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Original Article

Assessing the Knowledge, Practices, and Attitude towards Antimicrobial Resistance among Physicians, Pharmacists and the General Public in Wa Municipality

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Abstract - Antimicrobial Resistance (AMR) is the ability of microorganisms to withstand antimicrobial medications that previously could eliminate non-resistant strains. A major driver of AMR is irrational antibiotic use and inappropriate disposal. This cross-sectional survey was conducted in Wa Municipality, Upper West Ghana. Convenience sampling recruited 417 participants: 303 general public residents, 51 clinicians, and 63 pharmacists. Separate questionnaires collected demographics and information on antibiotic knowledge, attitudes, prescribing practices, and usage behaviors. Data was analyzed using IBM SPSS Statistics. The general public had limited knowledge of appropriate antibiotic use; 66% consumed antibiotics without prescriptions, correlated with education level. Nearly half disposed of antibiotics in household waste. Clinicians (85%) reported high patient demand for antibiotics, driving over-prescription. Most (76%) supported developing local AMR guidelines. Many pharmacists (66%) dispensed antibiotics without prescriptions and prolonged recommended durations. The results reveal critical gaps in AMR knowledge and risky antimicrobial use practices among all groups in this region. Implementing tailored educational campaigns, treatment guidelines, environmental strategies, and antimicrobial stewardship programs with stakeholder engagement can promote prudent use and curb resistance. Ongoing research should assess changes in knowledge, attitudes and behaviors over time.

Keywords - Antimicrobial resistance, Clinicians, Pharmacists, The general public, Antibiotic stewardship.

1. Introduction

Antibiotics are a class of antimicrobial drugs that kill or stop the growth and replication of bacteria (Singh et al., 2017). Their discovery and use in medicine revolutionized the 20th century, increasing average global human life expectancy by more than 20 years (Hutchings et al., 2019). Antibiotics work by targeting essential bacterial cell

mechanisms and physiology, ultimately killing or preventing the spread of bacteria (Kapoor et al., 2017; Tenover, 2006). For example, cell wall synthesis inhibitors like penicillin disrupt the construction of bacterial cell walls, causing the cells to burst. Protein synthesis inhibitors such as tetracycline prevent bacterial ribosomes from making essential proteins. Antibiotics like sulfonamides and trimethoprim interfere with key steps in bacterial folic acid metabolism, which is necessary for growth. With the widespread use of antibiotics around the world, antibiotic resistance has become a major problem. Resistant bacteria can withstand doses of antibiotics that would previously have killed them. Data from regions with high antibiotic use shows a direct link between usage levels and resistance rates. This confirms that inappropriate and excessive antibiotic use drives the global rise of antimicrobial resistance (Goossens et al., 2005; Llor & Bjerrum, 2014).

Some key factors contributing to imprudent antibiotic utilization include:

- Uncertainty in clinical diagnosis prompts unnecessary antibiotic prescribing.
- Inadequate knowledge among prescribers regarding proper indications and stewardship.
- Patient demands, expectations, and pressures to prescribe antibiotics.
- Financial incentives tied to antibiotic sales volumes.
- Limited regulation of antibiotic access and prescribing.
- Self-medication with antibiotics without medical oversight.
- Non-compliance with completing prescribed antibiotic treatment courses.
- Overuse of antibiotics in livestock and agriculture.
- Lack of public understanding about antibiotic indications, resistance risks, and proper use.
  (Andrajati et al., 2017; Asante et al., 2017; El Sherbiny et al., 2018; Yevutsey et al., 2017)

Antibiotic misuse has several risks, including the development and spread of resistant organisms in populations, failed treatments, increased expenses due to longer care or the need for last-line medications, and organ toxicities or adverse effects (Maira Faizullah, 2017). Antimicrobial Resistance (AMR) is the ability of microbes to survive and grow even when exposed to medications designed to kill them (Abushaheen et al., 2020). AMR is a major global problem driven by lax regulation around access and use of antibiotics and disposal of same in many countries (Hernando-Amado et al., 2019).

