et al., 2017)

Infections caused by resistant bacterial strains lead to up to two-fold higher rates of adverse outcomes compared with similar infections caused by susceptible strains. According to (Akram, et al) 2017 , these adverse outcomes may be clinical (death or treatment failure) or economic (costs of care, length of stay).

The disparate distribution of AMR among countries, cannot be ignored. (CDC, 2018). The high burden of AMR on developing countries could attributed to limited access to new antibiotics, increased financial burden, and the inability to pay for second-line antibiotics, which may be more expensive, hence causing worse treatment outcomes (Taxifulati, et al., 2018).

In resource-limited areas, insufficient diagnostic infrastructure and laboratory capacity, inconsistent AMR surveillance, and inadequately funded infection prevention and control programmes contribute to empiric antibiotic use based on syndromic approaches rather than microbiological data (Teferra, et al., 2020). This has led to high rates of antibiotic consumption in LMICs, which creates high selection pressure for resistant organisms (Pulcini, et al., 2013)

It is estimated that by 2050, 10 million deaths will be attributed to AMR annually and a cumulative amount of USD 100 trillion of the world's economic outputs will be lost due to AMR if substantive efforts are not made to contain this threat (Chunnilall, et al., 2015).

According to WHO, Food and Agriculture Organization of the United Nations (FAO) and World Organisation for Animal Health (WOAH) (2019), AMR exists everywhere and can impact anyone of any age, in any country in the world. The joint organisations report further emphasised that the impacts of unchecked AMR are wide-ranging and extremely costly, not only financially but also in terms of global health, food security, environmental well-being and socioeconomic development posing a major threat to the delivery of the 2030 Agenda for Sustainable Development. (Teferra, et al., 2020)

The effects of AMR extend beyond health into poverty as increased antimicrobial resistance will force people into poverty. Despite the shift in the global burden of disease to non-communicable diseases, infectious diseases disproportionately affect those living in poverty. Health systems in the LMICs rely on the availability of cheap antibiotics and are not equipped to cope with an increasing burden of resistant infections (Mahji, et al., 2017). The World Bank estimated that AMR could push 28 million people into extreme poverty by 2050 (African Union, 2021).

Evaluation of antibiotic use in any health institution requires a structured, methodological, and criteria-based assessment system that helps to evaluate the actual trend of antibiotic use in a particular setting. (Sisay, et al., 2017)

2.7 Core Drug Indicators

There are several well-recognized survey approaches to assess antibiotic or medicine use in healthcare facilities, one such assessment tool is based on World Health Organisation-International Network of Rational Use of Drugs (WHO-INRUD) core drug indicators. The WHO-INRUD core drug indicators are widely recognized as a global standard for health facilities' drug pattern assessment (Al-Azazyih, et al., 2017)

The WHO/INRUD core drug indicators are a good assessment of antibiotic use because they are informative, feasible, less likely to fluctuate over time and place as well as easier to measure drug use than the other complementary indicators (Chem & Anong, 2018). Therefore, the core indicators were selected for better quantitative evaluation of antibiotic use and prescribing patterns in this study. Table 1 gives an overview of the WHO-INRUD prescribing, patientcare and health facility indicators and their optimal values.

Table 1: World Health Organisation /International Network of Rational Drug Use (WHO/INRUD) Core Drug Indicators

Core Drug Indicators	**WHO Optimal values**	**Optimal index**
A Prescribing Indicators		
Average number of drugs per encounter	1.6-1.8	1
Percentage of drugs prescribed by generic name	100	1
Percentage of encounters with antibiotic prescribed	20.0-26.8	1
Percentage of encounters with injection prescribed	13.4-24.1	1

Percentage of drugs prescribed from essential drug list	100	1
B Patient indicators		
Average consultation time	≥10 minutes	1
Average dispensing time	≥ 90 seconds	1
Percentage of drugs dispensed	100	1
Percentage of drugs adequately labelled	100	1
Patients' knowledge on correct dose	100	1
C Facility indicators		
Availability of copy of essential drug list and treatment guidelines	100	1
Available of key drugs	100	1

WHO optimal values adapted from (Atif, et al., 2016) and Optimal indices adapted from (Chem & Anong, 2018)

There are three major categories of core drug use indicators namely, prescribing indicators (average number of antibiotics per encounter; percentage of antibiotics prescribed with generic name; percentage of encounters with antibiotics prescribed, percentage of encounters with injections prescribed).

Patient care indicators (average consultation time, average dispensing time, percentage of antibiotics dispensed, percentage of antibiotics actually labelled and patient knowledge of how to take the drug), and health facility indicators (availability of essential drugs, availability of standard treatment guidelines and formularies.) (WHO, 2019)

2.7.1 WHO-INRUD Prescribing indicators

The indicators of prescribing practices measure the performance of health care workers in several key dimensions related to appropriate antibiotic use. As indicated in the table above the percentage of encounters with an antibiotic prescribed is one of the core prescribing indicators, that is used to objectively

measure the patterns of antibiotic prescribing. The indicator has been widely used to determine the prevalence and appropriateness of antibiotics prescribing at facility, region or country level (WHO, 2019)

Research evidence has shown that antibiotic consumption is much higher in developing countries as compared to developed countries. Research by Atif et al., 2016 in Bangladesh reported an average numbers of antibiotic per prescription of 2.3, this is high than the admissible range of 1.6-1.8. Similar findings were reported by Amaha, et al., (2019) in Eritrea, where average number of antibiotics per prescription was 2.07.

The difference in prescribing seen in many countries and health care settings can be attributed to the differences in the level of awareness among clinicians working in different parts of the world and lack of harmonised national prescribing guidelines. (Tadesse, et al., 2012)

Having a higher number of drugs per prescription can adversely influence treatment outcomes as patients are more likely to be non-compliant and are at greater risk of interactions and adverse events. Moreover, prescribed medicines that are not warranted lead to fiscal implications for national healthcare systems including budget blowouts (Atif, et al., 2016).

Well-founded recommendations by the WHO regarding generic prescribing provide a safety measure for patients These recommendations clearly describe what should happen and they provide accessible information and promote effective communication among healthcare providers (WHO, 2014)

A study by Mudenda, et al., (2023) in Lusaka, Zambia revealed that antibiotics were prescribed on over half the prescriptions (52.2%) (optimal value 20.0–26.8%). To compare internationally, this value was relatively lower in other developing countries such as Bangladesh (25.0%) (Atif, et al., 2016) and Brazil (28.8%) (Zago, et al., 2023) .

High rate of antibiotic prescription would suggest that either every second person who presents at the health facility has an infection related issue, or that there is excessive and inappropriate prescribing of antibiotics occurring in hospital institution. (Nantongo, et al., 2022).

Regarding drugs prescribed from the essential drug list (EDL), most study findings were comparable to each other. Rational prescribing includes the optimal use of drugs selected from the EDL. These agents are older, time tested and available at lower cost than the originator new branded drugs (Atif, et al., 2016).

2.7.2 WHO-INRUD Patient-care indicators

Patient care indicators address key aspects of what patients experience at health facilities, and how well they have been prepared to deal with the pharmaceuticals that they have been prescribed and dispensed. The time that prescribers and dispensers spend with each patient sets important limits on the potential quality of diagnosis and treatment. Patients for whom antibiotics are prescribed should at a minimum receive, well labelled medications and should undertake how to take each drug. (WHO, 1993)

Amaha, et al., (2019) in a study in Eritrea, reported that the average consultation and dispensing time of facilities were 5.60 and 2.70 minutes respectively. Studies conducted by D'Arcy, et al., 2021 and Akram, et al., (2017) in Tanzania and India respectively revealed an average consultation time of 5.8 and 6.14 minutes respectively; and the average dispensing times were 1.90 and 1.28 minutes respectively.

Shorter consultation and dispensing time may lead to inadequate information about the medication being given to patients and patients had little chance to obtain information about their treatment. The potential reason for this variation can be due to differences in manpower, patient overload, set up of dispensary area and ease of access for essential materials like medicines, medical equipment among health facilities. (Sisay, et al., 2017)

The primary purpose of labelling of medicines is the clear unambiguous identification of the medicine and the conditions for its safe use. (Buul, et al., 2014) It is also an informative tool for stakeholders such as health-care professionals, patients and pharmacists. Chunnilall, et al., (2015) maintains that since adequate labelling increases patient awareness about the regimen that he/ she takes and hence increases treatment adherence and a better outcome, it must be promoted in all health institutions.

Since the availability of essential medicines in the dispensary of the institutions is one of the indicators for the quality of care, all medicines should also be made available as much as possible by the institutions (Akram, et al., 2017).

2.7.3 WHO-INRUD Health Facility Indicators

The ability to prescribe drugs rationally is influenced by many features of the working environment. Two particularly important components are an adequate supply of essential drugs and access to unbiased information about these drugs, without these, it is difficult for health personnel to function effectively. (WHO, 1993)

Kalonga, et al., (2020) in a study in Lusaka noted that the percent availability of key medicines in the stock was 83.5%, which is less than the optimal value mentioned in the WHO/INRUD recommendation. Many of the previous studies done in different settings also reported a lower value than the WHO/INRUD recommendation ranging from 66% to 96.7%. (Al-Azazyih, et al., 2017) (Atif, et al., 2016) (D'Arcy, et al., 2021) (Rabie & Kheder, 2020)

The possible reasons for lower than optimal values for availability of key essential antibiotics, could be an inadequate supply of medicines from the supplier(s), budget constraint, absence of medicines procurement policy, scheduled procurement, and a long process of acquiring from a private source for those medicines which may not be available from the local or government supplier. So, by identifying the possible gaps, the key medicines in the stock should be available 100%, as much as possible (Amaha, et al., 2019).

Availability of an essential drug list or formulary as well as a copy of standard treatment guidelines at health facilities enhances the delivery of better health care service to patients (Taxifulati, et al., 2018)

Nantongo, et al., (2022) in a study in Ethiopia reported that both essential drug list and standard treatment guidelines were available at the four hospitals that were being evaluated during the study period. Similarly, many previous studies also had these documents in their facilities (Alemu, et al., 2012) (Alemu, et al., 2012) (Atif, et al., 2016) (Mudenda, et al., 2023). Therefore, health institutions should uphold a good practice of having an EML/Formulary and a copy of the STG.

2.8 Indices of performance core drug indicators

Zhang and Zhi (2015) developed an index system for the comprehensive evaluation of rational drug use in the health care systems. The index system was developed for each indicator namely non-poly pharmacy index, generic name index, rational antibiotic use index injection safety index and essential drug list index.

Patient care drug indices include, consultation, dispensing, dispensed drugs, labelled drugs and patient knowledge index. For the calculation of indices of non-polypharmacy, rational antibiotic use, and safe injection use, the WHO optimal value is divided by the observed value. To obtain the indices of generic name and medicines from the essential medicines list, the observed value is divided by the WHO optimal value The optimal index for all indicators was set as 1, where values closer to 1 indicated rational use. (Wendie & Ahmed, 2021)

The index of Rational Drug Prescribing (IRDP), Index of Rational Patient-Care Drug Use (IRPCDU), and Index of Rational Facility-Specific Drug Use (IRFSDU) were then developed for prescribing, patient and facility indicators respectively. The Index of Rational Drug Prescribing (IRDP) is obtained by adding the index values of all prescribing indicators, IRPCDU, by adding index values of all patient indicators and IRFSDU by adding index values of all facility indicators. Finally, the Index of Rational Drug Use (IRDU) is calculated by adding up the total of IRDP, IRPCDU and IRFSDU. Often a rank is assigned to each health facility based on the IRDU value. (Sisay, et al., 2017)

Amaha et al, (2019) in a study in Eritrea's revealed that the overall IRDP was 4.4 It was lower than the optimal value of five (5). The study findings are like the research reported from North Ethiopia and several other Southern African countries where IRDP was also lower than five (Al-Azazyih, et al., 2017) (Atif, et al., 2016) (Chem & Anong, 2018) (Sisay, et al., 2017). Evidence from several studies in LMICs shows a clear need and opportunity for the policy makers and program managers to find a hasty solution to improve the rational use of antibiotics.

2.9 Determinants of antibiotic prescribing: Knowledge, attitude and practices.

While the major driver of antibiotic resistance is known to be the huge increase in antibiotic prescribing, especially in LMICs various other factors have been found to also influence antibiotic prescribing. These include patient characteristics such as low-socioeconomic status; age of patient; the presence of comorbidity; perceived demand and expectation from the patients; educational qualification and experience of

prescribers; source of updating knowledge; practice setting; diagnostic uncertainty; influence from medical representatives; and inadequate knowledge (Livorsi, et al., 2015)

In a study conducted in China by Coope, et al., (2022)) to identify the potential intrinsic and external determinants of antibiotic prescribing in primary care it was revealed that external factors like patient pressure, time pressure and financial incentives were significantly associated with physicians' antibiotics use rather than internal factors such as physicians' knowledge.

Coope et al (2022)'s findings are more relevant in public health institutions, where health care workers might have good knowledge, and attitude towards antibiotic use, but their practices are in mainly influenced by time and patient pressure.

In another study by Kalonga et al. in Lusaka (2020) to measure the knowledge and attitudes of primary care physicians towards antibiotic prescribing, physicians were found to have limited knowledge about antibiotic prescriptions. Poor knowledge, unawareness of antibiotic resistance, and limited motivation to change contributed to physicians' high antibiotics prescriptions. Drug availability, socioeconomic status of the patient and prescribers' in-service training were identified as major factors influencing prescribing decisions.

In a study conducted at primary healthcare facilities in East Africa by Luwumba, et al., (2021) reported that medical knowledge; clinical competency; good clinical practice; availability of diagnostics; and the desire to improve clinical practice were significantly associated with low prescribing of antibiotics.

A complex range of factors determine the inappropriate use of antibiotics in LMICs. The supply-side factors include lack of knowledge among prescribers or habitual prescribing that is not in line with best practice; inadequate medical education, training and supervision; pharmaceutical promotion; inadequate interaction times between health workers and patients; inaccurate perceptions of patient need and demands; and limited availability of diagnostic support tools. (Livorsi, et al., 2015)

There are also demand-side factors which include high expectations or beliefs of how effective antibiotic treatment could be; poor availability of information and lack of knowledge about the appropriate use of drugs for different conditions; the ability to easily access medicines over the counter without a prescription; and a strong culture or norm of self-prescribing medicines (Livorsi, et al., 2015)

The high level of antibiotic consumption in LMICs is related with multiple factors, as seen from the review of literature .Therefore any strategy that aims to curb the spread of AMR must tackle these multi-dimensional supply- and demand-side factors , physician and patient factors affecting the prescribing of antibiotics in clinical and community settings (Coope, et al., 2022)

2.10 Strategies to promote the rational prescribing of antibiotic

Rational use of antibiotics is one of the measures required to minimise the development and spread of resistance to antibiotics (WHO, 2017) The WHO, in its practical toolkit on Antimicrobial Stewardship Programmes in Healthcare Facilities in LMICs indicated that antibiotics must be prescribed rationally and that last-resort antibiotics be reserved for those patients who truly need them (WHO, 2019)

Interventions to improve antibiotic use are intended to achieve a variety of outcomes, including delaying the development of resistance; decreasing the use of antibiotic in situations for which antibiotics are not effective; increasing the use of a recommended antibiotic when one is indicated; reducing adverse drug events; and decreasing healthcare costs (Mbanga, et al., 2023)

The World Health Assembly's endorsement of the Global Action Plan on Antimicrobial Resistance in May 2015 and the Political Declaration of the High-Level Meeting of the General Assembly on AMR in September 2017, both recognise AMR as a global threat to public health. These policy initiatives acknowledge overuse and misuse of antimicrobials as the main driver for development of AMR. The Global Action Plan on AMR sets out five objectives (Table 2) as a blueprint for countries in developing national action plans on AMR (WHO, 2019).

