ARSI UNIVERSITY COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICINE, DEPARTMENT OF INTERNAL MEDICINE

ASSESSMENT OF ANTIBIOTICS PRESCRIPTION PATTERN AND ASSOCIATED FACTORS AMONG PATIENTS ADMITTED TO MEDICAL WARD OF ASELLA REFERRAL AND TEACHING HOSPITAL SOUTHEAST, ETHIOPIA

INVESTIGATOR: NAHOM PAULOS (MD, INTERNAL MEDICINE RESIDENT)

A RESEARCH THESIS TO BE SUBMITTED TO ARSI UNIVERSITY COLLEGE OF HEALTH SCIENCES, SCHOOL OF MEDICINE, DEPARTMENT OF INTERNAL MEDICINE, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR SPECIALTY CERTIFICATE IN INTERNAL MEDICINE

JANUARY 2026

ARSI, ETHIOPI

ASSESSMENT OF ANTIBIOTICS PRESCRIPTION PATTERN AND ASSOCIATED FACTORS AMONG PATIENTS ADMITTED TO MEDICAL WARD OF ASELLA REFERRAL AND TEACHING HOSPITAL SOUTHEAST, ETHIOPIA

INVESTIGATOR: NAHOM PAULOS **(MD, INTERNAL MEDICINE RESIDENT)**

ADVISORS:

1. ZEWDU HURISA (M.D, ASSISTANT PROFESSOR OF INTERNAL MEDICINE)
2. MR.SOLOMON GEBRETSADIK (MSC, ASSISTANT PROFESSOR OF PUBLIC HEALTH MANAGEMENT)

JANUARY 2026

ARSI, ETHIOPIA

Name of investigator	Nahom Paulos (MD, Internal Medicine Resident)
Name of advisor	Zewdu Hurisa (MD, Assist. Prof. of Internal Medicine)
Title of the research project	Antibiotic prescription pattern and associated factors among admitted patients at medical ward of Asella referral and teaching Hospital
Duration of the project	12 months (FEB, 2025 - JAN, 2026 G.C)
Study area	Asella Referral and Teaching Hospital
Address of investigator	Nahom Paulos (MD, Resident) Phone→+251911091625 Email dr.zegeyepaulos@gmail.com
Address of First advisor	Zewdu Hurisa (MD, Assist. Prof.) Phone→+251911767207 Email
Address of Second advisor	Solomon Gebretsadik (MSc, Assist. Prof.) Phone: +251949320147 Email: Solomonbereka@gmail.com

ABSTRACTS

***Background**: Antibiotics are vital for treating bacterial infections and reducing morbidity and mortality worldwide. However, widespread misuse and inappropriate prescribing have led to significant antibiotic resistance. In response, the WHO and national health authorities promote antimicrobial stewardship to optimize antibiotic use. Generating local evidence on prescribing practices is crucial for developing context-specific stewardship interventions. This study assessed antibiotic prescribing patterns and associated factors among patients admitted to the medical ward of Asella Referral and Teaching Hospital, Southeast Ethiopia.*

***Objective**: To assess antibiotics prescription pattern and identify factors associated with inappropriate antibiotic use among patients admitted to medical ward of Assela Referral and Teaching Hospital*

***Methodology**; An institution-based retrospective cross-sectional study was conducted at Assela Referral and Teaching Hospital medical ward. A total of 228 patient charts were reviewed in the study period. Data analysis was done using SPSS version 27. Descriptive statistics were performed to show the prevalence and frequencies of the collected variables. Those variables that show associations with the dependent variable at p <0.25 in the bi-variate analysis were entered into the multiple logistic regression. Adjusted odds ratios with their corresponding 95% confidence intervals and p-values were used to assess the strength of the associations. Variables with p-values of less than 0.05 in the multiple regressions were finally considered as statistically significant.*

***Result**: Of the 228 patient records reviewed, 50.9% were male, and 54.8% were aged 31–64 years. Community-acquired pneumonia was the most common diagnosis (20.6%). Ceftriaxone was the most frequently prescribed antibiotic (22.8%) of all prescriptions. Overall, 33% of participants received inappropriate prescriptions. In multivariable logistic regression, patients who do not have culture result show significant rate of inappropriate prescription pattern (AOR = 8.79; 95% CI: 1.98–39.05). Receiving two or more antibiotics was independently associated with higher odds of inappropriate prescription (AOR = 2.42; 95% CI: 1.15–5.10) and patients whose antibiotics was not de-escalated were associated with inappropriate antibiotics use (AOR = 2.40; 95% CI: 1.01–5.70).*

Conclusion*: One third of antibiotic prescriptions for medical inpatients were inappropriate. Culture result, Receiving two or more antibiotics and antibiotics de-escalation were independently associated with higher odds of inappropriate prescription. These findings highlight the need for routine antimicrobial stewardship interventions, prescriber education, and evidence based antibiotics treatment.*

Key words*: antibiotic prescribing pattern; inappropriate antibiotic use; medical ward; WHO prescribing indicators; Ethiopia*

ACKNOWLEDGMENT

First, I would like to thank Almighty God for making this research thesis. I would like to thank Arsi University, college of health sciences, departments of internal medicine and public health for preparing and funding this program. I would also like to express my deepest gratitude and heartfelt thanks to my advisors Dr. Zewdu Hurisa and Mr. Solomon Gebretsadik for their constructive comments and continuing support in developing this research proposal. I would also like to thank the hospital and its administrative bodies for letting me do this research and finally let my warm gratitude goes to those who will be participating in the data collection process.

Table content

List of tables

List of figures

ACRONYMS/ABBREVIATION

AMR	Antimicrobial resistance
AMS	Antimicrobial stewardship
ARTH	Assela Refferal and Teaching Hospital
AWaRe	Access, watch and reserve
EML	Essential medicine list
ETB	Ethiopian birr
LMIC	Lower and middle and income countries
OTC	Over the counter
WHO	World health organization

CHAPTER 1 INTRODUCTION

1.1. Background

Antibiotics, a “magic bullet”, are essential for treating various local and systemic infections by selectively killing or inhibiting the growth of disease-causing microorganisms(1). They are among the most commonly prescribed medications in hospitals worldwide (2) and have significantly reduced morbidity and mortality associated with infectious diseases(3). Beyond treating infections, antibiotics have played a crucial role in preventing infectious complications related to surgeries, organ transplants, and cancer chemotherapy(4).

Despite their success, the widespread misuse and overuse of antibiotics have led to the emergence of antimicrobial resistance (AMR), making many antibiotics less effective(5). Studies show a 65% increase in antibiotic consumption between 2000 and 2015, driven by excessive prescriptions in low- and middle-income countries(6). Alarmingly, around 50% of antibiotics are prescribed without following proper health guidelines(7), with empirical prescribing based on physician experience further contributing to this overuse(1).

Often dubbed the "Silent Pandemic", AMR necessitates immediate and efficacious intervention rather than being relegated to a future scenario (7). In the absence of preventive measures, projections indicate that by 2050, AMR could potentially supersede all other causes of mortality worldwide(1) Globally, estimates indicate that the direct fatalities linked to AMR surpassed 1.2 million in 2019, with a foreseen escalation to approximately 10 million deaths annually by 2050 if inadequate measures are implemented to curb AMR(1)

Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050, have found that, for the 84 bacterial pathogen–drug combinations evaluated in the study, there were 1·06 million (95% UI 0·841–1·27) deaths attributable to AMR and 4·78 million (4·00–5·55) deaths associated with AMR in 1990 (table 2). In 2019, AMR mortality increased to 1·20 million (1·05–1·35) attributable deaths and 4·94 million (4·43–5·45) associated deaths. In 2021, 1·14 (1·00–1·28) million deaths attributable to AMR and 4·71 million (4·23–5·19) deaths associated with AMR occurred(2)

Several factors contribute to rising antibiotic misuse, especially in Africa and other low- and middle-income countries. These include a high burden of infectious diseases, poor antibiotic stewardship due to inadequate healthcare training, lack of diagnostic equipment, over-the-counter antibiotic sales, and weak regulatory environments(6). Recognizing the link between antibiotic use and resistance, global strategies, including the UK's AMR plan, aim to reduce overall antibiotic consumption and promote rational use(8).

1.2. Statement of the problem

Many of the antibiotics in use today are unnecessarily prescribed for viral infections, such as the common cold. Thus, using antibiotics to treat these viral infections is considered misuse or overuse of antibiotics(3) A government agency has calculated that there are around 250,000 Clostridium difficile infections in hospitalized patients every year due to incorrect prescribing of antibiotics(3)

Approximately 30–50% of the global antibiotics consumed are prescribed inappropriately(1, 2, 5, 9). The antibiotics prescribed for respiratory tract infections unnecessarily constitute 40–80% in low- and middle income countries (LMICs)(4).

Inappropriate prescription of antibiotics is the main driver of antimicrobial resistance (AMR)(10), Antimicrobial resistance threatens infection control leading to longer hospital stays, need for more expensive medicines, death, financial challenges to those impacted and undermines the achievements in various areas of modern medicine(11). Bacterial AMR was responsible for 1.27 million death in2019 and this was predicted to rise to 10 million per year by 2050(12).

The emergence of antimicrobial resistance causes ever increasing need for new drugs, contributing to the rising cost of medical care, inappropriate and over use of medicines, wastage of resources, and result in significant patient harm in terms of poor patient outcomes and adverse drug reactions(13).

Irrational antimicrobial use remains to be a major challenge in developing countries. For instance, in Ethiopia, previous literatures indicated inappropriate use of antimicrobials in some hospitals(14).

Although antibiotics have a significant role in treating infection, its irrational use is also becoming problematic. The pattern, rate of admiration and the associated factors are a key indicator of our antibiotic utilization which can be weighed for its appropriateness by using WHO Prescription indicator tools. So, this research aims to investigate the pattern of our antibiotic prescription and the driving factor for the observed pattern.

1.3 Significance of the study

Even though antibiotics are the major class of drugs primarily utilized in most setups, knowing the exact rate of administration and pattern of prescription is of paramount importance in assessing local antibiotic prescription habits and helps to forecast the likely risk of antimicrobial resistance from the observed pattern. Identifying the factors with the observed prescription pattern also helps to plan intervention associated with these driving factors. Thus, the major significance of this research is studying the antibiotics prescription pattern and contributors for the observed pattern. To also investigate the rate of antibiotics use and therefore contribute for the development of local stewardship guidelines.

