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ORIGINAL RESEARCH

Knowledge, Attitudes and Practices of Patients on Antibiotic Resistance and Use in Public Hospitals of Amhara Regional State, Northwestern Ethiopia: A Cross-Sectional Study

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Background: Although inappropriate antibiotic use could contribute to the spread of antimicrobial resistance, data on the knowledge, attitude and practice of antibiotic use and resistance among patients in north-western Ethiopia are scarce. This study assessed patients' knowledge, attitudes and practices regarding antibiotic use and resistance in selected public hospitals of Amhara regional state, Ethiopia.

Methods: A cross-sectional study was conducted in selected public hospitals of Amhara regional state from November to December 2020 to assess the knowledge, attitude, and practice of patients on antibiotic resistance and use. Data were collected from 233 participants using a structured questionnaire and analyzed using SPSS version 23.

Results: According to the findings, 60.3% of the participants obtained their antibiotics without a prescription from private pharmacies, and the most commonly used antibiotic to treat human diseases was ampicillin (70.7%). Even though 69.8% of the patients heard about antibiotics and antibiotic resistance from several sources, 68.1–87.9% of them were unaware on the factors that contribute to the transmission of resistant bacteria to humans and the impact of antibiotic resistance on human and animal health. Using the mean score of 3.15 ± 0.08 as the cut-off, 37.5% of patients know about antimicrobial resistance and use. With a mean score of 27.6 ± 0.3, 45.3% of patients had positive attitudes toward prudent antibiotic use and resistance. About 44% of participants had a good practice, with a mean practice score of 4.95 ± 0.17. A higher level of education was associated with better knowledge, positive attitudes, and better practices regarding antibiotic use and resistance. Although 57.3% of respondents viewed poor handwashing practices in hospitals as a major factor contributing to increased antibiotic resistance, 59.9% of respondents viewed implementing hygiene, infection prevention, and control practices as a major strategy contributing to reducing antibiotic use and resistance.

Conclusion: According to the present study, there is a low level of awareness among patients about the proper antibiotics use and resistance. It is essential to raise awareness, develop, and implement interventions to reduce antimicrobial use and antibiotic resistance in the study area.

Keywords: antibiotic use, antibiotic resistance, attitude, knowledge, patients, practice

Introduction

In many developed and developing countries, antibiotics are the most commonly prescribed drugs. It is estimated that between 20–50% of antibiotic use is either unnecessary or inappropriate.[1,2] This contributes to raising the complexity of antibiotic resistance worldwide, which harms patient outcomes.[3,4] Patients' inappropriate use of antimicrobial is a major contributor to the global spread of antimicrobial resistance.

Inappropriate and excessive antibiotic use results from a complex interaction of numerous factors related to patient knowledge and attitude, such as patient demand; incorrect self-medication habits; noncompliance; patients' experience with antibiotics; and insufficient patient education.[5,6] The situation is even worse in developing countries, where the use of antibiotics without medical supervision is facilitated by lax regulation of the distribution and sale of prescription drugs.[7]

Antimicrobial can be obtained without a prescription in developing countries from community pharmacies, drug-stores, or even commodity shops.[8] According to studies conducted in various African and Asian countries, self-

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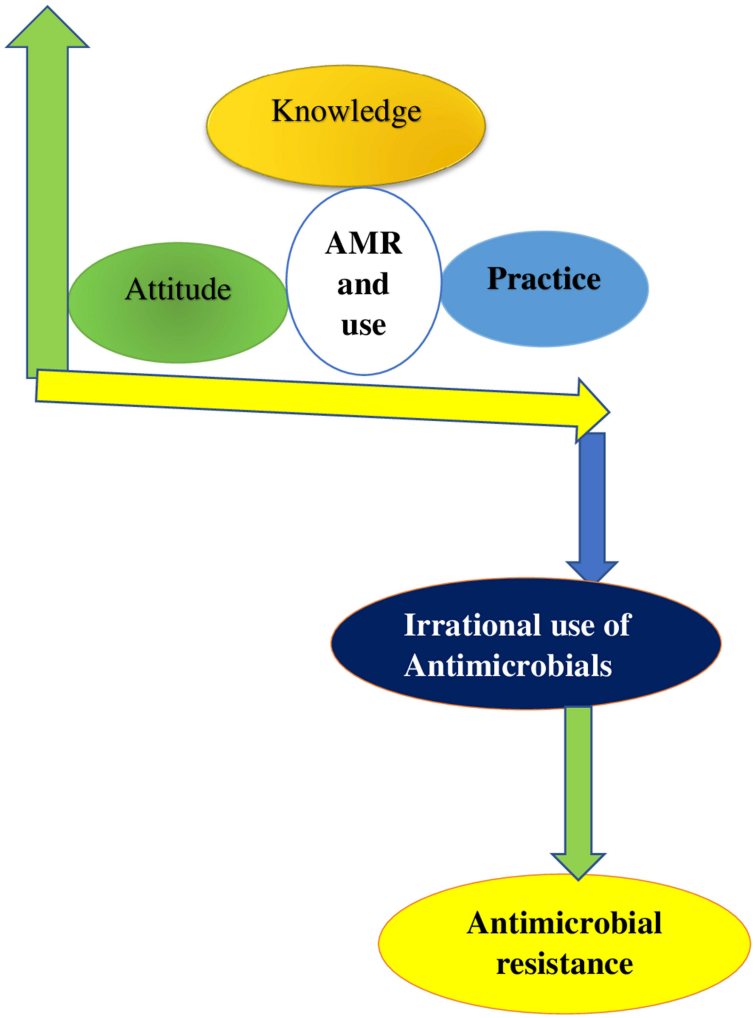
Graphical Abstract