Table 2 showing the five strategic objectives of the Global Action Plan on AMR

Strategic Objective	**Description**
Objective 1	Improve awareness and understanding of AMR through effective communication, education and training
Objective 2	Strengthen the knowledge and evidence base through surveillance and research
Objective 3	Reduce the incidence of infection through effective sanitation, hygiene and infection prevention measures
Objective 4	Optimise the use of antimicrobial medicines in human and animal health
Objective 5	Develop the economic case for sustainable investment that takes account of all the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines and other interventions.

In Zimbabwe antimicrobial resistance advocacy and containment efforts began in 2015. A National Medicines Survey (NMS) was conducted across the ten provinces of the country, followed by the development of the framework and systems to guide the development of a national plan of action.

A situation analysis was conducted with the purpose of identifying current knowledge and deficiencies regrading AMR, describe behaviours that facilitate the spread of AMR and identify research priorities (Mbanga, et al., 2023). In September 2017, the Zimbabwe One Heath Antimicrobial Resistance National Action Plan (NAP) was launched by the Ministry of Health and Child Care, with assistance from different stakeholders and development partners. The NAP for AMR (2017-2022) was implemented across the human and animal health, agriculture, and environment sectors.

The One Health Approach to AMR, which uses an interdisciplinary approach for surveillance and implementation of programs, policies, and research, is increasingly recognised as a vital component to national and global AMR strategies (African Union, 2021). In line with the WHO's Global Action Plan on Antimicrobial Resistance and the Zimbabwe's National Health Strategy 1, the national strategic plan on prevention and containment of AMR has been developed (Mhondoro, et al., 2019). The AMR prevention and containment strategic plan that embraces the One Health Approach has the following 5 strategic objectives ((WHO, 2019):

a) Improve awareness and understanding of antimicrobial resistance through effective behaviour change communication, education and training.

b) Strengthen the knowledge and evidence on antimicrobial use and resistance through surveillance and research.
c) Enhance infection prevention and control through effective environmental health, infection prevention and bio-risk measures in human, animal and plant health.
d)) Optimise the use of antimicrobials in human, animal and plant health care.
e) Strengthen and establish partnerships, alliances, governance and resource mobilization at all levels.

Since 2017, the governance of AMR prevention and containment in Zimbabwe has remained largely a function of the Ministry of Health and Child Care, with its development and implementation partners. (Chitungo, et al., 2022). The current antimicrobial resistance governance mechanism is comprised of a high-level National Inter-ministerial Committee, and multisector technical working groups.

A multi-sectoral coordinating committee was set up, with members from the Ministry of Health and Child Care (MoHCC), the Ministry of Lands, Agriculture, Fisheries, Water & Rural Development (MoLAFWRD) and the Ministry of Environment, Climate, Tourism & Hospitality Industry (MoECTHI) to oversee the implementation of the NAP for AMR (2017-2022). National-level governance is responsible for formulating policies and regulations and providing technical guidance and assistance to regional-level antimicrobial resistance coordinating platforms. (WHO, 2019) .

Zimbabwe's NAP for AMR (2017-2022) was concluded at the end of 2022. Preparations for the new NAP for (2023-2027) are already underway. The Food and Agriculture Organisation (FAO)'s Progressive Management Pathway for AMR tool

was used to evaluate the implementation progress, gaps and challenges of the first NAP. The report showed that while the country had made significant strides towards implementation of the AMR -NAP, there remains huge implementation gaps. One of the gaps identified was poor costing and budgeting (WHO, 2023).

2.10.1 Antimicrobial stewardship

Antimicrobial stewardship is defined as ensuring that every health care provider selects the right antibiotic; for the right indication (right diagnosis); the right patient; at the right time; with the right dose and route; causing the least harm to the patient and future patients (WHO, 2019)

ASPs are coordinated efforts and activities that help in appropriate use of antimicrobials. Thus, they reduce the incidence of drug-resistance, improve outcome, and decrease the spread of multi-drug resistant organisms. The core aspects of ASPs include multidisciplinary team meetings, antimicrobial policies with optimization of dose, rotation of antibiotic use to prevent resistance, antibiotic restriction policy and quick and safe conversion to oral antibiotics from parenteral antibiotics (Sanyal, et al., 2017).

To support effective implementation of this strategic objective in LMICs, the WHO has developed and issued a practical toolkit in its antimicrobial stewardship program in 2019, “Antimicrobial stewardship programmes in health-care facilities in LMICs - A practical toolkit (WHO, 2019).

For effective implementation and development of an ASP, the following core elements are important (Taxifulati, et al., 2018)

- **Leadership Commitment**: Dedicating necessary human, financial and information technology resources,
- **Accountability**: Head of clinical or appropriately appointed clinician and other health professionals responsible for program outcomes,
- **Appropriate Expertise**: Appointing a single pharmacist or microbiologist or infection prevention expert, leader responsible for working to improve antibiotic use,
- **Action**: Implementing at least one recommended action, such as systemic evaluation of ongoing treatment need after a set period of initial treatment (i.e., "antibiotic time out" after 48-72 hours),
- **Tracking**: Monitoring antimicrobial rational use and resistance patterns,
- **Reporting**: Regular reporting of information on antimicrobial use and resistance to health professional and other relevant staff as well as appropriate regional and local organizations, and: -
- **Education**: Educating clinicians, other healthcare professionals, hospital communities, patients and societies at large about resistance and optimal use of antimicrobials.

There are some strategies that could provide the basis for an ASP. These strategies can be used alone or in combination. These are as follows: -

- **Prospective audit with intervention and feedback**: A review of antimicrobial therapy by an infectious diseases physician or a clinical pharmacist with/ without training in antimicrobial stewardship who is not a part of the treatment team with face-to-face interactions and feedback given to the treatment team,

who can suggest changes to the antimicrobial prescription in comparison to hospital guidelines.

- **Preauthorization**: Preauthorization requires obtaining approval prior to the use of certain antibiotics. Preauthorization of antibiotic therapy before its use or administration into the patient requires expertise and staff to complete the authorizations in time (WHO, 2019) .This can optimize the initiation of antimicrobial therapy and avoid unnecessary use of antibiotics.
- **Facility-specific treatment guidelines** : These can optimize and help establish recommendations for antimicrobial selection especially for common conditions such as community acquired pneumonias, urinary tract infections and surgical prophylaxis. These could be based on local antibiotic susceptibilities, patient mix, drug formulary options available and more importantly standard treatment guidelines.

2.10.2 Other frameworks of antimicrobial stewardship

Another WHO framework for ASPs is the Access, Watch and Reserve (AWaRe) system. To promote the optimal use of antibiotics and assist antibiotic stewardship efforts, WHO introduced AWaRe classification of antibiotics in 2017. (WHO, 2017) This classification underlines that, where appropriate, narrow-spectrum antibiotics included in the Access group should be preferred over broad-spectrum antibiotics from Watch and Reserve groups to limit the selection and spread of antibiotic resistance.

Accordingly, WHO recommends that Access-group antibiotics should constitute at least 60% of overall antibiotic use (Siele, et al., 2015)

The Access group includes antibiotics that have activity against a wide range of commonly encountered susceptible pathogens while also showing lower resistance potential than antibiotics in the other groups. The Access group includes 48 antibiotics, 19 of which are included individually on the WHO Model List of Essential Medicines as first- or second -choice empiric treatment options for specified infectious syndromes (WHO, 2019).

The Watch group antibiotics includes antibiotics that have a higher resistance potential and includes most of the highest priority agents among the critically important antimicrobials for human medicine and/or antibiotics that are at relatively high risk of selection of bacterial resistance (D'Arcy, et al., 2021). Antibiotics in the Watch group should be prioritised as key targets of stewardship programs and monitoring. The Watch group includes 110 antibiotics, 11 of which are included individually on the WHO Model List of Essential Medicines as first- or second -choice empiric treatment options for specified infectious syndromes (WHO, 2017).

The Reserve group includes antibiotics and antibiotic classes that should be reserved for treatment of confirmed or suspected infections due to multidrug-resistant organisms. Antibiotics in the Reserve group should be treated as “last resort” options, which should be accessible, but their use should be tailored to highly specific patients and settings, when all alternatives have failed or are not suitable (Murray, et al., 2020). Antibiotics in the reserve group should be protected and prioritised as key targets of national and international stewardship programs involving monitoring and utilization reporting, to preserve their effectiveness (D'Arcy, et al., 2021). Twenty-two (22) antibiotics have been classified as the Reserve group. Seven (7) Reserve group

antibiotics are listed individually on the WHO Model List of Essential Medicines (WHO 2019).

Measuring antibiotic consumption through quantifying the use of antibiotics in each of the AWaRe categories, allows some inference about the overall quality of antibiotic use in each country. Several studies have recommended that health facilities should first measure antibiotic absolute and consumption the WHO-INRUD indicators and then evaluate relative use according to the AWaRe categories (Mudenda, et al., 2023) (Chitungo, et al., 2022) (Rabie & Kheder, 2020).

2.10.3 Interventions to improve antibiotic prescribing

Several interventions targeted at improving antibiotic prescribing among primary care and hospital care professionals have been implemented around the world. However, interventional studies that focus on improving the prescribing of antibiotics are not as common as the descriptive studies on antibiotics prescribing and use. (Koji, et al., 2019) Published studies on promoting the rational use of antibiotics are rare from LMICs and almost non-existent in Zimbabwe

Most studies showed that reduction in antibiotic prescribing was achieved through interventions focused on clinician education programs, such as interactive seminars; mailing campaigns; small group education focusing on evidence-based medicine and communication skills; educational outreach visit; guidelines and leaflets; and a combination of these educational strategies Behaviour changes interventions, mainly in high-income countries, have shown that educational guidelines and printed educational materials for providers have positive but modest improvements on prescribing behaviour. (Teferra & Getachew, 2021)

According to a systematic review by Feleke et al (2018) on use upper respiratory tract infections in children, strategies targeting both providers and caregivers are more effective than those targeting providers alone.

A systematic review of interventional studies showed that educational interventions, and electronic decision support were the only interventions with evidence of improved prescribing without adverse consequences. Three education-based interventions were found to have a benefit with evidence of not increasing adverse consequences. A clinic-based educational intervention for parents of paediatric patients had the largest reduction in overall antibiotic prescribing among the education interventions (21.3%) without increasing the number of return visits. (D'Arcy, et al., 2021)

Analysis of prescribing practices and interviews with prescribers highlighted priorities for ASP, which include increased awareness and education about antibiotic resistance, development and provision of policies and guidelines on antibiotic use, monitoring and surveillance of antibiotic use, improved laboratory and diagnostic services and ensuring availability and quality of products (Christensen, et al., 2022)..

The healthcare providers' prescribing behaviour is an important area to promote the rational use of antibiotics. Studies have shown that many countries have been successful in reducing prescribing of antimicrobials in secondary and tertiary hospitals in the past decades.

However, irrational use of antibiotics in primary healthcare where most of the people are prescribed antibiotics is still problematic. It is estimated that about 80% of antimicrobials are consumed in primary healthcare around the world. Therefore, effective interventions to improve healthcare providers' prescribing behaviours in

primary healthcare would greatly improve the rational use of antibiotics (Atif, et al., 2016)

Previous studies showed that multiplex interventions that combine different strategies to influence behaviour tend to have a higher success rate than interventions based on single strategies. A commonality amongst other reviews is that many of the interventions which worked well were combinations of restrictive and enabling strategies, i.e., educational techniques combined with forms of monitoring (Atif, et al., 2016).

2.11 Summary

This chapter has provided the literature review in the areas of antimicrobial resistance and use with the focus on antibiotics prescribing at health facilities using published literatures. The information retrieved from various literatures was organised into subtopics, which identified the broad problem of AMR, and then discussed the specific problem of antibiotic prescribing, through the WHO-INRDU indicators and finally the chapter provided information of strategies to promote rational prescribing and as well as highlight significant gains made by the country towards slowing the spread of AMR. Th next chapter discuss the research design and methodology.

CHAPTER 3 METHODOLOGY

3.1 Introduction

This chapter gives a detailed account of the research design, research methods, data collection, data management and ethical considerations that the researcher applied in undertaking the study.

3.2 Study Design and its appropriateness

Research designs are plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis. (Creswell, 2014). Quantitative research is an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured so that numbered data can be analysed using statistical procedures. In this study, a quantitative research design was used for data collection and analysis. Achieving the objectives of the study required collection of quantitative data.

A hospital -based, cross-sectional study was conducted at Marondera Provincial Hospital. The s cross-sectional study design was used to evaluate prescribing indicators through review of patient records. A prospective cross-sectional study design was employed for patient care and facility indicators. Patient records for patients admitted into the medical and paediatric wards from 01 January 2023 to 30 November 2023 were used to assess antibiotic prescribing practice and utilization patterns at the hospital. The second phase of the study was a survey

on the knowledge, attitude and practices of health care workers on antibiotic prescribing, AMR and antibiotic stewardship programmes.

The antibiotic prescribing pattern was the study's dependent variable (WHO indicators). Sociodemographic (gender, age, and residence) and antibiotic information (indication, frequency, and regimen/combination) were the independent variables

A quantitative cross sectional study design was chosen because it enabled more accurate, focused and effective measurement or assessment of the phenomenon that was being investigated. The study design was used by Wendie et al. (2019) to evaluate drug use patterns using WHO indicators in Dessie, Northeast Ethiopia.

3.3 Study setting and rationale for selection

Marondera Provincial Hospital is a tertiary care and referral hospital, which has been in operation since 1939, catering for nine districts in Mashonaland East Province with a 300-bed capacity. The clientele of the hospital is drawn from a 1.3 million population in the province. A total of 18 specialist, 16 government medical officers, 7 pharmacists, 221 registered nurses and 17 paramedical staff serve an average of 1300 inpatients per month. The hospital was chosen for the study because of the highest admission rate in the province which made it more probable to assess prescribing patterns among patients.

3.4 Study population

A population consists of all the items or individuals about which a researcher wants to draw a conclusion. Identifying the population of interest is an important first step in designing the sampling method. This entire population is often referred to as the theoretical or target population since it includes all the participants of theoretical interest to the researcher. These are the individuals about which the researcher is interested in generalizing (Creswell, 2014). The study had three sets of study population namely, patient or medical records for inpatients that were eligible for the study, outpatients visiting the OPD department and health care workers at Marondera Provincial. The section below, describes how each study population was selected and sampled.