CHAPTER 2 LITERATURE REVIEW

2.1 Antibiotic prescription patterns

To promote the optimal use of antibiotics and assist antibiotic stewardship efforts, WHO introduced the AWaRe classification in 2017. The 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 in order 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(5). Global antibiotic prescription practices in hospitals and associated factors: a systematic review and meta-analysis which included 403 studies covering 93 economies, the pooled prevalence of antibiotic prescribing among total prescriptions was 34.3% (95% CI = 29.6–39.3) in outpatient settings and 47.7% (95% CI = 45.8–49.5) in inpatient settings. The pooled percentages of antibiotics in the 'access' group were 48.5% (95% CI = 34.5–62.7) in outpatient settings and 43.8% (95% CI = 39.2–48.5) in inpatient settings. Subgroup analysis showed the prevalence of antibiotic prescribing was significantly higher in low-income compared to high-income economies. Additionally, there was a rising trend of the prevalence in inpatient settings over time(6). In the world, it is estimated that over half of all medicines are prescribed, dispensed or sold inappropriately, and that half of all patients fail to take their medicine correctly(7).

A systematic review and meta-analysis done that have evaluated antibiotics prescription practices in primary health care in low- and middle-income country Only 16 of the 48 studies identified through our systematic review reported detailed information on individual antibiotic drugs, and all but 3 had at least 60% of antibiotics being from the Access group(15). Three studies with a high proportion of Watch-group antibiotics were from Mexico, China, and Pakistan; however, we cannot generalize these estimates to overall antibiotic consumption in these countries based on only 1 study. In each assessment of Prescribing Practices and Factors Related to Antibiotic Prescribing in Community Pharmacies a cross-sectional study reveals considerable variations from the WHO recommendations for the different prescribing indicators in the community pharmacies of RAK, UAE. In addition, the study reports overprescribing of

antibiotics in the community setting, indicating the need for interventions to promote rational use of antibiotics in a community setting(8)country.(5)

A cross sectional study evaluating the prescribing practice using WHO indicators found that total of 600 patients were analyzed. Corresponding to 600 patients, of which 60.3% were female and 38.8% male with a median age of 25 (IQR: 42). A total of 1055 medicines were prescribed. The average number of medicines per prescription was 1.76 (Standard Deviation (SD): 0.85). Most of the medicines were prescribed by generic name (83.14%). Almost all the prescribed medicines (98.39%) were on the Eritrean essential medicines list Antibiotics were prescribed in 331 encounters (53%). Forty seven prescriptions had injections amounting to 7.8% of encounters. Of the total number of medicines prescribed, 349 (33.1%) were antibiotics. The most commonly prescribed antibiotics were: amoxicillin (42.1%), ciprofloxacin (20.1%), co-trimoxazole (9.5%) and amoxicillin clavulanate (4.9%). Medicines most commonly coprescribed with an antibiotic were: paracetamol (n= 106/326), Oral Rehydration Salt (ORS) (n=31/326), omeprazole (n=22/326) and ibuprofen (n=21/326). The WHO has developed a classification system called AWaRe which stands for Access, Watch and Reserve (16). According to this classification antibiotics have been classified into three groups based on whether they need to be generally accessed (Access Group) or carefully watched (Watch) group or only reserved for special situations (Reserve Group)(9).

Antibiotic prescription pattern among Primary Healthcare General Practitioners in the South Batinah Governorate of Oman, 2019 a cross-sectional study have found that Respiratory infections accounted for 62% of antibiotic prescriptions, of which 92.2% were inappropriately prescribed. Extended-spectrum antibiotics were inappropriately prescribed in 33.3% of cystitis cases, while 14.3% of gastroenteritis received incorrect spectrum of antibiotics. Amoxicillin represented 46.2% of antibiotic prescriptions, of which 84.4% were unnecessarily prescribed. Lower inappropriate antibiotic prescribing rate was linked to patients ≥ 18 years (OR = 0.46, 95% CI: 0.26, 0.82), those who underwent laboratory tests (OR = 0.22, 95% CI: 0.12, 0.39), and consultations at health centers (OR = 0.44, 95% CI: 0.24, 0.79). Arabic-speaking physicians were more likely to prescribe antibiotics inappropriately(10).

Antibiotics prescription pattern and determinants of utilization in the national health insurance scheme at a Tertiary Hospital in Nigeria, a retrospective study evaluated total of 802

prescriptions were successfully analyzed. All encounters had 3214 drugs with an average of 4 medicines per prescription ranging from 1-11 medicines. The proportion of prescriptions with more than 4 medicines was 36.4%. Of all the medicines prescribed, 275 were antibiotics and 46.9% of these antibiotics were prescribed by generic name, whereas 82.9% were prescribed from NHIS EML A total of 211 encounters contained at least an antibiotic. Majority of patients that were prescribed antibiotics were females (57.3%) The mean age of patients exposed to antibiotics was 33.9 ± 19.3 years with majority within the age group of 12-59 years (72.5%). Most of the antibiotics were prescribed in the second quarter of the year (34.6%)(6)

A systematic review and meta analysis that have evaluated antibiotics prescription practices in primary health care in low and middle income country has found that the proportion of patients seeking care for any reason who were prescribed antibiotics in this context often exceeded 50%(5).

Evaluation of antibiotic prescribing patterns among inpatients using World Health Organization indicators: A cross-sectional study have found that, total of 1444 antibiotics were prescribed for 861 (60.6%) of the hospital's 1420 inpatients during the study period. The average (mean ± SD) number of antibiotics prescribed per patient was 1.7 ± 1.6, with the highest value (five antibiotics) occurring on the medical ward for a mean ± SD period of 6.4 ± 2.7 days, and the longest time (14 days) occurring on the selected wards. Furthermore, 98.5% of antibiotics were prescribed using their generic names, and 100% of antibiotics were prescribed from Ethiopia's EML. summarizes the details of prescribing indicators. Because culture and sensitivity testing of antibiotics was not done at all at the hospital, all antibiotics were prescribed empirically in all cases. Antibiotics were prescribed for therapeutic purposes in the cases (83.3%) patients for the indication of pneumonia, sepsis, and urinary tract infection and for empiric purposes in 100% of the cases. The most widely used route of antibiotic administration was an injection, which was utilized in 78.7% of patients, mostly in pediatric wards (89.9%)(9).

A cross-sectional study evaluating antibiotic prescribing patterns among in patients using World Health Organization indicators the prescribing pattern of antibiotics in two DTCSH wards was analyzed using WHO prescribing indicators. During the study period, 60.6% of patients were prescribed antibiotics. This percentage was higher than the WHO's recommended range of 20–25.4%. This indicates that DTCSH has a high-rate antibiotic prescriptions. This percentage

matched that of prior research, which found 58.1% in southern Ethiopia,6 58.5% in Gondar,2 and 64.7% in southwest Ethiopia.16 On the other hand, our antibiotic prescribing rate was low when compared with the findings of Harar (66.9%),17 India (66%),18 Congo (68%),19 Eritrea (79.05%),13 and Pakistan (82.3%)(9)

A cross sectional study design conducted on Antibiotic Prescription Pattern, Appropriateness, and Associated Factors in Patients Admitted to Pediatric Wards of Tibebe Ghion Specialized Hospital, Bahir Dar, North West Ethiopia showed that antibiotics were prescribed for most of the patients (88.9%) for empiric treatment purposes. The main medical conditions for which antibiotics were prescribed were pneumonia (16.8%) and early-onset neonatal sepsis (14.0%)(9). A high proportion (30.8%) of the pediatric patients was exposed to inappropriate treatment(3).

Retrospective study was conducted from January 16 to 25, 2012, in outpatient department (OPD) pharmacies of Dessie Referral Hospital; About 378 (24.37%) antibiotics were prescribed in this study. This was different from other studies in other regions of the countries like Bahir Dar university Hospital (41.9%), University Gondar hospital (36.9%) and Debretabor (64.1%) (Desta et al., 2002) Jimma University specialized hospital 33.1% (Mohammed et al., 1997). The same was true when compared with studies in other countries USA (60%) (Strolley et al., 1992) and China 31% (Jun et al., 2011). It was extremely lower when compared with a study in surgical ward in Ethiopia which was 70% (Abula et al., 2004). The difference in the antibiotic prescribing pattern among different regions of the country might be due to difference in the prevalence of infectious diseases, differences in the qualifications and prescribing behaviors of prescribers (Riaz et al](11).

Assessment of medication prescription pattern at Bole health center, Ethiopia, a cross sectional study have shown that the average number of drugs prescribed per encounter was 2.03. The percentage of encounters in which antibiotics prescribed was 67.36%. The proportion of drugs prescribed by generic name and from an essential drug list was 98.14% and 99.25%, respectively(12).

Rational Drug Use in a Rural Area of Ethiopia: Based on WHO/ INRUD Prescribing Indicators The first indicator, a cross-sectional study have found that the “average number of drugs per PPs” acceptable range is between 1.6-1.8, according to WHO. In the current study at B1HC, the

calculated value exceeded the limit and was 2 (1.996). Compared to similar studies conducted in India (5.11), Aksum, Ethiopia (2.01), Saudi Arabia (2.4), the current study value was relatively close to the WHO/INRUD standard(15, 17, 18). Polypharmacy practice might be the reason for the observed variations. In contrast, studies conducted in Bahir Dar, North-West of Ethiopia (1.83), were almost close to the WHO standard (Due to a newly applied system reformation in the pharmaceutical and hospital setup of FHRH) than the current study percentage of drugs prescribed by the generic name", is expected to be 100% (WHO/INRUD standard). In the present study, 99.43%(13).

Inappropriate ceftriaxone utilization and predictor factors in Ethiopia: a systematic review and meta-analysis, showed that high national pooled prevalence of inappropriate ceftriaxone utilization, standing at 55.24%, highlighting a significant hazard in the use of this antibiotic(19)(14).

The antibiotic prescribing pattern in our study diverged from the World Health Organization-recommended guidelines. Furthermore, all antibiotics were given without a culture or sensitivity test in every case(9). Antibiotics are one of the drugs most prescribed by physicians but in most cases are prescribed inappropriately. For example, studies (9, 20) stated that 85% of all prescriptions generated by physicians are antibiotics(21).

Pattern of antimicrobial prescription in Africa: a systematic review of point prevalence surveys conducted on July 2022, have pointed that The high prevalence of antimicrobial use in sub-Saharan Africa reinforces the need for continued surveillance and concerted efforts to institutionalize and support antimicrobial stewardship for prescribers in health institutions in the region(5).

