HARAMAYA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

ANTIBIOTIC KNOWLEDGE, PRACTICE, AND ASSOCIATED FACTORS AMONG MOTHERS OF CHILDREN UNDER-FIVE IN RURAL HARAMAYA DISTRICT, EASTERN ETHIOPIA

MSc Thesis

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September, 2025

Haramaya University, Harar

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ANTIBIOTIC KNOWLEDGE, PRACTICE, AND ASSOCIATED FACTORS AMONG MOTHERS OF CHILDREN UNDER-FIVE IN RURAL HARAMAYA DISTRICT, EASTERN ETHIOPIA

A Thesis Submitted to the College of Health and Medical Sciences,

School of Pharmacy, Haramaya University

In Partial Fulfillment of the Requirements for the Degree of

Master in Clinical Pharmacy

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September, 2025

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APPROVAL SHEET
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POSTGRADUATE PROGRAM DIRECTORATE

I hereby certify that I have read and evaluated this thesis entitled **Antibiotic Knowledge, Practice, and Associated factors among Mothers of Children under-five in rural Haramaya District, Eastern Ethiopia**. I recommend that it is to be submitted as fulfilling the thesis requirement.

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As a member of the board of examiners of the MSc thesis open defense examination, I certify that I have read and evaluated the thesis prepared by **Jabir Aliye** and examined the candidate.

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Date Final approval and acceptance of the thesis are contingent upon the submission of its final copy to the Council of Graduate Studies (CGS) through the candidate's school graduate committee (SGC).

STATEMENT OF THE AUTHOR

With my signature below, I declare and affirm that this thesis is my own work and that all sources of materials used for this thesis have been fully acknowledged. This thesis has been submitted in partial fulfillment of the requirements for the degree of Master's in clinical pharmacy at Haramaya University and is deposited at the University Library to be made available to students and to others who want it as a reference.

I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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School:_____

BIOGRAPHIC SKETCH

I was born in Bedeno, located in the East Hararghe zone of the Oromia regional state, on January 1, 1979 E.C. My early education journey began in Bedeno, where I completed my primary, secondary, and high school education between 1983 and 1994 E.C. Following my secondary education, I pursued higher education and earned a Bachelor of Arts degree in Public Management from Ethiopia Civil Service University in 2000 E.C. After completing my undergraduate studies, I served in the Bedeno Woreda Civil Service Office and the Haramaya Town Civil Service Office until 2004 E.C. In 2005 E.C., I joined Haramaya University, School of Pharmacy and graduated with a Bachelor of Pharmacy (B.Pharm) degree in 2009 E.C. Following my graduation, I took on a leadership role as the head of the Haramaya Town Health Office until I started postgraduate studies at Haramaya University in 2013 E.C.

ACKNOWLEDGMENTS

First and foremost, I offer my deepest gratitude to Almighty ALLAH, whose boundless support and strength have sustained me throughout this journey.

I am sincerely thankful to the School of Pharmacy, College of Health and Medical Sciences, Haramaya University, for granting me the opportunity to pursue this research and for providing an environment conducive to academic growth.

My heartfelt appreciation goes to my advisors—Mr. Kirubel Minsamo, Dr. Abraham Nigussie, and Dr. Dumessa Edessa—for their unwavering support, insightful guidance, and constructive feedback throughout the development of this thesis. Their mentorship has been invaluable.

I would also like to extend special thanks to Mr. Abera Jambo (MSc) for his continuous encouragement, thoughtful suggestions, and generous assistance during the preparation of this work.

Finally, I am profoundly grateful to my family for their steadfast support and motivation, which have been the foundation of my perseverance. I also thank my friends for their encouragement and meaningful contributions, all of which have played a vital role in the successful completion of this study.

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LIST OF ACRONYMS AND ABBREVIATIONS

AMR	Antimicrobial Resistance
HH	Household
WHO	World Health Organization
URTI	Upper Respiratory Tract Infection
HDSS	Haramaya Health and Demographic Surveillance System
ETB	Ethiopian Birr
CBHI	Community-Based Health Insurance

ABSTRACT

Background: Lack of knowledge among mothers regarding antibiotic use in children under five contributes to inappropriate use, a key driver of antimicrobial resistance (AMR). Despite their critical role, limited data exist on mothers' antibiotic knowledge and practices in rural Ethiopia.

Objective: To assess antibiotic knowledge, practices, and associated factors among mothers of children under five in rural Haramaya District, Eastern Ethiopia.

Methods: A community-based cross-sectional study was conducted from May 29 to June 30, 2025, involving 380 randomly selected mothers. Data were collected using a pretested, interviewer-administered questionnaire and analyzed with SPSS version 21. Crude and adjusted prevalence ratios (PRs) with 95% confidence intervals (CIs) were calculated using modified Poisson regression models to identify factors associated with poor antibiotic knowledge and inappropriate practices. Significance was set at $p \leq 0.05$.

Results: Among participants, 225 (59.2%) had poor antibiotic knowledge. Of 127 mothers reporting antibiotic use for children under five, 51 (40.2%) practiced inappropriate use. Poor knowledge was significantly associated with lack of formal education (APR = 2.06; 95% CI: 1.04–4.09; $p = 0.014$), experience with suppliers (APR = 2.37; 95% CI: 1.08–4.20; $p = 0.004$), lack of clinic information (APR = 2.25; 95% CI: 1.12–4.50; $p = 0.006$), non-working (APR = 2.33; 95% CI: 1.10–4.78; $p = 0.008$), and longer distance to health facilities (APR = 2.46; 95% CI: 1.17–5.18; $p = 0.012$). Inappropriate antibiotic use was significantly associated with age of the child (APR = 0.76; 95% CI: 0.67–0.87; $p < 0.001$), non-prescribed access (APR = 1.87; 95% CI: 1.15–3.04; $p = 0.012$), obtaining drugs from primary clinics (APR = 5.75; 95% CI: 2.41–13.74; $p < 0.001$), pharmacies or drug shops (APR = 3.48, 95% CI: 1.19–10.24, $p = 0.023$) , kiosks (APR = 2.97; 95% CI: 1.13–7.75; $p = 0.027$), frequency of antibiotic use (≥4 times; (APR = 2.91; 95% CI: 1.35–6.29; $p = 0.007$), and rare instructions about drugs (APR = 3.18, 95% CI: 1.55–6.53, $p = 0.002$) .

Conclusion: Over half of mothers had poor knowledge of antibiotics, and inappropriate use for children was common. Targeted health education, regulated access, and proper counseling are essential to promote rational antibiotic use and reduce AMR risks.

Keywords: Antibiotic use, Knowledge, Practice, Mothers, Under-five children, Haramaya District, Ethiopia

1. INTRODUCTION

1.1. Background

Antibiotics are medicines formulated for the treatment or prevention of bacterial infections, administered to patients based on the prescription of a certified health care professional (Ajibola et al., 2018). Their use in both preventive and curable therapy have saved life of countless patients and improved patient care in general (Jifar and Ayele, 2018). Antibiotics play a critical role in managing bacterial infections (Banin et al., 2017). However,there is high prevalence of inappropriate use of antibiotics in under five year children from low-income and middle-income countries (LMICs) (Hassan et al., 2021) (Allwell-Brown et al., 2020) (Rashid et al., 2017). A lack of knowledge among parents, particularly mothers, regarding the appropriate use of antibiotics in children under five years of age can result in inappropriate antibiotic use, misuse, or incorrect practices with antibiotics (Al-Ayed, 2019a, Alzaid et al., 2020b). The poor antibiotic knowledge among parents, leads to antibiotic misuse or incorrect practices,which inludes failing to complete treatment, missing doses, reusing leftover medications, or overuse of antibiotics (AMR) (Goodluck et al., 2017).

The World Health Organization (WHO) reported that drug-resistant bacteria have reached alarming levels worldwide (Mestrovic et al., 2022). It is estimated that about 4.95 million people worldwide lose their lives each year due to AMR infections, with the number of deaths potentially increasing to 10 million by 2050 (Murray et al., 2022). AMR is also a serious threat to the health of children worldwide due to the increasing trend of resistant bacteria that cause common infections, such as acute respiratory infections (ARIs) and diarrhea in children (RAIHANA, 2019).

Mothers play a crucial role in the administration of antibiotics to children under five years of age (Revathi and Pandurangan, 2020). Parental, particulary mothers antibiotic knowledge and practices play a significant role in reducing morbidity in children under 5 years of age(Marsh et al., 2023). Insufficient knowledge among parents regarding the judicious use of antibiotics in managing common childhood illnesses can result in their misuse (Al-Ayed, 2019b). Parents may persist in their request for antibiotic prescriptions from prescribers, not adhere to treatment instructions, or may use antibiotics without consulting a doctor (Marsh et al., 2023). These

practices stem from misconceptions regarding antibiotic use and its potential adverse effects (Ramegowda et al., 2018), and this misuse of antibiotics is associated with demographic characteristics, including gender , age , race , education level , family income, place of residence , as well as other factors, such as lack of advice regarding rational antibiotic use, given by a physician (Pavydė et al., 2015).Furthermore, inadequate health education is a significant contributing factor to antibiotic misuse (Al-Ayed, 2019b).