3.4.1 Prescribing indicators

The study population was the medical records of inpatients admitted in the medical and paediatric wards at Marondera Provincial Hospital from 01 January 2023 to 30 November 2023.

3.4.2 Patient care and health facility indicators

The study population for evaluation of patient-care indicators were outpatients and their prescriptions who visited the hospital to seek treatment in the outpatient department (OPD) and pharmacy from 01 January 2023 to 30 November 2023 between the hours 7.00am to 5pm.

3.4.3 Knowledge, attitude and practices survey

The study population was health care workers that were stationed at Marondera Provincial Hospital during the period between 1st of January 2023 to the 31st of November 2023

3.5 Eligibility criteria

For the evaluation of prescribing indicators, all records of inpatients hospitalized in the hospital 's medical and paediatric wards with at least one antibiotic was included in the study However records of patients who were either of the following, pregnant mentally ill, unconscious, and critically ill were not included in the study. Records of patients who were on long-term antibiotic therapy were not selected into the study.

To evaluate patient care and health facility indicators, all patients who visited the OPD between 01 January 2023 -30 November 2023 were included in the study. Outpatients with chronic conditions, patients under the age of 18 years and patients seeking treatment in psychiatry, opportunistic infection and rehabilitation departments on scheduled visits to the hospital were not included Furthermore, patients who had prescriptions that contained any item apart from an antibiotic and patients visiting the hospital outside the normal employment hours were not included in the study.

For the KAP survey, all health care workers responsible for prescribing, dispensing and administering antibiotics at the hospital were included in the study. The study population for health care workers included, government

medical officers, registered general nurses, sisters in charge, matrons, pharmacist and primary care nurses

3.6 Sample size determination and sampling technique

Sampling is the process through which researchers look at a smaller sample of possible participants to draw conclusions about the population. Theoretically, a good sampling technique should produce a sample that is trustworthy and devoid of bias (each member of the population has an equal probability of being chosen). It is argued that a sample is representative of the full population of interest if it is trustworthy, impartial, and free from bias.

A representative sample allows the researcher to investigate the sample while drawing accurate conclusions about the larger population since it correctly reflects the characteristics of the population being studied. A poor sample could lead to meaningless findings based on research that is fundamentally flawed (Creswell, 2014). For this reason, the section below describes how the researcher arrived at the study sample size.

3.6.1 Prescribing indicators

The study was inherently, descriptive in nature, therefore, probability sampling using the single population proportion formula as described by Daniel, (2008) was considered to determine the required number of patient records to determine the antibiotic prescribing practices. The formula below was used to determine the sample size: -

n = z 2pq/e 2

Where:

- n = the sample size
- z = the z score corresponding with the desired level of confidence of 95% (z=1.96.)
- p = the estimated proportion in the population. The most conservative estimate is 0.50 and this was used in this study.
- q = 1 – p
- e = the tolerable margin of error or precision of the estimate. 5% margin of error was used in this study.

Using these values, the sample size was then calculated to be n = (1.96)2 (0.5) (0.5)/ (0.05) 2 = 384. Considering a design effect of 1.5 as the sampling involved multistage sampling, the sample size was 384*1.5 = 576.

The single proportion method suggested reviewing a total of 576 patient records, in both the paediatric and medical wards of the hospital to patterns of antibiotics prescribing.

The WHO (1993), however, recommends reviewing a total of at least 600 patient records to describe medicines use in a specific healthcare facility. Therefore, to make comparison on antibiotic use patterns with other previous studies, the sample size for prescribing indicators was selected to be 600 patient records., with 300 records from the paediatric ward and the other 300 records from the medical ward. To minimize the sampling bias (seasonal alterations or supply cycle of medicines), the patients record from both the paediatric and medical ward were arranged in order of the reference

number, (patient hospital number). divided into four quarters using the calendar months Using systematic random sampling the first 25 patient records from each month (75 patient records in the quarter) were selected

3.6.2 Patient care and health facility indicators

For assessment of patient care and health facility indicators, the WHO recommends that at least 100 patient encounters be included in a survey. 102 outpatients were recruited into the study. using a simple random sampling method. To remove the bias of seasonal alterations in volume of patients in the OPD, the patient selection was done of the same day of the week, throughout the study period.

3.6.3 Knowledge, attitude and practices (KAP) survey

Given that the study population was known the sample size for the KAP survey was calculated using EpiInfo™ version 7.2.6.0, Stat Cal application. Given a population of 312 health care workers, a power of 80%, confidence level of 95%, margin of error of 5% and a design effect of 1, a sample size of 94 was determined.

3.7 Data Collection technique and process

Data collection was done by the researcher, and two enumerators/research assistants were recruited to assist with the process. Data collection was done through reviewing patient records, observation and exit interviews for outpatients and finally through interviewer -administered questionnaires for health care workers and outpatients.

3.7.1 Role of research assistants in data collection process

Two pharmacy technicians, with at least 2 years' experience were recruited as research assistants. The research assistants were giving a 2-day orientation and training on the research objectives, ethical considerations and data collection before the study began

3.7.2 Data collection and storage

In this study, three data abstraction forms and two interviewer- administered - semi structured questionnaire were used to collect the necessary quantitative data required to answer the research questions. The prescribing indicator abstraction form (Appendix 4) was used to collect data required to evaluating prescribing practices. The patient care indicator form (Appendix 5) was used to collect data on patient care indicators. Data on health facility indicators was collected on an abstraction form (Appendix 6). A semi-structured questionnaire (Appendix 2), which has also been translated to the local language (Appendix 3) was used to administer exit interviews to patients visiting the OPD. Patients' sociodemographic characteristics; and route of administration; and type and number of prescribed antibiotics were collected from patients' medical charts or records. Health facility indicators were evaluated using the Zimbabwean Essential Medicines List (ZEML).

Participants responses from the KAP survey for healthcare workers were collected using a semi-structured questionnaire adapted and piloted from a combination of questionnaires already available in literature. (Livorsi, et al., 2015) (Luwumba, et al., 2021).

The questionnaire was divided into four sections. which consisted of closed-ended Likert style questions (one of the following options: strongly agree, agree, undecided, disagree, strongly disagree). Where strongly agree =5, agree=4, undecided=3, disagree=2 and strongly disagree =1. For this study a score ≥ 65% on each section on knowledge, attitude and practices was regarded as "good", while scores ≤65% were regarded as 'poor"

The questionnaire collected information on socio-demographic characteristic of participants as well as assess knowledge, attitude and practices of participants on antibiotic prescribing, AMR and antibiotic stewardship programmes. Data was coded, entered and stored in Microsoft Excel 2010. Data was protected through use of a password protected document and a password secured laptop. Figure 3 gives a schematic representation of how the research was conducted.

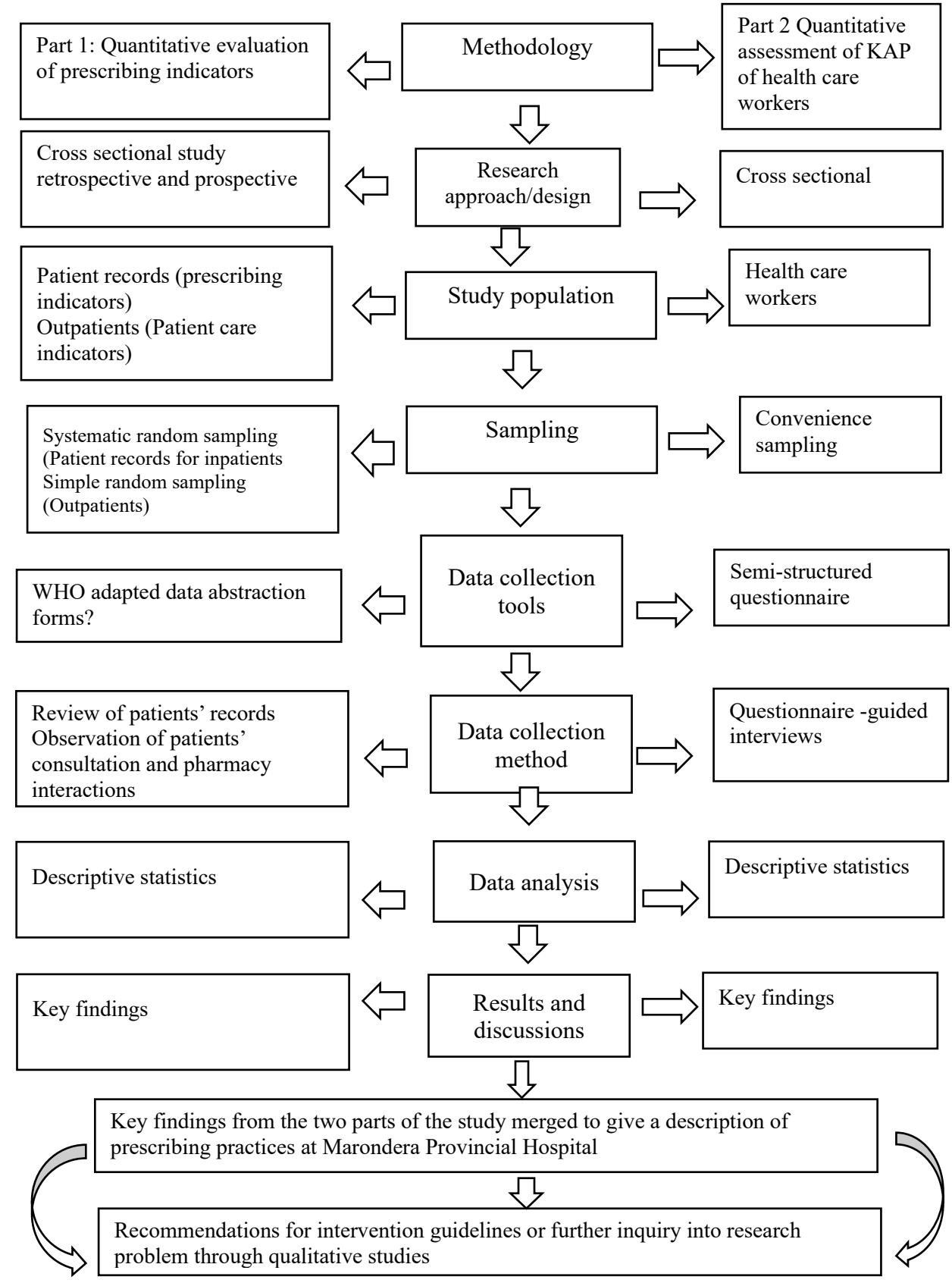

Figure 3: Schematic representation of the research method

3.8 Pretesting of Data collection Instruments

Prior data collection, all data collection instruments were pretested at Mahusekwa District Hospital., using 5% of the sample size from each study population (Daniel, 2008) Problems that were likely to compromise reliability and validity of results were corrected. The completeness of the filled information was checked at the end of each data collection day to by the principal investigator

3.9 Statistical Analysis

3.9.1 Statistical analysis of quantitative study of prescribing, patent care and health facility indicators

Data from each completed abstraction form was entered into Microsoft Excel. The data was then exported into EpiInfo version 7.2.6.0 for analysis. Descriptive statistics were used to determine the frequencies and percentages of occurrences of the study variables The outcome indicators were compared with the WHO standards and findings from similar studies conducted in tertiary health facilities in the region. For comprehensive appraisal of antibiotic utilization, a mathematical model was used to calculate performance indices for each WHO-INRUD indicator The optimal index value for all indicators is 1 (Zhang & Zhi, 2015).

- For the calculation of non-polypharmacy, rational antibiotic and injection safety indices, the following formula was used:- Index value $\frac{Optimal\ value}{Observed\ value}$
- All other indices (index of generic name, index of Essential Drugs List (EDL), consultation time index, dispensing time index, index of drugs actually dispensed, index of labelling of drugs, index of patients' knowledge, index of

EDL availability and index of key drugs availability in stock) were calculated by the following formula :- Index value $\frac{Observed\ value}{Optimal\ \ value}$

3.9.2 Statistical analysis of quantitative data on knowledge, attitude and practices of health care workers

Data from the KAP survey was be analysed using simple descriptive statistics to create frequencies and percentages.

Continuous variables, such as ages, were described as mean ± standard deviation or median Categorical variables, field of practice and gender, were described as proportions and compared using Chi-square test.

3.10 Ethical Considerations

A researcher commits to a range of responsibilities when deciding to undertake research. All research involves ethical decisions. A responsible researcher needs to afford the following considerations to the research participants: _

- that they will be fully informed of the research process before deciding on their involvement,
- that participation is voluntary (they have the right to withdraw without penalty or any ill-effects),
- that participants' rights will be upheld, and
- that information will be treated confidentially.

In this study, the researcher applied various techniques to ensure that ethical principles are maintained throughout the research process.

The ethical principles of voluntarily participation, informed consent , free from coercion, confidentiality and privacy were well explained to all study participants

The research participants were anonymous and were not asked to provide any form of identification such as name and address. Patient- and respondent-specific information such as names were not recorded and hence not used during data analysis.

Confidentiality of the data and reports generated from it were maintained by using codes in place of patient and /or health care workers names or other personal identifiers. In addition, the collected data was kept secured from unauthorised individuals to ensure confidentiality of the information. To ensure confidentiality of patient-specific information, medical charts as well as prescriptions were handled with great care and all the data was collected within hospital premises. A secluded room next to the pharmacy was used to interview outpatients and health care workers to maintain privacy and identity of participants.

Prior to data collection, information on the research and its objectives were given to participants by the researcher. Participants had the opportunity to ask questions related to the research before any data collection. Participants were also informed that they had the right to withdraw from the study if they so wished.

3.10.1 Ethical Clearance

Ethical clearance for the study was obtained from the Africa University Research Ethics Committee (AUREC) (Appendix 11). Informed written consent, translated to vernacular language (Appendix 8 and 9) was obtained from all the study participants. (Outpatient and health care workers) No

informed consent and was required for the prescribing indicators, as the study population were patient records.

Administrative clearance to conduct the study was sought and obtained from the Provincial Medical Directorate, Mashonaland East and the Medical Superintendent for Marondera Provincial Hospital. (Appendix 10)

3.11 Summary

The chapter described the research philosophy and justified the choice of a cross sectional approach. The study setting and its rationale for selection was discussed. Data quality control measures, such as pretesting of data collection instruments was also discussed and emphasis on ethical considerations that were observed were also highlighted.

CHAPTER 4 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presents data presentation analysis and interpretation of the study findings. Quantitative data analysis techniques were used to analyze the data collected and a combination of descriptive and inferential statistics were used to describe and provide different insights on the meaning of the data.

4.2 Quantitative results on prescribing practices at Marondera Provincial Hospital.

The first phase of the study focused on the first three research objectives which were firstly to assess antibiotic prescribing practices and use among inpatients at Marondera Provincial hospital using WHO-INRUD prescribing indicators, secondly to assess patient care indicators among outpatients and lastly to assess health facility indicators at Marondera Provincial hospital using WHO-INRUD core drug indicators from 01 January 2023 to 30 November 2023.