2.2. Factors associated with the prescription pattern

A cross sectional study design conducted on Antibiotic Prescription Pattern, Appropriateness, and Associated Factors in Patients Admitted to Pediatric Wards of Tibebe Ghion Specialized Hospital, Bahir Dar, North West Ethiopia showed that Residence in rural areas (P=0.046) and being 1 year old or younger (P<0.05) were found to be independent determinants of inappropriate drug use

A recently published umbrella review on antibiotic use for adults in primary care (though focused on dental care) identified several factors that appear to affect prescribing behaviors in HICs, such as socio-cultural context, financial incentives, personal beliefs, patients' attitudes, and AMR awareness(5) .Qualitative study of antibiotic prescription patterns and associated drivers in Sudan, Guinea- Bissau, Central African Republic and Democratic Republic of Congo, While there were specific findings in each context, the larger trend from these four MSF projects in Africa indicates widespread use of antibiotics based on unclear assumptions, which are often influenced by patient demands(22).

Factors Affecting Antibiotic Prescription among Hospital Physicians in a Low-Antimicrobial-Resistance Country: A Qualitative Study, identified four main themes affecting the physicians' antibiotic prescribing choices: (i) Clinical workflow pressures, (ii) Clinical uncertainty, (iii) Decision support, and (iv) Benevolence(23).

Intrinsic and external determinants of antibiotic prescribing: a multi-level path analysis of primary care prescriptions in Hubei, China, have found that knowledge was a significant predictor of attitudes ($\beta=0.154, p<0.05$), but higher knowledge and attitudes failed to translate into antibiotic prescribing practices (($\beta=-0.076 – 0.039$, $p>0.05$). Instead, external factors played a more important role and physician's antibiotic use was significantly associated with patient pressure ($\beta=0.102, p=0.022$), time pressure ($\beta=-0.164$, $p=0.002$), financial incentives ($\beta=-0.133 – -0.155$, $p=0.027$) and institutional environments (rural area, $\beta=0.408, p=0.002$; and high socioeconomic setting, $\beta=-0.641$ -0.578, $p< 0.001$). The prescribers who were male ($\beta=-0.168$, $p=0.007$) or had lower qualification ($\beta=-0.114$, $p= 0.028$) were also more likely to prescribe antibiotics than others(24).

Risk factors associated with antibiotic prescriptions for cases of enteric pathogens in Canada, 2015–2019, showed that antibiotic use in laboratory-confirmed cases of enteric illness and that antibiotic prescribing decisions may be influenced by factors outside of the realm of clinical significance. Examples of such factors outside the realm of clinical significance could include patient expectations (or perceived expectations) and concerns about the financial burden of the disease such as lack of access to paid sick leave(25).

2.3 Antimicrobial resistance associated with inappropriate prescription

Millions of people die every year as a result of antimicrobial resistance worldwide. An inappropriate prescription of antimicrobials (e.g., overuse, inadequate use, or a choice that diverges from established guidelines) can lead to a heightened risk of antimicrobial resistance(4). World Health Organization (WHO) estimated that 80%of antibiotics is used in the community, of which about20–50%isused inappropriately(17).

Antibiotic resistance is thought to be controlled if antibiotics are used wisely, and practical antibiotic use is associated with rational antibiotic use. Patients are said to be using medicines rationally if they obtain pharmaceuticals that are appropriate for their clinical needs, in doses that fit their specific needs, for an adequate period of time, and at the lowest feasible cost (9).

Antimicrobial resistance in Ethiopia: current landscape, challenges, and strategic interventions, a comprehensive literature review, have identified substantial levels of AMR, particularly in ESBL-producing and multidrug-resistant bacteria. ESBL-producing bacteria, primarily gram-negative, accounted for 18% to 55.5% of the data. Multidrug-resistant bacteria, resistant to three or more antibiotic classes, were present in 62.9% to 87.4% of the bacteria. MRSA, a major concern due to its resistance to beta-lactam antibiotics, was found in 5.3% to 32.5% of the strains. Additionally, Vancomycin-resistant Enterococci (VRE) were identified in 5.5% to 41.7% of the samples(15).

2.4 Economic impact of inappropriate antibiotic prescription

Our analysis suggests that inappropriate use of antibiotics has a considerable economic impact a top-down, retrospective economic impact analysis focusing on inappropriate use of antibiotics for the treatment of URIs in the Republic of Ghana, health care costs were estimated at around 20 M USD annually including 18 M USD for situation 1 and 2 M USD for situation 2. In addition, travel costs and lost income due to travel, together, were estimated to be around 44 M USD for situation 1 and 18 M USD for situation 2 A similar study reported substantial costs due to inappropriate antibiotic prescriptions for URIs of 297 M USD in Japan in 2016(17).

A systematic search was carried out in Medline via PubMed and Web of Sciences and included studies published from January 01, 2000 to December 09, 2016, have found that, the overall health-care costs in all studies for case and control groups were 8,107.375 USD versus 5,469.487 USD respectively(26).

A report from southern Iran, using Hospital records of hospitalized patients with empiric antibiotic prescription, from September 2016 to February 2017 have shown that, Totally antibiotic usage cost was 578,959.39 USD (24,316,294,800 Iranian Rials, IRR) for 6 months, which the excess costs of inappropriate antibiotic prescribing, was 471,319.69 USD (19,795,427,225 IRR). The estimated annual excess cost is 942,639.38 USD (39,590,854,450 IRR)(20).

At current resistance rates, the total GDP effect in Organisation for Economic Cooperation and Development (OECD) countries, accounting for increased healthcare expenditure, would amount to 2.9 trillion USD by 2050(10).

AMR-related morbidity or mortality are particularly severe in low-income and middle-income countries (LMICs), aggravating extreme poverty. If left unaddressed, LMICs will experience an estimated loss of greater than 5% of gross domestic product by 2050 due to loss of income from indirect costs of care, and the global annual gross domestic product willdeclinebyanestimated3·8%,resultinginagloballossof US$ 100trillion.2 AMR will also lead to a substantial increase in health-care expenditures due to the cost of prolonged hospital admission, intensive investigations or treatments, disability ,and death ,a figure that has been estimated to cost $4.6 billion in 2017(27).

2.4 Conceptual framework

Concepts have been adapted from relevant literature(11,14,22,25) to asses antibiotic prescription pattern and associated factors among patients admitted to medical ward ARTH

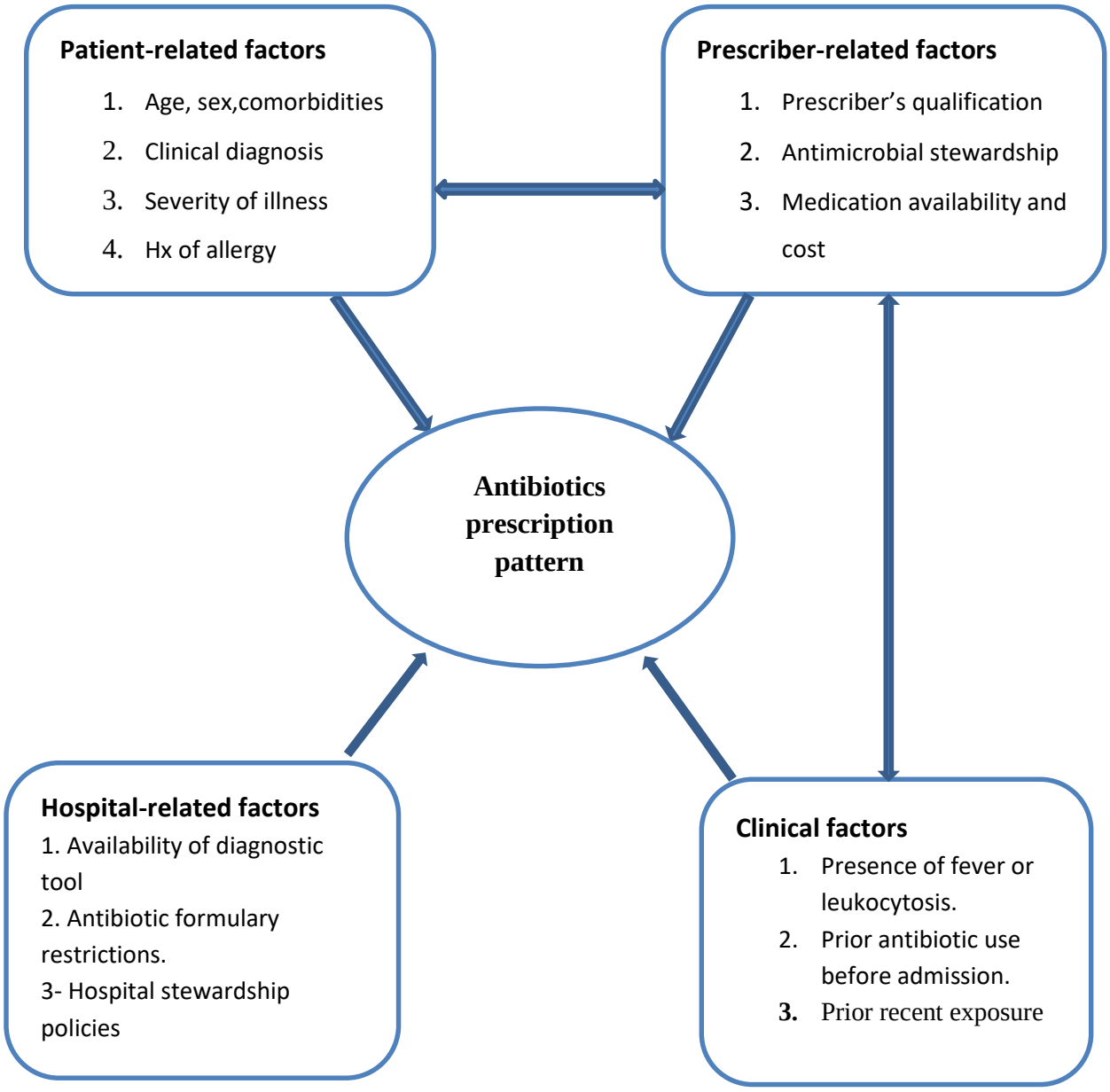


FIGURE 1 Conceptual framework antibiotic prescription pattern and associated factors among patients admitted to medical ward ARTH

CHAPTER 3 OBJECTIVES

3.1 General objectives

- To assess antibiotics prescription pattern and associated factors among patients admitted to Asella Referral and Teaching Hospital medical ward

3.2 specific objectives

- To assess antibiotics prescription patterns among admitted patients at ARTH.
- To assess associated factors with antibiotics prescription.

CHAPTER 4 METHODS

4.1 Study period and area

This study was conducted at Asella Referral and Teaching Hospital (ARTH), located in Asella town, Arsi Zone, Oromia Regional State, Ethiopia, from July 2025 to December 2025. Situated 175 km from Addis Ababa at an elevation of 2,356.7 meters, Asella has a subtropical highland climate with an average annual temperature of 15.47ºC and approximately 197 rainy days per year.

Founded in 1964, ARTH is now part of Arsi University's College of Health Sciences, serving as a tertiary referral center for over 3.5 million people in the Arsi Zone. The hospital has 297 beds and specialized departments, including Emergency, Internal Medicine, Pediatrics, Surgery, Gynecology and Obstetrics, Oncology, Dermatology, Radiology, Ophthalmology, Psychiatry, and an ICU.

The Internal Medicine department includes female (24 beds) and male (26 beds) wards, a 4-bed high-dependency unit (HDU), and a 6-bed ICU. Chronic disease follow-up clinics include diabetes, neurology, and general medical clinics, serving 35–40 patients daily and around 560 monthly. Based on data from clinical audit reports, around 100 patients are admitted to medical ward of ARTH every month. Care is provided by 1 cardiologist, 2 Neurologists, over 20 internists, 35 residents, and medical interns.

4.2 Study Design

A retrospective cross-sectional study was conducted at ARTH on patients admitted to medical ward during the study period

4.3 Population

4.3.1 Source population

All medical records of patients admitted to the medical ward of ARTH during the study period

4.3.2 Study population

All patients admitted at medical ward that fulfilled the inclusion criteria.

4.4 Inclusion and Exclusions Criteria

4.4.1 Inclusion criteria

- Patients admitted to the medical ward during the study period
- Patients who received systemic antibiotics for at least 24 hours

4.4.2 Exclusion criteria

- Patients who received systemic antibiotics for less than 24 hours
- Patients who received only topical antibiotics
- Patients who received only anti tuberculosis drugs

4.5 Sample size

The sample size for the study was determined using single population formula considering the following assumption. Based on a cross-sectional study done in Ethiopia, "Evaluation of antibiotic prescribing patterns among inpatients using World Health Organization indicators", 861 out of 1420 were found to be on at least one antibiotic with prevalence of 60% (9). We used P value 0.6.

Based on single population sample size formula,

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where

n – Sample size

Z - The value under standard normal table for the given value of confidence level

p – Proportion of antibiotic prescription rate

d – Margin of error of 5%

n = (1.96*1.96*0.6(1 – 0.6) / 0.05*0.05

n = 369

Since the study population is < 10,000 we should use the correction formula

$$nf = \frac{n}{1+\frac{n}{N}}$$

Where

nf – Final sample size

n – Sample size

N – Source population size

nf = 369 / 1 + (369 / 600)

nf = **228**

4.6 Sampling procedure

Data was collected from those sampled population and analyzed based on questionaries' The first chart was chosen based on simple sampling to get the very first chat.

4.7. Variables

4.7.1 Dependent variables

- Inappropriate antibiotic prescription

4.7.2 Independent variables

Provider related factors –

- Specialty level
- Antimicrobial stewardship
- Perceived pressure from patients
- Comfort level with diagnostic uncertainty
- Unavailability the desired drugs
- Diagnostic tests unavailability,

Patient related factor –

- Age
- Sex
- Socioeconomic status
- Education level
- Presence of comorbid condition
- Severity of infection
- Patient presentation
- Likelihood of bacterial infection
- History of antibiotic allergy

Clinical factors –

- Presence of fever or leukocytosis
- Prior antibiotic use before admission

System level –

- Institution policy and guideline
- Availability of microbiology lab service
- Access to rapid diagnostic tests
- Drug availability and cost

4.8 Operational Definition

Appropriate antibiotic use - Antibiotic prescription aligns with the Ethiopian FMOH/WHO guidelines for the diagnosed condition(30). They be should be prescribed for the right indication, at the right dose and for the right duration. And must meet the WHO AWaRe prescription guide.

Average number of drugs per Patient - the average number of drug per patient which should be between 1.6- 1.8(28)

Broad-spectrum antibiotics - Agents targeting a wide range of pathogens (e.g., ceftriaxone, meropenem)(33).

Comorbidity - Presence of ≥1 chronic disease (e.g., diabetes) alongside the primary diagnosis(35).

Definitive therapy - Antibiotics adjusted based on culture/sensitivity test results(32).

Empirical therapy - Antibiotics prescribed without microbiological confirmation of infection(31).

Inappropriate antibiotic use – any deviation in selection (AWaRe) or in any of the four prescription parameters without a valid documented justification renders the prescription inappropriate (30).

Percentage of drug prescribed by generic name - Should be between 90% and 99%(29)

Polypharmacy - Use of ≥2 antibiotics simultaneously(34).

4.9 Data collection tools and procedures

Pre-tested and structured questionnaire was utilized to collect data on socio-demographic, patient related, clinical related and prescriber related factors. The questionnaires are prepared in English language, translated to Afaan Oromo and Amharic. And finally was translated back to English language by other person who has good command of English, Afaan Oromo and Amharic to check for its consistency. An interviewer-administered questioner and chart review was used to collect the data using Kobo toolbox. Retrospective data was collected from july 1 to December 30, 2025. Four data collectors (four nurses) and one supervisor (general practitioner) participate in data collection process. Two days of training was given for data collectors and supervisor.

4.10 Data quality control

To assure the quality of the data, two days of training were given to data collectors and supervisor on the aim of the study, content of the questionnaire, how to conduct the interview and how to take laboratory results from patient chart. Data was collected using Kobo toolbox. Pre-test was done on the 5% of patients before the actual data collection and sequence of some questions was changed based on pre-test result.. The data collection was supervised by the principal investigator and checking of questionnaires at the end of each day of data collection, for consistency, completeness, clarity and accuracy was done. Defective questionnaires were rejected

4.11 Data processing and analysis

The collected data was obtained from Kobo toolbox, then edited, cleaned and compiled accordingly. All data was entered and coded using SPSS version 27 statistical software for analysis. Frequency and proportions were computed for description of the study population. Both

bivariate and multivariate analyses were used to see the association between dependent and independent variables. Variables with a p-value of < 0.25 at binary logistic regression were taken into a multivariable logistic regression to control confounding. And variables with a p-value of < 0.05 were considered as statistically significant predictors. Model fit was tested with Hosmer-Lemeshow Goodness of Fit test.

4.12 Ethical consideration

Ethical issues will be considered in all stages of the research process. Ethical Clearance was obtained from the institutional review board of Arsi University, Official letter from Arsi University to ARTH was sent. Detailed explanation about purpose and benefit of the study was given to the study population and their full cooperation and verbal consent were asked. Confidentiality and anonymity of the client's information was ensured throughout the execution of the study by taking only the required information without using the name of the client.

4.13 Dissemination plan

After research completion and finalizing report, this study will be presented to the department of internal medicine and public health, as part of internal medicine specialty thesis at Arsi University and submitted to graduate programs coordinating office and college of health sciences of Arsi University, Asella Teaching Hospital and other concerned institutions and stake holders for possible application and publication of the study. Publication in peer reviewed, national or international journals will also be considered

CHAPTER 5 RESULTS

5.1. Socio-demographic characteristics antibiotics prescription pattern

In our study, a total of 228 medical ward patient medical records with antibiotic drugs prescribed were evaluated. Majority of the participants were males (50.90%). Regarding the age category, 54.8% of the participants were in the age range of 31-64years. Rural residents (88.6%) outnumber urban residents (11.4%) significantly. Most participants are married (79.8%), with smaller groups being single (14.9%), widowed (4.4%), and divorced (0.9%) The educational attainment shows that 56.1% of participants cannot read and write while 19.7% have completed primary school and 19.7% have completed secondary school, while only 4.4% have attended college. A substantial majority of the participants have insurance coverage (86.4%), while 13.6% do not. (**Table 1**).

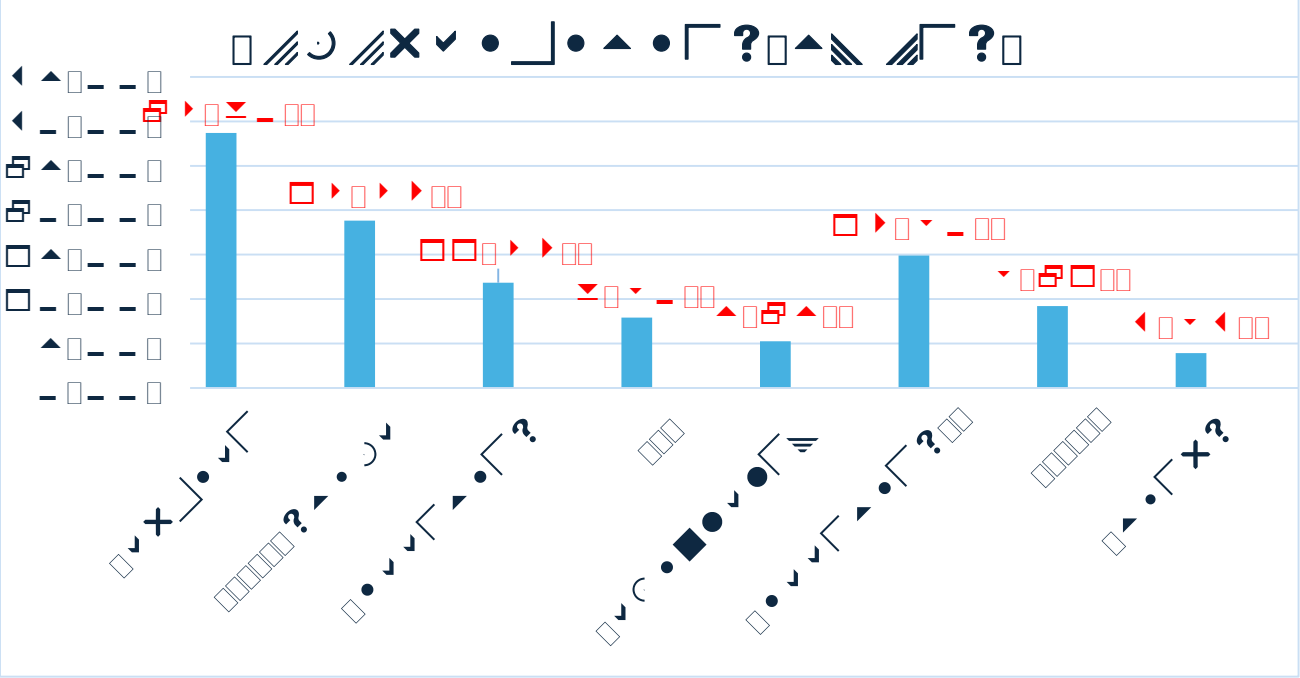
TABLE1 Socio-demographic characteristics antibiotics prescription pattern among patients admitted to Asella referral and teaching hospital medical ward

Variable	**Categorical**	**Frequence**	**Percentage**
Sex	Male	116	50.9
	Female	112	49.1
Age	Mean± Std. Deviation	47.12±18.603	
	15-30	61	26.8
	31-64	125	54.8
	=>65	42	18.4
Residence	Rural	202	88.6
	Urban	26	11.4
Marital status	Married	182	79.8
	Single	34	14.9
	Widowed	10	4.4
	Divorced	2	0.9
Educational status	Can not read and write	128	56.1

	Primary school	45	19.7
	Secondary school	45	19.7
	College	10	4.4
Insurance coverage	Yes	197	86.4
	No	31	13.6

The highest percentage of individuals in the sample, 28.70%, report having cardiac conditions. A significant portion of the population, 18.84%, suffers from Chronic Obstructive Pulmonary Disease (COPD) or asthma. In contrast, cancer or malignancy is less prevalent among the comorbidities, affecting only 5.25% of individuals. (**Figure 2.**)

FIGURE 2 Comorbidity types among patients admitted to Asella referral and teaching Hospital Medical Ward



5.2 Disease types for diagnosis among patients

Community-acquired pneumonia is the most prevalent diagnosis among the sample, affecting 20.61% of individuals. Close behind is hospital-acquired pneumonia, impacting 13.59% of the population. Sepsis is observed in 8.33% of individuals, while pyrogenic meningitis is reported in

10.08% of the sample. Additionally, acute exacerbations of Chronic Obstructive Pulmonary Disease (COP) are noted at 4.38%. Other noteworthy conditions include diabetic foot ulcers, which affect 2.19%, and urinary tract infections, found in 3.51% of individuals. (**Table 2.**)

TABLE 2: Disease Types for Diagnosis Among Patients Admitted to Asella Referral and Teaching Hospital Medical Ward

Variable	**Categorical**	**Frequence**	**Percentage**
Disease Diagnosis	Community-acquired pneumonia	74	20.61
	Sepsis	22	10.08
	Hospital-acquired pneumonia	31	13.59
	Pyrogenic meningitis	23	10.08
	Brain abscess	4	1.75
	Parapneumonic effusion	3	1.32
	Aspiration pneumonia	13	5.70
	Acute Exacerbation of COP	10	4.38
	Acute Exacerbation of B. Asthma	7	3.07
	Bronchiectasis	7	3.07
	Diabetics foot ulcer	5	2.19
	GI infection	4	1.75
	Ineffective endocarditis	6	2.63
	skin infection	5	2.19
	Nephritic syndrome	2	0.87
	Urinary tract infection	8	3.51
	Others	7	3.07

5.3. Clinical Characteristics and Treatment Outcomes

The data presents a detailed overview of antibiotic prescriptions, culture results, and severity of illness among patients.

The most prescribed antibiotic was Ceftriaxone, accounting for 22.81% of prescriptions. Cefepime and vancomycin were also frequently used, representing 20.17% of cases. Other notable combinations include Ceftriaxone and azithromycin (9.65%) and Ceftriaxone and doxycycline (8.77%). A variety of other antibiotic combinations were used, with prescriptions for Ceftriaxone and metronidazole at 6.14% and those for vancomycin and ceftazidime making up 2.63%. Notably, 91.7% of antibiotics were prescribed for empirical purposes. Culture samples were sent for microbial testing in 19.3% of cases, with growth identified in only 3.5% of cultures. Regarding adherence to guidelines, only 20.2% of prescriptions were based on established protocols, while 79.8% did not adhere to these guidelines. The majority of prescriptions involve two antibiotics, accounting for 63.6% (145 users), followed by one antibiotic, which is prescribed in 27.6% (63 users) of cases. The average (mean ± SD) number of antibiotics prescribed per patient was 1.82 ± 0.57, with the highest value (three antibiotics) occurring on the medical ward for a mean ± SD period of 8.5±3.13 days, and the longest time (21 days) occurring on the selected wards. In terms of prescription qualifications, the majority of antibiotic prescriptions were made by residents (90.35%), followed by interns (8.33%), with a minimal contribution from senior physicians (1.32%).

Regarding illness severity, 64.5% of patients were classified as having moderate illness, while 33.8% were categorized as severe. A smaller group, representing 1.8%, was classified as having mild illness. (**Table 3.**)

TABLE 3: Clinical characteristics and treatment outcome among patients admitted to Asella Referral and Teaching Hospital Medical Ward

Variable	**Categorical**	**Frequence**	**Percentage**
Antibiotics prescribed	Ceftriaxone	52	22.81
	Cefepime and vancomycin,	46	20.17
	Ceftriaxone and Azithromycin	22	9.65
	Ceftriaxone and doxycycline	20	8.77
	Ceftriaxone and metronidazole	14	6.14
	Ceftriaxone and vancomycin	12	5.26

	Vancomycin and ceftazidime	6	2.63
	Vancomycin + meropenem	5	2.19
	Vancomycin and metronidazole	5	2.19
	Ceftriaxone and vancomycin	12	5.26
	Ampicillin, ceftriaxone and vancomycin	3	1.32
	Cefepime, vancomycin and metronidazole	3	1.32
	Ceftriaxone, metronidazole and vancomycin	3	1.32
	Ampicillin, cefepime, and vancomycin	4	1.75
	Cefepime, vancomycin and cipro-floxacillin	4	1.75
	Cefepime, vancomycin and metronidazole	3	1.32
	Ceftriaxone and cipro-floxacillin	3	1.32
	Ceftriaxone and Augmentin	2	0.87
	Ceftriaxone, cipro-floxacillin and metronidazole	2	0.87
	Meropenem	2	0.87
	Cephalexin and B.pencillin	2	0.87
	Amoxacillin and clarithromycin	1	0.42
	Augmentin	1	0.42
	Azithromycin	1	0.42
Culture sent	Yes	44	19.3
	No	184	80.7

Culture results	growth	8	3.5
	Not growth	220	96.5
Based on guideline prescription	Yes	46	20.2
	No	182	79.8
Severity of illness	Mild	4	1.8
	Moderate	147	64.5
	Severe	77	33.8
treatment type of antibiotics	Empiric	209	91.7
	Definitive therapy	19	8.30
Number of antibiotics prescribed	One	63	27.6
	Two	145	63.6
	Three	20	8.8
Number of antibiotics pre one prescription	Mean± Std. Deviation	1.82±0.57	
Duration of treatment	Mean± Std. Deviation	8.53±3.13	

Among antimicrobial prescriptions, the most commonly prescribed antibiotics fall under the Access/Watch category, which has the highest frequency at 68 users (29.8%), followed by the Watch category with strong engagement at 63 users (27.6%).(**Table 4.**)

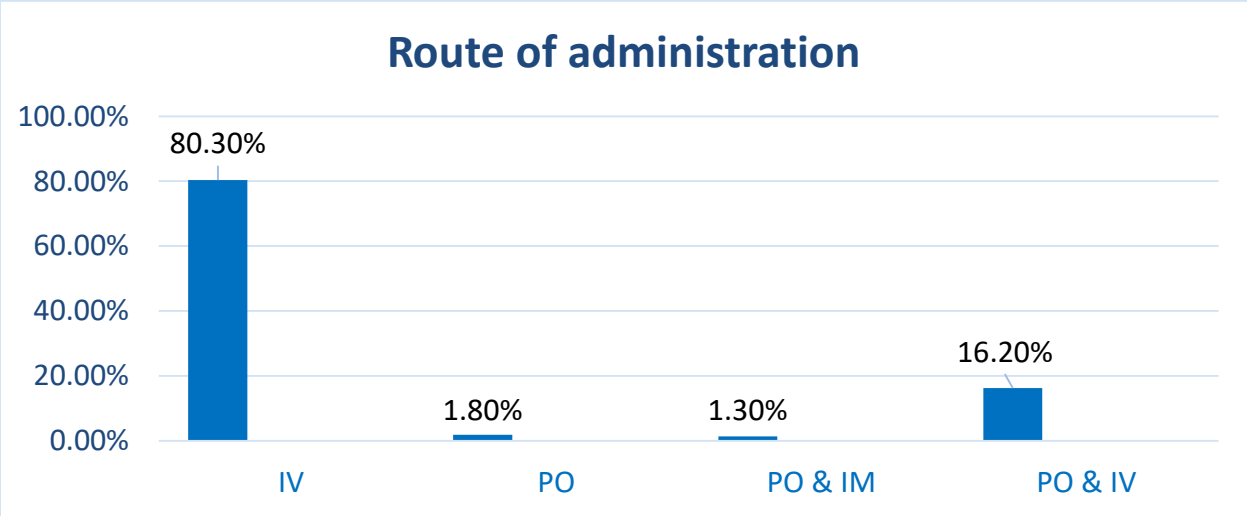
TABLE 4: Antimicrobial Categorization Among Patients Admitted to Asella Referral and Teaching Hospital Medical Ward

Variable	Categorical	Frequence	Percentage
AWaRe	Access	5	2.2
	Watch	66	28.9
	Reserve	63	27.6

	Access/Watch	68	29.8
	Watch/Reserve	26	11.4

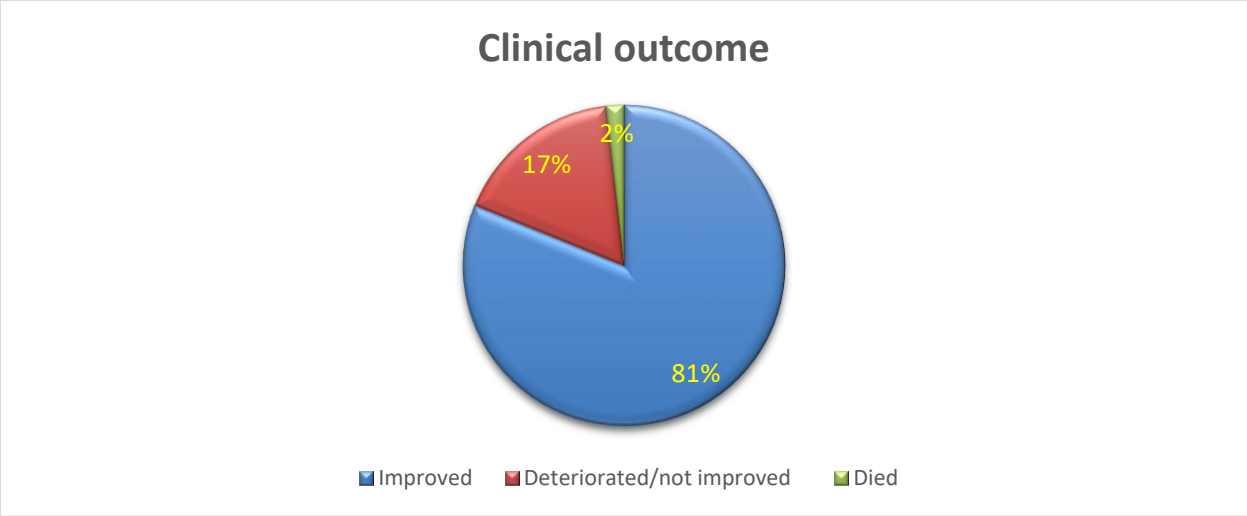
In this study, we examined various routes of medication administration within the studied population, revealing distinct patterns in treatment delivery. A significant 80.30% of medications were administered via intravenous (IV) routes. In contrast, the oral (PO) route was infrequently used, accounting for only 1.80% of total administrations. The combined use of oral and intramuscular (PO & IM) administration was even less common, making up a mere 1.30%. Conversely, the combination of oral and intravenous (PO & IV) routes was utilized in 16.20% of cases. (**Figure 4.**)

FIGURE 3 Antibiotics route of administration among patients admitted to Asella Referral and Teaching Hospital Medical Ward



The clinical outcomes among patients in the studied population reveal a notable effectiveness of the treatments administered. A significant 81% of patients experienced improvement in their conditions following medical intervention. In contrast, 17% of patients either deteriorated or did not show improvement. Additionally, the data indicates that 2% of patients unfortunately succumbed to their illness. (**Figure 5**)

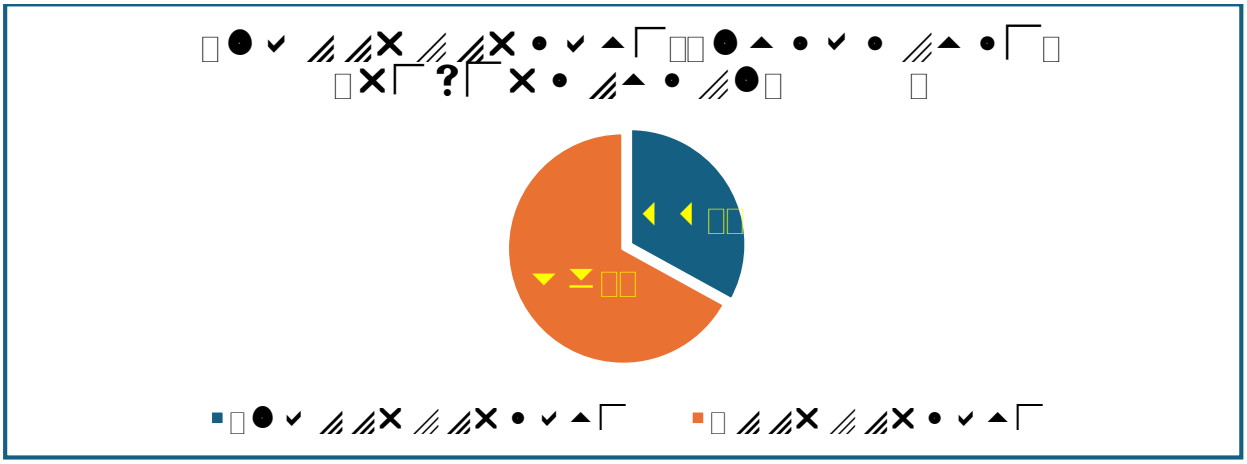
FIGURE 4 Clinical outcome among patients admitted to Asella Referral and Teaching Hospital Medical Ward



5.4 Prevalence of inappropriate antibiotic prescription

Out of a total of 228 patients, 67% received antibiotic prescriptions classified as appropriate. However, approximately 33% of these prescriptions are considered inappropriate. (**Figure 3.**)

FIGURE 5 Appropriateness uses antibiotics among patients admitted to Asella Referral and Teaching Hospital Medical Ward



5.5 Factors associated with inappropriate use of antibiotics

In multivariable logistic regression analysis, receiving two or more antibiotics was independently associated with higher odds of inappropriate prescription (AOR = 2.42; 95% CI: 1.15–5.10). Patients who do not have culture result shows significant rate of inappropriate prescribing (AOR

= 8.79; 95% CI: 1.98–39.05), indicating significantly improved prescribing appropriateness when microbiological evidence guided therapy. Antibiotic de-escalation was also independently associated with inappropriate prescription. Patients whose antibiotics was not deescalated was associated with inappropriate antibiotics use (AOR = 2.40; 95% CI: 1.01–5.70). Other factors including site of admission, insurance status, length of hospital stay, and respiratory infection were not statistically significant after adjustment

TABLE 5 FACTORS ASSOCIATED WITH INAPPROPRIATE USE OF ANTIBIOTICS

Variable	**Category**	**Inappropriate Antibiotics use (%)**	**Appropriate Antibiotics use (%)**	**COR (95% CI)**	**p-value**	**AOR (95% CI)**	**p-value**
Number of antibiotics	One antibiotic	12 (21.1)	45 (78.9)	1.00	—	1.00	—
	≥2 antibiotics	64 (37.6)	106 (62.4)	2.26 (1.12–4.60)	0.024	2.42 (1.15–5.10)	**0.020**
Site of admission	General ward	52 (30.8)	117 (69.2)	1.00	—	1.00	—
	HDU/ICU	24 (41.4)	34 (58.6)	1.59 (0.86–2.94)	0.141	1.67 (0.80–3.46)	0.172
Insurance status	No	6 (20.7)	23 (79.3)	1.00	—	1.00	—
	Yes	70 (35.4)	128 (64.6)	2.10 (0.82–5.39)	0.125	1.70 (0.61–4.75)	0.308
Culture result available	No	74 (38.1)	120 (61.9)	9.56 (2.22–41.12)	0.002	8.79 (1.98–39.05)	**0.004**
	Yes	2 (6.1)	31 (93.9)	1.00	---	1.00	---
Antibiotic de-escalation	No	67 (37.2)	113 (62.8)	2.50 (1.14–5.50)	0.022	2.40 (1.01–5.70)	**0.046**
	Yes	9 (19.1)	38 (80.9)	1.00	—	1.00	—
Length of hospital stay	≤7 days	55 (31.3)	121 (68.7)	1.00	—	1.00	—
	>7 days	21 (41.2)	30 (58.8)	1.54 (0.81–2.93)	0.188	1.41 (0.66–3.01)	0.370

Respiratory infection	No	19 (27.5)	50 (72.5)	1.00	—	1.00	—
	Yes	57 (36.1)	101 (63.5)	1.49 (0.80–2.76)	0.211	1.59 (0.81–3.12)	0.176

Bold values indicate statistical significance at p < 0.05, AOR – Adjusted Odds Ratio, CI – Confidence Interval, COR – Crude Odds Ratio

CHAPTER 6 DISCUSSION

Approximately 30–50% of the global antibiotics consumed are prescribed inappropriately(36). The aims of the study are to assess antibiotics prescription patterns and associated factors among patients admitted to ARTH medical ward.

In our study, a total of 228 medical records of patients in the medical ward with prescribed antibiotic drugs were evaluated. Most of the participants were male (50.90%). Regarding age categories, 54.8% of the participants were in the age range of 31-64 years. Rural residents accounted for 88.6% of participants. Most participants were married (79.8%). In terms of educational attainment, 56.1% of participants could not read or write, while 19.7% completed primary school. A substantial majority of the participants had insurance coverage (86.4%). Similarly, study conducted in United Arab Emirates, a total of 630 patients, of which 54.3% (*n* = 342) were female and 45.7% (*n* = 288) were male with a median age of 29 years (IQR: 14–42; 95% CI: 27–32). Another study conducted in Jinja city, Uganda. Majority of patients that were prescribed antibiotics were females (57.3%) The mean age of patients exposed to antibiotics was 33.9 ± 19.3 years with majority within the age group of 12-59 years (72.5%) (5)

Community-acquired pneumonia is the most prevalent diagnosis among the sample, affecting 20.61% of individuals. Close behind is hospital-acquired pneumonia, impacting 13.59% of the population. Sepsis is observed in 8.33% of individuals, while pyrogenic meningitis is reported in 10.08% of the sample. Additionally, acute exacerbations of Chronic Obstructive Pulmonary Disease (COP) are noted at 4.38%. Other noteworthy conditions include diabetic foot ulcers, which affect 2.19%, and urinary tract infections, found in 3.51% of individuals. Similar study conducted in north Ethiopia, The major reasons (conditions) for antibiotic use were SCAP (195), tonsillitis (114), and cellulitis (99) Others were AGN, meningitis, typhoid fever, GI Sepsis, AFI, conjunctivitis, H.pylori, and mixed infections(37). Different study done in Northwest Ethiopia, the most common health problems reported in this study were respiratory tract symptoms (30.2%), injury/wound (14.7%), and diarrhea (11.3%). Parallel with this, respiratory tract symptoms (74.6%), diarrhea (74.4%), and physical injury/wound (64.3%) were the three main reasons that the communities had used antibiotics inappropriately.(17). Another study done in Northwest Ethiopia. Pneumonia was the most common reason for hospitalization, accounting for

47 (16.8%) of the cases, followed by early-onset sepsis (n=39, 14%) and meningitis (n=21, 7.5%). These results are in line with a study conducted in Shenan Gibe Hospital, where the major medical conditions for prescribed antibiotics were pneumonia (n=125, 38.5%), sepsis (n=49, 15.2%), and acute gastroenteritis (n=41, 12.7%)(9, 38)

The most prescribed antibiotic was Ceftriaxone, accounting for 22.81% of prescriptions. Cefepime and vancomycin were also frequently used, representing 20.17% of cases. Other notable combinations include Ceftriaxone and azithromycin (9.65%) and Ceftriaxone and doxycycline (8.77%). A variety of other antibiotic combinations were used, with prescriptions for Ceftriaxone and metronidazole at 6.14% and those for vancomycin and ceftazidime making up 2.63%. similarly study done in Northwest Ethiopia, Ceftriaxone was the most widely used (84.9%) antibiotic among the mono therapeutic antibiotics, while ceftriaxone plus metronidazole (23.5%) was the most frequently used combination of antibiotics and another different study conducts in Eritrean, Of the total number of medicines prescribed, 349 (33.1%) were antibiotics. The most commonly prescribed antibiotics were: amoxicillin (42.1%), ciprofloxacin (20.1%), co-trimoxazole (9.5%) and amoxicillin clavulanate (4.9%)(6, 9)

A total prescription, 91.7% of antibiotics were prescribed for empirical purposes. Similarly, study conducted northwest and east Ethiopia, most of the pediatric patients (88.9%) were prescribed with drugs for empiric treatment purposes. This is similar to the results from studies conducted in two hospitals in Ethiopia, where 83.58% and 75.9% of the antibiotics were prescribed for empiric treatment in Nekemte Referral Hospital and Shenan Gibe Hospital, respectively(9, 38). Regarding adherence to guidelines, only 20.2% of prescriptions were based on established protocols, while 79.8% did not adhere to these guidelines. The majority of prescriptions involve two antibiotics, accounting for 63.6% (145 users), followed by one antibiotic, which is prescribed in 27.6% (63 users) of cases. The average (mean ± SD) number of antibiotics prescribed per patient was 1.82 ± 0.57, with the highest value (three antibiotics) occurring on the medical ward for a mean ± SD period of 8.5±3.13 days, and the longest time (21 days) occurring on the selected wards and 100% of antibiotics were prescribed using their generic names, and 100% of antibiotics were prescribed from Ethiopia's EML. In similar studies conducted in Hawassa, South Ethiopia, Aksum, Ethiopia, Saudi Arabia and India, the percentages (98.7%, 97.6%, 61.2%, and 89.88%, respectively) were relatively low than the

current study(42). All most study done to Evaluation of antibiotic prescribing patterns among inpatients using World Health Organization indicators: A cross-sectional study have found that, total of 1444 antibiotics were prescribed for 861 (60.6%) of the hospital's 1420 inpatients during the study period. The average (mean ± SD) number of antibiotics prescribed per patient was 1.7 ± 1.6, with the highest value (five antibiotics) occurring on the medical ward for a mean ± SD period of 6.4 ± 2.7 days, and the longest time (14 days) occurring on the selected wards. Furthermore, 98.5% of antibiotics were prescribed using their generic names, and 100% of antibiotics were prescribed from Ethiopia's EML(6). Another study done Rational Drug Use in a Rural Area of Ethiopia: Based on WHO/ INRUD Prescribing Indicators The first indicator, a cross-sectional study have found that the "average number of drugs per PPs" acceptable range is between 1.6-1.8, according to WHO. In the current study at B1HC, the calculated value exceeded the limit and was 2 (1.996)(43).

Among antimicrobial prescriptions, the most prescribed antibiotics fall under the Access/Watch category, which has the highest frequency at 68 users (29.8%), followed by the Watch category with strong engagement at 63 users (27.6%).

In this study, we examined various routes of medication administration within the studied population, revealing distinct patterns in treatment delivery. A significant 80.30% of medications were administered via intravenous (IV) routes. In contrast, the oral (PO) route was infrequently used, accounting for only 1.80% of total administrations. The combined use of oral and intramuscular (PO & IM) administration was even less common, making up a mere 1.30%. Conversely, the combination of oral and intravenous (PO & IV) routes was utilized in 16.20% of cases. Percentage of PPs with injections prescribed" should be in this target range (13.4%-24.1%), according to WHO/INRUD standard. In contrast, studies conducted in Addis Ababa, Ethiopia (8.4%), Hawassa, South Ethiopia (38.1%), and Bahir Dar, North-West of Ethiopia (10.8%)(41, 42). Possible reasons for the high use of injections could be the beliefs and attitudes of patients and health professionals about the efficacy of injection versus oral medication.

In our study, out of a total of 228 patients, 67% received antibiotic prescriptions classified as appropriate. However, approximately 33% of these prescriptions are considered inappropriate. Similarly study conducted in The overall inappropriate use of antibiotics in this study was 30.9%

of which 18% was used for self-medication and 12.9% was used for treatment of family member and in northwest Ethiopia (27.5%).(17, 41).

This study also assessed factors associated with inappropriate antibiotic use among hospitalized patients and identified several important determinants. Inappropriate antibiotic use in this study was strongly associated with multiple antibiotic prescriptions, lack of culture results, and failure to de-escalate therapy.

Number of antibiotics prescribed was significantly associated with inappropriate use. Patients receiving two or more antibiotics were more than twice as likely to experience inappropriate antibiotic use compared to those receiving a single antibiotic, even after adjusting for potential confounders (AOR = 2.42, 95% CI: 1.15–5.10). This finding is consistent with previous studies, which have shown that polypharmacy increases the risk of unnecessary duplication, incorrect combinations, and deviation from treatment guidelines(13). The tendency to prescribe multiple antibiotics may reflect diagnostic uncertainty, severity of illness, or empirical treatment practices, emphasizing the need for regular prescription review and antimicrobial stewardship interventions.

The availability of culture results emerged as the strongest predictor of appropriate antibiotic use. Patients without available culture results had nearly nine times higher odds of receiving inappropriate antibiotics compared to those with culture-confirmed diagnoses (AOR = 8.79, 95% CI: 1.98–39.05). This underscores the critical role of microbiological testing in guiding targeted therapy. The absence of culture results likely leads clinicians to rely on broad-spectrum empirical therapy, which increases the risk of inappropriate selection, dosing, or duration of antibiotics. Strengthening laboratory capacity and ensuring timely availability of culture and sensitivity results could substantially improve prescribing practices.

Antibiotic de-escalation was also significantly associated with appropriate antibiotic use. Patients whose treatment was not de-escalated were more than twice as likely to receive inappropriate antibiotics compared to those who underwent de-escalation (AOR = 2.40, 95% CI: 1.01–5.70). This finding highlights the importance of reassessing empirical therapy once clinical response or laboratory data become available. Failure to de-escalate may result in prolonged use

of broad-spectrum agents, increasing the risk of antimicrobial resistance, adverse drug reactions, and unnecessary healthcare costs.

Although higher proportions of inappropriate antibiotic use were observed among patients admitted to HDU/ICU, those with insurance coverage, longer hospital stays, and respiratory infections, these factors did not show statistically significant associations after adjustment. The lack of significance may be due to sample size limitations or overlapping effects with more influential factors such as disease severity and diagnostic availability. Nonetheless, the higher prevalence observed in critical care settings aligns with other reports suggesting that complex cases and severe infections often prompt aggressive empirical antibiotic use.

6.1. Strengths and Limitation of the Study

This study's strengths create a foundation for recognizing the complexities surrounding antibiotic prescriptions and their outcomes, paving the way for evidence-based interventions healthcare settings. It also gave a general overview of our antibiotics pattern and appropriatness. The assessment of core prescribing indicators was limited to antibiotic use. This may not show the actual practices only at one study setting. Besides, a cross-sectional nature of the study may affect the accuracy of results and cause difficulty finding out more predictor variables. Since the study focuses on a single facility, results may not be generalized to all hospitals. To address the limitations, we recommend further multicentered and prospective studies.

6.2. Conclusion

Out of a total of 228 patients, 67% received antibiotic prescriptions classified as appropriate. However, approximately 33% of these prescriptions are considered inappropriate. **I**nappropriate antibiotic use in this study was strongly associated with multiple antibiotic prescriptions, lack of culture results, and failure to de-escalate therapy. These findings reinforce the need for robust antimicrobial stewardship programs that promote rational prescribing, encourage microbiological testing, and support regular review and de-escalation of antibiotic therapy. Addressing these factors is essential to improve patient outcomes and combat the growing threat of antimicrobial resistance.

6.3. Recommendation

Recommendations for Future Practice: the need to utilize the culture and antibiotics de-escalation based on different conditions should be practiced. And whenever appropriate, single antibiotic with rational choice should be prescribed than a polypharmacy practice. The hospital and responsible stakeholders should formulate local prescription guideline and must avail culture and sensitivity tests and must adhere to WHO AWaRe protocol as well. Future research around this areas should address the antimicrobial resistance resulting from the inappropriate prescription pattern.

7. Reference

1. Ahmed SK, Hussein S, Qurbani K, Ibrahim RH, Fareeq A, Mahmood KA, et al. Antimicrobial resistance: Impacts, challenges, and future prospects. 2024;2:100081.

2. Naghavi M, Vollset SE, Ikuta KS, Swetschinski LR, Gray AP, Wool EE, et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. 2024;404(10459):1199-226.

3. Yimer YS, Addis GT, Alemu MAJSOM. Evaluation of prescription completeness, rational drug-use patterns using WHO prescribing, patient-care and facility indicators in Debre Tabor Comprehensive Specialized Hospital, Ethiopia: a cross-sectional study. 2022;10:20503121221122422.

4. Rabbani SA, Sridhar SB, Safdar M, Rao PG, Jaber AAS, AlAhmad MM, et al. Assessment of prescribing practices and factors related to antibiotic prescribing in community pharmacies. 2023;59(5):843.

5. Igirikwayo ZK, Migisha R, Mukaga H, Kabakyenga JJBPM. Prescription patterns of antibiotics and associated factors among outpatients diagnosed with respiratory tract infections in Jinja city, Uganda, June 2022–May 2023. 2024;24(1):446.

6. Tadesse TY, Molla M, Yimer YS, Tarekegn BS, Kefale BJSOM. Evaluation of antibiotic prescribing patterns among inpatients using World Health Organization indicators: a cross-sectional study. 2022;10:20503121221096608.

7. Getachew E, Aragaw S, Adissie W, Agalu AJAJPP. Antibiotic prescribing pattern in a referral hospital in Ethiopia. 2013;7(38):2657-61.

8. Al Mujaini SM, Almayahi ZK, Abouammoh NA, Al Amri SJBPC. Antibiotic prescription pattern among Primary Healthcare General Practitioners in the South Batinah Governorate of Oman, 2019. 2024;25(1):291.

9. Alekaw H, Derebe D, Melese WM, Yismaw MBJI, Resistance D. Antibiotic prescription pattern, appropriateness, and associated factors in patients admitted to pediatric wards of Tibebe Ghion Specialized Hospital, Bahir Dar, North West Ethiopia. 2022:6659-69.

10. Kasimanickam V, Kasimanickam M, Kasimanickam RJMS. Antibiotics use in food animal production: escalation of antimicrobial resistance: where are we now in combating AMR? 2021;9(1):14.

11. Kariuki SJTL. Global burden of antimicrobial resistance and forecasts to 2050. 2024;404(10459):1172-3.

12. Klein EY, Schueller E, Tseng KK, Morgan DJ, Laxminarayan R, Nandi A, editors. The impact of influenza vaccination on antibiotic use in the United States, 2010–2017. Open forum infectious diseases; 2020: Oxford University Press US.

13. Asefa L, Bayissa G, Abera ZJWJMS. Antibiotics use evaluation for pediatrics at nekemte referral hospital, East Wollega Zone, Oromia Region, West Ethiopia. 2016;13(1):17-26.

14. Zeleke A, Chanie T, Woldie MJIaom. Medication prescribing errors and associated factors at the pediatric wards of Dessie Referral Hospital, Northeast Ethiopia. 2014;7(1):1-6.

15. Woldu MAJDM. Antimicrobial resistance in Ethiopia: current landscape, challenges, and strategic interventions. 2024;1(1):68.

16. Hsia Y, Lee BR, Versporten A, Yang Y, Bielicki J, Jackson C, et al. Use of the WHO Access, Watch, and Reserve classification to define patterns of hospital antibiotic use (AWaRe): an analysis of paediatric survey data from 56 countries. 2019;7(7):e861-e71.

17. Gebeyehu E, Bantie L, Azage MJPo. Inappropriate use of antibiotics and its associated factors among urban and rural communities of Bahir Dar City Administration, Northwest Ethiopia. 2015;10(9):e0138179.

18. Janssen J, Afari-Asiedu S, Monnier A, Abdulai MA, Tawiah T, Wertheim H, et al. Exploring the economic impact of inappropriate antibiotic use: the case of upper respiratory tract infections in Ghana. 2022;11(1):53.

19. Tafere C, Endeshaw D, Demsie DG, Yismaw MB, Tefera BB, Yehualaw A, et al. Inappropriate ceftriaxone utilization and predictor factors in Ethiopia: a systematic review and meta-analysis. 2024;14(1):25035.

20. Apostol GLC, Collaborators GAR. Global Burden of Bacterial Antimicrobial Resistance 1990–2021: A Systematic Analysis with Forecasts to 2050. 2024.

21. Ogbonna BO, Ovwighose S, Okpalanma N, Mmaduekwe H, Okeke A, Anetoh M, et al. Pattern of Antibiotics prescription in a tertiary hospital in Delta state, Nigeria. 2022;8(1):1-11.

22. Eibs T, Koscalova A, Nair M, Grohma P, Kohler G, Bakhit RG, et al. Qualitative study of antibiotic prescription patterns and associated drivers in Sudan, Guinea-Bissau, Central African Republic and Democratic Republic of Congo. 2020;10(9):e036530.

23. Christensen I, Haug JB, Berild D, Bjørnholt JV, Skodvin B, Jelsness-Jørgensen L-PJA. Factors affecting antibiotic prescription among hospital physicians in a low-antimicrobial-resistance country: a qualitative study. 2022;11(1):98.

24. Liu C, Liu C, Wang D, Zhang XJAR, Control I. Intrinsic and external determinants of antibiotic prescribing: a multi-level path analysis of primary care prescriptions in Hubei, China. 2019;8(1):132.

25. Dougherty B, Finley R, Dumoulin D, Weese JS, Harper S, Parmley EJ, et al. Risk factors associated with antibiotic prescriptions for cases of enteric pathogens in Canada, 2015–2019. 2024;152:e131.

26. Founou RC, Founou LL, Essack SYJPo. Clinical and economic impact of antibiotic resistance in developing countries: A systematic review and meta-analysis. 2017;12(12):e0189621.

27. Ho CS, Wong CT, Aung TT, Lakshminarayanan R, Mehta JS, Rauz S, et al. Antimicrobial resistance: a concise update. 2025;6(1).

28. Bergman U, Popa C, Tomson Y, Wettermark B, Einarson T, Åberg H, et al. Drug utilization 90%–a simple method for assessing the quality of drug prescribing. 1998;54(2):113-8.

29. Steinman MA, Chren M-M, Landefeld CSJJogim. What's in a name? Use of brand versus generic drug names in United States outpatient practice. 2007;22(5):645-8.

30. Mengitsu B, Shafi O, Kebede B, Kebede F, Worku DT, Herero M, et al. Ethiopia and its steps to mobilize resources to achieve 2020 elimination and control goals for neglected tropical diseases: Spider webs joined can tie a lion. 2016;8(suppl_1):i34-i52.

31. Mettler J, Simcock M, Sendi P, Widmer AF, Bingisser R, Battegay M, et al. Empirical use of antibiotics and adjustment of empirical antibiotic therapies in a university hospital: a prospective observational study. 2007;7(1):21.

32. Altaf U, Saleem Z, Akhtar MF, Altowayan WM, Alqasoumi AA, Alshammari MS, et al. Using culture sensitivity reports to optimize antimicrobial therapy: findings and implications of antimicrobial stewardship activity in a hospital in Pakistan. 2023;59(7):1237.

33. Greenhalgh JM, Edwards JRJCM, Infection. A comparative study of the in vitro activity of meropenem and representatives of the major classes of broad-spectrum antibiotics. 1997;3:4S20-4S31.

34. Dal Negro R, Pozzi E, Cella SGJPP, Therapeutics. Erdosteine: Drug exhibiting polypharmacy for the treatment of respiratory diseases. 2018;53:80-5.

35. Rijken M, Van Kerkhof M, Dekker J, Schellevis FGJQolR. Comorbidity of chronic diseases. 2005;14(1):45-55.

36. Kim YC, Park JY, Kim B, Kim ES, Ga H, Myung R, et al. Prescriptions patterns and appropriateness of usage of antibiotics in non-teaching community hospitals in South Korea: a multicentre retrospective study. 2022;11(1):40.

37. Yehualaw A, Taferre C, Bantie AT, Demsie DGJBRI. Appropriateness and pattern of antibiotic prescription in pediatric patients at Adigart General Hospital, Tigray, Ethiopia. 2021;2021(1):6640892.

38. Barghouthi Achalu T, Mensa MJJAR. Retrospective drug use pattern of antibiotics in pediatric ward of Shenan Gibe hospital, Oromia Region, Ethiopia. 2017;1(1):106.

39. Čižman MJIjoaa. The use and resistance to antibiotics in the community. 2003;21(4):297-307.

40. Nyazema N, Viberg N, Khoza S, Vyas S, Kumaranayake L, Tomson G, et al. Low sale of antibiotics without prescription: a cross-sectional study in Zimbabwean private pharmacies. 2007;59(4):718-26.

41. Abula T, Worku AJTEJoHD. Self-medication in three towns of North West Ethiopia. 2001;15(1).

42. Desalegn AAJBhsr. Assessment of drug use pattern using WHO prescribing indicators at Hawassa University teaching and referral hospital, south Ethiopia: a cross-sectional study. 2013;13(1):170.

43. Abiye AA, Kedir HM, Salile SS, Woldamo BA, Ali HS, Berhe ABJJBCP. Rational drug use in a rural area of ethiopia: based on WHO/INRUD prescribing indicators. 2021;12:104-8.

44. Floege J, Johnson RJ, Feehally J. Comprehensive clinical nephrology E-book: Elsevier Health Sciences; 2010.

Annex 1: Subject information sheet

INTRODUCTION: how are you?

My name is …….. I am here on behalf of Dr. Nahom Paulos, from AUARTH. He is conducting a research on "Assessment of antibiotics prescription pattern and associated factors among patients admitted to medical ward of Asella referral and teaching hospital southeast, Ethiopia" for the partial fulfillment of specialty program in Arsi University. He received permission from Arsi University. The study will help in providing a base line data for policy makers and other researchers on issues. You are selected randomly to participate in this study because you are eligible for this study. Your participation is purely based on your willingness. You have full right either to participate or decline to be a participant in this study. If you choose to take part in the study you may respond to all the questions or you may not answer questions you don't want to, and have the right to stop the interview at any time. You also have the right to choose not to take part in this study. Participating in this study will not have any risk or harm. Whether you are willing to participate, refuse or decide to withdraw later, you will not be subjected to any ill treatment. If you agree to participate in the study, you will be asked to answer some questions about yourself, and the interview lasts with you will take about 20-30 minutes. We will also review your chart and results will be used in the research. Any information that you provide will be kept confidential, names will not be written or specified and all the questionnaires will be coded for anonymity. No one will have access to the non-coded data except the principal investigator. Only the principal investigator will know the details and He will discard it after completing analysis. The data will not be used for purposes other than the study. Your willingness and active participation is very important for the success of this study

Annex II: Informed consent

The above information regarding my participation in the study is clear to me. I have been given a chance to ask questions and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time.

Respondent agree to participate?

Yes **No**

1. If yes, continue the interview

2. If no, skip to the next participant by writing reasons for his refusal._____

Informed consent Certified by:

Respondent's signature/thumb print_____ Date _____

Interviewer: Name _____ Signature _____

Questionnaire ID number _____

Date of interview _____ Time started _____ Time completed_____

Result of interview:

1. Completed 2. Respondent not available 3. Refused 4. Partially completed

Checked by: Supervisor: Name _____ Signature_____

Annex III: Questionnaires

Questionnaire for Antibiotic prescription pattern and associated factors

Section A: Patient Demographics

1. Age: ____ years

2. Sex: Male / Female

3. Comorbidities (check all that apply): Diabetes, HIV, Hypertension, None

4. residency , urban or rural

5. health insurance coverage or not

Section B: Clinical Information

4. Primary diagnosis at admission: _____

5. Severity of illness: Mild / Moderate / Severe

6. Past infection and antibiotic exposure

7. Were diagnostic tests (e.g., culture/sensitivity) performed? Yes / No

- If yes, results: _____

Section C: Antibiotic Prescription

8. Antibiotic(s) prescribed: _____

9. Route of administration: IV / Oral / Both

10. Duration of therapy: ____ days

11. Was the antibiotic prescribed empirically (without culture results)? Yes / No

Section D: Prescriber Information

12. Prescriber's qualification: General Practitioner / Specialist / Other

13. Years of clinical experience: <1 / 1–5 / >5

Section E: Hospital Factors

14. Were antibiotic guidelines available? Yes / No

15. Were culture/sensitivity tests accessible during prescription? Yes / No

Section F antibiotic Factor

16. Proportion of patients receiving ≥2 antibiotics concurrently.

17. Common combinations (e.g., ceftriaxone + metronidazole).

18. Were antibiotics prescribed as prophylaxis? Yes / No

- If yes, specify reason: Surgical / Medical (e.g., immunocompromised)

19. Were multiple antibiotics prescribed? Yes / No

- List combinations: _____

20. Was de-escalation done after culture results? Yes / No / Not applicable

Length of hospital stay: ____ days

21. Did the patient develop adverse drug reactions? Yes / No

If yes specify the type of reaction

22. Clinical outcome at discharge: Improved / No change / Deteriorated

Annex Iv: Investigator Assurance Form

I the undersigned resident agree to accept all responsibilities for the scientific, ethical and technical conduct of the research project and for provision of required progress re-ports as per terms and conditions of the Research and Publication Committee and /or Department of Internal medicine, of Arsi University.

I also assert that this proposal is my original work, has not been presented for a degree in any other university and that all sources of materials used for the proposal have been accordingly acknowledged.

Name of Resident ……

Signature……

Date……

Approval of Advisors

1. Name of Advisor……

   Signature: ……..

   Date ……

2. Name of Advisor……

   Signature: ……..

   Date ……