UNIVERSITY of RWANDA

ASSESSMENT OF ANTIBIOTIC USE AMONG HOSPITALIZED PATIENTS USING WHO POINT PREVALENCE SURVEY (PPS) TOOL

CASE STUDY: RUHENGERI LEVEL TWO TEACHING HOSPITAL

A Dissertation submitted in partial fulfillment of requirements for the degree of
MASTER OF HEALTH SUPPLY CHAIN MANAGEMENT

In the college of medicine and health sciences
EAC Regional Centre of Excellence for Vaccine, Immunization, and Health Supply Chain Management

BY

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DECLARATION

I, Phn HABAKUBAHO Léon Donatien, hereby declare that this dissertation has been written by me without any external unauthorized help and that it has been neither presented to any institution for evaluation nor previously published in its entirety or parts. Any parts, words, or ideas of the dissertation, however limited, which are quoted from or based on other sources, have been acknowledged as such without exception.

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Signature:

ABSTRACT

Background: The inappropriate use of antibiotics in hospitals is a major contributor to antimicrobial resistance (AMR), posing significant public health challenges. In Rwanda, limited data exists on antibiotic prescribing patterns, making it difficult to implement targeted antimicrobial stewardship programs. This study assesses antibiotic use among hospitalized patients at Ruhengeri Level Two Teaching Hospital using the World Health Organization (WHO) Point Prevalence Survey (PPS) tool.

Methods: A cross-sectional observational study was conducted from January 17 to January 28, 2025. Data were collected on patient demographics, antibiotic prescriptions, and treatment indications using the WHO PPS methodology. Descriptive statistics were used to analyze the prevalence, prescribing patterns, and compliance with hospital and national guidelines. Chi-square tests and trend analyses were applied to assess associations between categorical variables.

Results: Among 270 hospitalized patients, 117 (43%) were on antibiotic therapy. The highest prevalence was observed in the pediatric (62%) and Neonatology (57%) departments. The most prescribed antibiotics were Ampicillin (20.3%) and Ceftriaxone (17.8%). Alarmingly, 100% of prescriptions were empirical, with no culture-based therapy recorded. Additionally, only 6.8% of patients were switched from intravenous to oral antibiotics, despite WHO recommendations for de-escalation. Approximately 40.3% of antibiotics belonged to the WHO Watch category, indicating a need for improved prescribing practices.

Conclusion: The findings highlight excessive empirical antibiotic prescribing, a lack of microbiological diagnostics, and limited de-escalation practices, increasing the risk of AMR. Strengthening antimicrobial stewardship programs, improving laboratory capacity for culture testing, and promoting guideline-based antibiotic prescribing are essential to optimizing antibiotic use at Ruhengeri Level Two Teaching Hospital.

Keywords: Antibiotic use, antimicrobial resistance, WHO PPS, Ruhengeri Level Two Teaching Hospital, antimicrobial stewardship

DEDICATION

I dedicate this dissertation to my beloved family and friends for their unwavering support, encouragement, and sacrifices. And to all healthcare professionals committed to the responsible use of antibiotics, fighting against antimicrobial resistance to safeguard public health.

ACKNOWLEDGMENTS

First and foremost, I am deeply grateful to the Almighty for granting me the strength, perseverance, and wisdom to complete this research.

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Finally, I acknowledge all researchers and scholars whose work laid the foundation for this study. This dissertation would not have been possible without their contributions to antibiotic stewardship and healthcare management.

Thank you all.

LIST OF SYMBOLS AND ACRONYMS

RL2TH: Ruhengeri Level Two Teaching Hospital

WHO: World Health Organization

PPS: Point Prevalence Survey

ASPs: Antimicrobial resistance programs.

AWaRe: Access, Watch, and Reserve

AMS: Antimicrobial Stewardship

GAP: Global Action Plan

HAI: Healthcare-associated infection

IPC: Infection Prevention and Control

MDROs: multidrug-resistant organisms

ESBL: extended-spectrum beta-lactamase

INN: International Nonproprietary Name

MTC: Medicine and Therapeutics Committee

CDC: Centers for Disease Control and Prevention

NAP: National Action Plan

TrACSS: Tracking AMR Country Self-Assessment Survey

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CHAPTER ONE: INTRODUCTION

1.1 Background to study

Antimicrobial resistance (AMR) is a critical growing global health concern that affects millions of people. Studies have shown that worldwide among 4.95 million people who died in 2019 suffered from drug-resistant infections and AMR directly caused 1.27 million of those deaths. It is also estimated that if no effective action taken to stop current trends towards increasing resistance in 2050 AMR will cause 10 million deaths annually by 2050(1,2).

There are evidence that Antimicrobial resistance (AMR) is exacerbated by the inappropriate use, overuse and misuse of antibiotics in healthcare settings where common infections become more difficult to cure, increasing morbidity and mortality rates but also Healthcare-associated infections can also be challenging to treat putting patients at risk(3–6).

In 2019 Rwanda had the 34th highest age-standardized mortality rate per 100,000 populations associated with AMR across 204 countries where, there were 2,400 deaths attributable to AMR and 9,800 deaths associated with AMR thus hindering effective stewardship interventions reason why Rwanda has developed a National Action Plan (NAP) to combat Antimicrobial Resistance (AMR), as reported in the World Health Organization's Tracking AMR Country Self-Assessment Survey (TrACSS). The initial plan covered the period from 2020 to 2024 and was developed through a multi-sectoral approach involving various stakeholders, including the Ministry of Health, the Ministry of Agriculture and Animal Resources, the Ministry of Environment, and other relevant agencies. This plan adopted the One Health approach, integrating human, animal, and environmental health sectors to address AMR comprehensively(7).

Building upon the first NAP, Rwanda launched its second National Action Plan on AMR for the period 2025–2030 during the World Antimicrobial Awareness Week in November 2024. This updated plan continues to embrace the One Health approach and focuses on enhancing surveillance systems, promoting responsible antimicrobial use across all sectors, strengthening governance and coordination mechanisms at national and local levels, and addressing gaps identified in the first NAP, such as limited access to diagnostics and the need for optimized antimicrobial prescriptions(8).

1.2 Problem statement

Antibiotic use in hospitals is a significant driver of antimicrobial resistance and involves administering antimicrobial agents to treat or prevent bacterial infections, especially in critically ill or immunocompromised patients. Studies have shown that a considerable proportion of antibiotic prescriptions in hospitals are inappropriate either due to incorrect indication, dosage, or duration to cure illnesses, stopping the development of resistant bacteria, and guaranteeing the availability of antimicrobial drugs for future generations(6,9). Ruhengeri Level Two Teaching Hospital plays a crucial role in providing healthcare services to a large population of 406 557 peoples within the Musanze District, however Ruhengeri Level Two Teaching Hospital like others hospitals in Rwanda currently lacks comprehensive data on antibiotic use patterns and the prevalence of antibiotic-resistant infections.

At the time of this study, no data on antimicrobial use in Ruhengeri level two teaching hospital settings, were available. Therefore, this study aimed to establish a baseline for ongoing antibiotic usage assessment and monitoring in Ruhengeri Level Two Teaching Hospital to improve quality and evaluate changes over time using the WHO Point Prevalence Survey (PPS) tool to inform targeted antimicrobial stewardship strategies(10).

1.3 Study Relevance

This research is highly relevant within the field of health supply chain management and is very important because directly impacts the procurement, distribution, and utilization of antibiotics by addressing Ruhengeri Level Two Teaching Hospital healthcare policies and procedures to verify that the assessment is valid, reliable, and compliant with international standards. The World Health Organization (WHO) Point Prevalence Survey (PPS) Tool was used to make it easier to compare the outcomes with data from other regions of the world and know how antibiotics are used in Ruhengeri Level Two Teaching Hospital thus making it important for managing the problems caused by antibiotic resistance, protecting patient health, and improving the standard of care in general(10).

1.4 Study Significance

This research lies in its potential to contribute valuable insights into the current state of antibiotic use within the Ruhengeri Level Two Teaching Hospitals and this is crucial for public health, patient welfare, policy, and research as will help mitigate antibiotic resistance, optimize antibiotic use, and align practices with international standards at Ruhengeri Level Two Teaching Hospital. At the end of this research, the findings of data will be used for future surveys to inform hospital policies, optimize resources, and contribute to national and global databases thus addressing the research gap in the context of antibiotic utilization for assessing antibiotic use among hospitalized patients, promoting rational use and reducing antibiotic resistance risk.

1.5 Study Justification

Evaluating the antibiotic use among hospitalized patients at Ruhengeri Level Two Teaching Hospital in Rwanda is a worthwhile step for several justifications including the following:

- **Resource Management:**
  - Understanding antibiotic use in healthcare to improve resource management, plan procurement, minimize waste, and ensure availability for those truly in need.
- **Antibiotic Stewardship:**
  - Aiding antibiotic stewardship by providing data on current antibiotic usage patterns, helping develop strategies to reduce antibiotic resistance.
  - Guiding the development of educational programs for healthcare providers on appropriate antibiotic use and contributing to the academic literature on antibiotic stewardship in Rwanda's healthcare system.
  - The study's data will guide the development of policies and guidelines for improving antibiotic prescribing practices and patient outcomes in Ruhengeri Level Two Teaching Hospital.
- **Public Health Impact:**
  - Ensuring patient safety by monitoring antibiotic use, as inappropriate antibiotic use can lead to adverse reactions, multidrug-resistant infections, and increased healthcare costs.
  - Aiding public health authorities in developing strategies to combat antibiotic resistance by providing insights into local resistance development patterns.

1.6 Study Objectives

This study aims to establish a baseline for ongoing antibiotic usage assessment and monitoring in Ruhengeri Level Two Teaching Hospital to improve quality and evaluate changes over time.

The specific objectives of this study are to:

- Assess the prevalence of antibiotic use among hospitalized patients.
- Evaluate compliance with hospital and national guidelines for antibiotic prescribing, as well as adherence to infection control measures.
- Identify patient groups or hospital departments with the highest antibiotic use to guide targeted interventions and strengthen stewardship efforts.