Knowledge, attitudes, and practices of patients on antibiotic resistance and use

medication is widely practiced on those continents.[9,10] Similar findings were found in various settings in Ethiopia, indicating a high prevalence of self-medication in the country.[11,12] Antimicrobial misuse is influenced by factors such as health professional incompetence, inaccessibility of healthcare facilities, and patients' knowledge, beliefs, and perceptions about antimicrobial use.[13]

In response to the global health risk posed by antibiotic resistance, the National Department of Health developed the Antimicrobial Resistance National Strategy Framework, intending to reduce future increases in resistant bacterial infections and improve patient outcomes in South Africa.[14] This framework emphasizes public communication to raise antibiotic awareness, as well as patient education on the dangers of antibiotic misuse.[14] Antibiotic use is influenced by patients' knowledge and attitude toward antibiotics.[13,15] Antibiotic misuse by patients significantly contributes to the emergence and spread of bacterial resistance.[13] Understanding patients' antibiotic knowledge, attitudes and practices can help to maintain antibiotic effectiveness and it is a crucial step in the design of strategies to combat this public health threat.

Currently, information on patients' knowledge, attitudes and practices regarding antimicrobial resistance (AMR) and antimicrobial use, factors that contribute to the utilization of antimicrobial and resistance, and intervention to reduce antibiotic

resistance and use in patients, as well as the impact of antimicrobial resistance, is scarce in Ethiopia, particularly in north-western Ethiopia. Therefore, we conducted a study to evaluate patients' knowledge, attitude, and practice regarding antimicrobial use and resistance in selected cities of Amhara regional state, north-western Ethiopia.

Materials and Methods

Study Design, Period, and Setting

An institutional-based cross-sectional survey study was conducted among inpatients who attend in public hospitals in Debre Tabor, Bahir Dar, and Debre Markos cities from November to December 2020 (Figure 1).

Sample Size and Sampling Technique

A sample size of 460 was calculated using a formula developed by Daniel and Cross[16] with the assumption of 5% margin of error (d), 95% confidence level (zα/2 =1.96), expected maximum correct answer on the questions about knowledge of AMR 50% will be assumed (P) and 20% contingency for non-response. All patients who attended in selected public hospitals during the study period and were willing to participate in the study were included, while those unwilling to participate in the study were excluded. To select a sample of respondents in the region, a multi-stage sampling procedure was used. First three cities were chosen at random from the Amhara region. Since each city has one public hospital all public hospitals found in the cities were used to select the participants. When the calculated sample size (460) was proportionally allocated to each stratum (livestock farm owners, physicians, and inpatients) based on their population, 232 patients were allotted. The participants were then assigned to each hospital in proportion to their population (Debre Markos Referral Hospital = 93, Bahir Dar Specialized Hospital =105, and Debre Tabor General Hospital =35), and study subjects were chosen using a simple random sampling technique.

Data Collection Tools and Procedure

The researchers developed structured questionnaires to collect data after conducting a thorough review of comparable studies.[9,17] The questionnaire is divided into 7 sections. The first section included demographic information such as age, gender, religion,

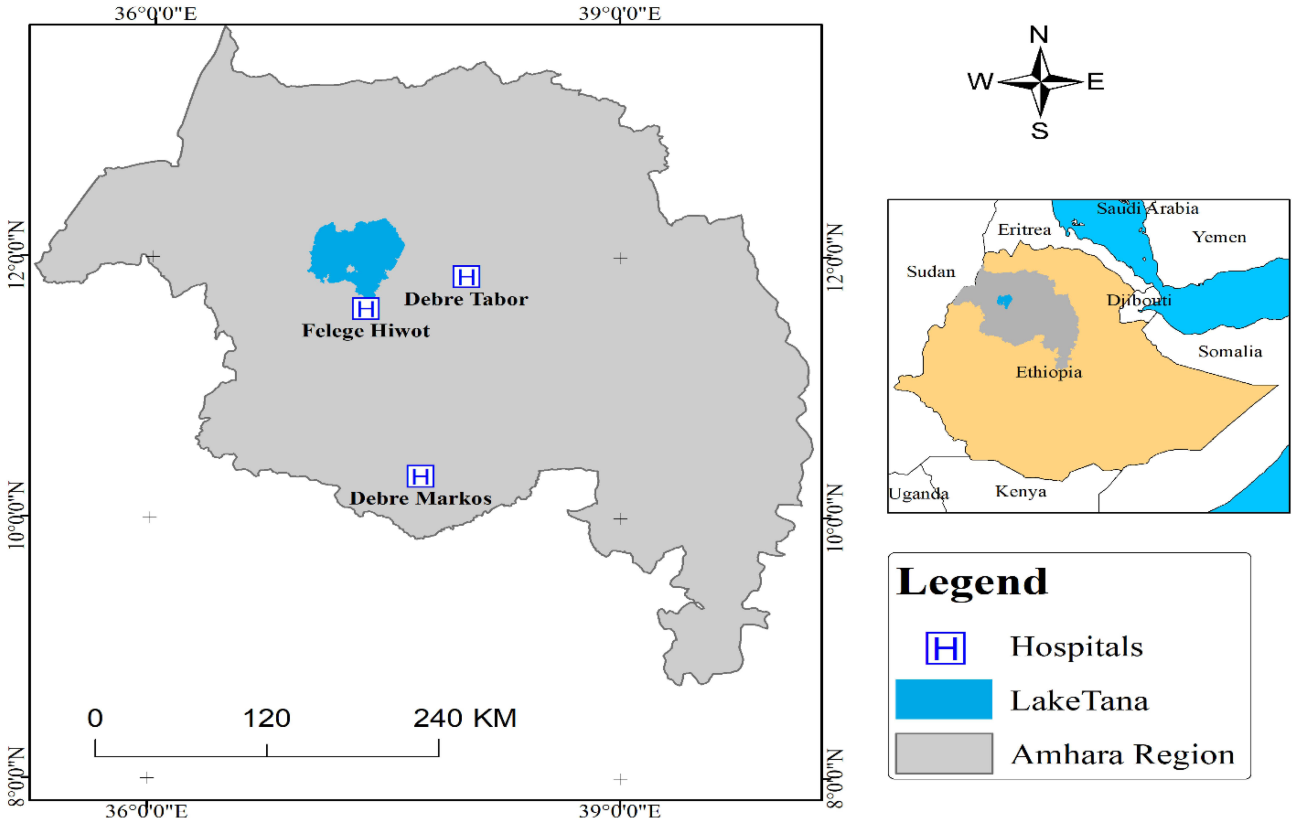


Figure 1 Map of the study area.