4.3 Prescribing indicators

The section below summarizes the research findings on the first objective, which sought to assess antibiotic prescribing practices in the paediatric and medical ward at Marondera Provincial Hospital, between 01 January 2023 and 31 November 2023.

4.3.1 Sociodemographic characteristics of inpatient in the paediatric and medical ward at Marondera Provincial Hospital

Out of 965 patient records that were reviewed, 627 had at least one antibiotic and were included in the study. The mean ± SD age of patients was 27.0± 18.7 years.

Three hundred and eighty-two (60.9%) of patients were female. The socio-demographic characteristics of the inpatients are described in Table 3.

Table 3: Socio-demographic characteristics of patients admitted in the selected wards in Marondera Provincial Hospital

Variables	**Category**	**Paediatric N=319 (%)**	**General Ward N =308(%)**	**Total Frequency N=(Total)**
Gender	Female	174 (54.5)	208 (67.5)	382 (60.9)
	Male	145 (45.5)	100 (32.5)	245 (39.1)
Age (Years)	Mean± SD	1.2 ± 1.8	32 ± 14.8	27.0 ± 18.7
Marital status	Minor	319 (100)	-	319 (50.8)
	Married	-	231 (60.7)	231 (36.8)
	Widowed	-	29 (18.2)	56 (9.0)
	Other	-	18 (5.8)	18(2.9)

4.3.2 Description of antibiotic prescribing indicators at Marondera Provincial Hospital using the WHO-INRUD core drug indicators

Out of 965 patients records that were sampled, a total of 1192 antibiotics were prescribed for 627 inpatients (65.0%, 95% CI 48.2–54.4%) patients. The average (mean ± SD) number of prescribed antibiotics per patient was found to be 1.90±0.75, with the highest value (five antibiotics) being observed on the general ward.

Furthermore, the percentage of antibiotics prescribed from the Essential Drug List of Zimbabwe (EDLIZ) was 100% and the percentage of antibiotics prescribed using their generic name was 81.2%. (Table 4)

Table 4: WHO-INRUD Prescribing Indicators of antibiotic use among patients admitted in selected wards at Marondera Provincial Hospital

Prescribing Indicators	**Paediatric N=605 (%)**	**General Ward N=587(%)**	**Total Frequency N= (1192)**	**Optimal value**	**Compliance to WHO-INRUD standards**
Average number of antibiotics per patient	1.89± 0.72	1.92 ± 0.74	1.90 ±0.75	1.6-1.8	No
Percentage of drugs prescribed by generic name	506 (83.6)	466(79.4)	976(81.2)	100	No
Percentage of encounters with antibiotic prescribed	319(33.1)	308 (31.9)	627 (65.0)	20.0-26.8	No
Percentage of encounters with injection prescribed	423 (71.4)	337 (57.4)	769 (64.5)	13.4-24.1	No
Percentage of antibiotics prescribed from essential drug list	605 (100)	587(100)	1192(100)	100	Yes

All antibiotics were prescribed empirically in all cases, as culture and sensitivity tests of antibiotics were not done for all the antibiotic encounters in the study. Injection was the most common route of antibiotic administration, used in 84.8% of all the patients.

4.3.3 Antibiotic prescribing patterns at Marondera Provincial Hospital

Out of all 627 patients, 229 (36.5%) of them had one antibiotic administered. 301 (48.0%) inpatients had at least two antibiotics prescribed. Of the 627 inpatients records reviewed, 82 (13.1%) had three antibiotics administered.

The number of inpatients prescribed with four antibiotics were 14 (2.2%). Only one (0.02%) inpatient had been prescribed and administered five antibiotics. Figure 4 summarizes the antibiotic prescribing pattern observed at Marondera Provincial Hospital in the period under review.

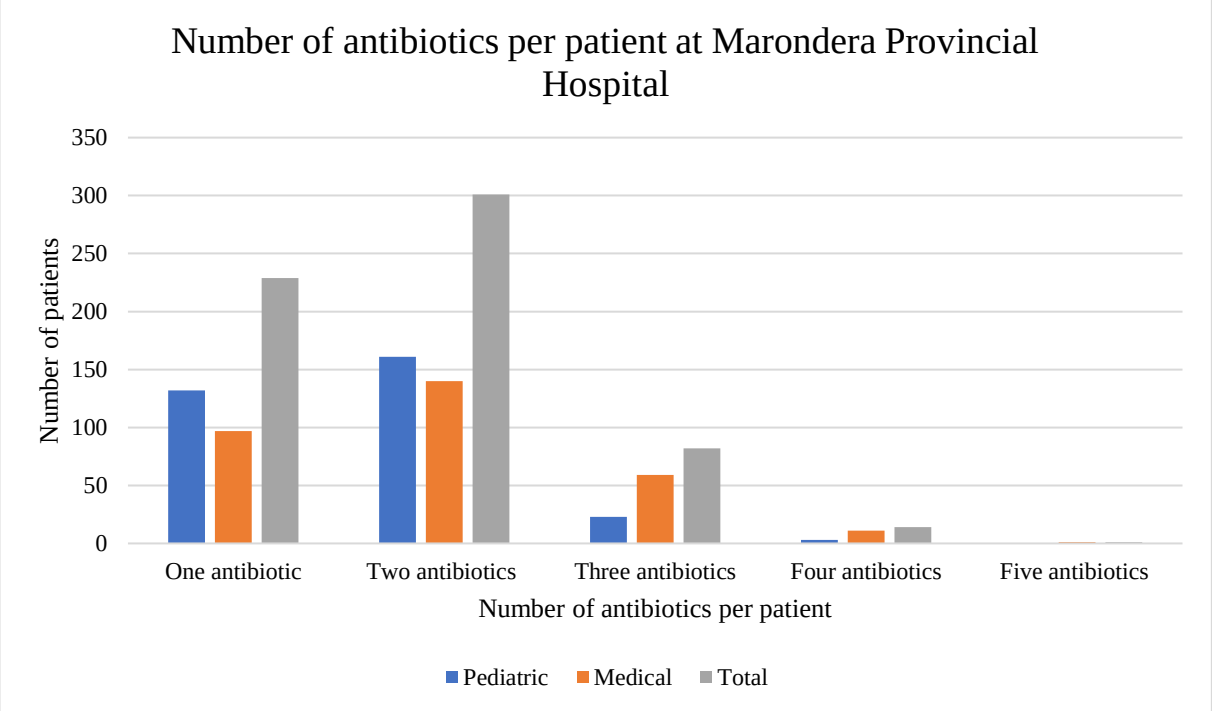

Figure 4: Total number of antibiotics per patient at Marondera Provincial Hospital between January -November 2023.

4.3.4 Categories of antibiotics prescribed at the selected wards at Marondera Provincial Hospital.

As presented in Table 5, the 13 antibiotics prescribed belong to nine antibiotic categories. Penicillins were the most prescribed category of antibiotics prescribed, 416 out of the 1192 antibiotics (34.9%) of the prescribed, followed by cephalosporins and aminoglycosides ,317 antibiotics (26.5%) and 241antibiotiics (20.2%) respectively. These three antibiotic categories accounted for about 82% of the antibiotics prescribed. Macrolides, tetracyclines and chloramphenicol were the least prescribed category of antibiotics.

Table 5: Categories of antibiotics prescribed to patient in the paediatric and medical ward at Marondera Provincial Hospital between January 2023 to November 2023

Antibiotic category	**Frequency N=Total (%)**	**Cumulative (%)**
Penicillins	416 (34.9)	416 (34.9)
Cephalosporins	317 (26.6)	733(61.5)
Aminoglycosides	241(20.2)	974 (81.7)
Nitroimidazoles	121(10.2)	1095(91.8)
Fluoroquinolones	49 (4.1)	1144 (95.9)
Macrolides	24 (2.0)	1168(98.0)
Sulphonamides	18 (1.5)	1186 (99.5)
Tetracyclines	4 (0.3)	1190 (99.8)
Chloramphenicol	2(0.2)	1192 (100)

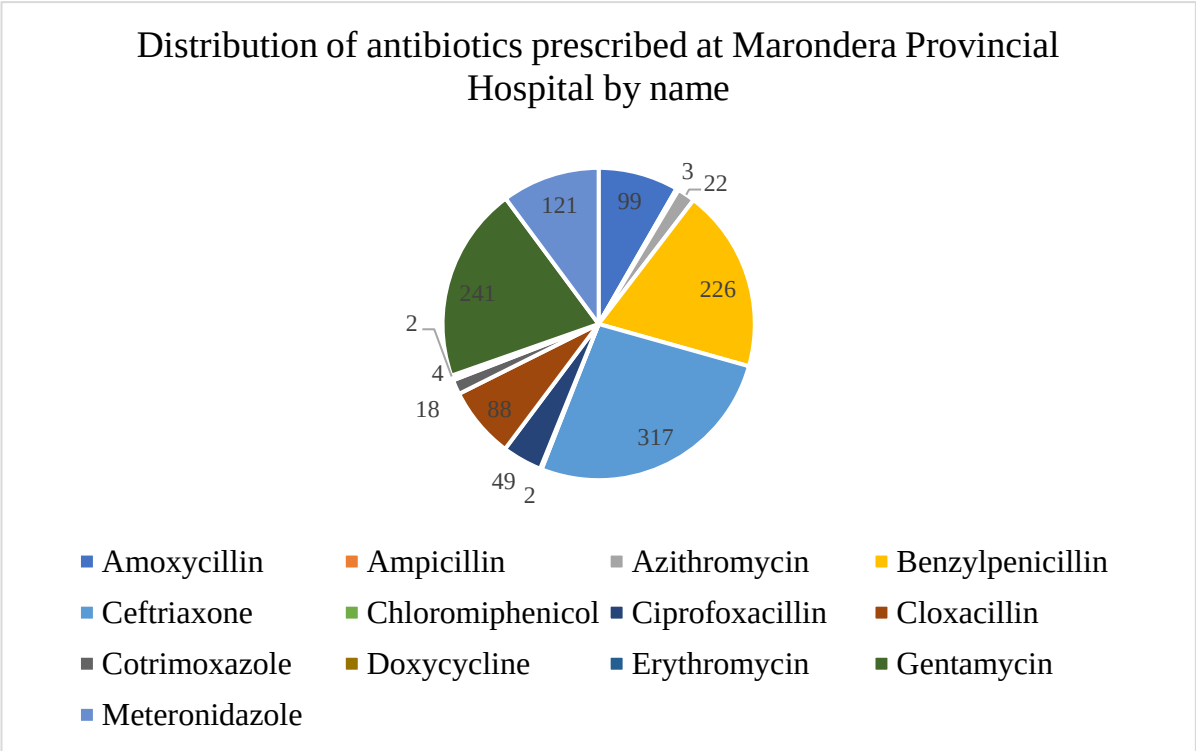

Figure 5: Distribution of antibiotics used in the paediatric and medical ward at Marondera Provincial Hospital between January 2023 -November 2023, by name.

By type of antibiotics, ceftriaxone was the most frequently prescribed (26.7%), followed by gentamycin (20.2%), benzylpenicillin (19.0%) and metronidazole (10.2%).

These four antibiotics accounted for about 78% of antibiotic consumption in both the paediatric and medical ward. Figure 6 summarizes the different antibiotics that were prescribed to the inpatients in the paediatric and medical wards at Marondera Provincial Hospital between January 2023 and November 2023

4.3.5 Performance indicators for antibiotic prescribing practices at Marondera Provincial Hospital

The performance indices for prescribing practices were calculated and the hospital scored an overall index of rational drug (antibiotic) prescribing (IRDP) of 3.35. Table 6 summarizes the overall prescribing practices.

Table 6: Index of Rational Drug (Antibiotic) Prescribing at Marondera Provincial Hospital between January 2023-November 2023

Index category	**Corresponding prescribing indicator**	**Observed value**	**Mean optimal value**	**IRDP index value**
Non-polypharmacy	Average number of antibiotics per patient	1.90	1.70	0.89
Generic name	Percentage of drugs prescribed by generic name	81.2%	100%	0.81
Antibiotic prescribing	Percentage of encounters with antibiotic prescribed	65.0%	23.4%	0.36
Injection safety	Percentage of encounters with injection prescribed	64.5%	18.8	0.29
Essential medicines	Percentage of antibiotics prescribed from essential drug list	100	100	1
Index of rational drug (antibiotic) prescribing			5	3.35

4.4 Description of patient-care indicators at Marondera Provincial Hospital

4.4.1 Sociodemographic indicators of outpatients at Marondera Provincial Hospital

One hundred and two (102) outpatients were recruited into the study to participate in the evaluation of patient care indicators at Marondera Hospital. Sixty-three (61.8%) of the participants were females. Fifty-two (51.0%) of the participants were in the age category of 31-50 years. The age category of (>50 years) had the least number of participants with 11 patients (10.8%). Fifty-eight (56.3%) of the outpatients were employed. Thirty-eight (36.8%) of the outpatients had attended tertiary level education. The socio-demographic characteristics of the inpatients are described in Table 7

Table 7: Sociodemographic characteristics of participants at the OPD at Marondera Provincial Hospital between January2023-November 2023.

Variables	**Category**	**Outpatients, N=102 (%)**
Gender	Female	63 (61.8)
	Male	39 (38.2)
Age (Years)	>30	39 (38.2)
	31-50	52 (51.0)
	>51	10 (9.8)
Level of Education	Primary	10 (11.8)
	Secondary	52 (50.5)
	Tertiary	38(37.2)
Employment status	Employed	58(56.9)
Unemployed	Unemployed	44(43.1)

4.4.2 Description of patient-care indicators at outpatient department of Marondera Provincial Hospital using the WHO-INRUD core drug indicators.

The average consultation time was 8.3 ± 3.3 minutes. The average dispensing time was 81.1 ± 30.8 seconds. One hundred and fourteen (68.4%) of the 174 antibiotics prescribed were dispensed.90.9% One hundred and sixty-seven (95.6%) of the antibiotics prescribed, were adequately labelled. The percentage of patients' knowledge of the correct dosage was 43.1%. The average score on 6-question - questionnaire administered through exit interviews was 3.4 ± 2.4. Table 8 summarizes the patient-care indicators at Marondera Provincial Hospital and give a comparison to the WHO-INRUD optimal values.

Table 8: WHO-INRUD Patient-care indicators among outpatients at the OPD at Marondera Provincial Hospital between January 2023-November 2023

Patient-care Indicators	**Total Frequency N= (174) [1]**	**Optimal value**	**Compliance to WHO-INRUD standards**
Average consultation time (minutes)	8.3 ± 3.3	>10	No
Average dispensing time(seconds)	81.1 ± 30.8	>90	No
Percentage of drugs actually dispensed	119 (68.4)	100	No
Percentage of drugs adequately labelled	168 (96.6)	100	No
Patients' knowledge on correct dose	44 (43.1)	100	No

4.4.3 Performance indicators for patient-care practices for outpatients at Marondera Provincial Hospital between January 2023 to November 2023

All indices for patient care indicators were summed up and gave a total score of the Index of rational patient care drug use (IRPCDU) of 3.81. Table 9 summarizes IRPCDU at Marondera Provincial Hospital.