1.7 Study Delimitation

Below are some delimitations of the study:

- This assessment was limited to Ruhengeri Level Two Teaching Hospital in Rwanda and may not apply to other healthcare settings across different regions or countries.
- This assessment was conducted within a specific time frame, one day to finish the ward and two weeks to finish all concerned departments within the hospital in order to provide a snapshot of antibiotic use prevalence.
- This assessment utilized only the WHO PPS tool which is designed to collect standardized data on antibiotic use and may not capture certain nuances or details beyond its predefined parameters.
- This assessment focused on antibiotic use in hospitalized patients only potentially excluding data on antibiotic use in outpatient settings or the community.

1.8 Study Limitation

Below are some limitations of the study:

- **Data completeness and accuracy:** these depend on the level of reporting and documentation from healthcare providers, which can vary and create biases or missing data.
- **Temporal Variation:** since the use of antibiotics can change over time, the results of the assessment could not reflect long-term patterns or variations in the prescription of antibiotics during specific seasons.
- **Interpretation of Results**: even if the evaluation offered insightful information about the prevalence of antibiotic usage, it might not instantly evaluate the suitability of prescription antibiotics or the clinical consequences associated with their use necessitating a thorough interpretation of results.

- **Sampling Bias:** the survey included sampling patients on a certain day and during a Specific period, thus sampling bias may occur and the sample may not accurately reflect all hospitalized patients at the hospital.

- The results of this study might not apply to different hospitals or healthcare environments with different patient populations, treatment modalities, or resource availability.

CHAPTER TWO: LITERATURE REVIEW

In this chapter, we looked at how antibiotic resistance is a critical global health issue exacerbated by the misuse and overuse of antibiotics develop successful antimicrobial stewardship programs that require an accurate estimate of antibiotic use in hospitals. The Point Prevalence Survey (PPS) instrument developed by WHO is widely used for this purpose, providing a standardized method to evaluate antibiotic prescribing patterns and identify areas for improvement(10). This review focused on the assessment of antibiotic use among hospitalized patients in Ruhengeri Level Two Teaching Hospital in Rwanda using the WHO PPS tool.

2.1Antibiotics and Antibiotic resistance

Antibiotics are medications that help the body's immune system fight off bacterial illnesses by either eradicating the germs or stopping their growth. They come in broad-spectrum and narrow-spectrum types with common classes including penicillins, cephalosporins, macrolides, tetracyclines, aminoglycosides, fluoroquinolones, sulfonamides, and glycopeptides. Antibiotics are used for the treatment of infections such as bacterial pneumonia, strep throat, and urinary tract infections. Antibiotics are also occasionally taken for prevention particularly in patients with compromised immune systems or before surgery(11).

Antimicrobial resistance (AMR) is a worldwide health concern resulting from the exposure of bacteria, viruses, parasites, or fungi to antimicrobial agents but their non-eradication. Longer illnesses, more expensive treatment, and greater death rates are the results of this. Overprescription, overuse, noncompliance, subpar medications, erroneous prescriptions, inadequate infection control, and inadequate cleanliness are some of the factors that lead to antimicrobial resistance (AMR). To maximize the use of antimicrobial drugs, the World Health Assembly has created a Global Action Plan (GAP) for Standardized data collection and improved monitoring systems required to inform policies and initiatives(12).

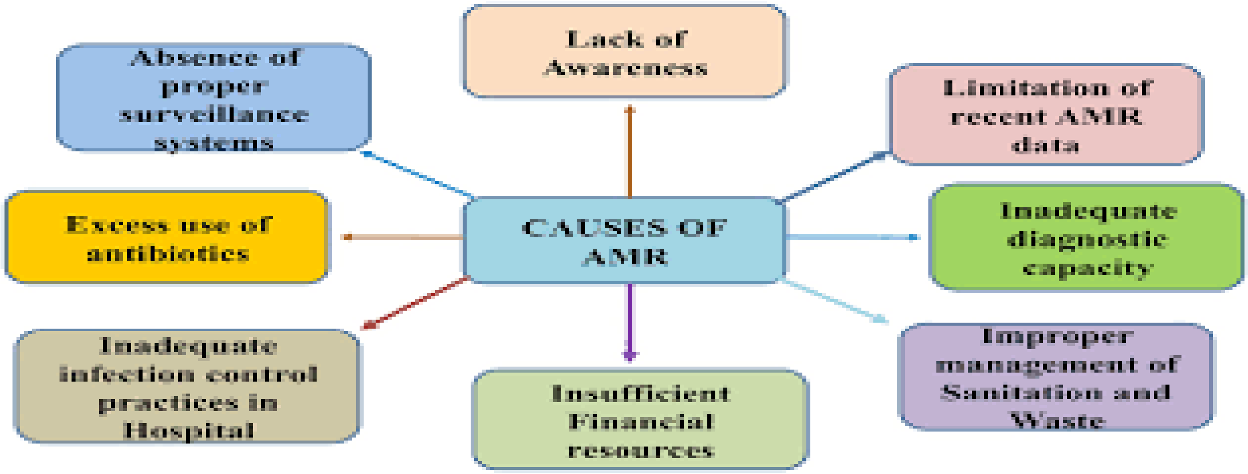

Figure 1 Main Cause of Antimicrobial Resistance

The causes of anti-microbial resistance as shown in the above image include: the absence of proper surveillance systems, excess use of antibiotics, inadequate infection control practices in hospitals, insufficient financial resources, lack of Awareness, limitation of recent anti-microbial resistance data, inadequate diagnostic capacity, and improper management of sanitation and waste.

2.2Antibiotics De-escalation

In antimicrobial stewardship, antibiotic de-escalation is a systematic tactic to maximize antibiotic use and minimize antibiotic resistance. It involves administering broad-spectrum antibiotics to cover various pathogens and then narrowing treatment based on clinical assessment and microbiological results. This involves identifying the specific pathogen and its antibiotic susceptibility then switching to a more targeted antibiotic and discontinuing unnecessary antibiotics. The goal is to reduce antibiotic-resistant bacteria, minimize side effects, and ensure the most effective use of antibiotics for each patient(13).

2.3 Antibiotics use in hospitals

Antibiotic use in hospitals is a significant driver of antimicrobial resistance and involves administering antimicrobial agents to treat or prevent bacterial infections, especially in critically ill or immunocompromised patients. Studies have shown that a considerable proportion of antibiotic prescriptions in hospitals are inappropriate either due to incorrect indication, dosage, or duration to cure illnesses, stopping the development of resistant bacteria, and guaranteeing the availability of antimicrobial drugs for future generations(3–5,14). Effective monitoring and assessment in this area by utilizing resources such as the WHO PPS can offer perceptions into the practices of prescribing and assist in creating focused interventions.

2.4 WHO Point Prevalence (PPS) Tool

The WHO Point Prevalence Survey (PPS) Tool is a standardized tool created to evaluate and track data on antibiotic prescribing patterns and other data pertinent to the management and treatment of infectious illnesses in hospitalized patients worldwide(10). It collects information on antibiotic prescribing by substance name, indication, patient category, and healthcare facility at specific points in time across hospitals and helps in determining the types of antibiotics prescribed their prevalence of use, and the clinical indications for their use. The methodology supports policymakers in improving antibiotic use by raising awareness, training, and evaluating interventions but is a standardized tool for monitoring and identifying targets for improvement.

2.5 Global and Regional Studies where WHO PPS was used

Global and regional studies have evaluated antibiotic use and healthcare-associated infections (HAIs) in hospitals using the WHO Point Prevalence Survey (PPS) Tool. These studies provide valuable insights into antibiotic prescribing patterns, HAI prevalence, and the effectiveness of antimicrobial stewardship programs. The data collected from these studies have been used for policy development, stewardship programs, education, training, benchmarking, and comparison. These studies emphasize the importance of ongoing surveillance and data collection to combat antibiotic resistance effectively and improve patient care outcomes globally(12).

2.6 Antibiotic use in Rwanda

Antibiotic use in Rwanda is being assessed through various studies, surveys, and data collection initiatives. Rwanda has developed a national action plan to combat antimicrobial resistance, focusing on monitoring and regulating antibiotic use in healthcare settings. Regional surveys reveal limited diagnostic facilities and high healthcare-associated infections (HAIs) hence efforts to improve infection prevention and control (IPC) and antimicrobial stewardship programs are crucial. Challenges include limited facilities, data gaps, policy enforcement, and international collaboration(2).

2.7 Directed Vs Empirical treatment

Empirical and directed treatments are two distinct methods for managing infections, especially in the context of antibiotic use. Empiric treatment is initiated based on a clinician's experience and knowledge of likely pathogens and their resistance patterns, often before specific laboratory results are available. It is used when immediate treatment is necessary, but the exact pathogen is not yet identified. Directed treatment, on the other hand, is administered after the identification of the specific pathogen and its susceptibility to antibiotics, allowing for targeted therapy. Both methods have advantages and risks, with empirical treatment often starting to manage immediate risks and being adjusted as more specific information becomes available(5).

2.8 WHO AWaRe Classification

The WHO AWaRe Classification is a system developed by the World Health Organization (WHO) to guide the appropriate use of antibiotics and combat antimicrobial resistance (AMR)(11). It categorizes antibiotics into three groups:

- **Access:** First-choice antibiotics that are effective, safe, and have a lower risk of resistance. These should be widely available.
- **Watch:** Antibiotics with a higher resistance potential. Their use should be limited to specific infections to avoid unnecessary resistance.
- **Reserve:** Last-resort antibiotics used for severe infections caused by multidrug-resistant (MDR) bacteria

2.8 Conceptual framework

In this study, Independent variables will include patient demographics, clinical factors, antibiotic-related factors, hospital-related factors, and dependent variables will include antibiotic use patterns, appropriateness of prescriptions, and compliance with hospital policies, patient outcomes, and antibiotic resistance. This study aims to understand how independent and dependent variables influence antibiotic use among hospitalized patients, highlighting the potential impacts on patient outcomes and antibiotic resistance development.