The improper disposal of leftover antibiotics contributes to AMR by releasing residues into the environment that exert selective pressure on bacteria and facilitate resistance gene transfer (Ayukekbong et al., 2017; Bernabé et al., 2017; El Sherbiny et al., 2018; Hernando-Amado et al., 2019; Maira Faizullah, 2017). Improperly disposed of antibiotics at landfills can become reservoirs of resistant microbes and promote resistance gene transfer. (Ayukekbong et al., 2017; Lubick, 2010; Sasu et al., 2011). This study evaluated current knowledge, attitudes, practices, and perceptions regarding antimicrobial use and resistance, specifically in Wa Municipality, Ghana. The focus included healthcare professionals (clinicians, pharmacists) and the general public.

Wa Municipality represents an understudied rural region where consequences of antimicrobial misuse often go unrecognized due to limited surveillance capacity. Assessing the local context is imperative, as cultural beliefs, social norms, and health infrastructure shape antimicrobial knowledge and practices regionally (Hassali et al., 2015). Identifying gaps can inform future public health initiatives promoting prudent antimicrobial use and stewardship.

2. Methodology

2.1. Study Design and Setting

Wa Municipality, Upper West Region, Ghana, was the site of this cross-sectional study. The population of Wa Municipality, which has a land area of 579.86 km^2, is primarily rural.

2.2. Study Population and Sampling

The study population comprised three groups: General public residents of Wa Municipality, Clinicians at healthcare facilities in Wa Municipality, and Pharmacists at healthcare facilities in Wa Municipality. Convenience sampling was used to recruit participants within each group. Questionnaires were distributed both online and in person to maximize participation. The final sample included 303 general public respondents, 51 clinicians, and 63 pharmacists.

2.3. Survey Instrument

Separate questionnaires were designed for each study group using Google Forms. Questionnaires collected information on categories such as demographics, knowledge of antibiotic use, resistance, prescribing, attitudes towards antibiotic use and resistance, self-reported prescribing and dispensing practices, and antibiotic usage behaviors. The general public survey contained 15 knowledge and 10 attitude/practice questions. The clinician and pharmacist surveys had 20 questions, each assessing knowledge, attitudes, and practices.

2.4. Data Collection and Analysis

Prior to analysis, completed surveys were gathered, with all identifiable information deleted. Using IBM SPSS Statistics Version 22, data was examined. Descriptive statistics were used to summarize survey data and demographic information. By using Pearson's chi-square tests, relationships between knowledge, attitudes, and practices were compared. Statistical significance was defined as $p<0.05$.

2.5. Ethical Considerations

All participants gave their informed consent and participated voluntarily. The privacy of all information was protected during data gathering and analysis.

3. Results and Discussion

3.1. Descriptive Analysis – Public

The study included 303 respondents: 233 males and 70 females aged 15-60 years. Most of the respondents (197) lived in urban areas of Wa Municipality, while 106 lived in rural areas. The majority of respondents (83%) had tertiary education and a variety of occupations, with students being the most common occupation. Table 1 summarizes general public responses regarding antibiotic use practices. Antibiotic "self-medication" is widespread and often incorrect, as seen by the 66% of respondents who confessed to using antibiotics without a doctor's prescription. This facilitates misuse, resistance, and potential adverse effects. More than half of the people surveyed prefer to use antibiotics for sore throats, usually caused by viruses, not bacteria (Shulman et al., 2012). Nearly half of the people surveyed throw away leftover antibiotics in the trash. Antibiotics should be disposed of properly (e.g., returned to a pharmacy) to prevent antibiotic contamination of the environment. Table 2 shows how knowledgeable the general public is about antibiotics and resistance. Over half knew that resistance develops when antibiotics cannot kill infections.

However, some think that resistance is the body's tolerance for antibiotics, which shows that there are misunderstandings about how resistance develops. According to a recent study, the general public uses antibiotics ineffectively. This is shown by the fact that people buy antibiotics from pharmacies without a prescription, do not follow the prescribed medication schedule, and use antibiotics to prevent conditions that they are not approved to treat. Not finishing the entire course of antibiotics a doctor recommends can cause bacteria to become resistant, which likely results in a higher likelihood of antibiotic resistance developing (Karuniawati et al., 2021). About half of the people surveyed knew that antibiotics are ineffective against viruses, so misconceptions about antibiotics are common. There were knowledge gaps about how antibiotic resistance can spread, although 64% of the people surveyed agreed that antibiotic overuse in animals contributes to human antibiotic resistance.