1.2. Statements of the Problem

Inappropriate use of antibiotics has led to AMR—a significant global health concern (Waaseth et al., 2019). The primary cause of this issue is the lack of knowledge regarding the appropriate use of antibiotics (Goodluck et al., 2017). Children under five years of age received 53% of all antibiotics prescribed to the pediatric population (Al-Dossari, 2013). However, antibiotic prescription is medically inappropriate in most situations (Ashena et al., 2022). It has been estimated that 20-50% of all antimicrobial use is inappropriate (Mohamed, 2015), which is the primary cause of AMR.

Insufficient knowledge among mothers (parents) regarding the use of antibiotics in managing common childhood illnesses can result in inappropriate antibiotic use, misuse, or malpractice (Al-Ayed, 2019b). The misuse or inappropriate use of antibiotics includes failure to complete treatment, skipping doses, reuse of leftover medicines, and overuse of antibiotics. The root cause is the lack of knowledge on the appropriate use of antibiotics that leads to (AMR) (Goodluck et al., 2017).

Inappropriate antibiotic practice due to poor knowledge of antibiotics leads to AMR, which has emerged as one of the biggest threats to human survival, contributing up to 7.7 million estimated deaths worldwide in 2019. The highest death rate was evident for sub-Saharan Africa (SSA), with 230 death records per 100,000 population (Edessa et al., 2024). In addition, approximately 700,000 people lose their lives globally each year due to antimicrobial resistance (Belachew et al., 2022). AMR infections are also a leading cause of death in Ethiopia. Children under five years are at the highest risk of AMR (Edessa et al., 2024). The WHO identified nine resistant bacteria of

international concern, almost half of which are commonly detected among children under-five years of age (Organization, 2014).

The prescription patterns of antibiotics are not well controlled in many countries, especially developing countries, including Ethiopia (Agarwal et al., 2015a). Doctors usually relate their pattern of overprescribing to parents` pressure. Pediatricians believe educating parents is necessary to promote the judicious use of antimicrobial agents (Al-Dossari, 2013). A recent study in Eastern Ethiopia found that nerly half (45.6%) of the ways people access antibiotics involve inappropriate practices, indicating widespread misuse of these drugs (Edessa et al., 2024). Studies that assessed the knowledge and practices of mothers (caregivers) towards antibiotics have indicated that lower socioeconomic status and education level as important factors that fueled the misuse of antibiotics (Teck et al., 2016) (Agarwal et al., 2015a) (Ding et al., 2015).

Although several studies have examined antibiotic knowledge and practices among mothers of children under five, community-based research focusing specifically on this age group remains limited in Ethiopia. Moreover, no study has been conducted in the present study area to assess mothers' antibiotic knowledge, practices, and associated factors, despite the widespread prevalence of inappropriate antibiotic use in Eastern Ethiopia(Edessa et al., 2024). To date, only one study in Ethiopia has addressed this issue(Zeru et al., 2020b); however, it did not focus on children under five nor did it evaluate the factors associated with mothers' antibiotic knowledge and practices in rural Haramaya District. Consequently, this study was designed to assess antibiotic knowledge, practices, and associated factors among mothers of children under five in rural Haramaya District.

1.3. Significance of the study

By identifying the factors associated with poor antibiotic knowledge and practices, this study will provide valuable insights for stakeholders. These insights can be used to implement health education initiatives and other measures to improve mothers' antibiotic knowledge and practices and ultimately reduce the associated risks. The findings will be beneficial to the Haramaya District Health Office, as they will provide essential information about antibiotic knowledge, practices, and associated factors among mothers of under-five children. This will enable stakeholders to adjust their plans and strategies to enhance their knowledge and practice.

1.4. Objective of the study

1.4.1. General objective

- ✓ To assess antibiotic knowledge, practice, and associated factors among mothers of children under-five in rural Haramaya district, Eastern Ethiopia, from May 29, 2025 to June 30, 2025.

1.4.2. Specific objectives

- ✓ To assess level of antibiotic knowledge among mothers of under-five children in the rural Haramaya district
- ✓ To examine antibiotic practices of mothers for children under-five in the rural Haramaya district
- ✓ To identify factors associated with poor antiobiotic use practices among mothers of under-five children in the rural Haramaya district.

2. LITERATURE REVIEW

Overview of Literature Review

Relevant studies on antibiotic knowledge, practices, and associated factors among mothers of under-five children were identified through searches in **PubMed, Scopus, Web of Science, Google Scholar, and HINARI**. Keywords included *"antibiotic knowledge"*, *"antibiotic practice"*, *"mothers"*, *"caregivers"*, and *"under-five children"*. Articles published in English between **2000 and 2024** were considered. Additional sources were identified through manual screening of references. Priority was given to **cross-sectional, cohort, and systematic reviews**, providing evidence on prevalence, determinants, and patterns of antibiotic use across different contexts.

2.1. Antibiotic knowledge among mothers of under-five children

Pooled evidence from a systematic review of 20 studies conducted in the last 20 years showed that parents' perceived need for antibiotics for their children is often linked to certain symptoms. Parents can easily tell when antibiotics are needed, for example, if symptoms of tonsillitis and earache are observed (parents from the UK), green nasal discharge (parents from the USA), and fever (parents from Ecuador and Hong Kong) (Cantarero-Arévalo et al., 2017).

A multicenter cross-sectional study conducted in Peru among mothers of under-five children reported that 79% of mothers incorrectly perceived that antibiotics could cure viral infections (Paredes et al., 2022). A cross-sectional study conducted in Jordan among 204 parents of under-five children reported that 58.3% of parents correctly identified the inappropriate use of antibiotics to reduce their efficacy and drive bacterial resistance (Shtayyat and Abu-Baker, 2023). A similar study in Pakistan revealed that 35% of parents mentioned that antibiotics must be administered in any case of fever, 47% thought antibiotics increase recovery time, and 51% knew that antibiotics have their own side effects (Siddiqui et al., 2014).

A cross-sectional study conducted in India among parents of children reported that only 17% agreeing that antibiotics have no role against viruses. Also only 20% accepted that antibiotics are not necessary for short duration fever and common cold. Around 60% are of the opinion that full course of antibiotics should be completed (Chinnasami et al., 2016). Another similar study in India revealed that 49.6% of mothers had moderately adequate knowledge (Lakshmi et al., 2021).a cross-sectional study done in Bangalore reported among 100 parents of under five children , 96% heard about antibiotics (Ramegowda et al., 2018).

Study conducted to assess Knowledge, Attitude and Practice of Mothers on Acute Respiratory Infection in children under five years in Saudi Arabia reported that 64.1% of mothers correctly identified while 35.9% incorrectly identified overuse of antibiotic drives bacterial resistance (Alluqmani et al., 2017). Similar study in Saudi Arabia reported that the parents in Saudi Arabia lack adequate knowledge regarding the use of antibiotics in the treatment of URTIs in children (Alzaid et al., 2020a). Another similar study in Saudi Arabia reported that, 31% of all interviewed parents had satisfactory knowledge on antibiotic use(Elbur et al., 2016).

A cross-sectional study done Iran to asseses antibiotic knowledge ,attitude and practice among 406 mothers of under 6 years showed that ,4 mothers (1%) were in poor level of knowledge, 140 (34.5%) mothers were in moderate level of knowledge, and 262 (64.5%) were in good level of knowledge of antibiotic use in their children (Ashena et al., 2022). A similar study conducted in Indonesia reported more than 70% of caregivers answered incorrectly about knowledge of antibiotics except for the knowledge of necessity of vaccination for children (RAIHANA, 2019).

A cross-sectional study conducted in Indonesia among female caregivers of under five children reported that of those who received antibiotics (100), 63 (63%) correctly identified to have taken antibiotics by the female caregivers (Alkaff et al., 2019a). A cross sectional study conducted in Navi Mumbai, India, which involved a total of 1000 parents of admitted children reported that 28% of parents correctly identified that antibiotics are used against bacterial infections while only 15.5% parents knew the meaning of the term antibiotic resistance, majority of parents (73.6%) stated that unnecessary use of antibiotics could harm the child (73.6%) (Agarwal et al., 2015a).

A similar study carried out in Riyadh, Saudi Arabia reported that only 1.4% of the parents identified correctly all antibiotics while 35.8% of them did not identify any antibiotic correctly (Al-Dossari, 2013). A cross-sectional study conducted in India among 250 mothers of under five

children revealed that 71.3% of the mothers are not aware that antibiotic resistance is a worldwide problem (Revathi and Pandurangan, 2020). Similar study in malaysia reported from 320 caregivers, only 25.2% and 21.6% of the parents could correctly identify amoxicillin and penicillin as the treatment of children's URTI (Teck et al., 2016).

A cross-sectional study conducted in Egyp that included 100 mothers reported that more than half of the studied mothers (64.0%) had poor knowledge about antibiotics use for their children (Abozed et al., 2016). Another study conducted in Egypt revealed that 76.7% of mothers had moderate knowledge regarding use of antibiotics in their children (Mohamed, 2015). A cross sectional study conducted in Sudan reported that 64.3% of mothers incorrectly replied antibiotics should be used in all cases of pneumonia (Saeed and Awadalla, 2020).