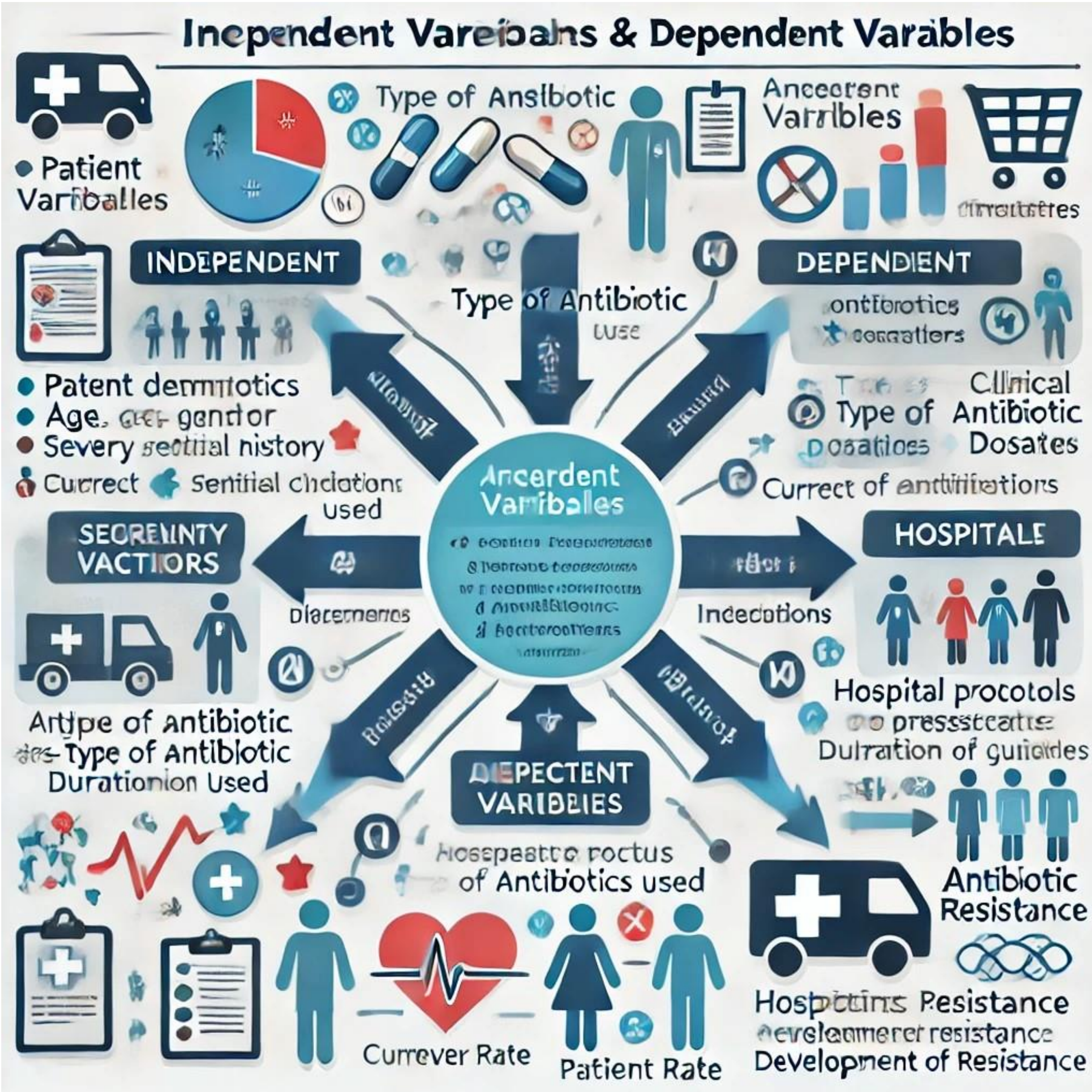

Figure 2 Conceptual framework

CHAPTER THREE: RESEARCH METHODS

3.1 Study design and setting

This is an observational cross-sectional descriptive study conducted from 17th to 28th January 2025 to evaluate antibiotic use among hospitalized patients at Ruhengeri Level Two Teaching Hospital. The hospital has a capacity of 313 beds and an average occupancy rate of 85%. It provides a secondary-care to population of approximately 406,557 people, located in Musanze District, Northern Province, Rwanda. The hospital also serves the surrounding districts. This location was chosen due to its diverse patient population and the availability of a range of healthcare services.

3.2 Study population and inclusion criteria

The survey covered all eligible patients, as Ruhengeri Level Two Teaching Hospital has fewer than 500 beds (313 beds), thus meeting the WHO Point Prevalence Survey criteria for a full census. A total of 270 hospitalized patients (including 117 on antibiotics) who met the inclusion criteria were included in the study and data were collected from the following six departments namely Internal Medicine, Neonatology, Pediatrics, Intensive Care Unit (ICU), Surgery and Gynecology and Obstetrics. The inclusion and exclusion criteria were based on the WHO Point Prevalence Survey tool guidelines, where were included hospitalized patients on antibiotics (except topical and ophthalmologic/eye antibiotics) before 08:00 AM on the day of the survey, Neonates born before 08:00 AM (counted separately from the mother) and exclude Patients admitted after 08:00 AM, outpatients Patients in day surgery/treatment, emergency room patients and discharged patients waiting for transportation(10).

3.3 Sample size and sampling procedure

The sampling followed the WHO Point Prevalence Survey guidelines, which require a census rather than statistical probability approach for hospitals with fewer than 500 beds(10). Since the hospital has 313 beds only, there was no sampling; we included all hospitalized patients meeting the inclusion criteria and they were 270 in total.

3.4 Research instrument, validity, and reliability

The study was conducted using World Health Organization (WHO) Point Prevalence Survey (PPS) Tool as the research instrument; the tool is designed to facilitate consistent and structured collection of antibiotic use data (e.g., name, dose, route, indication) across hospital settings. Apart from data on the use of antimicrobials, patient demographics (e.g., age, gender, ward/unit, admission diagnosis), Infection-related information (e.g., type of infection, culture and sensitivity results) were also collected. The WHO PPS tool is a validated international instrument, developed and endorsed by the World Health Organization, and has been widely used in global and regional surveillance studies, ensuring it meets international standards for antibiotic use monitoring(10). In order to enhance the content validity, the tool includes predefined indicators, consistent definitions, and clear inclusion/exclusion criteria. Reliability of the study was ensured by using standardized forms and protocols provided by the WHO PPS methodology. Prior to data collection, healthcare staff received training on the proper use of the WHO-PPS tool. In additional a pilot survey was conducted by the principal investigator along with trained healthcare staff to promote consistency and accuracy in data collection.

3.5 Data collection and study variables

Data were collected using the WHO Point Prevalence Survey (PPS) tool from January 17 to January 28, 2025, by reviewing the medical records of hospitalized patients who were receiving antibiotics at 8:00 AM on the day of the survey. The data collection process was led by the the principal investigator assisted by trained healthcare staff where the information on patient and antibiotic use was recorded was recorded. For patient related information we collected data on age, gender, ward/department of admission and date of admission. Information related to antibiotic use included antibiotic prescribed (name, dose, frequency), Route of administration (oral, intravenous), Indication for use (empirical or targeted), Number of antibiotics per patient, Compliance with WHO AWaRe classification (Access, Watch, Reserve), Use of International Nonproprietary Name (INN) vs. brand name; Culture and sensitivity testing as well as Switch from IV to oral therapy. In addition, we collected information on diagnosis, presence and type of infection, surgical status, and use of invasive devices.

3.6 Data analysis

After completing data collection, statistical analysis was performed to assess the prevalence and patterns of antibiotic use by using Microsoft Excel. Descriptive statistical methods were used to summarize the data on antibiotic use prevalence, patient demographics, and prescribing patterns but also Frequencies and percentages were calculated.

3.7 Ethical consideration

The study received approval from Ruhengeri Level Two Teaching Hospital directorate (Ref 1294/RL2TH/DG/2024).

CHAPTER FOUR: RESULTS

This chapter provides the study's findings. The section commences with demographic data of hospitalized patients who took part in the study. The collected data were analyzed using Excel and presented in figures.

4.1. Demographic characteristics of the study population

The study was conducted among 270 hospitalized patients between 17 January 2025 and 28 January 2025 who fulfilled the inclusion criteria, where 117 patients were on antibiotics. For the patients that were on antibiotics apart from the gynecology and obstetrics department where all patients are females, the Intensive Care Unit and Pediatric department had more females than males in hospitals since we had 56 males (48%) against 61 females (52%) (See figure 3).