marital status, occupation, and level of education. In the second part, patients were asked to answer a series of questions about antibiotic use. The third and fourth parts of the questions focused on participants' knowledge and attitudes toward antibiotic use and resistance. The fifth section of questions focused on participants' antibiotic use practices. Participants were asked about factors that contribute to antibiotic resistance in the sixth section of the questionnaire. Participants were asked about possible measures to reduce the risk of antibiotic resistance in the final sections of the questionnaire. At the time of completing the questionnaire, the investigators were present to answer any questions from the respondents.[18]

Three trained data collectors (health professionals) were assigned to the data collection process, and the data collection medium was translated to Amharic. For the study participants, hard copies of written informed consent containing questionnaires were distributed. Data from uneducated participants were gathered through interviews. Then, data collectors collected completed questionnaires from study participants, and the questionnaires were checked for accuracy. Incomplete questionnaires were returned to participants in the study for completion. The questionnaires were labeled and coded using the questionnaire number after completion.[18]

Methods of Measurement (Scoring)

Each correct response was given a score of 1 for knowledge and practice assessment, while a wrong or doubtful response was given a score of 0. Responses to attitude-related questions were graded on a 3-point Likert scale, with a "1" to disagree and a "3" to agree. We used the mean as a cut-off point because there was no cut-off point to assess poor and better knowledge. Scores above and equal to the mean indicate better knowledge, better practice, and a positive attitude, whereas scores below the mean indicate poor knowledge, poor practice, and a negative attitude.[18,19]

Data Quality Control

A pilot study involving 10% of the patients who were not included in the final study was used to ensure fluency and accuracy in question design and language. The contents of the data collection tools were slightly modified based on the pilot survey. The questionnaire was then reviewed and assessed by subject experts for its content, design, relevance, and understanding. Data collectors were trained and monitored regularly by the investigators.

Statistical Data Analysis

The response options for knowledge and practice items were binary. Likert-style responses were used for attitude questions. The Statistical Package for Social Sciences (SPSS 23.0, USA) was used to enter and analyze data. One-way ANOVAs were used to compare the mean scores and assess the relationship between independent variables and knowledge, attitude, and practice of patients on AMR and use. The Chi-square test was used to assess the association between knowledge, attitude, and practice. A multivariate linear regression model was used to identify factors associated with good antibiotic resistance and use knowledge, practice, and attitudes. P-value < 0.05 (two-sided) was used to determine statistical significance. Finally, the analyzed data were organized and presented in the appropriate tabular, graphical, and narrative formats.

Ethical Consideration

Ethical clearance was obtained from the Research and Ethical Review Board of Bahir Dar University College of Science with reference number PGRCSVD/17/2019. Moreover, written informed consent was obtained from all patients and all research was performed following relevant guidelines/regulations.

Results

Socio-Demographic Characteristics of Patients

Two hundred and thirty-two patients completed the survey and only one patient did not complete and it was rejected from the analysis. Analysis of demographic parameters showed that the majority of the participants were male (63.4%), married (59.5%), and at the age of 31–45 years (36.2%). Among the 232 respondents who determined their level of education, 36.6% were uneducated. Most participants were orthodox (92.2%) and 31% were farmers (Table 1).

Table 1 Demographic Characteristics of Patients (n=232)

Variables		N	%
Sex	Male	147	63.4
	Female	85	36.6
Age	18–30	79	34.1
	31–45	84	36.2
	46–55	31	13.4
	56–65	22	9.5
	>65	16	6.9
Marital status	Single	74	31.9
	Married	138	59.5
	Divorce	14	6
	Widowed	6	2.6
Education	Uneducated	85	36.6
	Primary	47	20.3
	Secondary	38	16.4
	Diploma	21	9.1
	Technique	12	5.2
	University	29	12.5
Religion	Orthodox	214	92.2
	Protestant	2	0.9
	Muslim	16	6.9
Occupation	Farmer	72	31
	House wife	28	12.1
	Merchant	35	15.1
	Teacher	18	7.8
	Student	38	16.4
	Daily labor	20	8.6
	Driver	3	2.6
	Health worker	6	2.6
	Others	12	5.2

Patients Information on Antibiotics, Antibiotic Resistance, and Uses

As the result shown in Table 2, all the respondents (100%) were taken antibiotics to treat different diseases from different sources and 60.3% of them bought their antibiotics from a private pharmacy without a prescription. It was found that 47.9% of patients took antibiotics more than 5 times in the 12 months before the study. A large proportion of patients