Table 9: Performance indicators for patient-care practices at Marondera Provincial Hospital between January 2023-November 2023

Index category	**Corresponding patient-care indicator**	**Observed value**	**Mean optimal value**	**IRDP index value[1]**
Consultation time	Average consultation time (minutes)	8.3	10	0.83
Dispensing time index	Average dispensing time(seconds)	81.1	90	0.90
Dispensed drug index	Percentage of drugs dispensed	68.4	100%	0.68
Labelled drug index[2]	Percentage of drugs adequately labelled	96.6	100%	0.97
Patients 'knowledge index	Patients' knowledge on correct dose	43.1	100%	0.43
Index of rational patient-care drug (antibiotic) use				3.81

4.5 Description of the health facility indicators at Marondera Provincial Hospital

The hospital had a copy of the national essential drug list of Zimbabwe (EDLIZ) which contains fifty-four anti-infective medicines, including generic antibiotics.

There was an existing Hospital Medicines and Therapeutic Committee (HMTC), but this was not fully functional. There was standard treatment guideline (STG) particularly for infectious diseases. During the study period, 63.0% of the antibiotics were found to be available in stock Tabel 10 summarizes the health facility indicators.

Table 10: WHO-INRUD Health-facility indicators at Marondera Provincial Hospital between January 2023-December 2023

Health-facility Indicators	**Observed Value**	**Optimal value**	**Compliance to WHO-INRUD standards**
Availability of copy of essential drug list and treatment guidelines	1	1	Yes
Percentage of key drugs available	63.0	100	No

4.5.1 Performance indicators for health facility indicators at Marondera Provincial Hospital between January 2023-November 2023

The index of rational facility -specific drug (antibiotic) use (IRFSDU). at Marondera Provincial Hospital was 1.63, Table 11 summarizes the performance indicators for the health facility.

Table 11: Performance indicators for health facility practices at Marondera Provincial Hospital between January 2023-November 2023

Index category	**Corresponding health-facility indicator**	**Observed value**	**Mean optimal value**	**IRFSDU index value[1]**
Index of essential drug list	Availability of copy of essential drug list and treatment guidelines	1	1	1
Index of key drug available	Percentage of key drugs available	63.0	100%	0.63
Index of health-specific drug use		68.4	100%	1.63

4.5.2 Summary of the antibiotic prescribing practices at Marondera Provincial Hospital

This section sums up the description of study findings from the quantitative investigation into antibiotic prescribing practices at Marondera Provincial Hospital. Table 12 summarizes all the WHO -INRUD indicators from the study with their performance index. An index value of 8.79 for rational drug use was attained, from the aggregate of all performance indices.

Table 12 Index of Rational Drug Use at Marondera Provincial Hospital between January 2023-November 2023.

Index category	**Corresponding prescribing indicator**	**Optimal value**	**Observed value**
Non-polypharmacy	Average number of antibiotics per patient	1	0.89
Generic name	Percentage of drugs prescribed by generic name	1	0.81
Antibiotic prescribing	Percentage of encounters with antibiotic prescribed	1	0.36
Injection safety	Percentage of encounters with injection prescribed	1	0.29
Essential medicines	Percentage of antibiotics prescribed from essential drug list	1	1
Consultation time	Average consultation time (minutes)	1	0.83
Dispensing time index	Average dispensing time(seconds)	1	0.90
Dispensed drug index	Percentage of drugs dispensed	1	0.68
Labelled drug index	Percentage of drugs adequately labelled	1	0.97
Patients 'knowledge index	Patients' knowledge on correct dose	1	0.43
Index of essential drug list	Availability of copy of essential drug list and treatment guidelines	1	1
Index of key drug available	Percentage of key drugs available	1	0.63
Index of Rational antibiotic use		12	8.79

4.6 Presentation of the quantitative results on the Knowledge, attitude, and practices survey for health care workers at Marondera Provincial Hospital

The fourth and final research objective was to investigate and evaluate the knowledge, attitude, and practices of health care workers at Marondera Provincial Hospital towards antibiotic prescribing antimicrobial resistance and antibiotic stewardship. The section below describes the study findings.

4.6.1 Socio-demographic characteristics of health care workers at Marondera Provincial Hospital from January 2023-November 2023.

Out of the 94 participants who were expected to respond to the questionnaire, 65 health care workers answered, giving a response rate of 69.1%. Forty-five (69.2%) of participants were female. Thirty-one (46.2%) of the participants were within the age group <30 years, followed by those within the age group 31-40 years (n = 28, 43.1%). The least represented age group was the > 50 years, with only 2 (3.1%) respondents The mean age of the participants was 32.8 ± 7.5 years. Forty-two (64.6%) of the participants were registered general nurses. Six (9.3%) of the participants were government medical officers (GMO), four (6.2%) participants were matrons, four (6.2%) participants were pharmacists and there were only two (3.1%) were specialist working in gynaecology and obstetrics. Thirty-one (46.2%) participants had worked for <5 years. The mean work experience was 7.1± 6.6 years. Table 13 summarizes the participants characteristics.

Table 13: Sociodemographic characteristics of health care workers at Marondera Provincial Hospital between January 2023-November 2023

Variable	Frequency, N=65(%)
Gender	
Male	20 (30.8)
Female	45 (69.2)
Age/category (mean± SD)	32.8 ±.7.5
<30 years	31(47.7)
31-40 years	28(43.0)
41-50 years	4(6.2)
>50 years	2(3.1)
Level of practice	
Specialist	2 (3.1)
Government medical officer	6 (9.3)
Matron	4(6.2)
Sister in Charge	7(10.8)
Registered General Nurse (RGN)	42(64.6)
Pharmacist	4(6.2)
Years in practice ((mean± SD)	7.1± 6.6
<5 years	30(46.2)
6-10 years	14(21.5)
11-15 years	12(18.5)
>15 years	9(13.8)

4.6.2 Knowledge, practice and attitude scores for health care workers at Marondera Provincial Hospital between January 2023-November 2023.

Forty-seven (72.3%) participants had good knowledge of antibiotic prescribing, antimicrobial resistance and antibiotic stewardship. Fifty-one (78.5%) respondents had a good attitude. Twenty- eight (43.1%) had poor practices towards antibiotic prescribing, AMR and ASPs. Table 14 summarizes the participants scores.

Table 14: Knowledge, attitude, and practice scores of HCWs at Marondera Provincial Hospital

Variable (N=65)	Frequency (%)
Knowledge	
Good	47(27.3)
Poor	18(27.7)
Attitude	
Good	51(78.5)
Poor	14(21.5)
Practices	
Good	37(56.9)
Poor	28(43.1)

4.6.3 Factors associated with health care workers' knowledge, attitude and practice scores

The Chi-square test showed a statistically significant association between the gender ($p = 0.01$) and the level of practice of the health care workers ($p = 0.03$). (Table 15). The attitude level of the interviewed HCWs towards antibiotic prescribing, AMR and ASPs also showed a statistically significant association with years of experience in practice ($p = 0.00$), (Table 15). The participants' practice of antibiotic prescribing, AMR and ASPs showed a statistically significant association with the age category ($p = 0.04$).

Table 15: Factors associated with health care workers' knowledge, attitude, and practices score

Variable (N=65)	**Knowledge level**			**Attitude level**			**Attitude level**		
N (%)	**Good**	**Poor**	**p-value**	**Good**	**Poor**	**p-value**	**Good**	**Poor**	**p-value**
Gender			0.01*			0.07			0.15
Male	16(80.0)	4(20.0)		16(80.0)	4(20.0)		11(55.0)	9(45.0)	
Female	31(68.9)	14(31.1)		35(77.8)	10(22.2)		26(57.8)	19(42.2)	
Age/category			0.05			0.23			0.04*
<30 years	20(64.5)	11(35.5)		25(80.6)	6(19.4)		16(51.6)	15(48.4)	
31-40 years	19(67.9)	9(32.1)		21(75.0)	7(25.0)		14(50.0)	14(50.0)	
41-50 years	4(100.0)	0(0.0)		3(75.0)	1(25.0)		4(100.0)	(100.0)	
>50 years	1(50.0)	1(50.0)		2(100.0)	0(0.0)		2(100.0)	0(0.0)	
Level of practice			0.03*			0.08			0.09
Specialists	2(100.0)	0(0.0)		2(100.0)	0(0.0)		1(50.0)	1(50.0)	
Government medical officer	5(83.3)	1(16.7)		6(100.0)	0(0.0)		3(50.0)	(50.0)	
Matron	3(75.0)	1(25.0)		3(75.0)	1(25.0)		2(50.0)	2(50.0)	
Sister in Charge	5(71.4)	2(28.6)		4(57.1)	3(42.9)		4(57.1)	3(42.9)	
Registered General Nurse (RGN)	31(73.8)	11(26.2)		33(78.6)	9(21.4)		24(57.1)	18(42.9)	

Pharmacist	3(75.0)	1(25.0)		3(75.0)	1(25.0)		2(50.0)	2(50.0)	
Years in practice (mean± SD)			0.21			0.01*			0.23
<5 years	22(73.3)	8(26.7)		25(89.3)	3(10.7)		17(56.7)	13(43.3)	
6-10 years	10(71.4)	4(28.6)		11(78.6)	3(21.4)		8(58.4)	6(42.9)	
11-15 years	9(75.0)	3(25.0)		5(41.7)	9(58.3)		7(58.4)	5(41.6)	
>15 years	7(77.7)	2(22.3)		7(77.7)	2(22.3)		5(55.6)	5(44.4)	

4.7 Merging of the quantitative findings from the two phases of the study

This section describes the integration of the two studies that were conducted sequentially to answer the research questions. The studies were designed to achieve different, but related objectives of the research which when combined addressed the research problem (Table 16). The studies were integrated at two points, in developing tools for data collection and at outcome level:

i. Tools for data collection: The data collection tools used in both phases of the study were developed based on the research objectives.

ii. Preliminary findings of the quantitative study on antibiotic prescribing were used in designing the questionnaire used for data collection during second phase of the KAP study

Table 16: Merging of findings from the two phases of the study

Research question	Answered by	Key findings	Alignment with conceptual framework
How does the antibiotic prescribing practices and use among inpatients at MPH compared to WHO-INRUD prescribing indicators from 01 January 2023 to 30 November 2023?	Patient record, review	There is high rate of antibiotic prescribing	A significant proportion of health care workers (43.1%) had poor practices on antibiotic prescribing, which relates to the high rate of prescribing as illustrated by the conceptual framework knowledge, practices of HCWs affect prescribing practices
What are the patient care indicators at Marondera Provincial hospital using WHO-INRDU core drug indicators from 01 January 2023 to 30 November 2023?	Observation of dispensing and consultation times and outpatient exit interviews	There are moderate good patient care practices. The hospital scored higher on the IRPCDU than other indicators	Good patient care practices, corresponding to high knowledge and attitude scores.
Which health facility indicators at Marondera Provincial Hospital match the WHO -INRUD from 01	Review of stock books and interview	There was good adherence to use of	High attitude scores are consistent with the fair number

January 2023 -30 November 2023.	of pharmacy personnel	antibiotics in the EDLIZ. However not all essential antibiotics were present at the time of the study	of HCWs with good practices and relates to adherence to EDLIZ antibiotics.
What is the level of knowledge, attitudes regarding antibiotic use, prescribing and antibiotic stewardship programmes, among health care workers at Marondera Provincial Hospital from 01 January 2023 and 30 November 2023?	Knowledge, attitude and practices survey	There is good knowledge, attitude and fair practice towards antibiotic use, AMR and ASPs	Good knowledge and attitude scores correlate to the high IRDP of 8.79 out of 12.

4.8 Summary

This chapter presented the findings of the two quantitative studies that were conducted simultaneously. The presentation on the results of the first phase of the study covered rate and practices on antibiotic prescribing, on patientcare and prescribers' adherence to clinical EDL in prescribing antibiotics. The chapter also discussed performance indices for each WHO-INRUD indicator. The knowledge, attitude and practices survey described the scores of the health care workers on each variable and described the factors that contributed to the different KAP scores observed in the study. The next chapter will present the discussion and conclusion of the study findings.

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the study, conclusions, and recommendations The study was conducted to evaluate the antibiotic prescribing practices at Marondera Provincial Hospital, in Marondera District. It was also the objective of the study to assess the knowledge, attitude and practices of health care workers towards antibiotic prescribing, AMR and ASPs. The preceding chapters laid down the background upon which the conclusions and recommendations summarised in this chapter were derived.

5.2 Discussion

This section of the study discusses the findings from evaluation of prescribing practices using WHO-INRUD indicators.

5.2.1 Prescribing Indicators

Most of the patients (60.9%) were female with a male to female ratio of 1:1.6. The number of females was greater than males across both medical and paediatric wards. Similar findings were reported by a study by Siele et al, 2015 where antibiotics prescriptions were prescribed more for females than males. Different studies have attributed this to the gender differences in health seeking behaviour, with women, being likely to visit health care facilities than male counterparts (Aldeyab, et al., 2011) About 50.8% of participants were minors, this is by default of the study design and study population, however the highest admission rate observed at Marondera Provincial Hospital was at the paediatric ward.

This study revealed that the average number of antibiotics per patient record was 1.90. This value is higher when compared with the ideal value (1.6–1.8) or less than 2. (WHO, 1993) . Similarly, values higher than the optimal value were recorded in studies from different parts of Africa ranging from (1.9 to 3.0). Rabie & Kheder, (2020) reported an average number of antibiotics per patient of 2.2 in Khartoum state, Sudan. Studies by Sisay et al (2017) in eastern Ethiopia reported a value of 3.0. Values in other developing countries reported in literature were ranging from 2.3 to 3.9) (Atif, et al., 2016) (Amaha, et al., 2019) (Wendie & Ahmed, 2021)

On the contrary, the average number of medicines per patient within the acceptable range was reported by Sema, et al., (2021) in Northwest Ethiopia (ranging from 1.65 to 1.8). It is worth mentioning that the study only captured number of antibiotics, on the patient record other medicines such as antiemetics, antiacids, antihypertensives were not recorded. Therefore, is highly likely that the average number of medicines per patient at the hospital is much higher than the optimal value. The prescription of many antibiotics for a patient may decrease adherence to treatment, increase the cost of medicine incurred by the patient, elevate the risk of drug interaction, and expose the patient to unnecessary potential side effects of the medication. For this, adhering to the WHO/INRUD recommendation should obtain attention in the institution. It is also likely, that higher antibiotic consumption or prescribing is seen in inpatients, given the severity of illness.

The percentage of antibiotics prescribed per encounter was 65.0% (95% CI ,48.2-54.453) which is more than 2 times the optimal value (20.0%-25.4%). This concurs with the study done by Nantongo et al., (2021) at Debre Markos Referral Hospital, Southwest Ethiopia (71.36%). Similarly, higher values were reported in South Africa,

64.3% and other countries in the region with values ranging from 27.62% to 82.5% (Chunnilall et al., 2015). Although the high use of antibiotics may be due to the prevalent nature of the infectious disease in developing countries, or the nature of illness among inpatients, it should be given attention since it may increase the risk of antibiotic resistance.