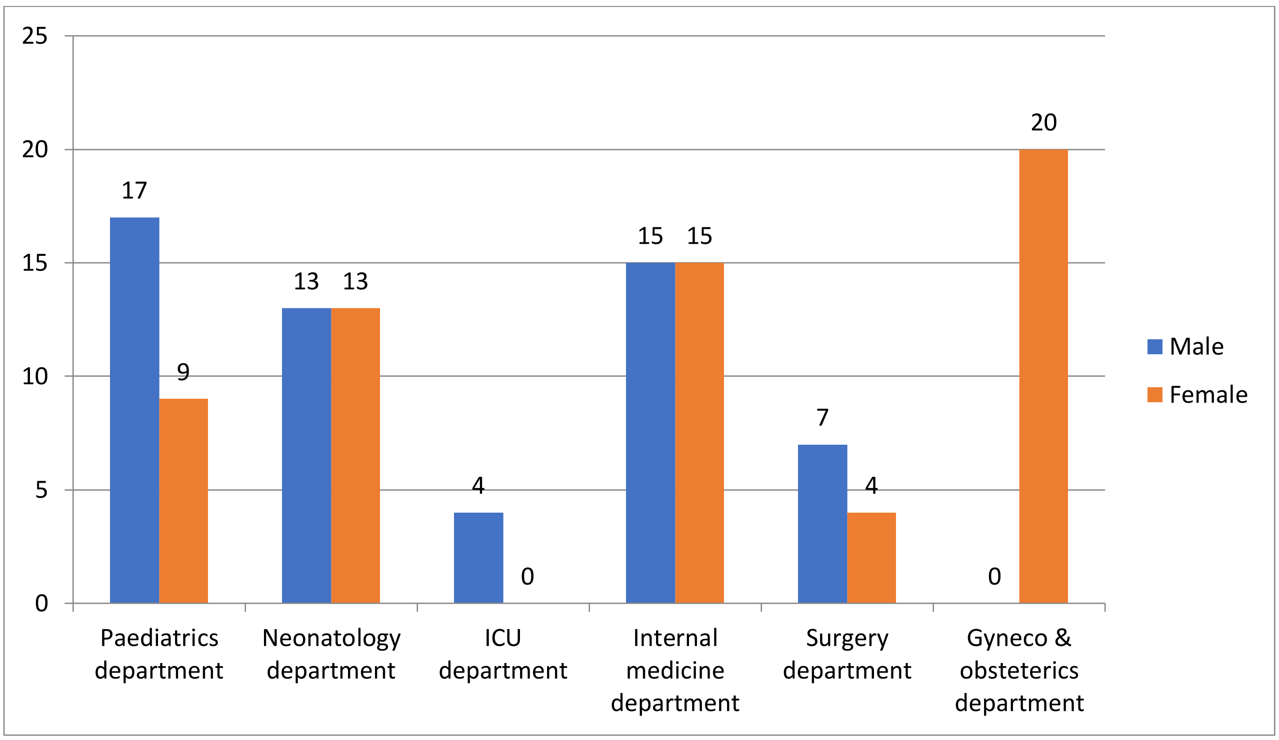

Figure 3 Distribution of patient's gender per department

4.2. Antibiotic prevalence and prescription patterns

4.2.1. Antibiotic Prevalence at Ruhengeri Level Two Teaching Hospital

The study was conducted among 270 hospitalized patients between 17 January 2025 and 28 January 2025, showing that 117 (43%) hospitalized patients were on antibiotic therapy where pediatric and Neonatology departments have shown to have a high prevalence of antibiotics with

26 (62%) patients on antibiotics out of 42 hospitalized patients and 26(57%) patients on antibiotics out of 46 hospitalized patients successively. (See Figure 4)

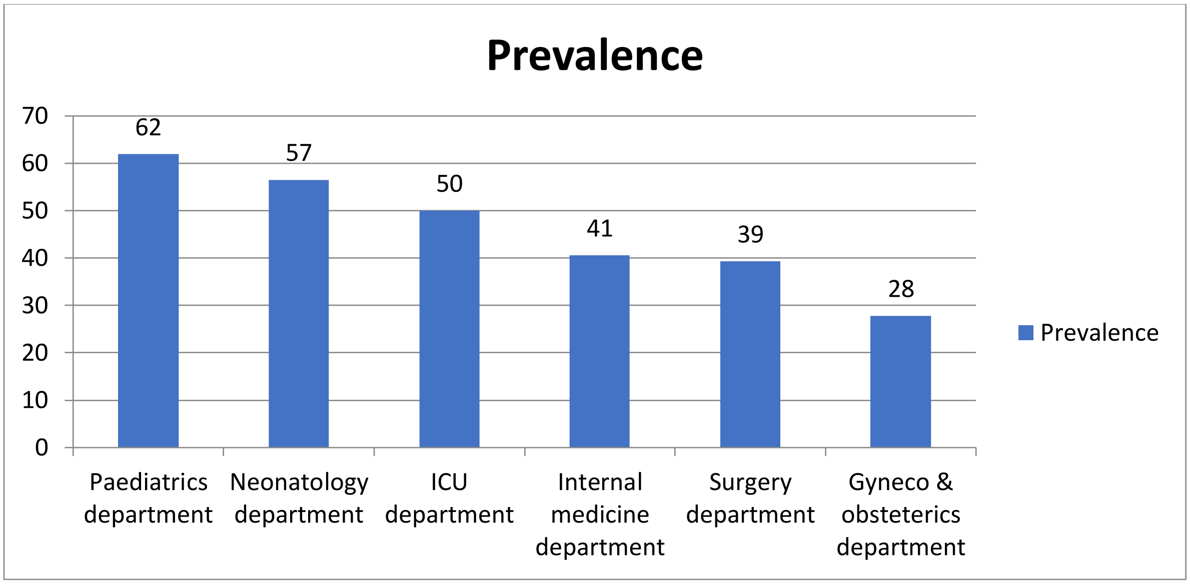

Figure 4. Antibiotic prevalence per department

4.2.2. Number of antibiotics prescribed per prescription

In general, 15.4 % (18/117) of the patients were prescribed one antibiotic, 65.8 % (77/117) were prescribed two antibiotics, 15.4 % (18/117) were prescribed three antibiotics, 2.6% (3/117) were prescribed four antibiotics and 0.9 % (1/117) was prescribed five antibiotics. The average number of antibiotics prescribed to patients was 2.1 antibiotics prescribed to patients where the Surgery department showed the highest rate of antibiotic prescriptions with an average of 2.3 while the lowest rate was observed in the Internal Medicine department with an average of 1.9 See Figure 5 and Figure 6).

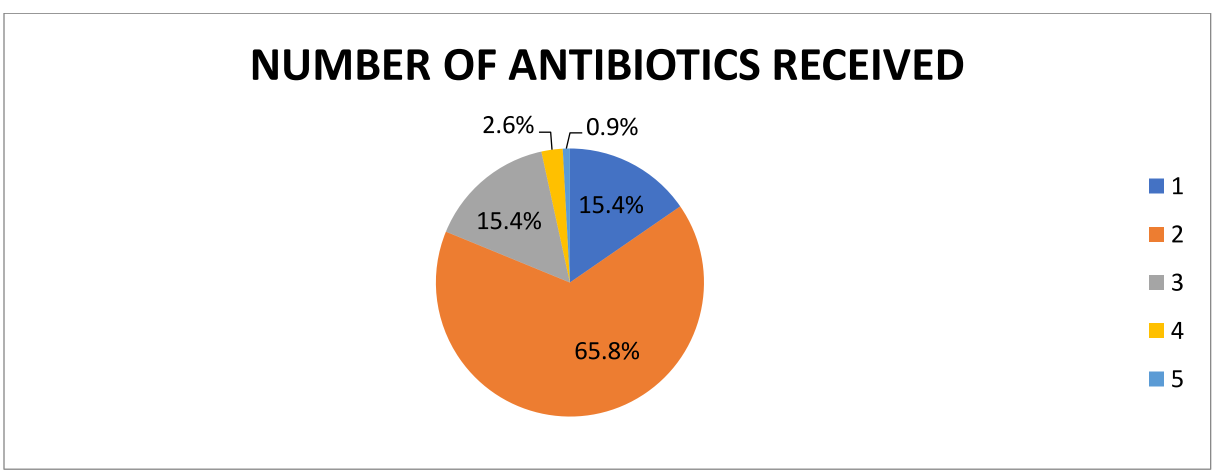

Figure 5 Number of Antibiotic prescribed per patient

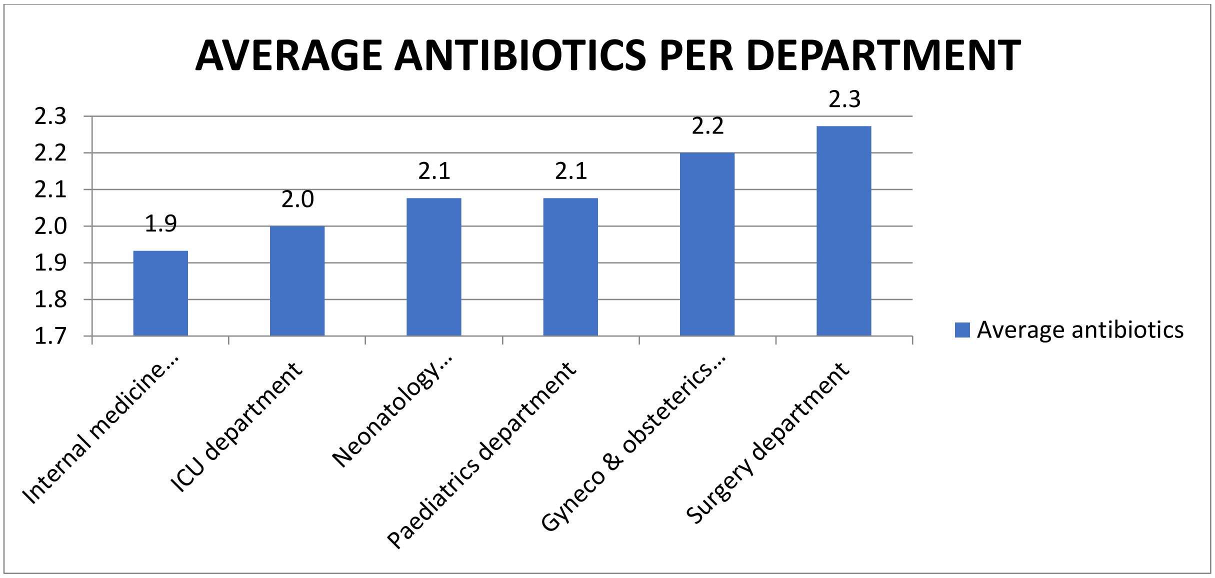

Figure 6 Number of Antibiotic prescribed per patient

4.3. Most commonly prescribed antibiotics to patients

4.3.1. Specific antibiotics most prescribed per hospital

Ampicillin was the most prescribed antibiotic (20.3%) followed by Ceftriaxone (17.8%), then.

Gentamicin (13.6%), Metronidazole (12.3%), Cefotaxime (8.1%), Cloxacillin (6.4%), Ciprofloxacillin (5.5%), doxycycline (3.4%), meropenem (2.5%), Amoxicillin, Azithromycin, Vancomycin (2.1%) and Erythromycin (1.3%). Other antibiotics had a prescribed rate of less than 1% (See Figure 7).