Table 2 Patients Information on Antibiotics, Antibiotic Resistance and Uses

Variables	Categories	N	%
Have you taken antibiotics?	Yes	232	100
	No	0	0
Sources of antibiotics	Medical prescription	52	22.4
	Private pharmacy without prescription	140	60.3
	Left over from a previous course	23	9.9
	Relatives	17	7.3
Frequency of taking antibiotics	Once	59	25.4
	2–5 times	62	26.7
	More than 5 times	111	47.9
Do you hear the terms antibiotic and antibiotic resistance	Yes	162	69.8
	No	70	30.2
Source of information	Doctors and nurses	87	37.5
	Family	32	13.8
	Pharmacy	11	4.7
	Media	18	7.8
	Course	14	6
	None	70	30.2
Reasons for use of antibiotics without medical prescription	Minimize cost	20	8.6
	Previous experience	43	18.5
	Quick relief	34	14.7
	Lack of time	99	42.7
	Absence of health insurance	36	15.5
Mode of transmission of resistant bacteria to human	Direct contact	20	8.6
	Animal product	21	9.1
	Contaminated water and soil	25	10.8
	Mobile genetic	8	3.4
	I do not know	158	68.1
Impacts of antibiotic resistance	Difficult to treat	15	6.5
	Medical cost	3	1.3
	Kill easily	2	0.9
	Difficult to treat and medical cost	8	3.4
	I do not know	204	87.9

(69.8%) heard about antibiotics and antibiotic resistance from different sources and 37.5% of patients heard this information from doctors and nurses (Table 2).

When patients in the study area were asked to answer the question of why they were using antibiotics without prescription, most of the respondents (42.7%) said that they were lack time to be examined by doctors. From the survey, it was found that 10.8% of the respondents responded that the main mode of transmission of resistant bacteria to humans was through the contaminated water and soil, while 68.1% of the respondents did not know any factors that contribute to the transmission of resistant bacteria to humans (Table 2).

Patients in the study area were asked if they knew any possible impacts of antibiotic resistance on human and animals' health and 6.5% of respondents said that difficult to treat disease caused by resistant microorganisms was the possible impact of AMR. On the other hand, 87.9% of respondents did not know the impact of antibiotic resistance on human and animals health (Table 2). Most of the respondents could mention the brand or generic name of at least one antibiotic that they had been used to treat diseases. Ampicillin (70.7%), ciprofloxacin (59.9%), and tetracycline (57.8%) were the most frequently used groups of antibiotics (Figure 2).

Knowledge, Attitudes and Practice of Patients on Antibiotic Resistance and Uses

As indicated in Table 3, the highest number of participants (59.9%) were responded to the statement that antibiotics are useful in fighting bacterial infections correctly, while the least number of participants (40%) were responded to the statement improper use of antibiotics can cause antibiotic resistance correctly. The total mean score for correctly answered knowledge questions was 3.15± 0.08 with a maximum score of 6 points. 87 participants (37.5%) scored mean and above the mean were considered to have adequate/better knowledge, while 145 (62.5%) scored below the mean and were considered to have poor knowledge. The mean knowledge scores of our study significantly correlated with the level of education and occupation of respondents (Table 4).

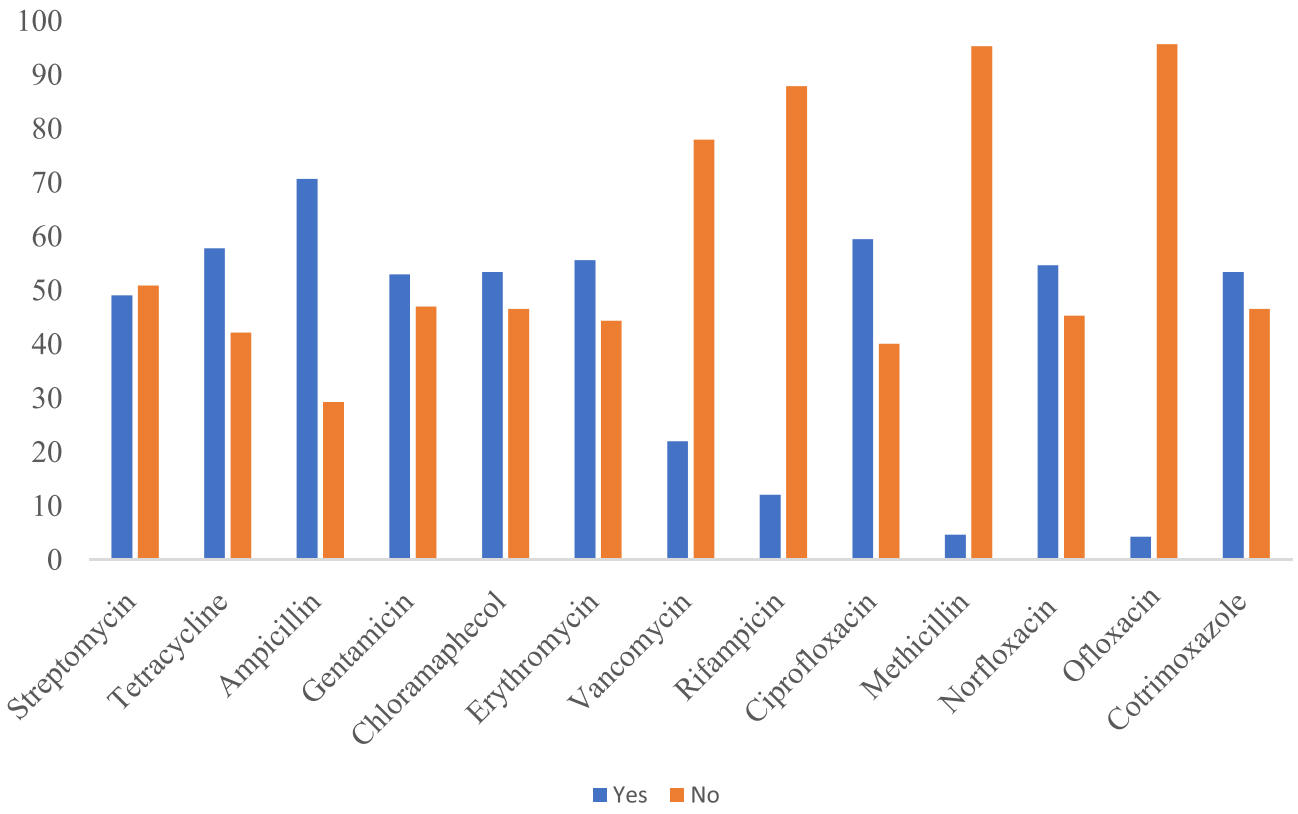


Figure 2 Common antibiotics used by patients.