The percentage of injection use was found to be 64.5 (95% CI = 7.8, 11.1) which is higher than to the ideal value of 13.4%-24.1%. .In a similar manner, higher values (28.5%) were reported by the study done at Bishoftu Hospital by Feleke et al (2018) Debre Markos Referral Hospital reported a value 48.36% (Wendie & Ahmed, 2021), Khartoum State, Sudan, a value of 57.6% (Rabie & Kheder, 2020).

Other studies have reported percentage of injection values within the WHO/INRUD optimum value or even lower results, ranging from 3.6% to 23.6%. (Sisay, et al., 2017) Even though injections are important formulations in certain emergency situations due to their fast onset of action, when other alternatives are not feasible, they have their own shortcomings including the risk of transmission of blood-borne infection and increased extra out-of-pocket expenditure. The hospital in the case of this study should investigate the high use of intravenous administration of antibiotics in the facility and aim to maintain a good practice in prescribing injection within the WHO/INRUD recommended optimum values.

The percentage of medicines prescribed by generic name at Marondera Provincial hospital was 81.2 %, which is lower than the ideal expectation which requires 100% of medicine prescription to be generic. Similarly, prescription of medicine by generic name is below the optimal value in most of the previous studies in different parts of

Ethiopia and India (ranging from 79.2%to 99.25% (Alemu, et al., 2012) (Akram, et al., 2017) (Feleke, et al., 2018). However, results consistent with the WHO/INRUD expectation were obtained in the study done at North-east Ethiopia with a value of 100% (Wendie & Ahmed, 2021).

In LMICs like Zimbabwe where resources are often scarce, generic prescribing substantively reduces the cost of medicine paid by patients as well as the cost of medicine incurred by facilities because generics are relatively affordable, accessible, and recallable compared to brand counterparts.

In this study, the percentage of prescribed medicines from EML was 100% which is in line with the accepted value (100%). Results consistent with this study were reported in the studies done at West Shewa Zone, Oromia, Ethiopia with a value of 100% (Gebramariam, 2018). However, the WHO/INRUD recommendation was not achieved in a study in Bangladesh by Atif et al (2016) where a value of 79.8% was reported.

The prescription of medicine from the essential drug list in the facilities should be preserved since it is one of the major tools for implementing the rational use of antibiotics. The adoption of such a list for any health facility can significantly improve the effectiveness of therapy; standardize treatment approaches even with different health care workers. and lower risk of adverse drug reactions.

All, 1192 (100.0%) antibiotics administered to inpatients were prescribed empirically and did not have culture and sensitivity tests done. However, it is good practice to conduct routine culture and sensitivity tests in facilities to create a profile and database

of antimicrobial-resistant pathogens. Ceftriaxone was the most prescribed antibiotic (26.7%), followed by gentamycin (20.2%) and benzylpenicillin (19.0%). This finding was consistent with a similar study conducted in Dessie, Northwest Ethiopia, in which ceftriaxone was the most prescribed antibiotic (Wendie & Ahmed, 2021). Among hospitalized patients, surgical site infection (ceftriaxone) and pneumonia (gentamycin) were suggested as plausible explanations for antibiotic utilization. Such antibiotic prescriptions have also been documented in South Africa 's tertiary and primary healthcare settings. (Chunnilall, et al., 2015)

In a study in conducted in southern and eastern Ethiopia amoxicillin was the most prescribed antibiotic, whereas, Eritrea, ampicillin (injection) was the most prescribed antibiotic. (Amaha, et al., 2019) (Sisay, et al., 2017). This disparity may be explained by the fact that the current study was conducted in a tertiary level hospital where all prescribers are at least general practitioners and are capable of prescribing second line or watch or reserve antibiotics with lower resistance data to treat complicated medical problems in patients referred from various primary healthcare settings.

5.2.2 Patient-care indicators

The results of the current study demonstrated that the average consultation time was 8.3 minutes. This result was similar to a study conducted in Pakistan (1.2minutes) (Atif, et al., 2016), but lower than studies conducted in Ethiopia (9.3) (Gebramariam, 2018). In general, longer consultation time is necessary to assess the patient, give appropriate heath education and increases the level of physician-patient interaction thereby improves patient satisfaction towards the healthcare system The reason behind shorter consultation time compared to the WHO optimal could be increased workload

of health staff and/or not understanding communication as an important aspect of their work role.

Average dispensing time reported in this study was 81.1 seconds. This is slightly lower than the proposed optimal normal values. Similarly shorter dispensing times were observed in various studies conducted in developing countries, such as India (42.3seconds), Sudan (41 seconds), Pakistan (34seconds), and Kenya (67seconds). (Amaha, et al., 2019) (Rabie & Kheder, 2020) (Mudenda, et al., 2023) (Kalonga, et al., 2020). However, a study by Chem et al., (2018) in Cameroons showed better results, with a dispensing time of 96.7 seconds, probably because of adequate patient to health worker ratio and good dispensing setting. According to the WHO, it is recommended that a dispensing time of 90 seconds be allocated to ensure thorough history-taking, physical examinations, accurate diagnosis, and prescribing, as well as effective patient education. Short dispensing time (less than 90 seconds) does not allow enough contact and opportunity for health care worker to explain every information to the patient. Many studies have also shown that patient adherence and compliance is directly proportional to dispensing time (D'Arcy, et al., 2021)

In this current study, the observed short dispensing time could be due to various reasons. Firstly, pharmacists and dispensers do not have sufficient time to explain medications to patient as they have too much workload. Furthermore, patients do not understand the dispenser's role and they also do not expect to learn more from the pharmacist or dispensers about their medication.

The percentage of antibiotics that were actually dispensed was 68.4% which was lower than the optimal value of (100%). Similarly, the WHO/INRUD recommended value

was not achieved in the studies by Atif et al (2016) and Sema et al (2018) which had values 56.4% and 82.2% respectively. Since the availability of essential medicines in the dispensary of the hospital is one of the indicators for the quality of care, all medicines should also be made available as much as possible by the hospitals.

Antibiotic labelling practice at the hospital was good. The percentage of drugs dispensed adequately labelled was 96.6.6%., however it was below the optimal value of 100%. The labelling practices noted in this survey was similar to the findings of the survey conducted in Ethiopia (80.1%) by Nantongo et al (2022) where patient names and other vital details about the drug dosage regimen were not written in the labels.

Only 43.1% of patients recalled the correct dosage of the medicine dispensed to them, which is lower as compared to the optimal value of 100%. Similarly, percentage of patients with knowledge of correct dosage lower than the recommended value were reported in the study in Eritrea (Amaha, et al., 2019), however good patient knowledge (92.4%) was demonstrated in a study by Chunnilall et al., (2015).

The poor patient's knowledge of antibiotics dispensed to them reported in this study may have resulted from inadequate counselling and labelling. This may affect patients' adherence to their, medications which could result in poor therapeutic outcomes.

5.2.3 Health facility indicators

A striking finding from our study was that all (100%) of the prescribed antibiotics were from the EDLIZ. This is consistent with the study conducted in Ethiopia, in which all (100%) of antibiotics were prescribed from the national essential medicines list (Feleke, et al., 2018). This could be explained by the fact that public hospitals in

Zimbabwe procure most of their medicines from the government supplier, National Pharmaceutical Company (NATPHARM). NATPHARM is a state-owned enterprise whose mandate is to procure, store and distribute medicines and medical supplies to public health institutions and predominantly supplies medicines based on the EDLIZ. Hence, prescribers at Marondera Provincial Hospital are stimulated to stick to the EDLIZ, resulting in full compliance with the WHO-INRUD indicator. Many studies have demonstrated deviations from meeting the target endorsed by WHO-NRUD; for example, 28.5% in India (Akram, et al., 2017) ,98.3% in Eritrea (Amaha, et al., 2019), and 87.1% in Zambia (Kalonga, et al., 2020). The study finding adhered to the standard value endorsed by the WHO, in that 100% of antibiotics were prescribed from the EDLIZ. The study was conducted in a tertiary hospital, where the antibiotic options may not be limited to the national STG and physicians may manage their patients based on their expertise. WHO recommends adherence of physicians to the medicines listed in the essential medicines list or formulary because it guides physicians towards prescribing medicines that are most efficacious, safe, and suitable for specific conditions. This promotes more rational and appropriate use of medications.

The percentage of the selected key essential medicines that were in stock during the study period was 63.0%. Similarly, a much lower value of 34.7% was reported in a study conducted in Bangladesh. (Atif, et al., 2016). However much higher values were reported at Gondar Teaching Hospital, Northern Ethiopia where the availability of key selected drug was 90.4% (Alemu, et al., 2012). A shortage of supply of essential medicines that treat common health problems is harmful to health status of patients, in that doctors may not be able to prescribe the correct essential medicine, or they are limited to prescribing out-of-stock antibiotics which may pose extra financial burden

on the patients' "through out of pocket" expense. This is one of the actions requiring the HMTC's attention at Marondera Provincial Hospital.

5.2.4 Indices of performance indicators

The overall IRDP in the current study was 8.79, which is lower than the optimal value of twelve (12). Moreover, it was also lower than 9.7 reported from South Africa (Chunnilall, et al., 2015). However, it was higher than a study conducted in Eritrea which reported a IRDP of 3.67 (Amaha, et al., 2019) The overall IRPCDU and IRFSDU were 3.81 (out of 5.0) and 1.63 (out of 2.0), respectively. The overall IRPCDU and IRFSDU were much higher than a study conducted in North-East Ethiopia with values of 2.51 and 0.64, respectively (Sisay, et al., 2017) (Sema, et al., 2021). The study finding necessitates that policy makers and HMTCs find a quick solution to improve the rational use of medicines in all areas.

5.3 Knowledge, attitudes and practices of health care workers

This section discusses the findings from the knowledge, attitude and practices of health care workers on antibiotic prescribing, AMR and ASPs conducted at the hospital. Forty-five (69.2%) of the HCWs were female and 90.7 % in the middle age (<30-50 years) group, which is comparable to the findings in similar previous studies (Livorsi et al., 2015). A greater proportion of HCWs in our study were registered general nurses which corresponds with findings from Lubwana et al (2021) who reported a higher proportion of respondents being female.

Antimicrobial resistance is an increasingly serious public health threat. Awareness of AMR is the first step in addressing and reducing this global problem. We found that

majority of (72.3%) HCWs at Marondera had good knowledge of AMR as a national and global concern, with specialist and government medical officers' doctors having better knowledge. However, as a group, HCWs' knowledge of antibiotic prescribing, AMR and ASPs was much lower than a study by Sefah, et al., (2023), in health care workers in Ghana reported 97.7% in knowledge of AMR and ASPs

More than half (78.5%) of the respondents had good attitude scores in our study. This finding is different with a previous study on antibiotic prescribing, AMR and ASPs attitude conducted in Ethiopia, where 16% of healthcare providers had a good attitude (Christensen, et al., 2022)

The variations in attitudes between the two studies could be because of differences in participating health facilities as well as the better awareness of the national policies on AMR and operationalisation of AMR programmes by HMTCs. The study showed that there was existence of a HMTC at, Marondera Provincial Hospital, though not fully functional. While Zimbabwe is at the formulation stages of the second NAP on AMR, which places AMR and antibiotic stewardship as a critical priority, the high attitude in our study suggests that health facilities could have adopted ASP programmes with strategies that improve healthcare providers' attitudes on AMR and antibiotic consumption from the first NAP on AMR, 2017-2022.

In this study, more than half (56.9%) of the respondents showed good practices. The study findings contradict with that of a previous study in Ghana, which found that over 70% of healthcare providers had poor practices towards antibiotic use and AMR. (Sefah, et al., 2023). Despite the good attitude reported in this study, almost half (48.7%) healthcare workers, segregated by level of practices showed poor practices.

The practice scores were low across all levels of practice. This finding could be an indicator of challenges in implementing ASPs programmes. The absence of a current NAP on AMR in Zimbabwe as well as ASP's guidelines for health facilities and non-functional microbiology laboratories, in health facilities may contribute to this fair AMS practice reported in this study

5.4 Limitations to the study

This study had several limitations both in method and literature. These are summarized below :-

5.4.1 Sampling limitations

Only one health facility out of the twenty-seven in Marondera District was included in the study. This might affect the generalisability of the study findings to all hospitals or health facilities in Marondera District, and more so Mashonaland East Province.

Although there were a significant number of government medical officers, matrons, and even specialist, the majority of the health care workers who participated in the knowledge, attitude and practices survey were registered nurses. It is possible that the different categories of professionals have different views and appreciation of the subject of antibiotic prescribing , AMR and ASP than the ones observed and captured in the study.

Data on knowledge, attitude and practices was also gathered from health care workers from all levels of practice, therefore the factors contributing to the current practice, may not accurately present the practices of the main antibiotic prescribers, who are physicians.

The evaluation of prescribing indicators was conducted using inpatients records, the results may not be generalized for outpatients' facilities.

5.4.2 Literature availability limitations

The limited availability of literature on antibiotic prescribing at health facilities in Zimbabwe made comparison of antibiotic use and consumption difficult. The study compared results from other low-middle income countries , particularly Ethiopia, Pakistan, Bangladesh, Kenya and South Africa where most research on antibiotic prescribing patterns have been conducted.

5.5 Conclusions

This study was aimed at providing evidence-based description of antibiotic prescribing practices at Marondera Provincial Hospital. The study began by assessing the WHO-INRUD indicators observed at the hospital using a quantitative study. This was followed by another quantitative study which evaluated the knowledge, attitude and practices of health care workers on antibiotic prescribing, AMR and ASPs. In this study, the antibiotic prescribing pattern conformed to only 2 out of 12 WHO-INRUD prescribing indicators. This necessitates the implementation of ongoing interventional techniques as well as periodic audits at all levels of health care to avoid the harmful repercussions of incorrect antibiotic prescribing. All antibiotics were obtained from the EDL of Zimbabwe, however, in all cases, antibiotics were given without a culture or sensitivity test. Establishing an antibiotic stewardship program, introducing antibiotic use based on culture and sensitivity tests, and developing institutional guidelines could all help to alleviate this problem. As a result, this study provides

evidence for the importance of establishing an antibiotic stewardship program and strengthening the function of HMTCs at the hospital.

Generally, there was good knowledge and attitudes of antibiotic prescribing, AMR and antibiotic stewardship among the health care workers surveyed in the study, though their practices were appreciable. Effective and sustainable efforts must be made by all key stakeholder groups to tackle the low levels of practice towards antibiotic prescribing among HCWs going forward. Proposed activities include reviewing the curricula for student HCPs among universities and nursing schools in Zimbabwe as well as ongoing continuous professional development activities post-qualification. These strategies are essential to increase awareness that inform good practices which will consequently reduce AMR rates in Zimbabwe in line with the goals of the NAP. on AMR.

5.6 Implications to practices

In addition to the implications for literature there are also considerations for policy, practice and future research. The study findings will benefit policy makers who seek to rationalize, antibiotic prescribing and strengthen hospital therapeutics committee in Zimbabwean health care system. There are also areas of practice which could be improved on, particularly around the potential over-use of antibiotics and the prescribing of drugs by generic name. The hospital can benefit from adopting antibiotic stewardship programmes, for the optimal and responsible use of antibiotics. Training and education are needed for health care workers around antimicrobial prescribing and stewardship programs to improve level of practice.