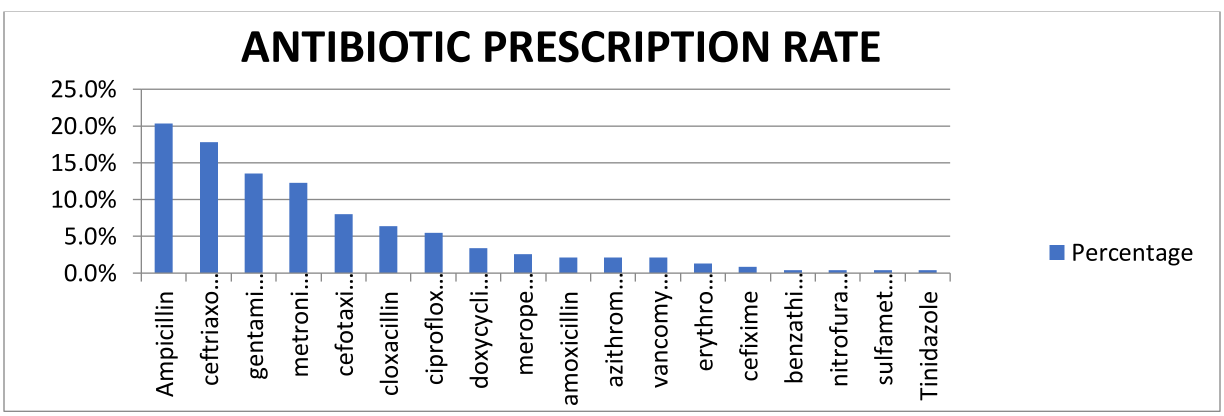

Figure 7 Antibiotic prescription rate

4.3.2. Specific antibiotics most prescribed per department

In general, the most prescribed antibiotics per hospital was Ampicillin (20.3%) followed by Ceftriaxone (17.8%), however depending on the department ampicillin and gentamicin were most prescribed in Neonatology and pediatric department with 45%;35% and 39%;20% successively. In other departments including internal medicine, surgery and intensive care unit departments' ceftriaxone was the most prescribed antibiotic at a rate of 37%; 28%, and 25% successively. For the gynecology and obstetrics department metronidazole was most prescribed by 35% (See Figures 8, 9, 10, 11, and 12)

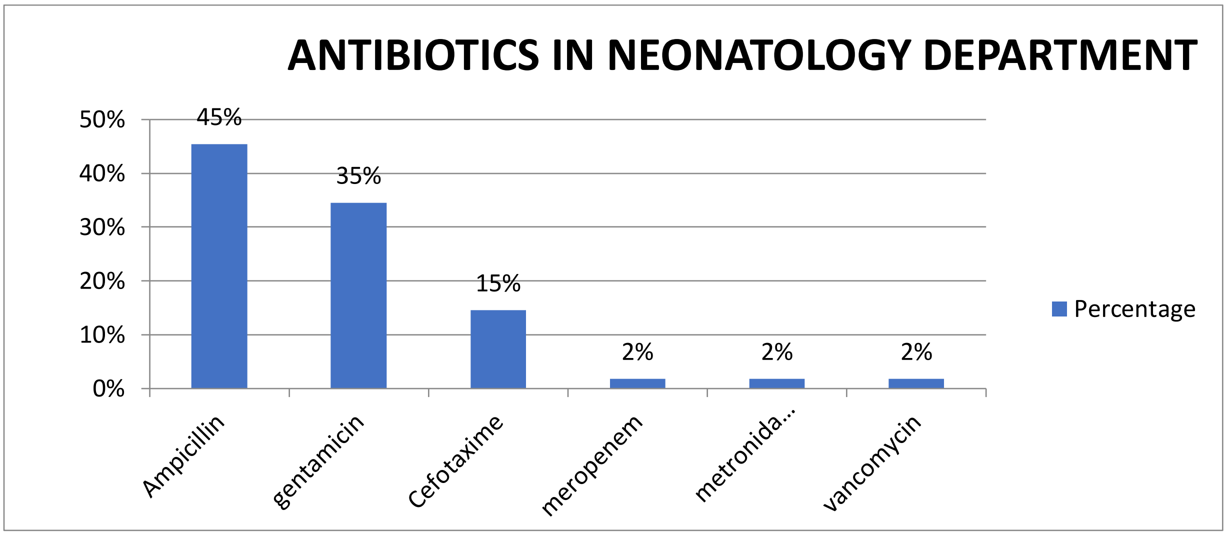

Figure 8 Antibiotic most prescribed per neonatology department

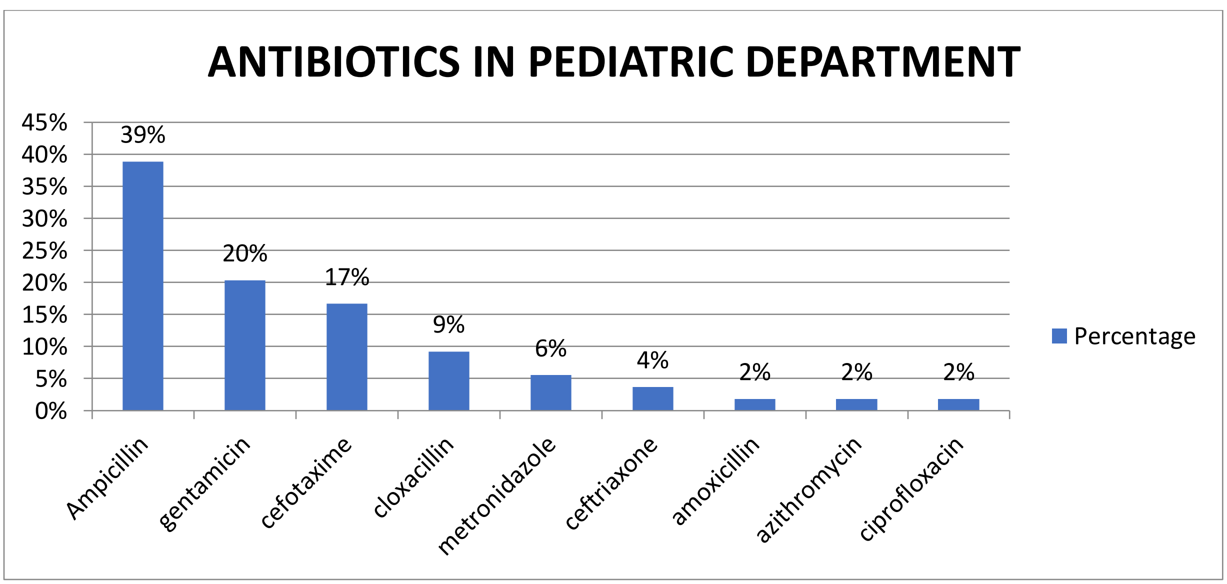

Figure 9 Antibiotics most prescribed per paediatric department

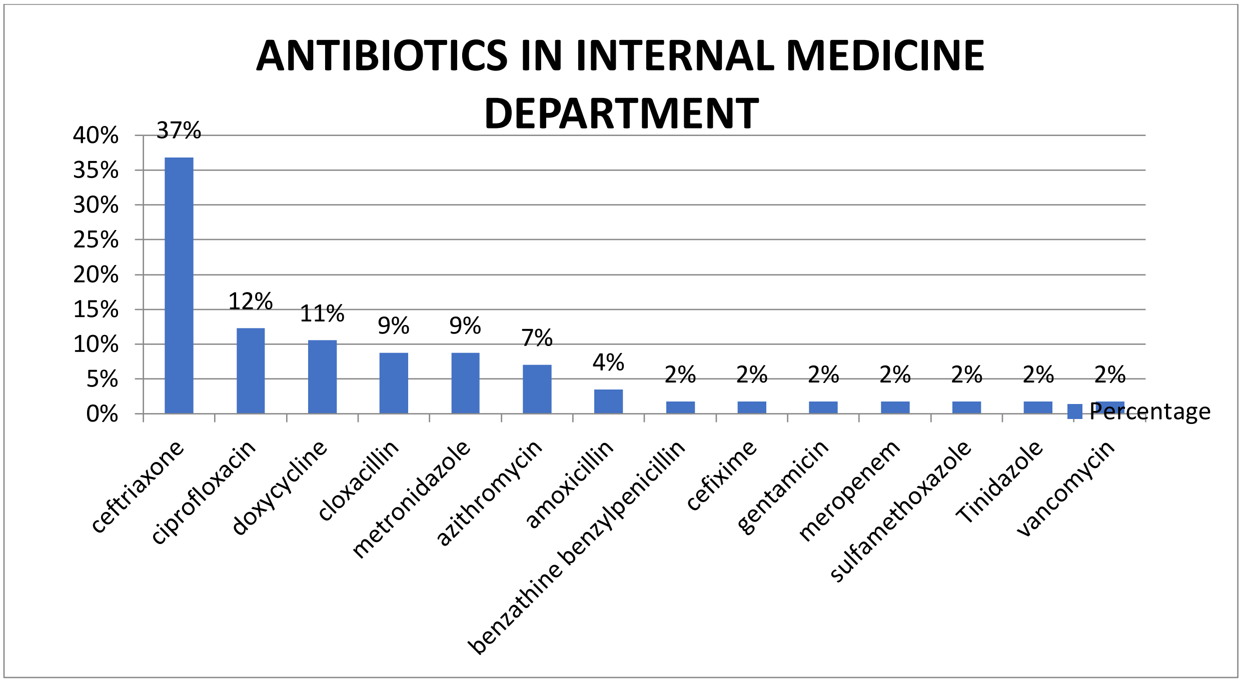

Figure 10 Antibiotics most prescribed per internal medicine department

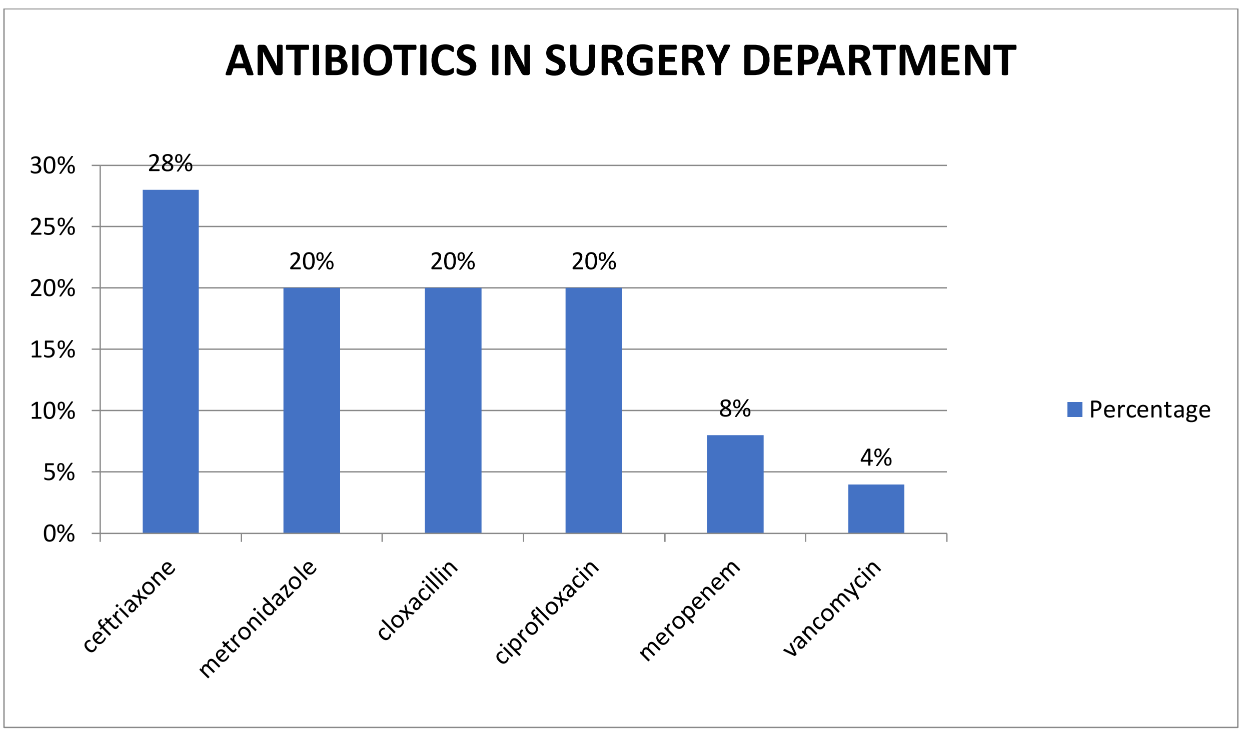

Figure 11 Antibiotics most prescribed per surgery department

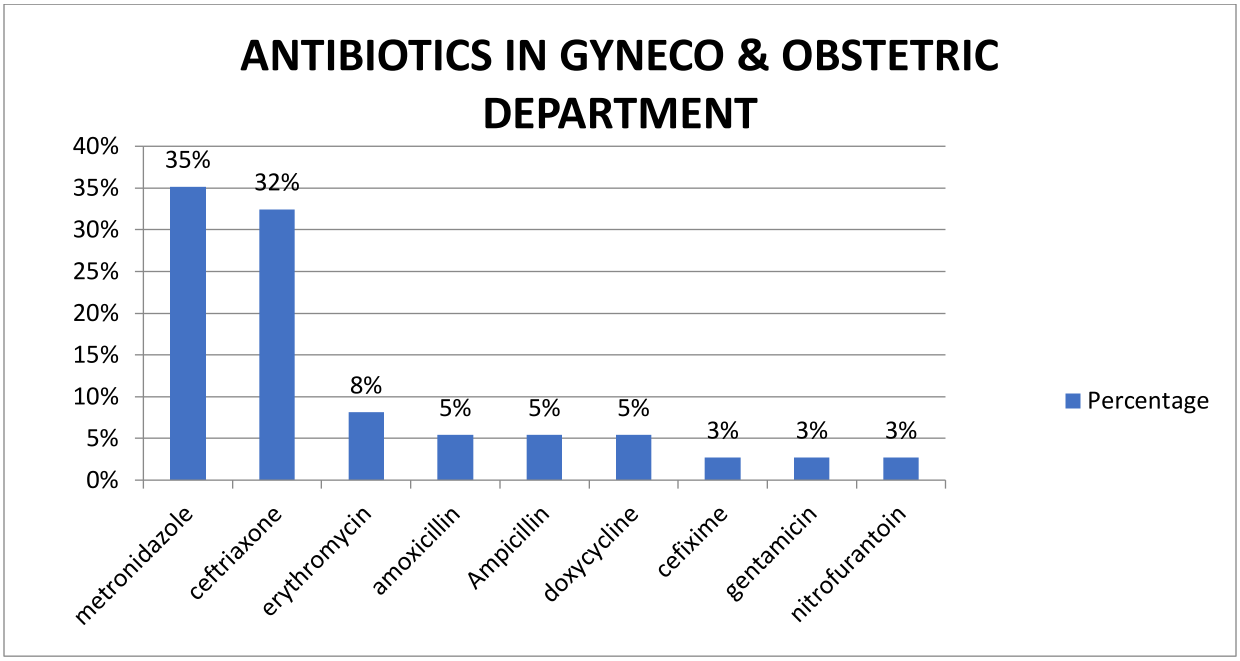

Figure 12 Antibiotic most prescribed per gynecology & Obstetric department

4.3.3 Specific antibiotic association most prescribed per prescription

The most prescribed antibiotic association was the association of Ampicillin-Gentamicin with a rate of 21% overall followed by ceftriaxone –Metronidazole with a rate of 12%, Ampicillin-Cefotaxime with a rate of 11%, Ceftriaxone-Ciprofloxacin with a rate of 5%, Ceftriaxone-Doxycycline with a rate of 4% and overall successively. Other antibiotic associations had the lowest proportion of prescribing. (See figure 13)

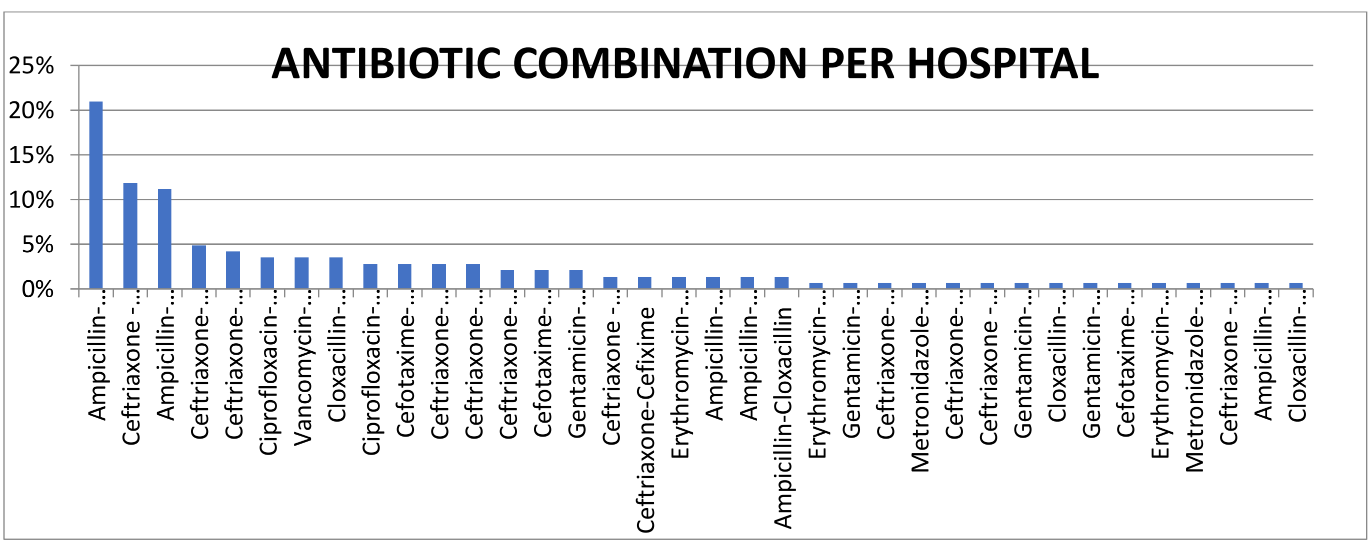

Figure 13 Antibiotic association most prescribed

4.4. Compliance with WHO guidelines

4.4.1. Specific antibiotic prescribed in hospital, according to WHO AWaRe classification

In this study, we find that among 236 antibiotics prescribed 141(59.7%) were in the WHO Access group 95 (40.3%) were in the WHO Watch group none was in the WHO Reserve group (see figure 14)

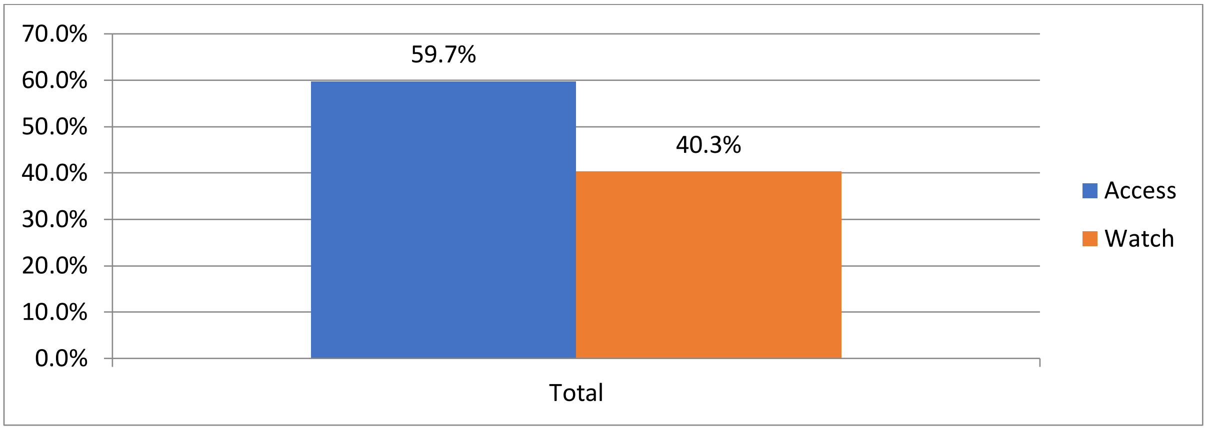

Figure 14 Antibiotic prescribed according to WHO AWARE classification

4.4.2. Specific antibiotic prescribed in INN

In this study, we find that among 236 antibiotics prescribed 222(94%) were written using INN (International Nonproprietary Name), and only 22(6%) were written by brand names (see Figure 15)

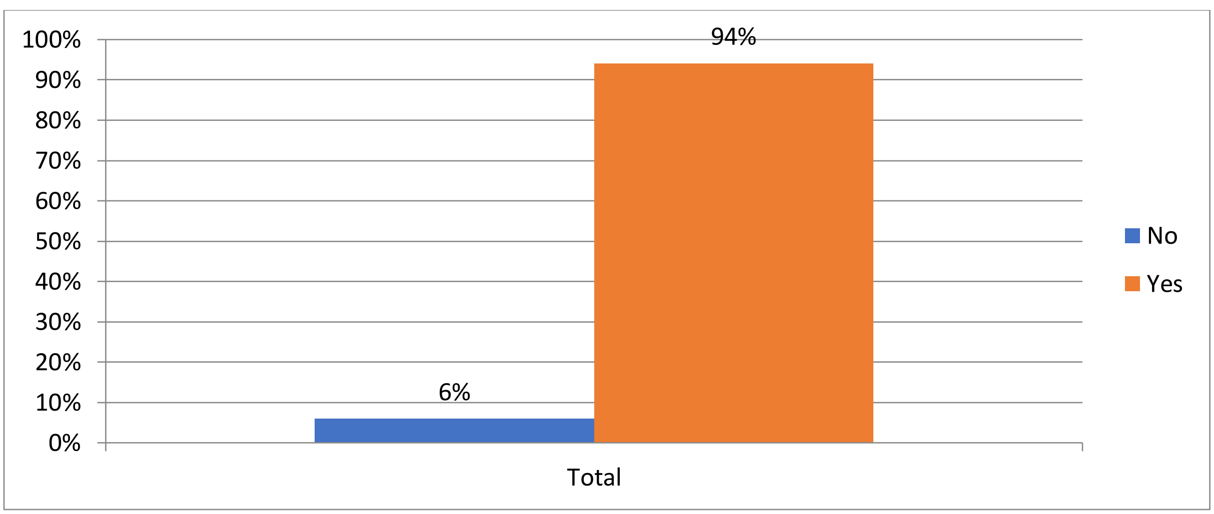

Figure 15 Antibiotic prescribed written using INN

4.5. Empirical Vs directed therapy

In this study, we find that among 117 patients who were prescribed antibiotics, none of the treatments were guided by microbiology culture results, all the patients (100%) were treated empirically.

4.6. Switch from Intravenous to oral therapy

In this study, we find that among 117 patients who were prescribed antibiotics, the switch from injection to oral form was done only for 8 patients representing 7% (see Figure 16)

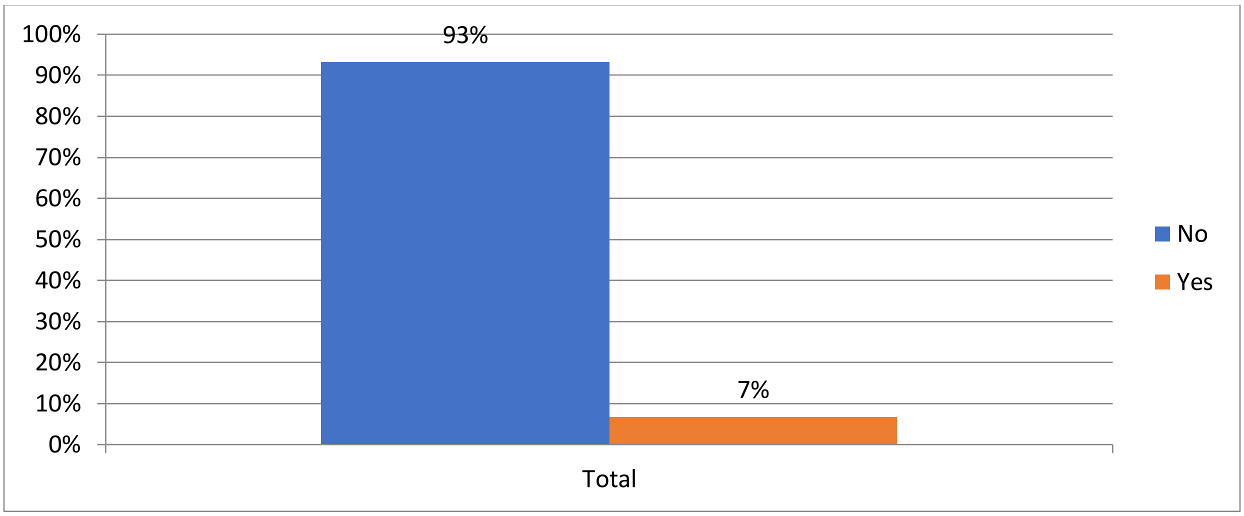

Figure 16 Antibiotic switched from injection to oral form

CHAPTER FIVE: DISCUSSION

This section discusses the importance, significance, and relevance of the results that assessed the use of antibiotics in hospitalized patients at Ruhengeri Level Two Teaching Hospital using the WHO Point Prevalence Survey (PPS) tool. It summarizes the main findings to provide significant insights into prescribing patterns, antibiotic prevalence, and compliance with WHO guidelines at this hospital relates them to the literature review and existing knowledge, and provides the basis for the conclusion and recommendations.

5.1 Antibiotic Prevalence and Prescription Patterns

The study revealed that 43% of hospitalized patients were on antibiotic therapy, with the highest prevalence observed in the pediatric (62%) and Neonatology (57%) departments. This high prevalence seen in these departments may be attributed to several factors beyond general concerns regarding infections. Neonates are highly vulnerable to infections due to their immature immune systems, making clinicians more likely to initiate empirical antibiotic therapy as a precaution. Findings seen in our study align with previous studies indicating that children, particularly neonates, are more vulnerable to infections and often receive empirical antibiotic treatment, especially the results from a study conducted at hospitals in western Iran compared with southern Asia and European hospitals(15). The high antibiotic usage in these departments may also be attributed to concerns regarding sepsis, respiratory infections, and other neonatal infections that require immediate intervention as noted in a study conducted in Egypt(6). Furthermore, the average number of antibiotics prescribed per patient was 2.1, with the surgery department showing the highest rate of 2.3 and internal medicine the lowest rate of 1.9. More than 80% of patients on antibiotherapy were prescribed more than one antibiotic. The multiple prescriptions indicate frequent combination therapy, which may be justified in severe infections but also raises concerns about the potential overuse of broad-spectrum antibiotics. These findings are quite similar to the results from a study conducted in tertiary hospitals in Rwanda that shows that the average number of antibiotics prescribed to patients is 2.17 in CHUB and CHUK(16).

5.2 Most Commonly Prescribed Antibiotics

The study identified Ampicillin (20.3%) and Ceftriaxone (17.8%) as the most prescribed antibiotics, followed by Gentamicin (13.6%) and Metronidazole (12.3%). This trend reflects global antibiotic prescribing patterns, where beta-lactams and aminoglycosides remain the primary choices due to their broad-spectrum efficacy and affordability A WHO PPS-based study in Ghana reported a similar pattern, with ceftriaxone and ampicillin among the most commonly used antibiotics, particularly in neonatal and pediatric units(17). Notably, Metronidazole was highly prescribed in the gynecology and obstetrics department (35%), likely due to its role in anaerobic infections. However, the reliance on Ceftriaxone, a WHO Watch category antibiotic, suggests potential overuse of broad-spectrum antibiotics, which could contribute to antimicrobial resistance (AMR) if not carefully monitored.

5.3 Compliance with WHO Guidelines

The study revealed that 59.7% of antibiotics belonged to the WHO Access category, while 40.3% were from the Watch category, with none classified under the Reserve category. This finding is significant as it highlights the extent to which broad-spectrum antibiotics, which are at higher risk of resistance development, are being utilized in hospitalized patients; The observed rate of 40.3% in our study is within the range but may still indicate overuse, depending on local guidelines and infection patterns and necessitates stricter antimicrobial stewardship to promote the use of narrow-spectrum agents whenever appropriate. A similar study done in North India on Ground level utility of Access, Watch, and Reserve classification found that while Access antibiotics were preferred in most cases, the Watch category antibiotics were still frequently prescribed (38.27%) due to the unavailability of culture results and pressure to treat infections empirically(11). Additionally, 94% of antibiotics were prescribed using their International Nonproprietary Name (INN), indicating a high level of compliance with WHO recommendations.

5.4 Empirical vs. Directed Therapy

A significant, and alarming finding, was that 100% of antibiotic prescriptions were empirical; meaning no culture tests were conducted before prescribing, thus no patients received directed therapy based on culture and sensitivity tests. Empirical antibiotic prescribing is problematic because it increases the risk of inappropriate antibiotic selection, leading to poor patient outcomes, prolonged hospital stays, and the development of multidrug-resistant organisms (MDROs). In a similar study on Antibiotic use at a tertiary hospital in Tanzania findings from a point prevalence survey showed also a high level (95%) of empirical therapy(5). The absence of culture-based prescribing also reduces the ability to track local resistance patterns, limiting efforts to develop effective antimicrobial stewardship interventions.

5.5 Switch from Intravenous to Oral Therapy

The study found that only 8 out of 117 patients (6.8%) were switched from IV to oral therapy, despite WHO guidelines recommending oral therapy whenever possible to reduce costs, adverse effects, and hospitalization duration(17). The prolonged use of IV antibiotics increases the risk of complications such as catheter-related bloodstream infections, prolongs hospital stays, and contributes to higher treatment costs emphasizing the need for improved antibiotic de-escalation strategies. Similar findings were reported in a study conducted in Lebanese university teaching hospitals, where limited IV-to-oral switching was observed (20.6%) were on concurrent IV and PO antibiotics and 304 (79.4%) were on IV antibiotics only due to the absence of clear hospital guidelines(18). Encouraging a structured IV-to-oral switch protocol at Ruhengeri Level Two Teaching Hospital could help optimize antibiotic use, reduce hospital burden, and improve patient outcomes.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The study highlights excessive empirical antibiotic prescribing, limited de-escalation practices, and the observed rate of 40.3% is within the range but may still indicate overuse, depending on local guidelines and infection patterns and necessitates stricter antimicrobial stewardship to promote the use of narrow-spectrum agents whenever appropriate. The overreliance on empirical therapy, combined with limited IV-to-oral switch rates, raises concerns about antimicrobial resistance and healthcare resource utilization. While there is commendable adherence to INN prescribing, the imbalance between Access and Watch antibiotics suggests an urgent need for strengthened antimicrobial stewardship programs (ASPs). The lack of culture-directed therapy further emphasizes the necessity of enhancing laboratory services to guide appropriate prescribing. By addressing these issues, Ruhengeri Level Two Teaching Hospital can serve as a regional model for antimicrobial stewardship, contributing data-driven insights to the international fight against AMR.

In general, below is Significance of our study Results Compared to WHO Recommendations by highlighting significant deviations from WHO recommendations, supporting the conclusion that antibiotic use at Ruhengeri level two teaching hospital is inappropriate or excessive**.** These results provide a strong basis for implementing antimicrobial stewardship programs (ASPs) and training.

Indicator	**Findings from our study**	**WHO Recommendation**	**Significance & Deviation**
Antibiotic Use Prevalence	65% of patients received ≥1 antibiotic	<40–50% in general hospital settings	Higher than WHO benchmark, suggesting overuse of antibiotics.
Route of Administration	>90% parenteral (IV)	WHO promotes IV-to-oral switch when possible	Excessive parenteral use; oral switch underutilized.
Antibiotic Classification (AWaRe)	High ceftriaxone use (Watch group)	Prefer Access group antibiotics	Overuse of broad-spectrum antibiotics, risk of resistance.

6.2. Recommendations

Based on the findings of this study, the following recommendations are proposed to address the overprescription and inappropriate use of antibiotics at Ruhengeri Level Two Teaching Hospital and to contribute to national and scholarly efforts in combating antimicrobial resistance:

1. For Ruhengeri Level Two Teaching Hospital:

- Establish an Antimicrobial Stewardship Program (ASP): A dedicated team comprising clinicians, pharmacists, microbiologists, and infection prevention personnel should be formed to monitor and guide appropriate antibiotic use.
- Enhance Diagnostic Capacity: Improve access to microbiological diagnostic services (e.g., culture and sensitivity testing) to facilitate evidence-based prescribing and Reduce reliance on empirical therapy.
- Regular Prescription Audits: Institutionalize periodic reviews of antibiotic prescriptions using tools like the WHO PPS to identify and address inappropriate prescribing trends.
- Continuous Professional Development: Conduct regular training for healthcare providers on standard treatment guidelines, rational antibiotic use, and emerging resistance patterns.
- Improve Documentation Practices: Strengthen patient record-keeping by ensuring that indications for antibiotic use, treatment durations, and stop/review dates are consistently recorded.

2. For the Ministry of Health:

- Policy Enforcement and Harmonization: Strengthen enforcement of national antimicrobial prescribing policies and harmonize treatment guidelines across healthcare facilities.
- Support for ASP Implementation: Provide technical and financial support to hospitals to establish and sustain antimicrobial stewardship programs.
- National Surveillance System: Develop and maintain a centralized database for tracking antibiotic use and resistance patterns across healthcare institutions using WHO PPS and other standardized tools.
- Public Sensitization Campaigns**:** Promote awareness among the general public on the risks associated with inappropriate antibiotic use and the importance of adhering to prescribed treatments.

3. For Future Researchers:

- Longitudinal and Multicenter Studies: Conduct extended and multicenter studies to capture trends in antibiotic prescribing and resistance across different regions and healthcare levels.
- Qualitative Investigations: Explore healthcare providers' knowledge, attitudes, and practices regarding antibiotic use to inform targeted interventions.
- Health Economic Analyses: Assess the economic impact of antimicrobial resistance and the cost-effectiveness of stewardship interventions. {Citation}

These recommendations aim to support local and national efforts to optimize antibiotic use, reduce resistance, and improve patient outcomes in line with global health priorities.

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Hospital Survey

HospitalID		Free text
HospitalCode		Free text
Survey_start_date		Indicate date as **YYYY-MM-DD**
Survey_end_date		Indicate date as **YYYY-MM-DD**
HospitalGroup		Drop-down list
HospitalGroupCode		
HospitalGroupAllSitesIncluded		Drop-down list
HospitalType		Drop-down list
HospitalTypeSpeciality		Free text. Input NA if HospitalType is not equal to Specialised
HospitalOwnership		Drop-down list
HospitalTotalBeds		Number
HospitalAcuteBeds		
HospitalICUBeds		
HospitalHighRiskBeds		
HospitalAnnualAdmissions		
HospitalAnnualPatientDays		
HospitalIncludedBeds		
HospitalEligiblePatients		
HospitalIncludedPatients		
PatientSampling		

Ward Survey

VARIABLE	RESPONSE	INSTRUCTIONS
HospitalID		Free text
WardID		Free text
WardCode		Free text
WardInvestigator		Free text
WardSurveyDate		Indicate date as **YYYY-MM-DD**
WardType		Drop-down list
WardTotalPatients		Input the total number of patients in the ward
WardEligiblePatients		Input the number of eligible patients to be included in the survey according to inclusion/exclusion criteria
WardIncludedPatients		Input the number of patients surveyed
WardSpecialties		Input value according to Annex II. If several specialties, separate with comma

Patient Survey

VARIABLE	RESPONSE	INSTRUCTIONS
HospitalID		Free text
WardCode		Free text
PatientID		Free text
PatientCode		Free text
Gender		Drop-down list
AgeYear (≥2)		Number. For patients aged less than 2 years, enter 0 in the field
AgeMonth (0-23)		Only for patients aged less than 2 years
PreTermBirth		Only for newborn with preterm birth: LP 34-36 weeks, MP 32-24 weeks, WP 26-32 weeks, EP <= 25 weeks
Child12YearWeight		Only for children aged <13, number (weight in kg)
NeonatesBirthWeight		Only for newborn, number (weight in kg)
AdmissionDate		Indicate date as **YYYY-MM-DD**
SurgerySinceAdmission		Drop-down list
CentralVascularCatheter		Drop-down list
PeripheralVascularCatheter		Drop-down list
UrinaryCatheter		Drop-down list
Intubation		Drop-down list
PatientOnAntibiotic		Drop-down list

PatientNumberAntibiotics		Indicate the number of antibiotics the patient has been prescribed **since admission**, regardless if the patient is on them today.
MalariaStatus		Drop-down list
TuberculosisStatus		Drop-down list
HIVStatus		Drop-down list
HIVOnART		Only if HIVStatus is "yes"
HIVCD4Count		Only if HIVStatus is "yes". Input number or unknown
McCabeScore		Drop-down list. See Annex III in protocol for specification
MalnutritionStatus		Drop-down list
COPDStatus		Drop-down list
TransferFromHospital		Drop-down list
TransferFromNonHospital		Drop-down list. Input "Yes" if patient transferred from a health facility other than hospital with **inpatient care**
Hospitalisation90Days		Drop-down list. Input "Yes" if patient has been previously admitted within the past 90 days
TypeSurgerySinceAdmission		Drop-down list. See Annex IX in protocol for category of surgery

Indication Survey

VARIABLE	RESPONSE	INSTRUCTIONS
PatientCode		Free text
IndicationCounter		Number or Drop-down list
IndicationType		Drop-down list
SurgicalProphylaxisDuration		Drop-down list
SurgicalProphylaxisSite		Drop-down list
Diagnosis		If IndicationType is SP or MP, select "NA - Not applicable"
StartDateTreatment		Indicate date as **YYYY-MM-DD**
ReasonInNotes		If the diagnosis was noted in the medical charts
CultureSampleTaken		Drop-down list
SpecimenType1		Free text. Only if CultureSampleTaken is "Yes"
CultureResult1		Free text. Only if CultureSampleTaken is "Yes"
AntibioticSusceptibilityTestResults1		Free text. Only if CultureSampleTaken is "Yes"
Microorganism1_1		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype1_1		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
Microorganism1_2		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"

ResistantPhenotype1_2		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
Microorganism1_3		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype1_3		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
SpecimenType2		Free text. Only if CultureSampleTaken is "Yes"
CultureResult2		Free text. Only if CultureSampleTaken is "Yes"
AntibioticSusceptibilityTestResults2		Free text. Only if CultureSampleTaken is "Yes"
Microorganism2_1		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype2_1		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
Microorganism2_2		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype2_2		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
Microorganism2_3		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype2_3		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
SpecimenType3		Free text. Only if CultureSampleTaken is "Yes"

CultureResult3		Free text. Only if CultureSampleTaken is "Yes"
AntibioticSusceptibilityTestResults3		Free text. Only if CultureSampleTaken is "Yes"
Microorganism3_1		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype3_1		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
Microorganism3_2		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype3_2		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"
Microorganism3_3		Coded value according to Annex VI. Only if CultureSampleTaken is "Yes"
ResistantPhenotype3_3		Free text. Only if AntibioticSusceptibilityTestResults is "Yes"

Antibiotic Survey

VARIABLE	RESPONSE	INSTRUCTIONS
PatientCode		
AntibioticCounter		Number or drop-down list
IndicationCounters		Number or drop-down list. If more than one indication is linked to the antibiotic, specify by sparating the count values with comma e.g. 1,2
AntibioticNotesName		Free text
AntibioticINNName_1		Drop-down list. INN name of active substance
AntibioticINNName_2		Drop-down list. INN name of second active substance if a combination product
AntibioticINNName_3		Drop-down list. INN name of third active substance if a combination product
AntibioticWrittenInINN		Drop-down list
StartDateAntibiotic		Indicate date as **YYYY-MM-DD**
UnitDose		Number
UnitDosesCombination		Number

UnitDoseMeasureUnit		Drop-down list
UnitDoseFrequency		Number
AdministrationRoute		Drop-down list
PrescriberType		Drop-down list
ParenteralType		Drop-down list
OralSwitch		Drop-down list
NbMissedDoses		Number
MissedDosesReason		Only if NbMissedDoses>0. Drop-down list
GuidelinesCompliance		Drop-down list
TreatmentType		Drop-down list
Comments		Free text