Table 3 Knowledge, Attitude and Practice of Patients on Antimicrobial Resistances and Use in Amhara Regional State, North Western Ethiopia (n = 232)

Knowledge Items			
Statements	**Correct N (%)**	**Incorrect N (%)**	
Antibiotics are useful in fighting bacterial infections	139 (59.9)	93 (40.1)	
Improper use of antibiotics can cause antibiotic resistance	102 (40)	130 (56)	
Antibiotic resistance is prompted by self-prescription	125 (53.9)	107 (46.1)	
Viral infection with fever should be treated with antibiotics	110 (47.4)	122 (52.6)	
Bacteria can become resistant against antibiotics	133 (57.3)	99 (42.7)	
Antibiotics have side effects	121 (52.2)	111 (47.8)	
Attitude Items			
Statements	**Agree N (%)**	**Neutral N (%)**	**Disagree N (%)**
Antibiotics help me to recover from a cold much quicker	112 (48.3)	34 (14.7)	86 (37.1)
I request antibiotics even if the doctor has advised against it	108 (46.6)	27 (11.6)	97 (41.8)
The doctor must prescribe more than one antibiotic if I have severe flu	92 (39.7)	107 (46.1)	33 (14.2)
I prefer to be able to buy antibiotics from the pharmacy with a doctor's prescription	104 (44.8)	45 (19.7)	83 (35.8)
More expensive the antibiotics will be more effective.	107 (46.1)	73 (31.5)	52 (22.4)
Antibiotics should be prescribed for all type of infections	82 (35.3)	97 (41.8)	53 (22.8)
Antibiotic resistance is one of the biggest problems the world faces	123 (53)	37 (15.9)	72 (31)
Everyone needs to take responsibility for using antibiotics	129 (55.6)	7 (3)	96 (41.4)
I am worried about the impact that antibiotic resistance will have on my health, and that of my family	115 (49.6)	20 (8.6)	97 (41.8)
I am not at risk of getting an antibiotic-resistant infection, as long as I take my antibiotics correctly.	110 (47.4)	31 (13.4)	91 (39.2)
Farmers should give fewer antibiotics to food-producing animals	101 (43.5)	24 (10.3)	107 (46.1)
People should not keep antibiotics and use them later for other illnesses	126 (54.3)	10 (4.3)	96 (41.4)
Doctors should only prescribe antibiotics when they are needed	111 (47.8)	42 (18.1)	79 (34.1)
Practice Items			
Statements	**Correct N (%)**	**Incorrect N (%)**	
I take my antibiotics according to directions on the label	123 (53)	109 (47)	
I take extra antibiotic pills if my condition worsens	98 (42.2)	134 (57.8)	
I stop taking my antibiotic when I start feeling better	111 (47.8)	121 (52.2)	
I share antibiotics with friends and family if they need them	115 (49.6)	117 (50.4)	
I reserve antibiotics to self-medicate for future use	116 (50)	116 (50)	

(*Continued*)

Table 3 (Continued).

I have completed the full course of treatment	132 (56.9)	100 (43.1)	
I have check expiry date of the antibiotic before using	111 (47.8)	121 (52.2)	
I prefer to take an antibiotic when I have any cough and cold	90 (38.8)	142 (61.2)	
I use antibiotics only when they are prescribed by a doctor or nurse	112 (48.3)	120 (51.7)	
Overall level of knowledge	Frequency (%)		
Better	87 (37.5)		
Poor	145 (62.5)		
Overall level of attitude	Frequency (%)		
Better	105 (45.3)		
Poor	127 (54.7)		
Overall level of practices	Frequency (%)		
Better	102 (44)		
Poor	130 (56)		

Regarding attitude, the majority 129 (55.6%) of the respondents strongly agreed that everyone needs to take responsibility for using antibiotics and the highest number of respondents 118 (50.9%) disagree on farmers should give fewer antibiotics to treat food-producing animals. The mean score of the participant's attitude was 27.6 ± 0.3 with the maximum score of 39 points. Participants who scored below the mean score were 127 (54.7%) which was considered poor attitude) and above and equal to the mean score were 105 (45.3%) which was considered a good attitude) (Table 3). The mean attitude of our study was significantly varied across age groups, marital status, levels of education, and occupation (Table 4).

As shown in Table 3, 131 (56.5%) was responded correctly to the statement I have completed the full course of treatment while the least number of participants 90 (38.8%) was responded correctly to the statement I prefer to take an antibiotic when I have any cough and cold. The mean score of the participant's practice was 4.34 ± 0.13 with a maximum score of 9 points. Participants who scored below the mean score were 130 (56%), which was considered to have poor practice) and above or equal to the mean score of 102 (44%) which was considered to have good practice) (Table 3). Practice scores significantly varied across marital status, levels of education, and occupation (Table 4).

Multiple linear regression analysis demonstrated that education levels were positively correlated with increased levels of knowledge, attitude, and practice on antibiotic use and resistance ($P < 0.05$). Patients who had a higher level of education(university) had 0.303 times better knowledge (95% C.I: 0.2-0.41), 1.1 times positive attitude (95% C.I: 0.64-1.5) and 0.23 times good practice than uneducated patients (95% C.I: 0.04-0.42) (Table 5).