5.7 Recommendations

Based on these findings of the study the researcher recommends the following: -

- There should be continuous education and training of health care workers, particularly physicians about rational prescribing of antibiotics. As shown in the study, prescribing, a complex process involving the initiation, monitoring, continuation and modification of medication therapy and demands a thorough understanding of clinical pharmacology as well as the judgement and ability to prescribe rationally for the benefit of patients. Hence improving prescribing practices may require interventions aimed at multiple operant factors, such as developing a safety-oriented attitude through improving health facility conditions, direct staff supervision and adopting a zero-tolerance policy for incomplete or incorrect prescriptions.
- The hospital medicine and therapeutics committee should play a central role in the implementation of the guidelines to improve the rational prescribing of antibiotics at health facilities through the coordination of all stakeholders' efforts. The multiplicity of antibiotics available and the complexities surrounding their safe and effective use make it necessary for hospitals to have an organized, sound program for maximizing rational use of medicines. The MoHCC in Zimbabwe recognizes the Hospital Medicines and Therapeutics Committee as the organizational keystone of the program. The Hospital Medicines and Therapeutics Committee which is an advisory group of medical staff that serves as the organizational line of communication between medical staff and pharmacy department. There is need for strengthening the role of

HMTCs as a policy-recommending body to the medical staff and the administration of the hospital on matters related to the therapeutic use of antibiotics.

- The findings of the study should be used as baseline data to investigate further into the patterns of antibiotic prescribing, in other health facilities at all levels

5.8 Suggestions for further research

The findings of the study highlighted the following areas for further research in relation to the prescribing of antibiotics at health care facilities: -

- Investigating the actual effect of implementing of antibiotic stewardship programmes on the practices of antibiotic prescribing using the findings of the current study as baseline data.
- Conduct antibiotic usage audits studies (prescription review and medicine use evaluation) in both public and private health facilities to provide evidence and baseline data to promote the rational prescribing of antibiotics in the Zimbabwe
- Explore the underlying factors for the irrational dispensing of antibiotics among health care workers, through an in-depth qualitative study.

5.9 Dissemination of results

A comprehensive report on the study findings will be shared, with Provincial Medical Directorate, Medical Superintendent, The District Heath Executive, and the other stakeholders The researcher is scheduled to present the study finding at the next

Provincial Health Executive meeting. The researcher also intends to share the research finding through reputable and peer -reviewed journal platforms.

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APPENDICES

APPENDIX 1: Questionnaire for health care workers' knowledge, attitude and practices on antibiotic prescribing

Section 1: Demographical information

Kindly fill in the details required in the table below, by using a tick or answering where appropriate

Participant number		
Gender	**Female** ○	**Male** ○
Age/years		
Field of practice	Government Medical Officer ○ Registered General Nurse ○ Matron○ Sister in Charge○ Primary Care Nurse ○○ Specialist○ Specify field of specialisation _____ Other ○ Specify_____	
Work experience/years		

Section 2: Knowledge on antibiotic prescribing and antimicrobial resistance

Please answer all the questions below by selecting any of the responses given below the question.

1. **Antimicrobial resistance is the ability of microbes to grow in the presence of a chemical (antibiotic) that would normally kill them or limit their growth.**
   ○ Strongly Agree
   ○Agree
   ○Undecided

○Disagree

○Strongly Disagree

2. **Antimicrobial resistance makes it harder to eliminate infections from the body**
   as existing drugs become less effective.

   ○ Strongly Agree

   ○Agree

   ○Undecided

   ○Disagree

   ○Strongly Disagree

3. **. Patients will have reduced risk of antibiotic resistant infections if prescribed fewer antibiotics.**

   ○ Strongly Agree

   ○Agree

   ○Undecided

   ○Disagree

   ○Strongly Disagree

4. **Antibiotics should be prescribed to any patient with aa cough and fever.**

   ○ Strongly Agree

   ○Agree

   ○Undecided

   ○Disagree

   ○Strongly Disagree

5. **Antibiotics that have been prescribed empirically, should be changed or adjusted based upon receiving microbiological culture and sensitivity test**

   ○ Strongly Agree

   ○Agree

   ○Undecided

   ○Disagree

   ○Strongly Disagree

6. **Antibiotic stewardship programmes aim to improve the use of antibiotics and prevent antibiotic resistance.**
   ○ Strongly Agree
   ○Agree
   ○Undecided
   ○Disagree
   ○Strongly Disagree
7. **Regular assessments on antimicrobial use and consumption, use of standard treatment guidelines and essential drug lists, are considered as antibiotic stewardship strategies to combat antibiotic resistance.**
   ○ Strongly Agree
   ○Agree
   ○Undecided
   ○Disagree
   ○Strongly Disagree
8. **Zimbabwe has a current National Action Plan (NAP) on Antimicrobial Resistance**
   ○ Strongly Agree
   ○Agree
   ○Undecided
   ○Disagree
   ○Strongly Disagree
9. **Treatment of self-limiting viral infections with antibiotics increases the risk of development of antibiotic resistance**
   ○ Strongly Agree
   ○Agree
   ○Undecided
   ○Disagree
   ○Strongly Disagree
10. **Implementing infection prevention and control practices (vaccination, water sanitation etc.) is the key action that communities and hospitals should take to prevent resistant infections and their spread.**
    ○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

Section 3: Attitudes towards antibiotic prescribing, antimicrobial resistance and antibiotic stewardship programmes

11. Antimicrobial resistance is NOT a significant problem in Zimbabwe.

○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

12. Prescribing antimicrobials to a patient who does not really need them may have a negative impact on their health.

○Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

13. The problem of antimicrobial resistance in public health is getting worse.

○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

14. Patient's demands and expectations for antibiotics contribute to the overuse or prescription of antibiotics

○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

15. **Participating in antimicrobial stewardship programmes will help increase awareness of antimicrobial resistance and promote rational prescribing of antibiotics among health care workers**

○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

16. **Do you believe that new classes of antimicrobials will be developed in the next 5–10 years?**

○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

17. **Rational prescribing of antibiotics by healthcare workers at health facility decreases the risk of d towards preventing antimicrobial resistance?**

○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

18. **I feel confident about my knowledge and practices in prescribing antibiotics.**

○ Strongly Agree

○Agree

○Undecided

○Disagree

○Strongly Disagree

19. **I would like to get more training and education on rational antibiotic use, antimicrobial resistance and antibiotic stewardship programmes.**
    ○ Strongly Agree
    ○Agree
    ○Undecided
    ○Disagree
    ○Strongly Disagree

Section 4: Practices on antibiotic prescribing, antimicrobial resistance and antibiotic stewardship programmes

20. **Do you prescribe antimicrobial drugs to your patients?**
    ○ Always
    ○Most of the time
    ○Sometimes
    ○Maybe
    ○Never
21. **Before initiating antimicrobial therapy, I send samples for culture and sensitivity test to inform the need for and/or choice of antimicrobial therapy?**
    ○ Always
    ○Most of the time
    ○Sometimes
    ○Maybe
    ○Never

22. **For management of cases, I refer to the Zimbabwean Essential Drug List (EDLIZ) or standard treatment guidelines, provided by the hospital or Ministry.**
    ○ Always
    ○Most of the time
    ○Sometimes

○Maybe

○Never

23. I can easily access information and materials I need to provide advice to patients on the prudent use of antibiotics and antibiotic resistance.

○ Always

○Most of the time

○Sometimes

○Maybe

○Never

24. In my interaction with patients, I offer advice on cautious use of antibiotics

○ Always

○Most of the time

○Sometimes

○Maybe

○Never

25. I participate in educational campaigns or trainings on rational antibiotic prescribing, antimicrobial resistance, and antibiotic stewardship programmes

○ Always

○Most of the time

○Sometimes

○Maybe

○Never

APPENDIX 2. Questionnaire for interviewing outpatients on their knowledge on the correct dosage regimen

Section 1: Demographical information

1. What is your gender?

Please choose only one of the following:

A. Male ○ B. Female ○

2. Which age group do you fall under?

***Please choose only one of the following**:*

A. <30 years ○ B. 40- <50 years ○

C. 30- <40 years ○ D. > 50 years ○

3. Health Facility

Marondera Provincial Hospital ○

4. What is your level of education?

Please choose only one of the following

A. Primary ○
B. **Secondary** ○
C. Tertiary ○

5. Employment status

A. Employed ○

B. Unemployed ○

Section 2: assessing patients, knowledge on the correct dosage

Please note: This section of the questionnaire will be used in conjunction with the patient's record or prescription to assess their knowledge on the correct dosage for the antibiotics they have been prescribed.

6. What is the name of the antibiotic you have been prescribed.?

A. Knows medicine ‘s name ○

B. Does not know medicine by name ○

7. For what purpose will you be taking this antibiotic?

A. . Knows the correct therapeutic indication ○

B. The information on the therapeutic indication is not complete ○

C. Does not know the correct therapeutic indication ○

D. Does not know the therapeutic indication ○

8. At what time of the day, do you take the antibiotic?

A. Knows the correct time for administration of the antibiotic (s) ○

B. Does not know the correct time for administration of the antibiotic(s) ○

9. How often do you take your medication?

A. Knows the correct time for dosage intervals ○

B. Does not know the correct time for dosage intervals ○

10. What is the number of tablets/capsules to be taken per single administration?

A. Knows the strength and dose of antibiotic(s) to be taken per single administration ○

B. Does not know the strength and dose of antibiotic to be taken per single administration ○

11. What is the duration of the antibiotic therapy?

A. Knows the duration of the therapy ○

B. Does not know the duration of the therapy ○

APPENDIX 3: Questionnaire for interviewing outpatients on their knowledge on the correct dosage regimen (Shona)

Shona Questionnaire for interviewing outpatients on their knowledge on correct dosage reg

<u>Chikamu chekutanga (1): Zvinotsanangura murwere</u>

1. **Rudzi rwekuberekwa narwo**

   Sarudza mhinduro imwe chete pane dzakapihwa:

   A. Murume ○

   B. B. Mukadzi ○

2. **Makore ekuberekwa**

Sarudza mhinduro imwe chete pane dzakapihwa:

   A. Makore aripasi pemakumi matatu ○

   B. Makore ari pakati pemakuni matatau nemakumi mana ○

   C. Makore ari pakat pemakuni mana, nemakuni mashanu ○

   D. Makore ari pamusore pemakuni mashanu. ○

3. **Chipatara chashanyirwa nemurwere**

   Marondera Provicial Hospital ○

4. **Chikamu chichikoro chakatsvikwa nemurwere**

Sarudza mhinduro imwe chete page dzakapihwa

   A. Chikamu chezvekudzidza kwekutanga ○

   B. Chikamu chezvekudzidz kwepiri ○

   C. Chikamu chezvekudzidza kwavakuru ○

5. **Nzira yekuzviraramisa inoshandiswa nemurewere**

   A. Pane kubasa kunotambiriswa kunoendwa nemurwere ○

   B. Hapana ku basa kutambiriswa kunoendwa nemurwere ○

<u>Chikamu chepiri (2) Kuongorora ruzivo rwemurwere pamusoro pemashandisirwa emishonga yaapihwa</u>

Cherechedza: Ichi chikamu chemubvunzo chichashandiswa pamwe chete nechinyorwa chimishonga yapihwa murwere. Donzvo riri rekuongorora ruzivo rwavo pamusoro pechiyero kana mashandisirwo emishonga yavanyorerwa nachiremba kana mukoti.

6. Zita remushonga wamapihwa rinonzi chii?

A. Murwere ano ziva zita remushonga kana mishonga ○

B. Murwere haazive zita remushonga kana mishonga ○

7. Uchatora mushonga uyu nokuda kwechinangwa chipi?

A. . Murwere anoziva chinanagwa ari kutora mushonga ○

B. Murwere haazive zvizere chinanagwa ari kutora mushonga, ○

C. Murwere anoziva chinanagwa ari kutora mushonga, asi haana chokwadi neruzivo rwaanarwo ○

D. Murwere haazive chinanagwa ari kutora mushonga ○

8. Mushonga (mishonga) yamapihwa inotorwa nguva dzipi dzezuva?

A. Murwere anoziva nguva chaiyo yaanofanira kutora mushonga ○

B. Murwere haanozive nguva chaiyo yaanofanira kutora mushonga ○

9. Mushonga wamapihwa unofanira kutorwa kangani pazuva?

A. Murwere anoziva nguva chaiyo yaanofanira kutora mushonga ○

B. Murwere haazive nguva chaiyo yaanofanira kutora mushonga ○

10. Mapiritsi managani amunofanira kutora, panguva imwe neimwe yamunotora mushonga?

A. Murwere anoziva huwandu kana zvikanu zvemapiritsi aanonwa kamwe chete ○

B. Murwere haazive huwandu kana zvikanu zvemapiritsi aanonwa kamwe chete

11. Munofanira kutora mushonga kana mishonga iyi kwenguva yakareba sei?

A. A. Murwere anoziva huhwandu kan kureba kwe nguva yakanofanira kutora mapiristsi ○

B. Murwere haazive huhwandu kan kureba kwe nguva yakanofanira kutora mapiritsi ○

APPENDIX 4: Prescribing Indicator Form

PRESCRIBING INDICATOR FORM

Location (Name of health facility) _____

Investigator_____ Date:_____

Patient #	**Date of treatment**	**Age (Years)**	**Number of drugs prescribed**	**Number of antibiotics prescribed**	**Number of antibiotics prescribed as generics**	**Number of antibiotics given as injectables**	**Number of drugs on Essential Drug List**	**Diagnosis**
Total								
Average								
Percentage					**of total drugs**	**of total cases**	**of total drugs**	

APPENDIX 5: Patient Care Indicator Form

PATIENT CARE FORM

Location (Name of health facility) _____

Investigator_____ Date:_____

Patient #	**Date of treatment**	**Consulting time (mins)**	**Dispensing time (secs)**	**Number of antibiotics prescribed**	**Number of antibiotics dispensed**	**Number of antibiotics adequately labelled**	**Knowledge of dosage (0/1)**
Count							
Total							
Average							
Percentage					**of total prescribed drugs**	**of total dispensed**	**of total cases/patients asked**

APPENDIX 6: Health Facility Indicator Form

HEALTH FACILITY INDICATOR FORM

Location: _____

Investigator: _____ Date: _____

Facility indicators Results	**Result**
Availability of a Zimbabwean National Formulary (Yes/No)	
Availability of Zimbabwean National Drug List (Yes/No	
Availability of standard Treatment Guidelines (Yes/No)	
Percentage availability of key indicator drugs (%)	

COMMENTS:

_____

_____

_____

SIGNATURE _____

APPENDIX 7: Informed consent form for health care workers,

INFORMED CONSENT FORM FOR HEALTH CARE WORKERS

My name is Nyaradzo Masvanganye, a final year student studying for a Master of Public Health at Africa University I am conducting a study on evaluation of antibiotic prescribing patterns among patients at Marondera Provincial Hospital using World Health Organization in collaboration with International Network of Rational Drug Use (WHO-INRDU) core drug indicators. I am kindly asking you to participate in this study by answering questions on the questionnaire.