Table 1. Summary of attitude-based questions

Questions	Yes	No
Consumption of antibiotics without a doctor's prescription	200 (66%)	103 (34%)
Knowledge about the usage of antibiotics	154 (51%)	149 (49%)
Insisted on an antibiotic prescription from the doctor	106 (35%)	197 (65%)
Completion of the course of treatment with antibiotics	168 (55%)	135 (45%)
Prefer to keep antibiotics at home	211 (70%)	92 (30%)
Acquisition of antibiotics from relatives or friends	46 (15%)	257 (85%)
Buy antibiotics from the pharmacy without a prescription	106 (35%)	197 (65%)
Use an antibiotic if I have a cough for more than a week	137 (45%)	166 (55%)
When I have a sore throat, I prefer to use an antibiotic	174 (57%)	129 (43%)
Disposal of antibiotics with household waste	138 (46%)	165 (54%)

Table 2. Summary of all knowledge-based questions

Questions	Agree	Disagree	Do not know
AMR develops when antibiotics no longer work to treat infections	196 (65%)	43 (14%)	64 (21%)
AMR is the tolerance level of the body when used to the antibiotic	174 (57%)	62 (21%)	67 (22%)
AMR is a global problem	195 (64%)	51 (17%)	57 (19%)
Flu and common cold are cured with a course of antibiotics	150 (50%)	104 (34%)	49 (16%)
AMR organisms can cause death	190 (63%)	35 (12%)	78 (25%)
Antibiotics are meant to be effective against bacteria	242 (80%)	19 (6%)	42 (14%)
Antibiotics are meant to be effective against viruses	93 (31%)	158 (52%)	52 (17%)
The common cold (flu) is caused by bacteria.	127 (42%)	115 (38%)	61 (20%)
The common cold (flu) is caused by viruses	133 (44%)	112 (37%)	58 (19%)
Antibiotics speed up recovery from the common cold (flu)	158 (52%)	93 (31%)	52 (17%)
Antibiotics can cause an imbalance in the body's own bacterial flora	161 (53%)	46 (15%)	96 (32%)
Stop taking antibiotics when experiencing side effects	177 (58%)	94 (31%)	32 (11%)

Discontinue treatment with antibiotics when feeling better	81 (26%)	193 (64%)	29 (10%)
Humans can be resistant to antibiotics	205 (68%)	58 (19%)	40 (13%)
Use of antibiotics can increase the resistance of bacteria	192 (64%)	52 (17%)	59 (19%)
Bacteria can be resistant to antibiotics	209 (69%)	44 (14%)	50 (17%)
Use of antibiotics among animals can reduce the effect of antibiotics on humans	101 (33%)	122 (40%)	80 (27%)
Resistance can spread from animals to humans	107 (35%)	107 (35%)	89 (30%)
Resistance can spread from human to human	126 (42%)	109 (36%)	68 (22%)
ABR is a problem in Ghana today	213 (70%)	25 (8%)	65 (22%)
AMR is a problem in the rest of the world today	194 (64%)	35 (12%)	74 (24%)

The relationship between respondents' educational level and their consumption of antibiotics without a prescription is described in this study (Table 3). This study found a link between higher education level and antibiotic use without a prescription (p=0.002). This means that people with higher education levels were more likely to take antibiotics without a doctor's prescription. This suggests that education alone is not enough to promote prudent antibiotic use. Proper disposal of antibiotics helps prevent antibiotic residues and antibiotic-resistant bacteria from contaminating the environment. Table 4 shows that people living in rural areas are more likely to dispose of leftover or expired antibiotics in household waste bins than those living in urban areas (p=0.035). Specifically, 41% of respondents who live in rural areas reported disposing of antibiotics in household waste bins, compared to 29% of respondents who live in urban areas. Disposing of antibiotics in household waste can contaminate landfills and local water sources with traces of antibiotics and antibiotic-resistant bacteria (Wellington et al., 2013). Over time, this can lead to the spread of antibiotic resistance (Daughton & Ruhoy, 2009). The higher rate of poor antibiotic disposal in rural areas is concerning, as these areas may have less developed water sanitation infrastructure than cities. The amount of Antibiotic Resistance Genes (ARGs) in the environment can rise as a result of disposing of antibiotics—regardless of expiration status—in home trash cans or flushing them down the toilet or sink. (Kümmerer, 2009). This difference shows that rural communities need more education and awareness about proper antibiotic disposal, as environmentally harmful practices seem more common in these areas.