Pearson's correlation was used to assess the bivariate relationship between KAP scores. Among KAP scales there were positive and strongest correlations between knowledge and attitude (0.246) while practice was not significantly correlated with knowledge and attitude (Table 6).

Factors that Contribute to Increasing Antibiotic Resistance

Although most factors were significantly perceived by the majority of respondents as important factors that contribute to increasing antibiotic resistance, poor handwashing practice in hospitals (57.3%), poor awareness of AMR (56%), use of antimicrobial for animal growth promotion (55.2%), lack of rapid and effective diagnostic techniques (54.3%) and substandard quality of antibiotics (53.4) were the most important factors. On the other hand, 58.6% perceived that widespread or overuse of antibiotics in agriculture were not the main factor that contributes to increasing antibiotic resistance (Table 7).

Table 4 Relation Between Participants' Characteristics and Knowledge, Attitude and Behavior About Antibiotic Resistance and Use

Demographic Variables		Knowledge Score		Attitude Score		Practice Score	
		Mean ± SD	P-value	Mean ± SD	P-value	Mean ± SD	P-value
Sex	Male	3.1±1.2	0.181	27.5±4.8	0.691	4.4±2.0	0.424
	Female	3.3±1.2		27.8±5.2		4.2±2.0	
Age	15–30	3.2±1.2	0.698	28.7±5.2	0.006	4.6±2.2	0.218
	31–45	3.1±1		27.9±4.9		4.2±2.1	
	46–55	3.0±1.2		26.1±3.9		4.6±1.9	
	56–65	3.0±1.3		24.9±2.5		4.0±1.5	
	>65	3.4±1.4		27.3±6.3		3.4±1.6	
Marital status	Single	3.3±1.2	0.103	29±5.5	0.005	5±2.1	0.006
	Married	3.0±1.1		26.7±4.5		4.1±1.9	
	Divorce	3.1±1.5		29.5±5.4		3.5±2.3	
	Widowed	4±1.4		28.2±3.3		4.3±1.8	
Education	Uneducated	2.8±0.9	<0.0001	25.8±4	<0.0001	3.6±1.7	<0.0001
	Primary	2.7±1.3		26.7±4.6		4.6±1.9	
	Secondary	3.1±1.1		27.2±4.7		4.6±1.9	
	Diploma	4.0±1.0		30.6±5.3		5.2±2.5	
	Technique	3.4±1.2		29.1±6.2		5.4±1.9	
	University	4.1±1.0		32.4±3.8		4.8±2.2	
Religion	Orthodox	3.1±1.2	0.716	27.5±5.0	0.261	4.4±2.0	0.955
	Protestant	3.0±1.4		31.0±2.8		4.0±0.0	
	Muslim	3.4±1.2		29.2±4.9		4.3±2.0	
Occupation	Farmer	2.7±1.0	0.001	26.0±4.0	<0.0001	3.7±1.9	0.001
	House wife	2.8±1.1		25.8±4.3		3.5±1.4	
	Merchant	3.4±1.3		27.1±4.5		4.6±2.0	
	Teacher	3.9±1.0		28.6±5.5		5.2±2.5	
	Student	3.3±1.2		29.6±5.2		4.7±1.9	
	Daily labor	3.6±1.1		29.4±5.6		4.7±2.1	
	Driver	3.7±0.6		32.3±5.7		6.7±0.6	
	Health worker	3.5±1.4		28.8±4.7		5.7±2.6	
	Others	3.1±1.2		30.8±5.3		4.5±2.2	

Interventions that Contribute to Reducing Antibiotic Use and Resistance

Although most strategies were perceived by the majority of respondents as important strategies that contribute to reducing antibiotic use and resistance, implementing hygiene, infection prevention, and control practices (59.9%),

Table 5 Multiple Linear Regression Analyses for Predicting Score of Knowledge, Attitude & Practice

Variables	B	t	Sig.	95.0% Confidence Interval for B	
				Lower Bound	Upper Bound
Knowledge					
Constant	2.679	13.124	0.000	2.277	3.081
Education	0.303	5.648	0.000	0.198	0.409
Attitude					
Constant	25.694	30.511	0.000	24.034	27.353
Education	1.077	4.861	0.000	0.640	1.514
Practice					
Constant	3.916	10.675	0.0000	3.193	4.639
Education	0.231	2.395	0.017	0.041	0.421

Table 6 Correlation Between KAP

Variables		Knowledge	Attitude	Practice	N
Knowledge	Pearson Correlation	1	0.246**	0.09	232
	Sig. (2-tailed)		<0.0001	0.174	
Attitude	Pearson Correlation	0.246**	1	0.017	232
	Sig. (2-tailed)	<0.0001		0.798	
Practice	Pearson Correlation	0.09	0.017	1	232
	Sig. (2-tailed)	0.174	0.798		

Note: **Correlation is significant at the 0.01 level (2-tailed).

Table 7 Factors that Contribute to Increasing of Antibiotic Resistance

Factors Contributing to Antibiotic Resistance	Correct N (%)	Incorrect N (%)
1. Lack of access to local antibiogram data	120 (51.7)	112 (48.3)
2. Widespread or over use of antibiotics in agriculture	96 (41.4)	136 (58.6)
3. Self-prescription by patients	111 (47.8)	121 (52.2)
4. Bacterial mutations	118 (50.9)	114 (49.1)
5. Poor hand washing practice in hospitals	133 (57.3)	99 (42.7)
6. Poor hygiene, infection prevention and control practice	114 (49.1)	118 (50.9)
7. Lack of rapid and effective diagnostic techniques	126 (54.3)	106 (45.7)
8. Use of antimicrobials for animal growth promotion	128 (55.2)	104 (44.8)
9. Sub-standard quality of antibiotics	124 (53.4)	108 (46.6)
10. Poor awareness on AMR	130 (56)	102 (44)

developing institutional guidelines for antimicrobial use (57.8%), governments should reward the development of new antibiotics (57.8%), proper isolation of the patient (57.3%) and increasing the use of complementary treatments (56.9%) were the most important strategies. In contrast, 59.9% of the respondents perceived that reduction of antibiotic use in the outpatient setting was not the main strategy that contributes to the reduction of antibiotic resistance (Table 8).

Discussion

Inappropriate antibiotic use can have adverse consequences on various levels. Knowledge, attitude, and practice of patients on drug-related issues can greatly influence the way drugs like antibiotics are used. Assessment of public use of such drugs may provide valuable information that could help toward developing interventions targeting to enhance the utilization of antibiotics.

In this study, all patients used antibiotics to treat different diseases from different sources. The majority (60.3%) of the respondents bought their antibiotics from a private pharmacy without a prescription, some of them (22.4%) provided from health institutions with a medical prescription, and others obtained the antibiotics from relatives and previously stored in their house. A significant variation was observed among the literature regarding the use of antibiotics without prescription. For example, about 76% of antibiotic use without prescription was reported in India,[20] 72% in Ghana,[21] 32.7% in Italy,[22] 28.8% in Saudi Arabia[23] and 9% in Hong Kong.[6] This difference could be due to variation of regulation and its enforcement from one area to another and knowledge, attitude, and practice of the communities. The results demonstrate the necessity for appropriate public education on the aim and action of antibiotics.

In the current study, all the patients reported that they use antibiotics a minimum of once within the 12 months before the study. This report is comparable to a study done in Namibia (80%).[24] However, it is more than the study done in Lithuania 24.9%,[25] in Ireland 39%[26] and in Bahir Dar 35.9%.[27] Many factors might be attributed to the difference seen, including the pattern of disease prevalence within the given area, data collection area, and period.

It was found that a large proportion of patients 69.8% participating in the survey was heard about antibiotics and antibiotic resistance from different sources. Most respondents heard this information from doctors and nurses (37.5%), whereas 30.2% of respondents did not hear the information from any sources. A study done in Nepal reported that only 16% of the patients had heard about different terms for antibiotics and most of them (5.6%) heard about AMR and its related terms from media (newspaper, TV, radio).[28]

According to the current study results, the most common reasons for using antibiotics without prescription by patients were lack of time to be examined by doctors, lack of health insurance, previous experience to use the antibiotics,

Table 8 Interventions that Contribute to Reduce Antibiotic Use and Resistance

Interventions to Reduce Antibiotic Use and Resistance	Correct N (%)	Incorrect N (%)
1. Regular antibiotic surveillance programs	120 (51.7)	112 (48.3)
2. Proper isolation of the patient	133 (57.3)	99 (42.7)
3. Implementing hygiene, infection prevention and control practices	139 (59.9)	93 (40.1)
4. Strict government policy for antibiotics restriction and rational antibiotic use in human and animals	130 (56)	102 (44)
5. Reduction of antibiotic use for outpatient setting	93 (40.1)	139 (59.9)
6. Develop institutional guideline for antimicrobial use	134 (57.8)	98 (42.2)
7. Education on antimicrobial therapy for prescribers	109 (47)	123 (53)
8. Establish rapid and effective diagnostic techniques	129 (55.6)	103 (44.4)
9. Governments should reward the development of new antibiotics	134 (57.8)	98 (42.2)
10. Pharmaceutical companies should develop new antibiotics	126 (54.3)	106 (45.7)
11. Increasing the use of complementary treatments (herbs)	132 (56.9)	100 (43.1)

minimize cost, and get quick relief from their diseases. Several studies have reported different reasons for self-medication, including non-seriousness of the illness,[29–33] saving time,[30–32] cost-effectiveness,[31–33] ease of accessibility.[30,33,34]

From the survey, it has been found that most of the patients did not know any factors that were contributing to the transmission of resistant bacteria to humans, and some patients listed that contaminated water and soil, consumption of animal products, direct contact between humans and animals and mobile genetic material were the factors responsible for the transmission of resistant bacteria to humans. Most of the patients also did not know the impact of antibiotic resistance on human and animals' health and others mentioned that difficult to treat disease caused by resistant microorganisms, high medical costs, and kill patients easily were possible impacts of antibiotic resistance on humans and animals' health.

Most of the respondents were ready to mention the brand or generic name of a minimum of one antibiotic that they had been will not treat diseases. Ampicillin, ciprofloxacin and tetracycline were the most frequently used groups of antibiotics. The foremost common antibiotic used by the participants was amoxicillin, followed by ciprofloxacin and norfloxacin, respectively.[35]

This study has shown many misconceptions about antibiotic use and resistance. 47.4% of respondents correctly thought that viral infection with fever should not be treated with antibiotics. Different results were found in studies conducted in several countries. For instance, about 42.2% of respondents in Iraq reported antibiotics do not treat viral infections,[36] 29.8% in Kuwait,[9] 17.0% in Malaysia,[37] 65% in the USA,[38] 73.2% in Sweden[39] and 66.4% of the population thought that antibiotics are effective against cold or cough in Saudi Arabia.[40] This difference might be because of the variation in socio-demographic factors, regulation from one area to another and its enforcement, knowledge, attitude, and practice of the communities'.

The current study revealed that 59.9% of respondents reported antibiotics are useful in fighting bacterial infections. This finding is lower than the different studies conducted in Iraq 91.6%,[36] Kuwait 66.5%,[9] Malaysia 78.3%,[37] USA 90.0%[38] and Sweden 77.2%.[39] A study conducted in India reported that more than half of the participants believed that antibiotics are not safe to use and can have possible adverse effects[35] supports the current study, which stated that 52. 2% of respondents reported antibiotics to have side effects. In a similar study, it was found that nearly half of the participants believed that antibiotic does not cause side effects.[37] In another study, more than two-thirds of the participants believed that antibiotics can have allergic reactions.[41]

Furthermore, 57.3% of respondents said that bacteria can become resistant to antibiotics. A similar study was conducted in Iraq[36] and Sweden[39] was found that 73.4 and 80.7% of respondents reported that bacteria could resist antibiotics, respectively. In this study, only 40% of participants agreed that improper use of antibiotics could lead to antimicrobial resistance. This finding is lower than the study done in Harar (78.3%),[42] in Bahir Dar (71.4%),[33] Namibia (72%),[24] and Jordan (50%).[43] The current study revealed that 87 (37.5%) of patients were classified as having adequate/better knowledge which is lower than results reported by Ramchurren et al[44] who stated that 205 (53%) patients were classified as having good knowledge based on the scoring. The difference seen could be due to socio-demographic and setting differences.

Regarding the attitude, 54.3% of patients strongly agreed that people should not keep antibiotics and use them later for other illnesses. It is better than a study by Pechere et al a higher rate of wrong belief among the public was reported with 62% believing that leftover antibiotics can be saved and used again.[45] A study conducted in the United Kingdom also identified a good number of respondents reported to have kept antibiotics for future use.[46] Furthermore, studies conducted by Lim and Teh[37] and Pavydė et al[25] reported that 17% and 28.5% of respondents kept antibiotics in their homes for future use, respectively.

It is found that 105 (45.3%) of patients have adequate/better attitudes which are lower than the result reported by those who stated that than over half the sample (n = 211, 55%) of patients were classified as having good attitudes towards antibiotic use.[44] The participants within this study had a low attitude score, thus it is evidence that the public holds inappropriate beliefs concerning antibiotic use, which could adversely affect the way they are used. Public education is the best way to overcome such incorrect beliefs. It is reasonable to involve strict regulatory control to make sure that antibiotics are not dispensed by pharmacists without a prescription.

Regarding the practice of patients, the current study indicated that 43.1% of the respondents have not completed the full course of treatment. In the study conducted in the UK, only 11% reported not having finished their last antibiotic

course as prescribed.[46] In this study, 49.6% of the participants reported that they shared antibiotics with friends and family if they need them, which was higher than other studies.[42,47] A good percentage of respondents in the study in Oman was reported of exhibiting the unhealthy practice of sharing antibiotics with other members of the family or friends, which could result in the misuse of antibiotics.[48] A study conducted in South Africa reported that 230 (60%) patients were classified as having good antibiotic practices[44] which higher than the current study (44%).

In addition, the current study showed that the majority of the respondents perceived most of the factors as important factors that contribute to increasing antibiotic resistance, such as poor awareness of AMR, use of antimicrobial for animal growth promotion, lack of rapid and effective diagnostic techniques and substandard quality of antibiotics were the most important factors. In contrast, the majority of respondents (58.6%) perceived that widespread or overuse of antibiotics in agriculture were not the main factor that contributes to increasing antibiotic resistance.

Moreover, although the majority of respondents perceived most strategies as important strategies that contribute to reducing antibiotic use and resistance, implementing hygiene, infection prevention, and control practices, developing institutional guidelines for antimicrobial use, governments should reward the development of new antibiotics, proper isolation of the patient and increasing the use of complementary treatments (herbs) were the most important strategies. In contrast, most of the respondents supposed that reduction of antibiotic use in the outpatient setting was not the main strategy that contributes to the reduction of antibiotic resistance.

Our finding showed that there were positive and strongest correlations between knowledge and attitude which indicated that knowledge is one of several determinants of attitude. Knowledge–attitude-behavior models have theorized that knowledge is one determinant of attitude and increased knowledge is likely to lead to attitudes that are more stable and resistant to negative changes.[49] The only socio-demographic factor found to be associated with knowledge, attitudes and practices relating to antibiotic use was education. Respondents with higher education had better knowledge and more appropriate attitudes and practices, a finding consistent with other studies.[6,50–53] Similar observations were also reported in studies conducted in Malaysia, Palestine, and Hong Kong, which demonstrated that patients with higher levels of education were more likely to have good antibiotic knowledge and positive attitudes toward antibiotic usage.[6,52,54]

Limitation of the Study

The major limitation of this study was the relatively small number of participants selected from three cities of north-western Ethiopia which might not reflect the real situation of KAP of patients in Ethiopia as a whole. In addition, the cross-sectional study design can influence the cause and effect relationship of the predictor variables and the dependent variables (knowledge, attitude, and practice) of the patients. Lack of previous related studies led the discussion looks repetition of the results particularly on possible impacts of antibiotic resistance, the main mode of transmission of resistant bacteria to humans, important factors that contribute to increasing antibiotic resistance, and important strategies that contribute to reducing antibiotic use and resistance.

Conclusion

The study's findings revealed a knowledge gap, negative attitudes, and malpractice in the use of antimicrobial and resistance, which will hasten antimicrobial resistance development. Therefore, awareness creation programs should be planned to improve the community's knowledge, attitude, and practice of appropriate antimicrobial use and measures should be taken to eliminate the practice of dispensing antimicrobial without prescription.

Abbreviations

KAP, Knowledge, Attitude and Practice; WHO, World Health Organization; AMU, Antimicrobial Use; AMR, Antimicrobial Resistance; ANOVAs, Analysis of Variance.

Data Sharing Statement

Please contact the author for data requests.

Ethics Approval and Consent to Participate

This study was approved by the Research and Ethical Review Board of Bahir Dar University College of Science with reference number PGRCSVD/17/2019. Moreover, all respondents were aware of the purpose of this study, consented to participate in the survey and this study was conducted following the Helsinki declaration.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted, and agreed to be accountable for all aspects of the work.

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