A. Purpose of the study:

The purpose of the study is to assess and describe the current antibiotic prescribing practices and to describe the knowledge, attitude and practices of health care workers on antibiotic use and consumption order to facilitate development of evidence-based intervention guidelines to improve antibiotics use and consumption at healthcare facilities.

Studies on antibiotics prescribing practices (rate and patterns of antibiotics prescribing), especially healthcare facilities, are limited in Zimbabwe. Undertaking such kinds of studies is especially important to improve antibiotic prescribing and thereby reduce the emergence of antibiotic resistance.

B. Reason for selection or inclusion into the study

Good prescribing habits among health care workers is instrumental to preventing the development and spread of AMR.

You have been selected to participate in the study as a health care worker, to contribute to the research inquiry into knowledge, attitudes and practices on antibiotic prescribing, antimicrobial resistance, and antibiotic stewardship programmes. Fifty-three (53) other health care workers have been selected to participate in the study.

C. Procedures and duration

If you decide to participate you will be asked to answer questions on your knowledge, attitude and practices regarding antibiotic prescribing, AMR, and antibiotic stewardship programmes, through a semi-structured questionnaire guided interview. The interview will take about 15-20 minutes.

D. Benefits and/or compensation

The research does not offer any incentive, benefit, or compensation to the study participant.

E. Confidentiality

Names and any other identification will not be asked for in the questionnaires or interviews and any information that is obtained in the study that can be identified with the participant will not be disclosed without their permission. Interviews will be conducted in a secluded room, to respect the privacy of the participant.

F. Voluntary participation

Participation in this study is voluntary. You are welcome to decline the request to participate in this study If you choose to participate in the study, and at any point during

the process you wish to withdraw your consent, you are free to discontinue participation without penalty.

Before you sign this form, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over

G. Authorization

If you have decided to participate in this study, please sign this form in the space provide below as an indication that you have read and understood the information provided above and have agreed to participate. -

Name of Research Participant (please print) _____ Date_____

Signature of Research Participant or legally authorized representative_____

If you have any questions concerning this study or this consent form beyond those answered by the researcher including questions about the research, your rights as a research participant, or if you feel that you have been treated unfairly and would like to talk to someone other than the researcher, please feel free to contact the Africa University Research Ethics Committee on telephone (020) 60075 or 60026 extension 1156 email aurec@africau.edu

Name of Researcher_____

APPENDIX 8: Informed consent form for outpatients

INFORMED CONSENT FOR OUTPATIENTS AT MARONDERA PROVINCIAL HOSPITAL(ENGLISH)

My name is Nyaradzo Masvanganye, a final year student studying for a Master of Public Health at Africa University I am carrying out a study on evaluation of antibiotic prescribing patterns among patients at Marondera Provincial Hospital using World Health Organization in collaboration with International Network of Rational Drug Use (WHO-INRDU) core drug indicators am kindly asking you to participate in this study by allowing me to observe and measure doctor-consultation time, pharmacy dispensing time , review your prescription and administer a 3 minute interview on your knowledge of correct of dosage of the drugs you have been prescribed by the health care worker .

A. Purpose of the study:

The purpose of the study is to assess and describe the current antibiotic prescribing practices using WHO-INRDU core drug indicators and to describe the knowledge, attitude and practices of health care workers on antibiotic use and consumption order to facilitate development of evidence-based intervention guidelines to improve antibiotics use and consumption at healthcare facilities.

Studies on antibiotics prescribing practices (rate and patterns of antibiotics prescribing), especially healthcare facilities, are limited in Zimbabwe. Undertaking such kinds of studies is especially important to improve antibiotic prescribing and thereby reduce the emergence of antibiotic resistance.

B. Reason for selection or inclusion into study

Good prescribing habits among health care workers is instrumental to reduce the misuse of antibiotics and will prevent development and spread of AMR. As a patient, you have been selected to participate in the study to contribute to the research inquiry into the patient's knowledge of correct dosage regimen. The patient knowledge of correct dosage helps measure the effectiveness of the information provided to patients on the dosage regimen of the drugs they received from the health facility or pharmacy Ninety-nine (99) other outpatients will be recruited into the study

C. Procedures and duration

If you decide to participate in the study, the researcher, will measure the time taken between consultation with the health care worker and the time taken to be dispensed with antibiotics written on the prescription. The researcher will also ask to review the prescription given to you by the health care worker and will administer a 3-minute interview to assess your knowledge on the correct dosage regimen for the drugs you would have been prescribed.

D. Benefits and/or compensation

The research does not offer any incentive, benefit, or compensation to the study participant.

E. Confidentiality

Names and any other identification will not be asked for in the questionnaires or interviews and any information that is obtained in the study that can be identified with the participant will not be disclosed without your written permission.

F. Voluntary participation

Participation in this study is voluntary. you welcome to decline or deny participating in this study If you chose to participate in the study, and at any point during the process you wish to withdraw your consent, you are free to discontinue participation without penalty.

Before you sign this form, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over.

G. Authorization

If you have decided to participate in this study, please sign this form in the space provide below as an indication that you have read and understood the information provided above and have agreed to participate.

Name of Research Participant (please print) ----------Date----------

Signature of Research Participant or legally authorized representative----------

If you have any questions concerning this study or consent form beyond those answered by the researcher including questions about the research, your rights as a research participant, or if you feel that you have been treated unfairly and would like to talk to someone other than the researcher, please feel free to contact the Africa University Research Ethics Committee on telephone (020) 60075 or 60026 extension 1156 email aurec@africau.edut

Name of Researcher ----------

APPENDIX 9: Informed consent form for outpatients, (Shona)

INFORMED CONSENT FOR OUTPATIENTS AT MARONDERA PROVINCIAL HOSPITAL (SHONA)

Zita rangu ndinonzi Nyaradzo Masvanganye, ndiri mudzidzi spa Africa University uye ari mugore rekupedzisira mu chidzidzo che Master of Public Health. Ndiri kuita ongororo pamusoro pekushandiswa kwemishonga inorwisa mabhakitiriya pakati pevarwere paMarondera Provincial Hospital ndichishandisa mipimo uye kurudziro ye World Health Organization (WHO) vachishanda pamwe neInternational Network of Rational Drug Use (WHO-INRDU). Ndiri kukumbira nomutsa mutore chikamu muchidzidzo ichi nekundibvumira kucherechedza uye kuyera nguva yekubvunzurudza nachiremba, uye nguva yekupihwa mishonga, Ndinokumbira zvekare kutenderwa kuongorora chinyorwa chemishonga chamapihwa nachiremba, uye kukubvunzai mibvunzo inoongorora ruzivo rwenyu maererano ne matorerwa or mashandisirwo emishonga iri pachinyorwa chemishonga

A. Chinangwa cheongororo ino

Chinangwa chekuongorora netsakurudzoino ndeye kutsanangura mashandiro emishonga inoshandiswa kurwizi hutachiwana muzvipatara, ongororo ichishandisa memipimo ye WHO-INRDU. Mutsakuridzo iyi tichaongorora zvekare ruzivo, mafungiro uye maitiro evashandi vehutano pamusoro pekushandisa mishonga yekuuraya hutachiwana, Donzvo retsvakuridzo iyi, nderekuzoburitsa, huchahapupu hunozoshandiswa kukurudzira nhungamiro dzevashandi vezveutano kuvandudza kushandiswa kwemishonga inorwisa zvirwere.

B. Chikonzero wasarudzwa kutora chikamu muongororo ino

Tsika dzakanaka dzekunyora mishonga pakati pevashandi vehutano dzinobatsira kuderedza kushandiswa zvisina kufanira kwemishonga inorwisa mabhakitiriya kana zvirwere uye ichadzivirira kukura nekuparirara kweAMR. Semurwere ashanyira chipatara, iwe wasarudzwa kutora chikamu mudzidzo iyi kuti utibatsire pakuongorora nekutsvakurudza ruzivo rwemurwere rwematorerwo kana mashandisirwo emishonga yavapihwa pachipatatra. Ruzivo rwemurwere rwechiyero chemushonga waanofanira kutora, runobatsira a kuyera kushanda kwemashoko kana dzidziso inopiwa varwere nanachiremaba kana mukoti, pamusoro pehuwandu hwemishonga yavakagamuchira kubva kunzvimbo yechipatara.

C.Maitirwo eongororo uye nguva ichatorwa mukuita tsakirirdzo

Kana iwe ukasarudza kutora chikamu muchidzidzo, mutsvakurudzi, achayera nguva ichatorwa pakati pekukurukurirana kwemurwere nachirema. Mutsvakurudzi achatarisa zvekare uye nguva inotorwa kuti upiwe mishonga inorwisa mabhakitiriya yakanyorwa pachinyorwa chemushonga. Mutsvakurudzi achakumbirawo kuongorora chirevo chakapiwa kwauri nemushandi wehutano uye achapa hurukuro yemaminitsi matatu kuti aongorore ruzivo rwenyu pamusoro peshandisirwo emishonga yamapihwa.

D. Muripo or betsero patendera kupinda muongororo iyi

Muongororo iyi, mutsvakiridzi haana, mari, zvekudya, kana zvipo zvaachapa kuvarwere vachatenda kuva chikamu che dzidzo kana ongororo ino.

E. Kuchengetedzeka kwe zita, kana kuzivikanwa zve varwere vachapinda muchikamau chedzidzo iyi.

Mazita uye chero chimwe chinhu chinokwanisa kuzivisa vanhu nezvenyu, hachizobvunzwi muongororo ino. Tinovimbisa kuchengetedza konzero dzenyu, kana chimwe chinhu chinokwanisa kuita kuti vanhu vakuzivei, Kunyangwe nemashoko amuchitaura muhurukuro yamuchaita nemutsakurudzi., haazodzokoredzwa kune mumwe munhu kana nzvimbo. Mibvunzo ichabunzwa muongororo ino anechekuita bedzi nechinangwa nedonzvo yeongororro ino. Kana kubvunzurudzwa uye chero ruzivo runowanikwa muchidzidzo chinogona kuzivikanwa nevanhu. hazvizoziviswa pasina mvumo yenyu yakanyorwa.

F. Kuzvisarudzira kutora chikamu muchidzidzo ichi, zvisina kumanikidzwa

Kutora rutivi muchidzidzo ichi ndekwekuzvidira. Uye munotenderwa uramba kutora chikamu muchidzidzo ichi. Kana muchingwe masarudzwa kutora chikamu muchidzidzo, uye asi mukanzwa kumanikidzwa kana mumbunyikidzwa ne chero chinhu kana maitirwo etsvakiridzo ino, makasununguka kubvisa mvumo yenyu, panguva ipi zvayo pasina chirango.

Musati masaina fomu iyi, tapota bvunzai chero mibvunzo pane chero chikamu chechidzidzo ichi chisina kujeka kwamuri. Mutenderwa kutora nguva yakawanda sezvinodiwa kuti ufunge nezvazvo.

G. Chiratidzo chemvumo yekutora chikamau mutsakiridzo yapihwa nemurwere,

Kana imi makasarudza kutora chikamu muchidzidzo ichi, tapota saina fomu iri munzvimbo icharatizwa, sechiratidzo chekuti makaverenga uye makanzwisisa ruzivo rwakapiwa pamusoro pedonzvo rechidzidzo chino, mapa bvumo yenyu yekutora chikamu mutsvakiridzo ichi.

Zita remurwere apa mvumo yekutora chikamu mutsvakiridzo_____

(Dhinda zita rako)

Zuva, musi negore _____

Siginicha yemurwere ari kutora chikamu muchidzidzo ichi kana yemumiriri wake ari pamutemo_____

Kana imi muine mibvunzo pamusoro pechidzidzo ichi kana muchiri neda kuwedzera ruzivo rwechidzidzo ichi, kupfuura iyo yakapindurwa nemutsvakurudzi kusanganisira mibvunzo pamusoro pekutsvakurudza, kodzero dzako semunhu apa bvumo yekutora chikamu mutsvakurudza, kana uye iwe uchinzwa kuti wakabatwa zvisina kunaka uye unoda kutaura nemumwe munhu kunze wemutsvakurudzi, tapota inzwa wakasununguka kutaura neAfrica University Research Ethics Committee parunhare (020) 60075 kana 60026 kuwedzera pa 1156 email aurec@africau.edu

Zita remutsvakurudzi_____

APPENDIX 10: Letter of Approval from the Provincial Medical Director's Office, Mashonaland East Province

Telephone: 24207/8, 24571

Telegraphic Address:
"PROVMED, MARONDERA"
Fax: 23967

ZIMBABWE

Reference:

MINISTRY OF HEALTH AND CHILD CARE
PROVINCIAL MEDICAL DIRECTOR
(MASHONALAND EAST)
P.O.BOX 10
MARONDERA
ZIMBABWE

11th October 2023

The Medical Superintendent/District Medical Officer

- **MARONDERA PROVINCIAL HOSPITAL**
- **MAHUSEKWA DISTRICT HOSPITAL**

RE: PERMISSION TO CONDUCT RESEARCH : DR NYARADZO MASVANGANYE

The above matter refers.

Permission has been granted for the above-named to carry out a cross sectional study that seeks to evaluate antibiotic prescribing patterns amongst patients in health facilities. The study also seeks to assess the knowledge and attitudes of health care workers on antibiotic prescribing, antimicrobial resistance and antibiotic stewardship.

Thank you for usual cooperation.

MIN. OF HEALTH & CHILD CARE
P.M.D. MASHONALAND EAST
11 OCT 2023
P.O. BOX 10, MARONDERA
ZIMBABWE

pp
Dr P.F Matsvimbo
PROVINCIAL MEDICAL DIRECTOR – MASHONALAND EAST

/sk

APPENDIX 11: Approval letter from the Africa University Research Ethics Committee (AUREC)

Investing in Africa's future

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 Website: www.africau.edu

Ref: AU3030/23 9 November, 2023

NYARADZO MASVANGANYE
C/O Africa University
Box 1320
MUTARE

RE: AN EVALUATION OF ANTIBIOTIC PRESCRIBING PRACTICES AMONG PATIENTS AT MARONDERA PROVINCIAL HOSPITAL, IN MARONDERA RURAL DISTRICT USING WHO-INRDU CORE DRUG INDICATORS

Thank you for the above-titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.

a) Research proposal

- **APPROVAL NUMBER** AUREC 3030/23
  This number should be used on all correspondences, consent forms, and appropriate documents.
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** November 9, 2023
- **EXPIRATION DATE** November 9, 2024
- **TYPE OF MEETING** : Expedited
  After the expiration date, this research may only continue upon renewal. A progress report on a standard AUREC form should be submitted a month before the expiration date for renewal purposes.
- **SERIOUS ADVERSE EVENTS** All serious problems concerning subject safety must be reported to AUREC within 3 working days on the standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

AFRICA UNIVERSITY
RESEARCH ETHICS COMMITTEE (AUREC)
APPROVED
P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU
ASSISTANT RESEARCH OFFICER: FOR CHAIRPERSON
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE