Knowledge, attitude and practices of residences toward antimicrobial usage and resistance in Gondar, Northwest Ethiopia

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Research Article

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Abstract

Background

Antimicrobials are essential for human and animal health. Drug resistance to an antimicrobial agent follows the introduction of a new antimicrobial agent. Evidence suggests that the public plays an important role in the risk, increase, and spread of antimicrobial resistance. The purpose of this study was to assess the knowledge, attitudes, and practices of the Gondar city residences regarding antimicrobial use and resistance.

Methods

A cross-sectional study was conducted from April to July 2021 on 400 randomly selected Gondar city residents using a pretested semi-structured questionnaire. The descriptive and Chi-square tests were used to analyse the data.

Results

The response rate was one hundred percent. Approximately 75% of respondents were men, with 32% having completed secondary school. Nearly 74% and 35% of participants were married and worked in various government jobs, respectively. Furthermore, 48%, 54%, and 50% of respondents, respectively, had moderate knowledge, a positive attitude, and good practice concerning antimicrobial use and resistance. The chi-square analysis revealed a significant ($p < 0.05$) disparity between knowledge and educational level, marital status, and position in the house. The respondents' attitude level was also significantly associated ($p < 0.05$) with their educational level, marital status, occupation, and position in the house. Respondents' practice level was also significantly associated (p 0.05) with their educational level and occupation. The study also found a significant relationship between respondents' knowledge and attitude ($\chi2 = 215.23$, $p \leq 0.001$), knowledge and practice ($\chi2 = 147.2$, $p \leq 0.001$), and attitude and practice ($\chi2 = 116.03$, $p \leq 0.001$).

Conclusion

This study found that study participants had some misconceptions about antimicrobial use and resistance. As a result, enforcing antimicrobial regulation and educating people about antimicrobial use are both recommended.

1. Introduction

Microbes have been around for a million years and are one of the oldest creatures on the planet. While other advanced huge ancient animals and plants perished, these tiny microorganisms adapted,

developed, and survived in this changing nature throughout the eras. Microbes, on the other hand, are thought to be some of nature's most adaptable and successive creatures. Since that time, these microbes have been subjected to antibiotics derived from other microorganisms, such as *Penicillium notatum* [1]. Furthermore, hundreds of natural, semi-synthetic, and synthetic antimicrobial molecules are used to treat infections in both humans and animals [2]. These antimicrobials have been widely used in animals for disease prevention, control, and treatment, as well as growth promoters. Over several decades, the use of antimicrobial drugs has become widespread, and these drugs have been widely misapplied in both humans and food-producing animals in ways that promote the selection and spread of resistant microbes [3].

Misuse and overuse of various antimicrobial agents in the health care setting and the agricultural industry are regarded as major contributors to the emergence of antimicrobial resistance. Besides that, spontaneous evolution, pathogen mutation, and the transmission of resistant genes via horizontal gene transfer are significant contributors to antimicrobial resistance [4]. More than half of all medicines are prescribed, dispensed, or sold improperly and not following the principle of rational drug use, and more than half of patients fail to take them correctly. This erroneous dose leads to an increase in antimicrobial resistance. Despite ongoing efforts to improve antimicrobial prescribing and address issues such as self-prescribing, unnecessary use for viral infections, dosing errors, and excessive treatment durations, the global rate of antimicrobial-resistant infections continues to rise [5].

Antimicrobial resistance and the rise in MDROs globally are associated with increased morbidity and mortality, cross-transmission within and between healthcare settings, and increased consumption of limited patient-care resources. Despite increased awareness, the publication of antimicrobial stewardship guidelines, and several initiatives, the proportion of resistant strains causing both health care and community-associated infections continues to rise, while the number of new antimicrobials continues to fall [6].

In general, antimicrobial resistance is a global public health concern that has been exacerbated by the overuse of antimicrobials around the world [7]. Further to that, it is a major concern for most African countries with low and middle incomes, which are associated with poverty, a high prevalence of infectious disease, and uncontrolled antimicrobial use in animals and humans [8, 9]. There is little information available about antimicrobial use and resistance in Ethiopia. Similarly, some studies show that inappropriate antibiotic use is linked to a variety of factors such as a low education level, job engagement, and a lack of knowledge about the use of human antibiotic preparations to treat animals [10, 11]. However, it is questionable to what extent knowledge, attitude, and behavioural practices of animal and human antimicrobial usages and resistance exist in the study area. Thus, the study of human and animal antimicrobial usage and resistance in the study area contributes by identifying the factors that contribute to a low level of knowledge, attitudes, and behavioural practices, allowing the community to be aware of the condition and apply possible intervention measures to reduce the risks. As a result, the purpose of this study was to assess residences' knowledge, attitudes, and behavioural practices regarding human and animal antimicrobial usage and resistance in Gondar, northwest Ethiopia.