Table 3. Educational status and consumption of antibiotics

Education of Respondents	**Consumption of Antibiotics without the Doctor's Prescription**		
	Yes	**No**	**Total**
College/University	176 (69.8%)	76 (30.2%)	252
High School	24 (47.1%)	27 (52.9%)	51
Total	200	103	303

Table 4. Residence and disposal of antibiotics

Residence of Respondents	Disposal of Antibiotics with Household Waste		
	Yes	No	Total
Urban	98 (50%)	98 (50%)	196
Rural	40 (37.4%)	67 (62.6%)	107
Total	138	165	303

Table 5. Analysis of completion of antibiotics treatment and experiencing side effects

Stop Taking Antibiotics When Experiencing Side Effects	Completion of the Course of Treatment with Antibiotics		
	Yes	No	Total
Agree	100 (56.5%)	77 (43.5%)	177
Disagree	53 (56.4%)	41 (43.6%)	94
Do not know	15(46.9%)	17 (53.1%)	32
Total	168	135	303

This study looked at the relationship between respondents failing to complete a course of antibiotic treatment and stopping the antibiotics because of side effects (Table 5). Of the people who reported not finishing their prescribed course of antibiotics, 56.5% said they stopped taking the antibiotics when they experienced side effects. However, a similar percentage (56.4%) of the people who said they finished their course of antibiotics also said they would have stopped if they had experienced side effects. (Table 5). This suggests that other factors, such as forgetting doses, feeling better and stopping early, or not understanding the dosing instructions, are more likely to lead to antibiotic non-adherence. More research is needed to fully understand why people do not finish their course of antibiotics. However, these results suggest that interventions to address antibiotic non-adherence should address all potential reasons, not just side effects.

3.2. Descriptive Analysis – Clinicians

The survey included 51 clinicians: 29 males and 22 females aged 23-60 years. Most (76%) had 1-10 years of work experience, while 24% had worked for over ten years. Most clinicians agreed that patient demands contribute to the overuse of antibiotics. 73% believed patients often demand antibiotics for viral infections like colds.

This inappropriate pressure could heavily influence over-prescription. 82% of clinicians recognized that antibiotic-resistant infections can make medical procedures more dangerous, reflecting their awareness of the clinical risks of rising antibiotic resistance. 76% of clinicians felt that developing local antibiotic resistance guidelines would be more useful than global ones, suggesting they recognize the need for location-specific recommendations to address regional resistance patterns. A little over half of the clinicians (51%) disagreed that antibiotic committees and guidelines are obstacles to care, implying that most clinicians support stewardship initiatives. More details of clinicians' responses are shown in Table 6 below.