A cross-sectional study conducted in Aksum, Ethiopa, among 384 participants reported that 77.6% of the parents acknowledged that inappropriate use of antibiotic leads to bacterial resistance. However, only 29.4% of the parents believed URTIs are of viral origin and do not require antibiotics (Zeru et al., 2020b).

2.2. Antibiotic practices among mothers of under-five children

A cross-sectional study conducted in Iran, which involved 302 mothers with children under five years, reported that mothers' antibiotic practice levels were poor in 55 (18.2%), moderate in 210 (69.5%), and good in 37 (12.3%) (Nafei et al., 2022). A cross-sectional study conducted in China among 4200 caregivers of children revealed that 48.2% of respondents had not been prescribed antibiotics for children in the past six months (Chang et al., 2018).

A similar study design conducted in Indonesia among female caregivers of under-five children reported that from 203 children,100 received antibiotics, of whom only two children (0.9%) purchased without prescription (Alkaff et al., 2019a).

A study in India reported that 70% of the mothers had unsatisfactory practices (Lakshmi et al., 2021). In Peru, more than half of the parents (52%) reported having self-medicated their child with antibiotics (Paredes et al., 2022). A cross-sectional study conducted in India among 250 mothers showed that 59.3% of the respondents give higher doses of antibiotics to their child than what doctors prescribed (Revathi and Pandurangan, 2020)

A cross-sectional study conducted in Saudi Arabia that included 544 parents reported that 68.6% of parents purchased antibiotics without a prescription, whereas 31.4% purchased antibiotics only after obtaining a prescription (Al-Ayed, 2019b). Another study in Saudi Arabia reported that 48.3% of parents reused the antibiotic previously administered for the same symptoms (Elbur et al., 2016). A similar study in Iran reported that 65.3% of mothers stated that they never gave antibiotics to their children without a doctor's prescription (Ashena et al., 2022). A study conducted in China involving 854 participants reported sixty-two percent of parents had self-medicated their children with antibiotics (Yu et al., 2014).

A cross-sectional study conducted in Egypt that included 100 mothers reported that the majority of studied mothers (84.0%) had satisfactory practices regarding the use of antibiotics for their children with URTI (Abozed et al., 2016). Another study conducted in Egypt, which included 400 mothers of under-five children, reported that more than two-thirds of mothers self-medicated their children without doctor consultation for common health problems, such as cough, vomiting, diarrhea, and fever (Mohamed El Sheshtawy et al., 2019). Moreover, another similar study in Egypt reported that more than half of mothers (53.3%) had poor practice regarding the use of antibiotics for their children with URTI (Mohamed, 2015)

A cross-sectional study conducted in Nigeria on mothers of under-five children reported that the majority (72.0%) of mothers had administered antibiotics to them. Of these, 48.5% were prescribed by physicians and 24.4% were self recommended (Adisa et al., 2018b). A similar study design in Tanzania reported from a total of 730 caregiver interviews, that parental self-medication with antibiotics to under-fives was 47.7% (95% CI=43.7, 51.8) (Simon and Kazaura, 2020a). A cross-sectional study conducted among 384 participants in Aksum, Ethiopia, reported that only 12.8% of the parents did not always follow the doctors′ advice regarding antibiotic use (Zeru et al., 2020b).

2.3. Factors associated with poor antibiotic knowledge and practices

2.3.1. Socio-demographic and child-related factors

The pooled evidence of systematic reviews gathered from 20 countries from studies published in the last 20 years showed that the parental good level of knowledge about antibiotic use in their children (when and how to use it), often correlated with living in a Western country (Cantarero-Arévalo et al., 2017). A study conducted in Iran revealed that a higher antibiotic knowledge and practices of mothers had a significant relationship with a higher level of education (p <0.001) (Ashena et al., 2022). Another study in Iran reported that a higher level of antibiotic practice (p = 0.007) among mothers was significantly associated with a higher level of education (Nafei et al., 2022).

A study conducted in Saudi Arabia reported that higher education was the only predictor of satisfactory knowledge (AOR 2.5: 95% CI: 1.7- 4.5; p= 0.026) (Elbur et al., 2016). A study done in Turkey showed females gender compared to males gender, using a small number of antibiotics in the last 1 year compared to using a large number of antibiotics in the last 1 year associated with both a better level of antibiotic knowledge and practices of parents (Albayrak et al., 2021). A multicenter study in Peru reported that parents who were < 20 years old were more likely to have low knowledge about antibiotics (adjusted PR 2.39, 95% CI 1.32–4.34) compared to those aged > 40 years (Paredes et al., 2022).

A study conducted in India reported that males, parents with higher levels of formal education, and previous use of antibiotics were found to have more knowledge regarding antibiotics and fewer misconceptions (p<0.05) (Agarwal et al., 2015a). Another study conducted in India reported a significant association between practice on antibiotic use and education, age of child at levels of p < 0.05 and p < 0.01, respectively (Lakshmi et al., 2021). Moreover, a study in Cyprus reported that low parental education was the most important independent risk factor positively related to antibiotic misuse (AOR = 2.88, 95% CI 2.02 to 4.12, p < 0.001) (Rousounidis et al., 2011).

A study conducted in Egypt reported a significant relationship between mothers' knowledge and their residence, educational level, and occupation with statistical significance (p≤0.05), while mothers' practices were only significantly associated with educational level (p≤0.019) (Abozed et

al., 2016). In Tanzania study revealed Independent factors associated with parental self-medication with antibiotics to under-fives were distance to the nearest health facility (Simon and Kazaura, 2020a)

2.3.2. Household and healthcare related factors

A systematic review conducted to assess parental knowledge of antibiotic use in children reported, good level of antibiotic knowledge is associated with high socioeconomic position (Cantarero-Arévalo et al., 2017). Study conducted in Turkey also showed that higher income level compared to low income level is associated with better level of antibiotic knowledge and practices (Albayrak et al., 2021). A cross-sectional study conducted in Iran reported that increasing the number of children (i.e., family size) is associated with increased poor antibiotic practice of mothers of under-five children (P=0.02) (Nafei et al., 2022). Study in Tanzania reported independent factors associated with parental self-medication with antibiotic for children under-five, which is a poor antibiotic practice, related with low average household income (Simon and Kazaura, 2020a). Study in Malaysia also reported a significant association was noted between the family's income and parents antibiotic knowledge. The poor antibiotic practices were also associated with the lack of access to health information sources, especially in rural remote areas (Teck et al., 2016).

2.3.3. Illness and behavioral related factors

The behavior of mothers can influence their children such as prescribing medication for their sick children which is a very common practice in many developing and underdeveloped countries where a significant proportion of individuals handle or treat their minor (mild) illnesses without the consultation of a doctor. This way, sadly, is growing day by day, in addition, some people prefer to search on the internet for the treatment of signs and symptoms and use smartphone apps, this behavior is very popular leading to severe health-related problems that may be short or longterm health effects (Pavydė et al., 2015).

Several studies have highlighted that parental expectation of receiving antibiotic prescriptions, previous use experience with antibiotics, and perceived effectiveness of antibiotics are strong drivers of inappropriate antibiotic use for children (**Tec**k et al., 2016) (Thabet et al., 2015). A study conducted in the United States showed that asthmatic children received antimicrobials more frequently than children without asthma. Another study showed that the overuse of antibiotics in

asthmatic children may be linked to respiratory tract infections associated with asthma exacerbations and to increased comorbidities associated with asthma, rather than routine treatment of asthma itself (Al-Ayed, 2019b).

2.4. Conceptual framework

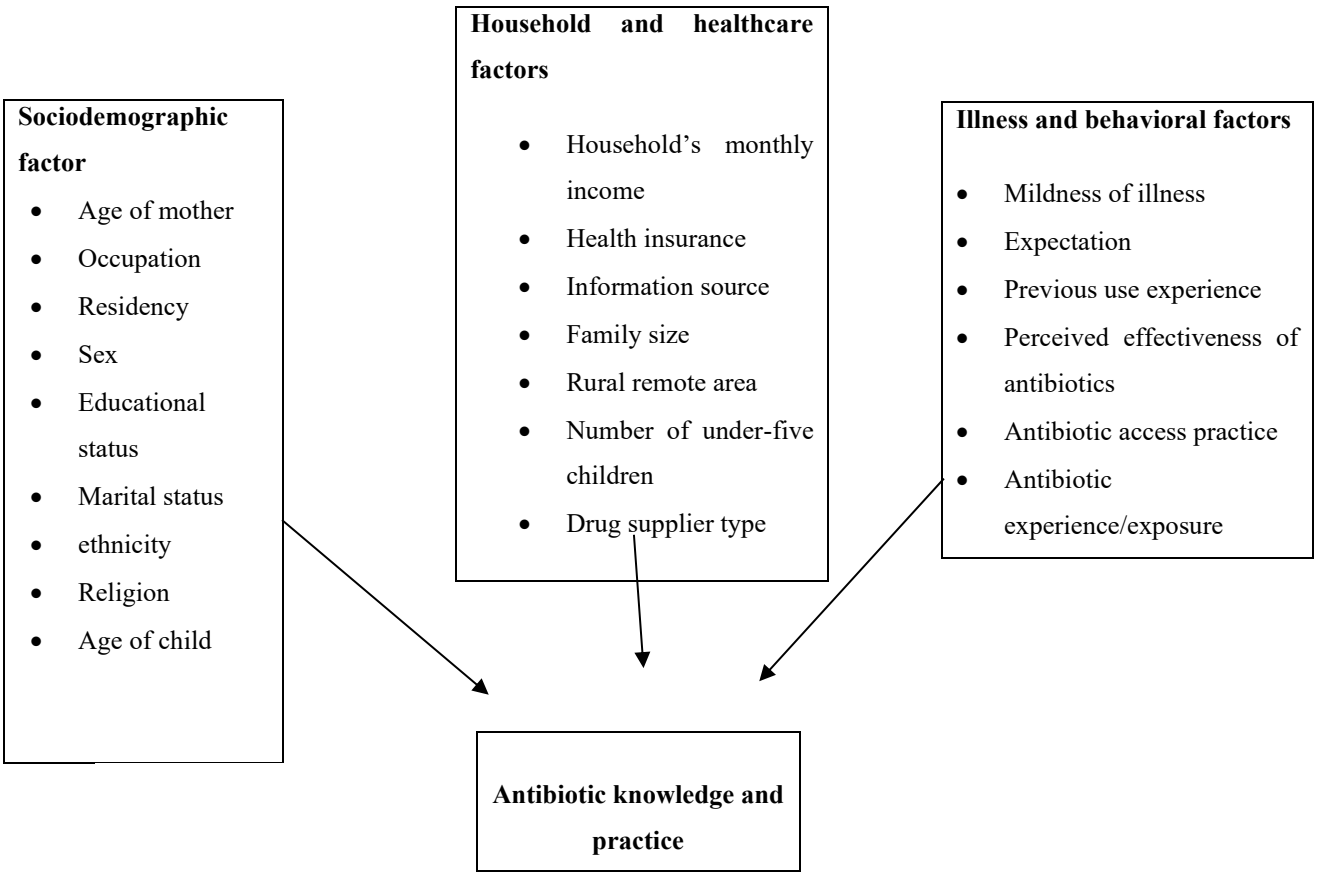

Figure 1: Conceptual framework of factors associated with poor antibiotic knowledge and practices among mothers of under-five children (constructed by the investigator from the review of different literature)

3. MATERIALS AND METHODS

3.1. Study Area and Period

This study was conducted in Haramaya district, Eastern Hararghe zone, Oromia Regional State of Ethiopia. It is one of the 18 districts of the zone and is located 520 km to the East of Addis Ababa, the capital city of Ethiopia. The district is geographically located at 42° 3’ longitude, and 9° 26’ latitude, with its altitude ranging from 1,400 to 2,340 meters above sea level. It is bordered by Kurfa Chale district in the south, by Kersa District to the West, Dire Dawa city to the North, to the East by Kombolcha district, and by the Harari National Region State to the southeast (Adem, 2021).

The district has an estimated total population of 304,276. Of these 152,442 (50.1%) are men and 151,834 (49.9%) are women (Adem, 2021). Haramaya has 34 rural kebeles and three urban kebeles in Haramaya town (Girma Gudata et al., 2022). Haramaya district has one district hospital (located in Haramaya town), eight health centers, and 38 health posts. There are also 12 private clinics and five traditional medical practitioners. All the health centers are accessible by road (Girma Gudata et al., 2022). The study was conducted during the period of May 29, 2025 to June 30, 2025.

3.2. Study design

A community-based cross-sectional study design was used. The study was undertaken through household survey at selected clusters (i.e., administrative units/villages) in rural Haramaya district.

3.3. Population

3.3.1. Source Population

All mothers of children under-five living in rural Haramaya district were the source population.

3.3.2. Study Population

Study population for this study were mothers of children under five from selected kebeles in rural Haramaya district who met the inclusion criteria during the study period.

3.4. Inclusion and exclusion criteria

3.4.1. Inclusion Criteria

Mothers having at least one child aged below five years old and who lived in selected kebeles of rural Haramaya district at least six months before the data collection time were considered for the study.

3.4.2. Exclusion Criteria

Mothers who were away during the past six months just before the data collection period were excluded from the study. Mothers who are health workers were excluded from the survey.

3.5. Sample size determination

To determine the sample size for this study; the outcome variables and factors that were significantly associated with the outcome variables from previous similar studies was considered. The sample size for specific objectives was calculated separately by adding 10% contingency on all specific objectives and the one with the largest number was then considered for this study.

For the first and second specific objectives, the sample size for the study was determined using the following formula:

For specific objectives 1: $\boldsymbol{n = \frac{(Z\alpha/2)^2 \, P\,(1-P)}{d^2}}$

Where, n=the minimum sample size required, p = expected proportion of the outcome of interest, z = the standard value of confidence level of alpha = 95%, d=the margin of error between the sample and the population (0.05), and proportion of poor knowledge for antibiotics, p = 34.2% taken from the above similar study (Paredes et al., 2022).

Accordingly, $n = \frac{(1.96)^2 \, 0.355\,(1-0.342)}{(0.05)^2} = \frac{(1.96)^2 \, 0.342\,(1-0.342)}{(0.05)^2} = \frac{0.342*0.654}{0.0025} = 345.7 \approx 346$

When 10% contingency added, the sample size was 380.

For the second specific objective: $\boldsymbol{n = \frac{(Z\alpha/2)^2 \, P\,(1-P)}{d^2}}$

For the second specific objective, P = 18.2% (mothers' poor antibiotic practice for use children under five children) (Nafei et al., 2022).

$$n = \frac{(1.96)^2\ 0.182(1-0.182)}{(0.05)^2} = \frac{(1.96)^2\ 0.182(1-0.182)}{(0.05)^2} = \frac{0.182*0.0.818}{0.0025} = 229$$

Therefore, when 10% contingency is added, it result in 252.

For the third specific objective: Sample size for this specific objective was determined using double population proportion formula with the use of EPI-INFO software.

Table 1: Sample size calculation for factors associated with mother's poor antibiotic use practices for children under five using Epi-Info, 2025.

		Mother's poor antibiotic use practices for children under five			
		Yes	**No**		
Factors	**Assumptions**	**%outcome of Exposed**	**%outcome of unexposed**	**Reference**	**Sample size**
Age of respondent	CI:95% Power:80% Ratio: 1:1 OR:2.39	56.5%)	23.6%	(Paredes et al., 2022)	214
Mothers education level	CI:95% Power:80% Ratio: 1:1 OR:2.357	80%	62.9%	(Teck et al., 2016)	240
Health insurance	CI:95% Power:80% Ratio: 1:1 OR:2.52	67.9%	32.1%	(Abrahim et al., 2023)	172

By comparing the calculation results of all sample sizes determined for each specific objective, the largest minimum sample size obtained for specific objective one (i.e., 346) was considered for this study. After adding 10 % for the possible non-response rates, the sample size considered for this study was determined 380 mothers of children under five.

3.6. Sampling procedure

A simple random sampling technique (lottery method) was used to select 11 kebeles from among the rural kebeles under the Haramaya Health and Demographic Surveillance system (HDSS) of Haramaya University, including Amuma, Damota, Becheke, Kerensa Derebe, Finkile, Kuro, Biftu Geda, Ifa Oromia, Adele Welteha, Gobe Chala, and Negeya, with Fendisha Lencha considered as a pre-test site. The total number of mothers with children under five years of age in the selected kebeles as of January 2025 was 10,135 (unpublished data obtained from Haramaya district Health office). A proportional allocation was used to sample the study participants based on the number of active mothers of children under five in each selected kebeles. As per information obtained from the Haramaya district Health office, the total number of mothers of children under five in each selected kebeles were 900 for Amuma, 736 for Kerensa Derebe, 689 for Adele welteha, 410 for Becheke, 1316 for Biftu Geda, 591 for Damota, 432 for Finkile, 1208 for Gobe Chala, 1331 for Ifa Oromia, 1599 for Kuro, and 923 for Negeya. The list of households where mothers of children under-five lived with their respective addresses was obtained and directed from each Kebele administrative office. From each kebele, the required number of mothers of children under-five was taken proportional to their size. This required number of mothers of children under five from each selected Kebele was sampled using a simple random sampling technique. A schematic presentation for the sampling process is presented in Figure 2 below.

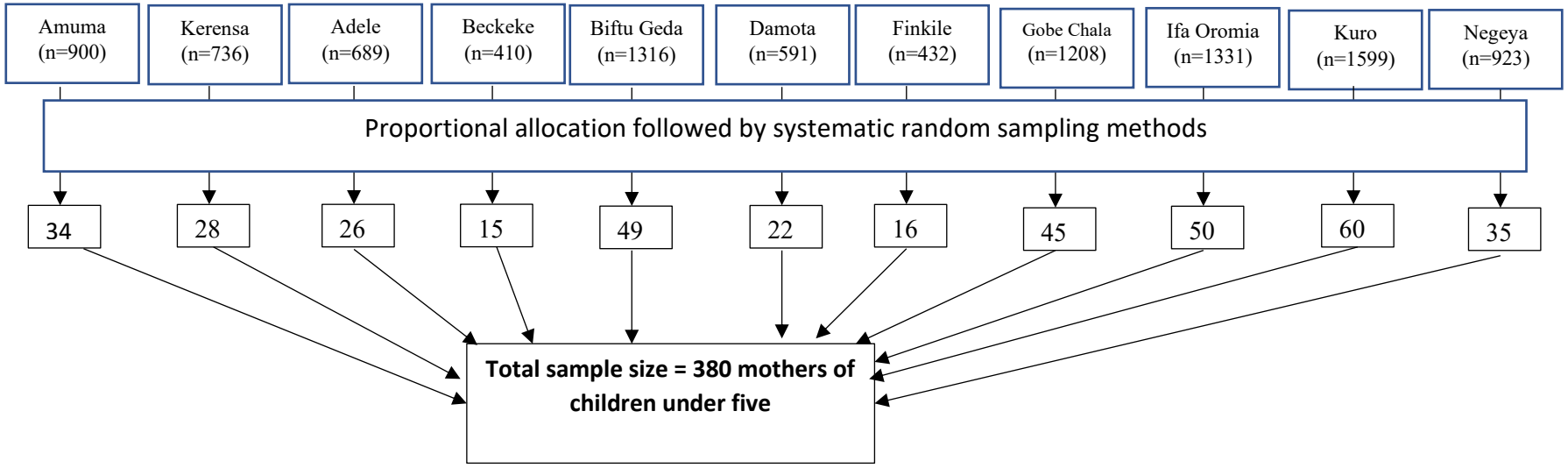

Figure 2: Schematic presentation of the sampling procedure for study participants from selected rural Haramaya district, eastern Ethiopia, 2025.

3.7. Data Collection Methods

3.7.1. Data Collection Instruments

A questionnaire was prepared in reference to similar studies (Agarwal et al., 2015a) (Albayrak et al., 2021) (Al-Dossari, 2013) (Alluqmani et al., 2017) (Alkaff et al., 2019a) (Elbur et al., 2016) (Revathi and Pandurangan, 2020) (Shtayyat and Abu-Baker, 2023) (Yu et al., 2014). The questionnaire contained three parts. The first part included sociodemographic characteristics such as age, gender, marital status, residence, ethnicity, religion, occupation, and level of education. The second part consisted of 25 questions about antibiotic knowledge such as the knowledge of general antibiotic information, antibiotic usage, antibiotic resistance, and antibiotic side effects. The answer choices are "True", "False", and "Don't know" for the knowledge, which was scored as 0 (for No/Don't know the answer) and 1 (for Yes answer) for the positive items, and vice versa for the negative items.

The third part contains 20 questions about antibiotic practices of mothers for under five children includes, general practices of antibiotics, mothers' patterns of antibiotic practice in common childhood illnesses, reasons for self-medications.

3.7.2. Data Collectors

Three diploma pharmacy technicians and one pharmacist supervisor who were fluent in Afaan Oromo but did not work at the study sites were recruited for data collection. Training mainly on the objectives of the study, respondent rights, informed consent, and interview techniques was provided to data collectors in two days (one day theoretical and one day practical). The supervisor and principal investigator closely followed the data collection process throughout the data collection period. All questionnaires were reviewed and corrected each night accordingly if there were errors**.**

3.7.3. Data Collection Procedure

Data were collected from mothers of children under five at the selected kebeles in each using a household survey. The data collectors started the data collection after identifying the selected households for eligibility. A face-to-face interview was conducted at each selected household using a structured questionnaire. The participants were informed about the study title, purpose, procedure, risks and benefits, rights, and confidentiality of the

study. The interview took an average of 10 - 20 minutes and was carried out in a private setting.

3.8. Study Variables

3.8.1. Dependent Variables

Mothers' knowledge of antibiotic use for under-five year children

Mothers' practices of antibiotic use for under five year children

3.8.2. Independent Variables

Socio-demographic characteristics of the mothers: sex, age, marital status, residence, ethnicity, religion, Occupation and educational level.

Household and child-related factors: family size, household monthly income, health insurance, Information source, rural remote area and number of under-five children.

Treatment-seeking approach: Mildness of illness, expectation, previous use experience, and perceived effectiveness of antibiotics.

3.9. Operational Definitions

Knowledge: Peoples' understanding and expectations of antibiotics (Teck et al., 2016). Number (%) mothers who answered correctly below the mean of the total knowledge questions was considered to have **poor knowledge** (Bianco et al., 2020)

Practice: Number (%) of mothers who scored below the mean of the total practice questions was considered to have poor practice and those who scored mean and above have good practice (Abrahim et al., 2023).

3.10. Data quality control

An interviewer-administered questionnaire was developed after reviewing related studies. Most of the questions developed were customized from previously published studies conducted in different countries and are tailored to suit the local situation and assure their applicability. The questionnaire items were modified to be used in the Ethiopian setting.

Two days' training was provided to the data collectors by the principal investigator on objectives, eligible study subjects, consent, the benefit of the study, and items in the questionnaire. The questionnaire was translated into Afaan Oromo languages and again translated back into English to check the consistency of the questionnaire by language experts in both cases. The questionnaires was pre-tested a week before the actual data collection days on 5% of the sample size in unselected kebele for the study, and then correction and modification of the tool was undertaken accordingly.

During data collection, a trained supervisor oversought on the data collectors to supervise how they were doing their tasks in the study area. At the end of each data collection day, the principal investigator also checked the completeness of the filled-out questionnaires. To avoid data errors, double data entry through EpiData version 4.6 was used, and proper categorization and coding of the data was done during the data cleaning phases.

3.11. Data Analysis

The collected data were entered into Epidata 4.2 and exported to Statistical Package for Social Sciences (SPSS) version 21 for analysis. The analysis of answers to questions was involve descriptive quantitative statistics, e.g., frequency and percentage for categorical variables and means ± standard deviation (SD) for numerical variables. Then the information was presented using frequency tables, figures, and graphs.

A binary logistic regression analysis was done to see the association of with mothers' poor antibiotic knowledge status and modified poisson regression with robust standard error was employed to identify factors associated with inappropriate antibiotic use practice of the mothers for children under-five. Accordingly, factors with p-values ≤ 0.25 in the univariate association were retained for inclusion into the multivariable logistic and modified Poisson regression analysis to identify the independent variables associated with each of the dependent variables. A multicolinearity test was carried out to see the correlation between independent variables using variance inflation factor. The assumptions of binary logistic regressions was checked by the likelihood ratio test and Hosmer-Lemeshow test to assess whether the necessary assumptions for the application of binary logistic regression was

fulfilled. The odds ratio and prevalence ratio (PR) were calculated with 95% CI, and a P-value ≤ 0.05 was considered statistically significant.

3.12. Ethical Considerations

Before embarking on any steps of the study, ethical clearance was obtained from the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University. Then an official letter of permission was written from the College of Health and Medical Science to selected kebeles in which the study was conducted. After permission was obtained from each selected kebele administrator, data collection was started. For all study participants, information was given about the study before data collection on its possible risks, benefits, confidentiality, privacy, voluntary activity, right of withdrawal, and the time the questionnaire can take, and then informed, voluntary, written, and signed consent was obtained from each participant before data collection. Personal identification was not written on the questionnaire to maintain the confidentiality of the study participants.

3.13. Information Dissemination

The final result of this finding will be presented in an open defense and submitted to Haramaya University School of Graduate Study and Haramaya District Health Office. Finally, it will be published in a peer-reviewed journal and presented at different national and international conferences and seminars.

4. RESULTS

4.1. Socio-demographic characteristics of mothers

A total of 380 mothers of children under-five were studied with 100% response rate. Of a total mothers, 292 (76. 84%) of them were with aged 20-39 years with mean age of 30 years. Among the mothers, 352 (92.63%) of them were married, 274 (72.11%) were housewives, and more than half, 248 (65.26%) of them had no formal education(Table 2).

Table 2: Sociodemographic characteristics of mothers of under-five children in rural haramaya, eastern Ethiopia (n=380).

Variable	Category	Frequency	Percent
Age	< 20 years	28	7.37
	20-39 years	292	76.84
	40-59 years	53	13.95
	⩾ 60 years	7	
Mean age ± SD		30.0 ± 9.3	
Religion	Muslim	380	100
Ethnicity	Oromo	380	100
Educational status	No formal education	248	65.26
	Primary education	117	30.79
	Secondary education	10	2.63
	Tertiary education	5	
Marital status	Single	11	2.89
	Divorded/Widowed	17	4.47
	Married/living togather	352	92.63

Occupation	Housewife	274	72.11
	Farmer	83	21.84
	Unemployed	9	
	Merchant	6	
	Employee	5	
	Other*	3	

Asterisk (*)-daily laborer.

4.2. Household characteristics and child-related factors

Among 380 households, 91.8% were enrolled in community-based health insurance. Health facilities were the main source of information on child care and antibiotics (73.8%), followed by drug stores (15.2%) and family members (10.4%). Of the children, 143 (60.1%) were female and 95 (39.9%) were male, with a mean age of 2.12 years (SD = 1.26). The mean monthly household income was 8,498 ETB (SD = 5,883). Most households (74.2%) had five or more members, with a mean family size of 3.66 (SD = 0.63). Mothers traveled an average of 46.1 minutes (SD = 33.4) to access health services, indicating moderate accessibility challenges in these rural areas(Table 3).

Table 3: Household charatecteristics and child related factors among mothers of under-five children in rural haramaya, eastern Ethiopia (n=380)

Variable	Category	Frequency	Percent
CBHI use	No	31	8.16
	Yes	349	91.84
Information source	Health facility	248	73.81
	Drug store	51	15.18
	Family members	35	10.42
	Others	2	

Family size	Three	32	8.42
	four	66	17.37
	≥ five	282	74.21
Average family size (**± SD**)		3.657895 ± .6281151	
Average m**onthly income** of the household **(ETB)**	Mean ± SD	8,500 ± 5,880	
Sex of antibiotic user child	Female	143	60.08
	Male	95	39.92
Average age of antibiotic user child	Mean±SD	2.121849 ± 1.258668	

4.3. Treatment-seeking behaviors of mothers of under-five children

For treatment-seeking in severe illness, 40.5% of mothers went to hospitals, 19.2% to health centres, and 10.3% to private clinics. A quarter of mothers seek multiple sources (24.7%). Most mothers (86.6%) reported that prior use of antibiotics would influence their future use. (Table 4).

Table 4: Treatment-seeking behaviors of mothers of under-five children in rural Haramaya district, 2025 (n = 380)

Characteristics	Response	Freq.	Percent
Healthcare options sought in severe illness	Hospital	154	40.5
	Health centre	73	19.2
	Private clinic	39	10.3
	Multiple sources	94	24.7
	Pharmacy/drug shop	2	
	Herbalist/others	3	
Previous experience	Would still use	329	86.6
	No influence	51	13.4

4.4. Antibiotic knowledge and practice of mothers of under-five children

Regarding antibiotic knowledge, the percentage of mothers who answered correctly below the mean of the total knowledge questions was considered to have poor knowledge. Accordingly, from a total of 380 mothers, 225 (59.21%) of them responded below the mean score and have poor antibiotic knowledge. On the other hand, the percentage of mothers who scored below the mean of the total practice questions was considered to have inappropriate antibiotic practice. Of the 380 mothers, 127 (33.42%) of them used antibiotics for their under-five children. From 127 study participants with antibiotic practice, 51 (40.16%) of them practiced inappropriate antibiotic use (Table 5).

Table 5: Antibiotic knowledge and practice among mothers of under-five children in rural Haramaya, eastern Ethiopia (n=380)

Variable	Category	Frequency	Percentage
Antibiotic knowledge	Good knowledge	155	40.79
	Poor knowledge	225	59.21
Antibiotic use for children	Yes	127	33.42
	No	253	66.58
Antibiotic use practice	Appropriate	76	59.84
	Inappropriate	51	40.16

4.5. Factors Associated with Poor Antibiotic Knowledge among Mothers of Under-Five Children

4.5.1. Bivariate Poisson Regression Analysis of Factors Associated with Poor Antibiotic Knowledge of Mothers

In bivariate Poisson Regression Analysis each independent variable with poor knowledge was assessed for its association. As a result, Mothers'age 20–39 years (CPR = 1.45; 95% CI: 1.13–1.87; $p = 0.004$) and age ≥40 years (CPR = 1.35; 95% CI: 0.95–1.92; $p = 0.090$) were associated with higher poor antibiotic knowledge compared to ≤20 years, Mothers' educational level (CPR = 0.68; 95% CI: 0.50–0.92; $p = 0.013$), Family size ≥5 (CPR = 0.73; 95% CI: 0.54–0.99; p = 0.045), experience-suppliers (CPR = 2.10; 95% CI: 1.25–3.52; $p = 0.005$), Working (CPR = 0.44; 95% CI: 0.33–0.67; $p < 0.001$), clinic information (CPR = 0.50; 95% CI: 0.30–0.85; $p = 0.012$) and Distance to health facility (CPR = 1.23; 95% CI: 0.98–1.55; $p = 0.087$) were considered for Multivariable Poisson Regression Analysis at *P*-value ≤ 0.25 and to identify an adjusted association with the prevalence of poor knowledge (Table 6).

Table 6: Bivariate Poisson Regression Analysis Showing Crude Prevalence Ratios (CPR) for Factors Associated with Poor Antibiotic Knowledge among Mothers of Under-Five Children(n = 380)

Variable	Category	N (%)	CPR	95% CI	p-value
Age (years)	≤20	40 (10.5)	1	–	–
	20–39	260 (68.4)	1.45	1.13–1.87	0.004
	≥40	80 (21.1)	1.35	0.95–1.92	0.090
Education	No	150 (39.5)	1	–	–

	Yes	230 (60.5)	0.68	0.50–0.92	0.013
Family Size (FS)	3	110 (28.9)	1	–	–
	4	140 (36.8)	0.81	0.59–1.12	0.210
	≥5	130 (34.3)	0.73	0.54–0.99	0.045
Perceived experience of the drug supplier	No	300 (78.9)	1	–	–
	Yes	80 (21.1)	2.10	1.25–3.52	0.005
Working status	No	250 (65.8)	1	–	–
	Yes	130 (34.2)	0.44	0.33–0.67	<0.001
Information source	No	340 (89.5)	1	–	–
	Yes	40 (10.5)	0.50	0.30–0.85	0.012
Distance to health facility	Near	270 (71.1)	1	–	–
	Far	110 (28.9)	1.23	0.98–1.55	0.087

CPR, Crude prevalence ratio; Cl, confidence interval

4.5.2.Multivariable Poisson Regression Analysis of Factors associated with Mothers' Poor Antibiotic Knowledge

Mothers with no formal education were more likely to have poor antibiotic knowledge compared to those with education (APR = 1.044; 95% CI: 1.009–1.081; p = 0.014). Mothers with no experience-suppliers were more likely to have poor knowledge than those without experience (APR = 4.802; 95% CI: 1.666–13.842; p = 0.004). Mothers who were not working were more likely to have poor knowledge compared to those who were employed (APR = 0.303; 95% CI: 0.125–0.731; p = 0.008). Mothers who did not receive

clinic information were more likely to have poor knowledge than those who received information (APR = 0.448; 95% CI: 0.253–0.795; $p = 0.006$) (Table 7).

Table 7: Multivariable Poisson Regression Analysis Showing Adjusted Prevalence Ratios (APR) for Factors Associated with Poor Antibiotic Knowledge among Mothers of Under-Five Children(n = 380)

Variable	Category	N (%)	APR	95% CI	p-value
Education	No	150 (39.5)	1	–	–
	Yes	230 (60.5)	1.044	1.009 – 1.081	0.014
Perceived experience of drug supplier	Poor	300 (78.9)	1	–	–
	Good	80 (21.1)	4.80	1.666 – 13.842	0.004
Working status	No	250 (65.8)	1	–	–
	Yes	130 (34.2)	0.30	0.125 – 0.731	0.008
Clinic information	No	340 (89.5)	1	–	–
	Yes	40 (10.5)	0.45	0.253 – 0.795	0.006
Distance to health facility	≤1km	270 (71.1)	1	–	–
	>1km	110 (28.9)	1.23	0.980 – 1.550	0.087

APR, Adjusted prevalence ratio; Cl, confidence interval

4.6. Factors associated with inappropriate antibiotic use practice of mothers for children under-five

4.6.1. Univariable mixed-effects Poisson regression analysis of factors associated with inappropriate antibiotic use practices among mothers of under-five children

Mothers aged 20–39 years had 53% decreased practice of inappropriate antibiotic use for children under-five. (CPR = 0.47, 95% CI: 0.28–0.81, $p = 0.006$) compared to those aged less than 20 years. Mothers with practice of non-prescribed antibiotic access had 2.81 times greater prevalence of inappropriate antibiotic use practice for children under-five compared to those who did not (CPR = 2.81, 95% CI: 2.02–3.90, $p < 0.001$). Drug source also showed significant associations: obtaining antibiotics from private clinics (CPR = 5.57, 95% CI: 2.16–14.37, $p < 0.001$), pharmacy/drug shop (CPR = 3.50, 95% CI: 1.13–10.88, $p = 0.030$), and others including kiosks (CPR = 3.80, 95% CI: 1.35–10.72, $p = 0.012$) revealed increased prevalence of inappropriate use compared with obtaining them from hospitals or health centers. Regarding previous antibiotic courses, mothers who reported using antibiotics four or more times in the past six months had 2.08 times increased prevalence of inappropriate antibiotic use practices (CPR = 2.08, 95% CI: 1.31–3.30, $p = 0.002$) compared with those with one antibiotic course. Belief about antibiotic quality was also important: mothers who perceived antibiotics as being of poor quality had nearly twice greater prevalence of inappropriate antibiotic use practice compared to those who believed in their quality (CPR = 1.84, 95% CI: 1.20–2.83, $p = 0.005$). Mothers who were rarely instructed about drugs had 2,29 time greater prevalence of inappropriate antibiotic use for children under-five (CPR = 2.29, 95% CI: 1.48–3.52, $p < 0.001$) compared to those who always instructed about drugs (Table).