2. Material And Methods

2.1. Study area

The study was conducted in Gondar, a city in northwest Ethiopia, 740 kilometres from the capital, Addis Abeba. The city is a historic and tourist destination in the country. The city's elevation ranges from 1800 to 2200 meters above sea level. It receives 1000 millimetres of rain per year on average. The city's annual maximum and minimum temperatures are 30.7°C and 22°C, respectively, with an overall average temperature of 26°C. The relative humidity in the city ranges from 60–70% during the rainy season and from 30–40% during the dry season. Gondar had a population of 500,788, with 300,000 men and 200,788 women [12].

2.2. Study design

From April to July 2021, a cross-sectional study was conducted in Gondar, Northwest Ethiopia, to assess residences' knowledge, attitude, and behavioural practices regarding human and animal antimicrobial use and resistance. The research was carried out following the Helsinki Declaration as well as national and institutional standards.

2.4. Study population and sample size

The source population consisted of adults of both genders who were at least 18 years old and lived in Gondar city. Thrusfield's formula was used to determine the number of samples included in this study [13]. The 95% confidence interval, 5% desired absolute precision, and 50% expected prevalence were all factors to consider. As a result, 384 people from Gondar city were included in the study. However, after accounting for a 5% non-response rate, the final sample size was 400.

2.5. Data collection and tools

2.5.1. Data collection

For data collection via interview, a semi-structured questionnaire was used. The questionnaire was developed after reviewing the literature on how to conduct a KAP survey, as well as global antimicrobial studies. The questionnaire consisted of four sections, with the majority of the questions being closed-ended. Two epidemiology and public health experts reviewed the questionnaire items for content validity. Based on expert feedback and recommendations, questionnaire items were modified to better suit the local population. Furthermore, prior to data collection, participants in this study were given verbal information to inform them of the purpose of the study, and they were free to leave the interview at any time, and all data will be kept securely.

2.5.2. Measurement tools

Antimicrobial usage and resistance knowledge

Nine questions were asked to determine the residence's level of knowledge concerning antimicrobial use and resistance. Six of the questions were on a Likert scale, while the other three were open-ended, allowing respondents to express their opinions. A correct answer to each closed-ended question received three points, two uncertain points, and one point for a wrong answer. The score ranged from 6 to 18 points, and it was categorized into three levels based on Bloom's cut-off point of 60-80%, as follows: High level (80-100%) 15–18 points; Moderate level (60-79%) 11-14 points and a low level (less than 60%) 6–10 points [14].

Attitude on antimicrobial usage and resistance

There were eight questions, one positive and seven negative statements, with Likert scale answers ranging from agreeing to disagree. A knowledge scale was used to assess the rating scale. The scores ranged from 8 to 24, and all individual responses were summed and calculated for means. The results were categorized into three (Positive Attitude, Neutral Attitude and Negative Attitude). Positive Attitude 19-24 (80 -100%), Neutral Attitude 15-18 (60 - 79%), and Negative Attitude 8-14 (less than 60%) [14].

Practice on antimicrobial usage and resistance

This section contained eleven questions. There were ten closed-ended questions, eight Likert questions, one yes/no and one multiple-choice question, and one open-ended question. The previous rating scale was used to assess the responses. The scores in measuring antimicrobial usage and resistance ranged from 8 to 24 and were classified into three levels based on Bloom's cut off point of 60-80% [14]. The levels of practice were good (80-100%) of 19 - 24 scores, fair (60-79%) of 15-18 scores and poor (less than 60%) of 8-14 scores [14].

2.6. Data management and analysis

Using Microsoft Excel® 2010, the collected data was classified, filtered, and coded. The information was then exported to STATA version 16 (Stata Corp. Texas, USA) for statistical analysis. The socio-demographic characteristics of the study participants were shown using descriptive statistics. As appropriate, numerical data were expressed as mean ± standard deviation or percentage. The Chi-square test ($\chi 2$) was used to test the relationship between knowledge, attitude, and practice to identify the most important demographic factors. When the *p*-value is less than 0.05, the data is considered significant

3. Results

3.1. Socio-demographic characteristics of respondents

The analysis of demographic parameters revealed that the vast majority of participants 301 (75.25%) were males, 128 (32%) were secondary school graduates, 294 (73.5%) were married, and 139 were employed in various government careers (34.75%). However, 99 (24.75%), 50 (12.5%), 8 (2%), and 54 (13.5%) of those polled were females, vocational school graduates, widowed, or unemployed, respectively

(Table 1). The average age of the study subjects was 43.85 years, with a standard deviation of 13.48 years, and a minimum age of 18 and a maximum age of 70 years.

Table 1

3.2. Respondents' knowing of antimicrobial use and resistance

The respondents' mean knowledge score was 13.137 out of a possible 18 points (SD = 3.008). What's more, approximately 48% of respondents had "moderate knowledge," 35% had "high knowledge," and 17% had "low knowledge" about antimicrobial resistance and usage. Alternatively, as shown in Table 2, 54.5% of respondents were aware that antimicrobials are effective against bacteria. Similarly, half of the participants (51.5%) agreed that antimicrobials help with cold recovery. Approximately 47% disagree that antimicrobials are effective against the virus.

Table 2

3.3. Respondents' attitudes toward antimicrobial use and resistance

More than half of the study participants (53.75%) were found to have a "positive attitude," 27.25% had a "neutral attitude," and 19 percent had a "negative attitude" toward AMU and AMR. The mean attitude score for all respondents was 18.06 out of a possible 24 points (SD = 3.7). The attitude scores ranged from 8 to 24, with 8 being the lowest and 24 being the highest.

According to Table 3, half of the respondents agreed with the statement "to finish the course of treatment with AM even if they feel better." About 35% of those polled agreed that they would seek antimicrobials from relatives or friends rather than from health care providers. However, more than half of the respondents (60.75%) disagreed with this statement. Similarly, the majority (74%) of respondents had a positive attitude (Disagree) for the statement - I prefer to be able to buy antimicrobials from the pharmacy without a prescription, and eighty-six (21.5%) of respondents agreed to do so, while nineteen (4.75%) remained uncertain. In addition, the statement stated, "When I have a minor illness, I prefer to use an antimicrobial and feel better quickly." 148 (37%) agreed, 79 (19.75%) were unsure, and 173 (43.25%) disagreed (See Table 3).

Table 3

3.4. Respondents' antimicrobial use and resistance practices

All respondents had a mean practice score of 17.96 out of a possible 24 points (SD=2.73). About half of the participants had a good practice, 39 percent had fair practice, and 11.25% had poor practice. The minimum and the maximum number of practices were eight and twenty-four, respectively.

Two hundred seventy (54.25%) of those questioned said they always consult a doctor before beginning antimicrobial therapy. However, 42 (10.5%) of the participants took antimicrobials without consulting with a health professional. Out of the study participants, 61.25% always completed the full course of their antimicrobial treatment and 16.25% sometimes did. While 22.5% were never finished. Furthermore, 60.5% of animal owners had never treated their animals with an antimicrobial prescribed for a human. However, 28% and 11.5% of respondents, respectively, treated their animals with antimicrobials prescribed for humans. Half of the respondents (50%) confirmed that they always complete the full course of treatment for their animals, 28.25% occasionally, and 21.75% never complete treatment for their animals (Table 4).

Table 4

3.5. Association between socio-demographic factors and respondents' knowledge, attitude, and practice

Respondent knowledge level was significantly influenced by several socio-demographic characteristics, including education level ($\chi2 = 437.8$, $p = 0.001$), marital status ($\chi2 = 22.49$, $p = 0.001$), occupation ($\chi2 = 189.33$, $p = 0.001$), house ownership ($\chi2 = 19.08$, $p = 0.014$) and position in the house ($\chi2 = 28.44$, $p = 0.002$) (Table 5). Similarly, participants' attitude levels were significantly attributable to their education level ($\chi2 = 222.7$, $p = 0.001$), marital status ($\chi2 = 20.53$, $p = 0.002$), occupation ($\chi2 = 116.6$, $p = 0.001$), and position in the house ($\chi2 = 22.95$, $p = 0.011$) (Table 6). Furthermore, the study participant's practice level was significantly influenced by education level ($\chi2 = 178.6$, $p = 0.001$) and occupation ($\chi2 = 111.5$, $p = 0.001$) (Table 7).

3.6. Relationship between respondents’ knowledge, attitude and practice

Respondent knowledge was found to have a significant relationship with respondents' attitudes toward AMR and AMU ($\chi2 = 215.23$, $p < 0.001$). The proportion of respondents with positive attitudes rises as their level of knowledge rises (Sup Table 1). Similarly, a significant association ($\chi2 = 147.2$, $p < 0.001$) was found between respondents' knowledge and practice (Sup Table 2). It implied that, as participants in the study's level of knowledge on AMU and AMR increased, so did the proportion of respondents with good practice. Furthermore, a significant interaction ($\chi2 = 116.03$, $p < 0.001$) was observed between respondents' attitudes and good practices regarding AMU and AMR. It suggests that respondents' attitudes have a direct influence on their level of practice (Sup Table 3).

4. Discussion

Inappropriate AMU and the associated risk of AMR is a growing public health issue worldwide. The misuse and abuse of antimicrobials in agriculture, veterinary medicine, and human medicine have been identified as major contributors to the global spread of AMR [15]. The emergence and spread of antimicrobial-resistant pathogens impede the use of antibiotics for both preventative and therapeutic purposes. This issue is becoming more prevalent in low-income African countries [16]. As a result, a

questionnaire survey was used in this study to assess knowledge, practices, and attitudes toward AMU and AMR in Gondar City, Ethiopia. Antimicrobial use and resistance knowledge, attitudes, and practices are critical for combating global antimicrobial resistance [17].

According to the findings of the current study, the majority of participants (72.3%) are aware of what antimicrobials are, but only 36.3% are conscious of what they are used for. Amoxicillin was the most commonly used antibiotic among the study participants. The current finding is consistent with the findings of Gebeyehu et al. [10] in Bahir Dar, Ethiopia, Widayati et al. [18] in Indonesia, Sindato et al. [15] in Tanzania, Ocan et al. [19] in Uganda, and Ramay et al. [20] in Guatemala, who reported that Amoxicillin was the most commonly used antibiotic by study participants.

Understanding which conditions can be treated with antibiotics is also important, as using antibiotics for conditions that are not treatable with these medications contributes to misuse and, as a result, resistance development [18]. People in Gondar who participated in the study had sufficient knowledge (54.5%) to answer questions about whether antimicrobials are effective against bacteria, but this is lower than the previous studies in Germany [21] and Malaysia [22], which found that 83.7% and 76.7% of participants correctly identified antibiotics are effective against bacteria, respectively. However, in the current study, some respondents (20%) are unsure whether antimicrobials are effective against bacteria, which is consistent with Kuwait (25.3%) [23]. Thus, some attribute this lack of knowledge to the common use of the term "germ" during counselling or the provision of medical advice to the public/patients rather than the microbiological terms "bacteria" or "virus."

Poverty is also a major driver of AMR development in both developing and developed countries. In developing countries, factors such as insufficient access to effective drugs, unregulated antimicrobial dispensing and manufacture, and insufficient antimicrobial treatments due to cost all contribute to the development of AMR [16]. The use of antimicrobials, according to a large number of participants (48.5%) in this study, can increase bacterial resistance to them. This supports the findings of Tesfaye [24] in Bahir Dar Ethiopia, Pereko et al. [25] in Namibia, Jifar and Ayele [26] in Harar Ethiopia, and Darwish et al. [27] in Jordan, where 69.7%, 72%, 78.3%, and 50% of respondents believed, respectively. As a result, this finding indicates that the majority of those who took part in the study were well-versed in the risks associated with the use of antimicrobials. Antimicrobial agents are widely used in animal production systems in Ethiopia, as in other Sub-Saharan countries; however, evidence on antimicrobial usage is limited and anecdotal [28]. Antimicrobial resistance must be addressed through a variety of actions, including interventions that reduce inappropriate and unnecessary antimicrobial use in humans and animals while ensuring that effective antimicrobial therapy is available when needed [29].

The effectiveness of antimicrobials is jeopardized by antimicrobial resistance, which can arise from discontinuing the entire course of treatment. According to studies, the reasons for the discontinuation of antimicrobials are a lack of knowledge and awareness about antimicrobial use [10]. The participants' attitude toward antimicrobial use and resistance was unavoidable and restrictive in this study. As a result, half of the respondents (50.5%) acknowledged the importance of continuing to take their prescribed

medication even after they felt better. While approximately 40% of respondents believed that patients should discontinue treatment as soon as they felt better. This finding is higher than the study done in Bahir Dar Ethiopia by Gebeyehu et al. [10], which reported 27%, and lower than the reports of Dyar et al. [29] in Kuwait, Sakr et al. [30] in Lebanon, and Darwish et al. [27] in Iraq, which reported 45–60% of respondents, respectively, believed that patients should stop their treatment as soon as they felt better. As a result of this misunderstanding in antimicrobial use, the patient is at risk of relapse with resistance to pathogenic bacteria. Inadequate dosing, incomplete courses, and indiscriminate drug use have also contributed to the emergence and spread of antimicrobial resistance, which is a current issue in various countries.

Similarly, we practice self-medication every day in the form of self-care for our health. Self-medication refers to the use of drugs, herbs, or home remedies on one's initiative or the advice of another person, without first consulting a doctor [31]. In this study, 54.25% of study participants had a positive attitude because they never took antimicrobials without first consulting with their doctor. However, 10.5 percent of them did not develop such an attitude and prefer to consult with and obtain antimicrobials from other sources. The current finding was lower than reports from other countries, including the UAE [32], Lebanon [33], Iraq [34], Palestine [35], Jordan [36], and Yemen [37]. Meanwhile, it was higher than reported by You et al. [38] in Hong Kong, McNulty et al. [39] in the United Kingdom, Ling Oh et al. [22] in Malaysia, and Widayati et al. [18] in Indonesia, who reported attitude levels ranging from 4.8 - 9%. The differences observed in the studies were attributed to differences in sample size, education level, and sociodemographic characteristics of the study participants.

Antibiotics that were leftover in many countries around the world reported that medicine at home was one of the major sources of antibiotics that are stocked for emergency or future use issues [40]. In this study, 15% of respondents agreed that they keep leftover antimicrobials at home in case they need them in the future. The findings are comparable to Jifar and Ayele's report in Harar, Ethiopia [26]. The current finding, however, was lower than that of a study conducted in Malaysia [41], Namibia ([25], and Jordan [27]. The disparities observed between the studies could be attributed to differences in the study participants' awareness and education levels.

Furthermore, significant associations ($p < 0.05$) between various socio-demographic factors and KAP scores were noticed in the current study. Antimicrobial knowledge scores tended to rise as one's level of education increased. Similarly, participants with a college/university education, a secondary education, or a vocational education had higher knowledge scores than those with only primary education or no formal education. It corroborates the findings of Sindato et al. [15] in Tanzania. There was also a statistically significant ($p < 0.05$) relationship found between respondents' knowledge and practice, knowledge and attitude, and practice and attitudes. As a result, it implied that as participants in the study's knowledge of AMU and AMR increased, so did the proportion of respondents with good practice and behaviour.

5. Conclusion

The current study's findings indicate that there is some appropriate knowledge about antimicrobial usage and resistance. However, there were misunderstandings and a lack of knowledge about antimicrobial use, with respondents believing that antimicrobials were used to treat a common cold. Respondents demonstrated good practice, particularly in the use of antimicrobials, with the majority consulting a doctor before taking antimicrobials and refusing to take them from friends or pharmacies without a prescription. Meanwhile, there was a significant error in not taking the full dose of treatment. This malpractice reflected the public's lack of knowledge and incorrect beliefs about the prudent use of antimicrobials. Respondents with a high educational level have good knowledge and understanding. This study's findings are important because they provide valuable information for developing an intervention in public health promotion to improve knowledge, attitudes, and practices about antibiotics. Thus, educational interventions on antibiotic use and its relationship with drug resistance are required to promote the prudent use of antibiotics, as is a policy to increase knowledge and awareness about antibiotics, which includes mass media advertising by the Ministry of Health.

Abbreviations

AMR
Antimicrobial Resistance
AMU
Antimicrobial Use
MDROs
Multidrug Resistance Organisms

Declarations

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Authors’ contributions

RB collected the data and HD analyzed the results. RB, HD and ZST wrote the manuscript. All authors have edited the manuscript and approved the final manuscript.

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Data availability

All data generated during this study are available to the authors upon request.

Ethical Approval and informed consent

Before administering the questionnaire survey, participants provided written informed consent. The study was approved by the College of Veterinary Medicine and Animal Sciences ethical committee (number: CVMASc/13.160/2020)

Consent for publication

Not applicable

Competing interests

We declare that no conflict of interest.

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Tables

Table 1**:** Sociodemographic characteristics of study participants

Variable		Number (n=400)	Percentage (%)
Sex	Male	301	75.25
	Female	99	24.75
Education level	Primary	86	21.50
	Secondary	128	32
	Vocational	50	12.5
	College/university	71	17.75
	No formal education	65	16.25
Marital Status	Married	294	73.5
	Unmarried	89	22.25
	Divorced	9	2.25
	Widowed	8	2
Occupation	Government	139	34.75
	Nongovernment	68	17
	Student	45	11.25
	Private	94	23.5
	No work	54	13.5
Household size	Less than three	144	36
	Four to six	198	49.5
	Greater than six	58	14.5
Animal ownership	One species	176	44
	Two species	155	38.75
	Three or more species	69	17.25
Ownership of house	Private	157	39.25
	Rent	148	37
	Family	70	17.5
	Temporary shelter	15	3.75
	Other	10	2.5
	Husband	212	53

Position in the house	Wife	73	18.25
	Son	68	17
	Daughter	21	5.25
	Relatives	7	1.75
	Others	19	4.75

Table 2**:** Knowledge of respondents about antimicrobial usage and resistance

Knowledge question	**Agree**	**Uncertain**	**Disagree**	**Mean ± SD**
Do you think antimicrobials are effective against bacteria?	218	80	102	2.29± 0.847
	54.5	20	25.5	
Do you think antimicrobial speed up the recovery from common cold?	206	94	100	2.26± 0.834
	51.5	23.5	25	
Do you think antimicrobials are effective against viruses?	112	101	187	1.81± 0.845
	28	25.25	46.75	
If you get adverse side effects during a course of antimicrobial treatment, do you stop taking antimicrobials?	225	85	90	2.33± 0.821
	56.25	21.25	22.5	
Do you think that the use of antimicrobials can increase the resistance of bacteria to them?	194	115	91	2.25± 0.804
	48.5	28.75	22.75	
Do you think that the use of antimicrobials in animals can reduce the effect of antimicrobials in humans?	172	126	102	2.17± 0.809
	43	31.5	25.5	

Table 3**:** Attitude toward antimicrobial usage and resistance

Attitude question	Agree	Uncertain	Disagree	Mean ± SD
I always complete the course of treatment with antimicrobials even if I feel better	202	40	158	2.11± 0.943
	50.5	10	39.5	
It is good to be able to get antimicrobials from relatives or friends without having to see a medical doctor?	138	19	243	2.26± 0.941
	34.5	4.75	60.75	
I prefer to be able to buy antimicrobials from the pharmacy without a prescription.	86	19	295	2.52± 0.825
	21.5	4.75	73.75	
The effectiveness of antimicrobials is better if they are newer and more costly (New brand than the common one and more expensive than the usual antimicrobials).	114	16	270	2.39± 0.899
	28.5	4.75	73.75	
Antimicrobials are safe drugs and can be commonly used	168	166	66	2.25± 0.721
	42	41	16.5	
I prefer to keep unused antimicrobials at home in case there may be a need for them	80	129	191	2.27± 0.775
	20	32.25	47.75	
When I have a minor illness, I prefer to use an antimicrobial and feel better quickly.	148	79	173	2.06± 0.894
	37	19.75	43.25	
Missing one or two doses does not alter the effectiveness of antimicrobials	131	65	204	2.18± 0.897
	32.75	16.25	51	

Table 4**:** Public response for each practice question regarding antimicrobial usage and resistance

Practice question	Always	Sometimes	Never	Mean ± SD
Do you consult a doctor before starting an antimicrobial?	217	141	42	2.43± 0.676
	54.25	35.25	10.5	
Do you check the expiry date of the antimicrobial before using it?	240	99	61	2.44± 0.744
	60	24.75	15.25	
After you start feeling better, do you save the remaining antimicrobials for the next time you get sick?	60	175	165	2.26±0.703
	15	43.75	41.25	
After taking 2–3 doses and starting feeling better, do you give the leftover antimicrobials to your friend/roommate if they get sick?	84	117	199	2.28± 0.791
	21	29.25	49.75	
Do you complete the full course of treatment each time you take antimicrobials?	245	65	90	2.38± 0.830
	61.25	16.25	22.5	
Do you treat your animals with antimicrobials prescribed for humans by your decision?	46	112	242	2.49± 0.693
	11.5	28	60.5	
Do you take your animals to Vet clinic for diagnosis?	79	215	106	1.93± 0.677
	19.75	53.75	26.5	
If you purchase antimicrobials for your animals, do you complete the full course?	200	113	87	1.71± 0.799
	50	28.25	21.75	

Table 5**:** Association of knowledge with socio demographic characteristics

Variable		No of respondents	Knowledge			c2	*p*-value
			High (%)	Moderate (%)	Low (%)		
Education level	Primary	86	7 (8.2)	74 (86)	5 (5.8)	437.8	0.000
	Secondary	128	44 (34.4)	82 (64)	2 (1.6)		
	Vocational	50	20 (40)	27 (54)	3 (6)		
	College/university	71	69 (97.2)	1 (1.4)	1 (1.4)		
	No formal education	65	0 (0.0)	7 (10.8)	58 (89.2)		
Marital status	Married	294	90 (30.6)	142 (48.3)	62 (21.1)	22.49	0.001
	Unmarried	89	44 (49.4)	42 (47.2)	3 (3.4)		
	Divorced	9	3 (33.3)	5 (55.6)	1 (11.1)		
	Widowed	8	3 (37.5)	2 (25)	3 (37.5)		
Sex	Female	99	31 (31.3)	51 (51.5)	17 (17.2)	0.9	0.637
	Male	301	109 (36.2)	140 (46.5)	52 (17.3)		
Occupation	Government	139	92 (66.2)	43 (31)	4 (2.8)	189.3	0.000
	Nongovernment	68	14 (20.6)	46 (67.6)	8 (11.8)		
	Student	45	12 (26.7)	32 (71.1)	1 (2.2)		
	Private	94	21 (22.3)	53 (56.4)	20 (21.3)		
	No work	54	1 (1.9)	17 (31.5)	36 (66.6)		
House hold size	Less than three	144	48 (33.3)	71 (49.3)	25 (17.4)	1.75	0.782
	Four to six	198	72 (36.4)	95 (48)	31 (15.6)		

	Greater than six	58	20 (34.5)	25 (43.1)	13 (22.4)		
Animal ownership	One species	176	57 (32.4)	90 (51.1)	29 (16.5)	1.89	0.756
	Two species	155	58 (37.4)	71 (45.8)	26 (16.8)		
	Three or more species	69	25 (36.2)	30 (43.5)	14 (20.3)		
Ownership of the house	Private	157	57 (36.3)	69 (44)	31 (19.7)	19.08	0.014
	Rent	148	44 (29.7)	75 (50.7)	29 (19.6)		
	Family	70	32 (45.7)	36 (51.4)	2 (2.9)		
	Temporary	15	6 (40)	6 (40)	3 (20)		
	Other	10	1 (10)	5 (50)	4 (40)		
Position in the house	Husband	212	69 (32.5)	93 (43.9)	50 (23.6)	28.44	0.002
	Wife	73	41 (56.2)	19 (26)	13 (17.8)		
	Son	68	33 (48.5)	33 (48.5)	2 (3)		
	Daughter	21	11 (52.4)	9 (42.9)	1 (4.7)		
	Relatives	7	4 (57.1)	3 (42.9)	0 (0.0)		
	Other	19	4 (21)	12 (63.2)	3 (15.8)		

Table 6**:** Association of attitude with demographic characteristics

Variable		No of respondents	Attitude			c2	*p* – value
			Positive (%)	Neutral (%)	Negative (%)		
Education level	Primary	86	34 (39.5)	41 (47.7)	11 (12.8)	222.7	0.000
	Secondary	128	82 (64.1)	42 (32.8)	4 (3.1)		
	Vocational	50	32 (64)	8 (16)	10 (20)		
	College/university	71	63 (88.7)	7 (9.9)	1 (1.4)		
	No formal education	65	4 (6.1)	11 (16.9)	50 (77)		
Marital status	Married	294	145 (49.3)	87 (29.6)	62 (21.1)	20.54	0.002
	Unmarried	89	62 (69.7)	20 (22.5)	7 (7.8)		
	Divorced	9	4 (44.5)	2 (22.2)	3 (33.3)		
	Widowed	8	4 (50)	0 (0.0)	4 (50)		
Sex	Female	99	50 (50.5)	31 (31.3)	18 (18.2)	1.1	0.577
	Male	301	165 (54.8)	78 (25.9)	58 (19.3)		
Occupation	Government	139	107 (77)	20 (14.4)	12 (8.6)	116.6	0.000
	Nongovernment	68	31 (45.6)	30 (44.1)	7 (10.3)		
	Student	45	26 (57.8)	14 (31.1)	5 (11.1)		
	Private	94	42 (44.7)	34 (36.2)	18 (19.1)		
	No work	54	9 (16.7)	11 (20.4)	34 (62.9)		
House hold size	Less than three	144	68 (47.2)	47 (32.6)	29 (20.2)	9.1	0.059
	Four to six	198	115 (58)	52 (26.3)	31 (15.7)		
	Greater than six	58	32	10	16		

			(55.2)	(17.2)	(27.6)		
Animal ownership	One species	176	97 (55.1)	48 (27.3)	31 (17.6)	1.6	0.808
	Two species	155	79 (51)	42 (27.1)	34 (21.9)		
	Three or more species	69	39 (56.5)	19 (27.5)	11 (16)		
Ownership of the house	Private	157	86 (54.8)	39 (24.8)	32 (20.4)	8.7	0.365
	Rent	148	72 (48.6)	45 (30.4)	31 (21)		
	Family	70	44 (62.8)	19 (27.2)	7 (10)		
	Temporary	15	9 (60)	2 (13.3)	4 (26.7)		
	Other	10	4 (40)	4 (40)	2 (20)		
Position in the house	Husband	212	113 (53.3)	54 (25.5)	45 (21.2)	22.95	0.011
	Wife	73	33 (45.2)	24 (32.9)	16 (21.9)		
	Son	68	44 (64.7)	17 (25)	7 (10.3)		
	Daughter	21	15 (71.4)	6 (28.6)	0 (0.0)		
	Relatives	7	3 (42.9)	4 (57.1)	0 (0.0)		
	Other	19	7 (36.8)	4 (21.1)	8 (42.1)		

Table 7**:** Association of practice with demographic characteristics

Variable		No of respondents	Practice			c2	*p*-value
			Good (%)	Fair (%)	Poor (%)		
Education level	Primary	86	38 (44.2)	45 (52.3)	3 (3.5)	178.6	0.000
	Secondary	128	69 (53.9)	58 (45.3)	1 (0.8)		
	Vocational	50	34 (68)	12 (24)	4 (8)		
	College/university	71	51 (71.8)	19 (26.8)	1 (1.4)		
	No formal education	65	7 (10.8)	22 (33.8)	36 (55.4)		
Marital status	Married	294	145 (49.3)	112 (38.1)	37 (12.6)	5.29	0.507
	Unmarried	89	46 (51.7)	38 (42.7)	5 (5.6)		
	Divorced	9	4 (44.5)	4 (44.5)	1 (11)		
	Widowed	8	4 (50)	2 (25)	2 (25)		
Sex	Female	99	48 (48.5)	41 (41.4)	10 (10.1)	0.39	0.821
	Male	301	151 (50.2)	115 (38.2)	35 (11.6)		
Occupation	Government	139	102 (73.4)	33 (23.7)	4 (2.9)	111.5	0.000
	Nongovernment	68	33 (48.5)	31 (45.6)	4 (5.9)		
	Student	45	18 (40)	25 (55.6)	2 (4.4)		
	Private	94	39 (41.5)	44 (46.8)	11 (11.7)		
	No work	54	7 (13)	23 (42.6)	24 (44.4)		
House hold size	Less than three	144	70 (48.6)	56 (38.9)	18 (12.5)	1.3	0.861
	Four to six	198	102 (51.5)	77 (38.9)	19 (9.6)		

	Greater than six	58	27 (46.6)	23 (39.7)	8 (13.7)		
Animal ownership	One species	176	88 (50)	67 (38.1)	21 (11.9)	2.12	0.713
	Two species	155	80 (51.6)	57 (36.8)	18 (11.6)		
	Three or more species	69	31 (44.9)	32 (46.4)	6 (8.7)		
Ownership of the house	Private	157	73 (46.5)	66 (42)	18 (11.5)	13.3	0.102
	Rent	148	77 (52)	49 (33.1)	22 (14.9)		
	Family	70	33 (47.2)	35 (50)	2 (2.8)		
	Temporary	15	10 (66.7)	3 (20)	2 (13.3)		
	Other	10	6 (60)	3 (30)	1 (10)		
Position in the house	Husband	212	106 (50)	75 (35.4)	31 (14.6)	10.5	0.400
	Wife	73	35 (50)	29 (39.7)	9 (12.3)		
	Son	68	33 (48.5)	32 (47.1)	3 (4.4)		
	Daughter	21	11 (52.4)	9 (42.9)	1 (4.7)		
	Relatives	7	5 (71.4)	2 (28.6)	0 (0.0)		
	Other	19	9 (47.4)	9 (47.4)	1 (5.2)		

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