Table 6. Summary of all questions to clinicians

Questions	Agree	Disagree	Do not know
Do individuals who have a common cold insist on receiving an antibiotic?	37 (73%)	14 (27%)	0 (0%)
Do you believe that medical operations such as cancer therapy and organ transplantation may become dangerous because of ABR infections?	42 (82%)	9 (18%)	0 (0%)
AMR is a problem in my daily practice.	38 (75%)	11 (22%)	2 (3%)
In terms of antibiotic resistance, local guidelines might be more beneficial than global ones.	39 (76%)	9 (18%)	3 (6%)
Antibiotic committees and guidelines are more of a hindrance than a benefit to clinical care.	10 (20%)	33 (65%)	8 (16%)
An organization that carries out community education and awareness campaigns regarding antibiotic resistance is, in my opinion, necessary.	50 (98%)	1 (2%)	0 (0%)
Patient demands for antibiotics contribute to over prescriptions and overuse.	42 (82%)	8 (16%)	1 (1%)
During the last 5 years, I have received some teaching/training on antibiotic resistance spread.	36 (71%)	15 (29%)	0 (0%)
I am aware of the nonclinical and environmental pathways by which genes causing antibiotic resistance spread.	38 (75%)	8 (16%)	5 (9%)
Antibiotics are meant to be effective against bacteria.	50 (99%)	0 (0%)	1 (1%)
Antibiotics are meant to be effective against viruses.	3 (6%)	47 (92%)	1 (1%)
The common cold (flu) is caused by bacteria.	10 (20%)	41 (80%)	0 (0%)
The common cold (flu) is caused by viruses.	44 (86%)	7 (14%)	0 (0%)
Antibiotics speed up recovery from the common cold.	14 (27%)	36 (72%)	1 (1%)
Antibiotics can cause an imbalance in the body's own bacterial flora.	46 (90%)	4 (9%)	1 (1%)
Experiencing side effects while taking antibiotics is a sign of stopping the medications.	21 (41%)	29 (58%)	1 (1%)
It is sometimes appropriate to discontinue antibiotic treatment if a patient feels better before the course is complete.	4 (9%)	47 (92%)	0 (0%)
Humans can be resistant to antibiotics.	45 (88%)	6 (12%)	0 (0%)
The use of antibiotics can increase the resistance of bacteria to them.	44 (86%)	7 (14%)	0 (0%)
Bacteria can be resistant to antibiotics.	48 (94%)	3 (6%)	0 (0%)
The use of antibiotics among animals can reduce the effect of antibiotics on humans.	19 (37%)	21 (41%)	11 (22%)
Resistance can spread from animals to humans.	29 (57%)	13 (25%)	8 (18%)
Resistance can spread from human to human.	36 (71%)	11 (22%)	4 (7%)
ABR is a problem in Ghana today.	50 (99%)	1 (1%)	0 (0%)
AMR is a problem in the rest of the world today.	46 (90%)	5 (10%)	0 (0%)

3.3. Descriptive Analysis – Pharmacists

Most pharmacist respondents were male (83%), aged 21-40 years (97%) with diplomas (80%) and 1-10 years of experience (82%). Alarmingly, 32% reported often or always dispensing antibiotics without prescriptions, and another 34% do so occasionally. This inappropriate dispensing facilitates misuse and overuse. 46% acknowledged sometimes extending antibiotic durations beyond doctors' prescriptions using personal discretion. This inappropriate practice can facilitate misuse, overuse, and resistance. However, 38% frequently communicated with prescribers when concerned about a prescription, indicating good stewardship. 48% reported screening prescriptions against guidelines before dispensing, implying modifications are sometimes made without consulting the prescriber. 60% stated they always or often educate patients about proper antibiotic use and resistance issues. Nonetheless, increased education efforts could still help. Table 7 summarizes pharmacists' self-reported potentially inappropriate antibiotic dispensing attitudes and behaviors regarding antibiotic dispensing practices.

Table 7. Summary of attitude-based questions for pharmacists

Question	Always	Often	Occasionally	Rarely	Never
I dispense antimicrobials on prescription, having obtained complete clinical information	20 (32%)	20 (32%)	12 (19%)	2 (3%)	9 (14%)
I dispense antimicrobials without a prescription	1 (2%)	8(13%)	22 (34%)	17 (27%)	15 (24%)
I sometimes dispense antimicrobial for durations more than prescribed by the physician on the patient's request	0 (0%)	1 (2%)	7 (11%)	5 (8%)	50 (79%)
Occasionally, I dispense antibiotics for longer periods of time than the doctor orders, depending on my judgment and experience.	0 (0%)	3 (5%)	17 (27%)	14 (22%)	29 (46%)
Prior to dispensing, I verify that the antimicrobial prescription complies with local regulations.	30 (48%)	16 (25%)	9 (14%)	5 (8%)	3 (5%)
I collaborate with other health professionals for infection control and antimicrobial stewardship	13 (21%)	24 (38%)	11 (17%)	12 (19%)	3 (5%)
If I have any doubts about whether an antibiotic prescription is appropriate, I discuss it with the prescriber	38 (60%)	18 (29%)	7 (11%)	0 (0%)	0 (0%)
Before determining to administer the prescription antibiotic, I look for more clinical information (e.g., drug interactions, adverse drug responses, allergy, etc.)	33 (52%)	19 (30%)	6 (10%)	5 (8%)	0 (0%)
In order to encourage the best possible use of antibiotics, I participate in antimicrobial awareness programs.	14 (22%)	14 (22%)	20 (32%)	9 (14%)	5 (8%)
I educate patients on the use of antimicrobials and resistance-related issues.	38 (60%)	15 (24%)	8 (13%)	2 (3%)	0 (0%)
I try my best to stop or lessen the spread of illnesses in the neighborhood.	18 (29%)	25 (40%)	13 (21%)	5 (8%)	2 (3%)
I question the patients' understanding of the recommended antibiotic and how to use it.	18 (29%)	16 (25%)	16 (25%)	12 (19%)	1 (2%)