Table 8: Univariable mixed-effects modified Poisson regression analysis of factors associated with inappropriate antibiotic use practices among mothers of under-five children (n = 127)

Variable	Category	N (%)	CPR	95% CI	p-value
Age in years	≤ 20	28 (22.0%)	1		
	20–39	76 (59.8%)	0.47	0.28 – 0.80	0.006
	≥ 40	23 (18.1%)	0.57	0.25 – 1.30	0.183
Age of antibiotic user child		–	0.74	0.62-0.87	0.000
Non-prescribed access	No	102 (80.3%)	1		
	Yes	25 (19.7%)	2.81	2.02 – 3.90	0.000
Drug supplier	Hospital/health center	28 (22.0%)	1		
	Primary clinic	33 (26.0%)	5.57	2.16 – 14.37	0.000
	Pharmacy/drug shop	15 (11.8%)	3.50	1.13 – 10.88	0.030
	Others*	51 (40.2%)	3.80	1.35 – 10.72	0.012
Previous antibiotic courses	Once	101 (79.5%)	1		
	Two times	16 (12.6%)	0.97	0.485 – 1.959	0.943
	Three times	7 (5.5%)	2.08	1.31 – 3.29	0.002
	≥ Four times	3 (2.4%)	1.30	0.32 – 5.26	0.713
Belief in the quality of antibiotic received	Yes (good quality)	93 (73.2%)	1		
	No	34 (26.8%)	1.84	1.19 – 2.82	0.005
Fewer dose use experience	No	82 (64.6%)	1		
	Yes	45 (35.4%)	1.44	0.89 – 2.34	0.136
Frequency of instruction about drugs	Frequently instructed	117 (92.1%)	1		
	Rarely instructed	2 (1.6%)	2.29	1.48 – 3.52	0.000
	Never instructed	8 (6.3%)	1.27	0.60-2.70	0.523

CPR, Crude prevalence ratio; Cl, confidence interval

*others-includes kiosks or drug dealers.

4.6.2. Multivariable mixed-effects modified Poisson regression analysis for factors associated with inappropriate antibiotic use practices among mothers of under-five children

A one year increase in a child age was associated with 24% decrease in the prevalence of inappropriate antibiotic use practice for children by mothers of children under-five (APR: 0.76; 95% CI: 0.67-0.87; P<0.001). Mothers with non-prescribed antibiotic access practice had 1.87 times greater practice of inappropriate antibiotic use compared with those who did not (APR = 1.87, 95% CI: 1.15–3.04). Compared to mothers who obtained antibiotics from hospitals or health centers, the practice of inappropriate antibiotic use for children was 5.75 times greater among those who obtained antibiotics from primary clinic (APR: 5.75; 95% CI: 2.40 – 13.74), 3.48 times greater among those who obtained antibiotics from drug store/shops (APR: 3.48; 95% CI: 1.18 – 10.23), and 2.96 times greater among those who obtained from kiosks or drug dealers (APR: 2.96; 95% CI: 1.13 – 7.75). Furthermore, mothers who had taken antibiotics four or more times in the past six months had 2.91 times greater practice inappropriate antibiotic use for children (APR: 2.91; 95% CI: 1.35 – 6.29) than those who had an antibiotic course of one time. Rarely instructed mothers had 2.29 times greater prevalence of inappropriate antibiotic use practice for children under-five (APR: 2.29; 95% CI: 1.484 – 3.519) than those who had been frequently instructed about drugs (Table 9).

Table 9: Multivariable mixed-effects Poisson regression of factors associated with inappropriate antibiotic use practices among mothers of under-five children (n = 127)

Variable	Category	N(%)	APR	95% CI	p-value
Age of mothers in	≤ 20	1	1		
years	20–39	0.87	0.87	0.55 – 1.37	0.546
	≥ 40	1.50	1.50	0.57 – 3.95	0.412
Age of antibiotic		–	0.76	**0.67-0.87**	≤0.001
user child					
Non-prescribed	No	1	1		
antibiotic access	Yes	1.87	1.87	**1.15 – 3.04**	0.012
	Yes	1	1		

Counseling about antibiotics	No	1.21	1.21	0.63-2.32	0.555
Drug supplier	Hospital/health center	1	1		
	Primary clinic	5.75	5.75	**2.40 – 13.74**	≤0.001
	Pharmacy/drug shop	3.48	3.48	**1.18 – 10.23**	0.023
	Others*	2.96	2.96	**1.13 – 7.75**	0.012
Previous antibiotic courses in the past six months	Once	1	1		
	Two times	1.17	1.17	0.64 – 2.12	0.614
	Three times	1.67	1.67	0.81 – 3.44	0.162
	≥ Four times	2.91	2.91	**1.35 – 6.29**	0.007
Belief in the quality of antibiotic received	Yes (good quality)	1	1		
	No	1.35	1.35	0.88 – 2.05	0.167
Fewer dose use experience	No	1	1		
	Yes	1.08	1.08	0.66 – 1.79	0.741
Frequency of instruction about drugs by suppliers	Frequently instructed	1	1		
	Rarely instructed	2.29	2.29	**1.484 – 3.519**	≤0.001
	Never instructed	1.27	1.27	0.60-2.70	0.523

APR, Adjusted prevalence ratio; Cl, confidence interval

5. DISCUSSION

This study showed that 59.21% of mother's of under five children have poor antibiotic knowledge. This finding was in line with study conducted in Pakistan (58.3%) (Shtayyat and Abu-Baker, 2023). The finding is lower than study conducted in Peru (79%) (Paredes et al., 2022), Indonesia (70%) (Alkaff et al., 2019b), but higher than study conducted in India (17%)(Agarwal et al., 2015b). The differences in antibiotic knowledge among mothers across various studies can be attributed to different factors including inadequate education, limited access to healthcare information, and insufficient communication between healthcare providers and patients.

In this study, mothers with no formal education were more likely to have poor antibiotic knowledge compared to those with education. similarly, a study conducted in Cyprus reported that low parental education was the most important independent risk factor positively related to poor antibiotic knowledge (AOR = 2.88, 95% CI 2.02 to 4.12, $p < 0.001$) (Rousounidis et al., 2011).The study also found that mothers with no experience-suppliers were more likely to have poor antibiotic knowledge than those without experience.

Moreover, mothers who have not a work were more likely to have poor knowledge compared to those who have a work . Finally study showed that mothers who did not receive drug information were more likely to have poor knowledge than those who have received drug information.This study reported that 40.2% of mothers had inappropriate antibiotic use practices for their children under-five. The finding was lowe than study conducted at Peru (52%) (Paredes et al., 2022), Saudi Arabia (68.6%) (Al-Ayed, 2019a), and Tanzania (47.7%) (Simon and Kazaura, 2020b). On the other hand, the finding was higher than study conducted at Iran (18.2%) (Sharif et al., 2021), Nigeria (24.4%) (Adisa et al., 2018a), and Aksum, Ethiopia (12.8%) (Zeru et al., 2020a). The differences in inappropriate antibiotic use practices among mothers of under-five children across various studies can be attributed to a complex interplay of healthcare system characteristics, public health education, cultural beliefs, socioeconomic factors, study methodologies, and local health policies. Not only does it pose immediate health risks to children suc]h as adverse

drug reactions or ineffective treatment, but it also contributes to the broader public health challenge of antibiotic resistance (Llor and Bjerrum, 2014).

This study revealed that age of child was negatively associated with poor antibiotic use practice.A one year increase in a child age was associated with 24% decrease in the prevalence of inappropriate antibiotic use practice for children by mothers of children under-five.

This study also showed that non-prescribed antibiotic access was significantly associated with inappropriate antibiotic practice. In addition,this study also reported that Compared to mothers who obtained antibiotics from hospitals or health centers, the practice of inappropriate antibiotic use for children was 5.75 times greater among those who obtained antibiotics from primary clinic, 3.48 times greater among those who obtained antibiotics from drug store/shops, and 2.96 times greater among those who obtained from kiosks or drug dealers. Mothers with non-prescribed antibiotic access practice had 1.87 times greater practice of inappropriate antibiotic use compared with those who did not. Mothers with non-prescribed antibiotic access practice, those who accessed antibiotics from primary clinics, drug store/drug shops, or kiosks, those with multiple antibiotic courses and those who were instructed about drugs rarely had a significantly increased practice of inappropriate antibiotic use for children under-five compared with their counterparts (Agarwal et al., 2015a) (Al-Ayed, 2019b)

To address both the knowledge and practice gaps, a multifaceted approach is necessary. Healthcare providers must take an active role in educating mothers during routine check-ups and consultations (Balea et al., 2024). This could involve discussing the appropriate use of antibiotics as part of a broader conversation about child health. Additionally, healthcare systems should consider implementing standardized educational materials that can be shared with patients (Bhattad and Pacifico, 2022). Furthermore, public health campaigns aimed at raising awareness about antibiotic use should target not just mothers but the entire community. These campaigns can utilize various media platforms social media, radio, television to reach a wider audience and emphasize the importance of responsible antibiotic use (Redfern et al., 2020). Collaboration between healthcare professionals, educators, and community leaders will be vital in fostering an environment

where mothers feel supported in making informed decisions about their children's health (Shittu and King).