In contrast, a study in Pakistan confirmed (70.8%) pharmacists always informed the general public about the risks of antibiotic resistance since they are the source of primary healthcare information (Napolitano et al., 2013). The unavailability and limited access to clinicians in most communities cause the pharmacist to play the dual role of administering antibiotics and providing recommendations to the public on antibiotic use.

This study found that the pharmacists surveyed generally understood some basic principles about antibiotics, such as that they are ineffective against viruses and that stopping an antibiotic course early can promote resistance (Table 8). However, there were some knowledge gaps. For example, 44% of pharmacists incorrectly believed that animal antibiotic use does not affect human resistance when evidence shows otherwise (Marshall & Levy, 2011). This highlights an area needing more education on inter-species resistance transmission. Grasping all emergence pathways is critical for pharmacists to provide appropriate stewardship guidance to patients. For example, one unaware that animal use imperils drug efficacy may not caution against overusing antibiotic ointments. Furthermore, 24% of the pharmacists mistakenly thought that side effects were a reason to stop antibiotic treatment without talking to a provider (Table 8). More education could reinforce side effects alone do not warrant non-adherence. While these pharmacists generally understood antibiotics' role in bacterial infections, gaps existed regarding topics like cross-species resistance spread. Table 8 demonstrates that pharmacists generally understand antibiotics' role in bacterial infections but have knowledge gaps regarding topics like transmission of resistance between species. Filling these knowledge deficits is imperative for pharmacists to optimize stewardship through patient counseling and prescribing interventions.

Table 8. Summary of knowledge-based questions for pharmacists

Questions	Agree	Disagree	Do not know
AMS programs improve patient care	61 (97%)	2 (3%)	0 (0%)
It is best to implement AMS at the community pharmacy level	58 (92%)	4 (6%)	1 (2%)
Antimicrobial resistance is less of an issue thanks to AMS initiatives	56 (89%)	5 (8%)	2 (3%)
Community pharmacists should have proper training on the use of antibiotics	61 (96%)	1 (2%)	1 (2%)
Community pharmacists must participate in pertinent conferences, workshops, and other learning opportunities to improve their knowledge of antimicrobial stewardship	58 (92%)	2 (3%)	3 (5%)
Individual efforts at antimicrobial stewardship have minimal impact on the issue of antimicrobial resistance	33 (52%)	27 (42%)	3 (5%)
I believe that the only professionals who should be knowledgeable about antimicrobial stewardship are prescribing physicians	9 (14%)	53 (84%)	1 (2%)
It is the duty of pharmacists to play a leading part in the health system's antimicrobial stewardship and infection control initiatives	60 (95%)	1 (2%)	2 (3%)
Antibiotics are meant to be effective against bacteria	63 (100%)	0 (0%)	0 (0%)
Antibiotics are meant to be effective against viruses	6 (10%)	56 (88%)	1 (2%)
Experiencing side effects while taking antibiotics is a sign to stop the medications	15 (24%)	45 (71%)	3 (5%)
It is sometimes appropriate to discontinue treatment with antibiotics if you/patient feel better before the course are complete	6 (10%)	57 (90%)	0 (0%)
Humans can be resistant to antibiotics	50 (79%)	12(19%)	1 (2%)
The use of antibiotics can increase the resistance of bacteria to them	52 (83%)	9 (14%)	2 (3%)
The use of antibiotics among animals can reduce the effect of antibiotics on humans	28 (44%)	28 (2%)	7 (2%)

3.4. Key Findings

This study found several important knowledge gaps and suboptimal practices related to antibiotics and Antimicrobial Resistance (AMR) among the general public, clinicians, and pharmacists in Wa Municipality, Ghana.

3.5. General Public

Education level did not affect the likelihood of people using antibiotics without a prescription, which is different from some previous studies (Ayana et al., 2021). The high rate of self-medication (66%) is concerning, given the risks involved. The environment continues to be a reservoir of antibiotic resistance, as nearly half of the antibiotics disposed of were thrown away into household waste bins (Anwar et al., 2020). Significant knowledge gaps existed about antibiotic use, resistance spread, and appropriate use.

3.6. Clinicians

Most clinicians (85%) reported that patients often demand antibiotics, which can lead to overprescribing (Asante et al., 2017). There was strong support for local antibiotic resistance guidelines (76%), given the different resistance patterns in different regions (Tadesse et al., 2017). Interestingly, there were knowledge gaps about how antibiotic resistance can spread through the environment.

3.7. Pharmacists

Pharmacists dispensing antibiotics without a prescription is still very common (66%), even though it is against practice guidelines (Contopoulos-Ioannidis et al., 2001). 92% of pharmacists agreed that they play a key role in antimicrobial stewardship, which supports expanding their role in this area. Continuing education on optimal antimicrobial use is needed for pharmacists.

3.8. Significance and Implications

This study found that all groups had significant knowledge gaps and poor practices related to Antimicrobial Resistance (AMR), which shows a need for improved public health education, prescribing guidance, and antimicrobial governance. Locally-adapted educational initiatives, treatment guidelines, environmental mitigation, and stewardship programs involving healthcare providers and the public can help promote prudent antibiotic use and reduce resistance (Abbo et al., 2013). However, it will also be important to change cultural attitudes and norms around antibiotics and their use (Dejene et al., 2022). Our findings were specific to rural Ghana but may also be relevant to other regions and developing countries. Further research is required to adapt interventions better and track their long-term effects on knowledge, attitudes, and practices. Preserving the effectiveness of antimicrobials is essential worldwide, and it will require contextualized, multifaceted One Health strategies with stakeholder engagement.

4. Conclusion

This study evaluated healthcare professionals' and the general public's knowledge, attitudes, and practices with regard to antibiotic use and resistance in rural Wa Municipality, Ghana. The findings were concerning and suggest that there is a need for improved antimicrobial stewardship in this region. The general public had significant gaps in knowledge about how to use antibiotics appropriately and engaged in risky self-medication behaviors, such as taking antibiotics without a prescription. Clinicians reported that patients often demanded antibiotics even when they were not necessary, which can lead to overprescribing. Pharmacists often dispensed antibiotics without a prescription and sometimes extended antibiotic durations beyond what was prescribed. Overall, these findings suggest that antibiotic prescribing practices in this region are suboptimal and that patient pressure and demands play a role. Both the public and clinicians had significant knowledge limitations about antibiotic indications, resistance, and transmission. Additionally, widespread household disposal of antibiotics is

contributing to environmental contamination. Targeted interventions that engage all stakeholders are urgently needed to promote prudent antibiotic use and stewardship in this region.

The research's conclusions make the following recommendations imperative:

1. Implement public health education campaigns to dispel misconceptions about antibiotics and teach people how to use them properly, including when they are and are not indicated.
2. Develop clinical guidelines for antibiotic prescribing tailored to local resistance patterns and resource limitations.
3. Strengthen antimicrobial stewardship programs with a focus on training pharmacists and clinicians.
4. Increase regulation, auditing, and oversight of antibiotic dispensing and prescribing practices.
5. Provide accessible antibiotic disposal programs to reduce environmental contamination.
6. Conduct further research to evaluate changes in knowledge, attitudes, and behaviors over time and assess the impact of interventions.

Data Availability Statement

Upon request, all information pertaining to this study can be provided.

Consent

All participants provided their informed consent and participated at their own volition. Throughout data collection and processing, confidentiality was upheld.

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Authors Contribution

The concept was created by EUO, RA, and YAM, who also oversaw the research and helped to edit the manuscript. Sample gathering, data analysis, and manuscript preparation were handled by GAAA and CAA. Coordination, assistance with manuscript completion, and design of the sample strategies were all provided by EUO and REA. The final manuscript was read and approved by all writers.

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