5.1. Strengths and Limitations of the Study

Strengths

- This study is among the few community-based studies conducted in rural Ethiopia that specifically examined both knowledge and practices of antibiotic use among mothers of under-five children, thereby addressing an important Knowledge of Antibiotic use and practice concern.
- The use of a mixed-effects modified Poisson regression model allowed adjustment for clustering at the village level, which strengthens the validity of the associations identified.
- The relatively large sample size and high response rate enhanced the statistical power and representativeness of the findings.
- By exploring both knowledge and practice dimensions and their associated factors, the study provides a more comprehensive understanding that can guide tailored interventions.

Limitations

- The cross-sectional design limits the ability to establish causal relationships between independent variables and poor antibiotic knowledge or inappropriate practices.
- Data were collected through self-reporting, which may be subject to recall bias or social desirability bias, particularly regarding inappropriate antibiotic use.
- The study was conducted in a single rural district, which may limit the generalizability of the findings to other settings with different healthcare systems, cultural practices, or socioeconomic conditions.
- Certain variables such as household income, health literacy level, and healthcare-seeking behavior were not deeply explored, which might have provided additional insights into the determinants of mothers' knowledge and practices.

6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The findings of this study underscore critical gaps in the knowledge and practices related to antibiotic use among mothers of under-five children. It is particularly concerning that more than half of the participants exhibited a poor understanding of antibiotics, which can lead to serious health implications for their children. Furthermore, a significant proportion of these mothers were found to be engaging in inappropriate antibiotic usage for children, raising alarms about the potential for adverse health effects and the development of antibiotic-resistant strains of bacteria. Addressing these issues through enhanced education are essential to improve health outcomes and combat the growing challenge of antibiotic resistance in the community.

6.2. Recommendations

Based on the present findings the following recommendations were made:

For Mothers of Under-Five Children:

- Always consult a healthcare professional before administering any antibiotics to your child. Do not self-medicate or use leftover antibiotics from previous prescriptions.
- Adhere strictly to the prescribed dosage and duration of antibiotic treatment. Complete the entire course even if your child feels better before finishing it.
- Participate in community health programs that focus on antibiotic awareness and share this knowledge with other mothers.

For Health Professionals:

- Create an open environment where mothers feel comfortable asking questions about antibiotics and their child's health.
- Participate in or organize community workshops focused on educating parents about antibiotic resistance and safe medication practices.

For Health Bureaus:

- Establish systems to track antibiotic prescriptions in pediatric populations to identify trends and areas for intervention.
- Work with local organizations to create culturally sensitive educational materials that resonate with diverse populations.

For Researchers:

- Investigate the underlying factors contributing to poor knowledge and practices regarding antibiotic use among mothers, including cultural beliefs and access to information by conducting further studies.

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8. APPENDIXCES

8.6. Data Collection Questionnaire

S/N	**Question**	**Response Options**
1	Kebele name	_____
2	Gender	Male / Female
3	Age of mother (years)	_____
4	Ethnicity	_____
5	Religion	_____
6	Educational status of mother	None primary Secondary highereduc._____
7	Number of children	_____
8	Monthly family income	_____
9	Marital status	A.married/living with B.Divorced C.Single D.Widow
10	Occupation	A.Farmer B.Housewife C.Daily labor D.Gov't employee
11	Distance from nearest health facility	A.Near B.Far
12	Source of health-related information	A.Gov't Health Facility B.Private Health Facility C.Others_____
13	Age of child	

14	what_antibiotics_do?	A. Against Bacteria B. Against Virus C. Stop pain
15	Did your child receive antibiotics in the past 6 months?	A. Yes B. No
16	What is the indication of antibiotics ?	A. Stomachache B. Bladder infection C. Weakness
17	Do you complete the course of antibiotics as prescribed?	A. Yes B. No
18	Can antibiotics harm the child/any perceived illness?	A. Yes B. No
19	Have you ever used leftover antibiotics from a previous prescription?	A. Yes B. No
20	What antibiotic_mean?	A. Painkiller B. Drug against infection
21	Upper Respiratory Infection is caused by a virus	A. True B. False C. I don't know
22	Antibiotics should always be given for cold, cough, and catarrh	A. True B. False C. I don't know
23	Antibiotics can cure infections caused by viruses	A. True B. False C. I don't know
24	Antibiotics do not have side effects	A. True B. False C. I don't know

25	Giving more than one antibiotic works better than one	A. True B. False C. I don't know
26	Antibiotics should only be obtained with a doctor's prescription	A. True B. False C. I don't know
27	Overusing antibiotics may make them ineffective	A. True B. False C. I don't know
28	Taking antibiotics in advance can prevent a child from the common cold	A. True B. False C. I don't know
29	The more expensive the antibiotics, the more effective	A. True B. False C. I don't know
30	Antibiotics can be used for any child with a fever	A. True B. False C. I don't know
31	Children with flu-like symptoms recover faster with antibiotics	A. True B. False C. I don't know
32	A full course of antibiotics should be completed even if the child improves	A. True B. False C. I don't know
33	Antibiotic resistance is a worldwide problem	A. True B. False C. I don't know
34	Antibiotics are used to treat pain	A. True B. False C. I don't know

35	Inappropriate antibiotic use reduces efficacy and drives resistance	A. True B. False C. I don't know
36	Antibiotic use can prevent complications from upper respiratory tract infections	A. True B. False C. I don't know

Mothers' Practice of Antibiotics

S/N	**Question**	**Response Options**
37	Your pharmacist gives you information about antibiotic use/Counseling/	Never / Rarely / Sometimes / Often / Always
38	Your doctor explains why antibiotics are prescribed	Never / Rarely / Sometimes / Often / Always
39	I check the expiration date before using antibiotics on my child	Never / Rarely / Sometimes / Often / Always
40	I stop giving antibiotics if the child starts to recover	Never / Rarely / Sometimes / Often / Always
41	I reuse leftover antibiotics for similar symptoms	Never / Rarely / Sometimes / Often / Always
42	I gave antibiotics without prescription for high fever	Never / Rarely / Sometimes / Often / Always
43	Practicing self-medication for diarrhea	Yes / No
44	I consult a pediatrician when symptoms begin	Yes / No
45	What are drug suppliers in your village?	Hospital/HC, Primary Clinics, Pharmacy/drug shops, others
46	Previous antibiotic courses of child	Yes / No
47	Do you believe in quality of antibiotic received	Yes /No

48	Do yor child has Fewer dose use experience?	Yes / No
49	Frequency of instruction about drugs	Frequently, Rarely , Never

Reasons for Giving Antibiotics Without Physician Consultation

S/N	**Question**	**Response Options**
50	Lack of time/money to visit physician	Always / Most of the time / Usually / Sometimes / Never
51	Child's condition did not seem serious	Always / Most of the time / Usually / Sometimes / Never
52	Knowledge of antibiotics for same symptom	Always / Most of the time / Usually / Sometimes / Never
53	Pharmacist recommended antibiotic	Always / Most of the time / Usually / Sometimes / Never
54	Friend or relative recommended antibiotic	Always / Most of the time / Usually / Sometimes / Never

8.7. Curriculum Vitae

1. Background information

Full name: Jabir Aliye Ahmed	Nationality: Ethiopian
Age: 35years	Date of birth: 01/05/1981
Sex: Male	Tell: +251911040767
Address: Haramaya	
Email: jobiraa@gmail.com	
Working institution: Maya City	

2. Educational background

S. No	Name of school	Place	Grade	Year in E.C
1	Elementary school	Bedeno	1-8	1985-1990
2	Secondary High School	Bedeno	9-12	1991-1994
3	Ethiopian Civil Service University	A.A	BA in Management	1998 -2000
4	Haramaya University, CHMS	Harar	Degree (B. pharm)	2005-2009
5	Haramaya University	Harar	MSc Student of Clinical pharmacy	2015- 2017

CHMS: College of Health and Medical Science

3. Language Skills

S. No	Language	Listening	Reading	Speaking	Writing
1	**English**	Excellent	Excellent	Excellent	Excellent
2	**Amharic**	Excellent	Excellent	Excellent	Excellent
3	**Oromic**	Excellent	Excellent	Excellent	Excellent

4. Computer skills

- Very good in Microsoft Word, Microsoft PowerPoint, and Microsoft Excel
- Very good in Statistical Package for Social Science software (SPSS)

5. Working experiences

- I have experience as Head of Health office

6. I have experience in the service of pharmaceutical care at Haramaya General Hospital