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Knowledge, attitude, and practices of pharmacy professionals in Freetown regarding antibiotic use and antimicrobial resistance

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Abstract
Antimicrobial resistance, a growing global public health concern, is a growing issue affecting pharmacy professionals and patients. The WHO estimates that bacterial antimicrobial resistance led to 4.95 million deaths worldwide in 2019 and could lead to $1 trillion in increased healthcare expenses by 2050. Pharmacy vendors, including pharmacists and non-pharmacists, play a crucial role in the fight against antimicrobial resistance, but there is low knowledge about antibiotic use and antimicrobial resistance among pharmacy professionals. This study aimed to assess the knowledge, attitude, and practices of pharmacy professionals regarding antibiotic use and antimicrobial resistance, finding that respondents had significant misconceptions about antimicrobial resistance and varied dispensing practices. Data collection was done using a 35-item online questionnaire, and sampling was done using a random sampling method. Excel 2016 was used for analysis, using a mixed method approach (qualitative and quantitative). Factors such as market competition, work experience, education levels, and attitude scores influenced practice scores. Further training and monitoring are needed to address antimicrobial resistance.

Keywords: Pharmacy, antibiotics, antimicrobial resistance, practice

Introduction
Since Sir Alexander Fleming discovered penicillin in 1928, antibiotics have remained one of the most important medical breakthroughs, saving millions of lives. However, bacteria and other microorganisms have continued to evolve defense mechanisms, leading to antimicrobial resistance (AMR), a phenomenon where pathogens no longer respond to drugs designed to kill or inhibit them [1]. AMR is now recognized as one of the top ten global health threats, with far-reaching consequences for human, animal, and environmental health, making it a significant One Health issue [2]. The overuse and misuse of antibiotics in both human and animal sectors have accelerated the emergence of resistant strains, complicating treatment outcomes and increasing healthcare costs [3, 4].

Globally, AMR is associated with high morbidity, mortality, and economic burden. The WHO estimates that bacterial AMR was directly responsible for 1.27 million deaths in 2019 and contributed to 4.95 million deaths worldwide. Projections suggest that drug-resistant infections could cause 10 million deaths annually by 2050 and drive up to 24 million people into poverty [5]. The economic impact is multifaceted, including increased healthcare costs due to prolonged hospital stays and expensive treatments, reduced productivity, and broader macroeconomic consequences such as GDP losses and rising poverty rates [4, 6]. These effects are expected to be particularly severe in low- and middle-income countries (LMICs), with predictions that AMR could cause 4.1 million deaths in Africa by 2050 if unchecked [7].

The causes of AMR are diverse, ranging from irrational prescribing and dispensing practices, self-medication, and use of antibiotics as growth promoters in agriculture, to environmental contamination from hospitals and wastewater facilities [2, 8, 9]. Genetic factors such as epistasis further complicate resistance development, while climate change has been recognized as an emerging contributor to the crisis [10]. Inadequate infection prevention and control measures, coupled with weak surveillance systems in LMICs, exacerbate the problem [11]. Natural products such as Aloe vera have demonstrated antimicrobial activity [12],

Highlighting the potential of alternative agents to complement antibiotic stewardship efforts and reduce reliance on conventional antibiotics, thereby indirectly contributing to the fight against antimicrobial resistance.

The consequences of AMR are profound. Resistant infections often require second- or third-line treatments, which are more toxic, less effective, and costly, leading to longer hospitalizations, increased mortality, and severe side effects such as organ failure [13, 14]. Misuse of antibiotics for viral illnesses such as influenza, COVID-19, or the common cold, as well as for non-bacterial conditions like menstrual pain or pregnancy prevention, has been widely reported in different populations [1]. These misconceptions highlight the critical role of knowledge and attitudes in shaping antibiotic use.

Pharmacy professionals are frontline actors in the fight against AMR, as they dispense antibiotics and provide guidance to patients. Their knowledge, attitudes, and practices directly influence antibiotic use and stewardship. However, studies across different regions reveal varying levels of knowledge. While some report moderate to high awareness among pharmacy students and professionals [15], others highlight poor knowledge and widespread misconceptions, even among healthcare workers [16, 17]. In Sierra Leone, limited literature exists on pharmacy professionals' understanding of AMR, though studies among students and hospital settings reveal high rates of antibiotic misuse and misconceptions, including the belief that antibiotics can treat viral infections or serve as pain relievers [18, 19].

Attitudes towards antibiotic use also play a crucial role. Positive attitudes, such as seeking medical advice before using antibiotics, can reduce misuse, but financial constraints and limited access to healthcare often drive patients to self-medicate or request antibiotics directly from pharmacies [17, 20]. Even individuals with higher education and knowledge may engage in inappropriate practices such as storing leftover antibiotics or sharing them with others [21]. Among pharmacy professionals, attitudes are expected to align with their knowledge, yet studies show mixed results, with some recognizing their role in controlling resistance while others underestimate the impact of their dispensing practices [16].

Despite the critical role of pharmacy professionals, they are often overlooked in AMR research compared to other healthcare workers. Given their frontline position and influence on patient behavior, assessing their knowledge, attitudes, and practices is essential for designing effective antimicrobial stewardship programs and policies. This study therefore aims to evaluate the knowledge, attitudes, and practices of pharmacy professionals in Freetown regarding antibiotic use and antimicrobial resistance, to determine whether these parameters influence their dispensing decisions and to inform targeted strategies for combating AMR and improving public health outcomes.

Methodology

Sample Size

This study covered a total of 20 pharmacy professionals within Freetown. The study included only licensed community pharmacies and excluded hospital pharmacies. The term pharmacy professionals was used to describe those people who work and dispense drugs at pharmacies, they include pharmacists and pharmacy attendants, otherwise known as assistants or technicians. The pharmacy attendants included those pharmacy workers who are not pharmacists but also dispense antimicrobial drugs, including student interns, pharmacy technicians, and other assistants. The sample size was determined based on feasibility and the exploratory scope of the study.

Sample Area

This study was conducted in Freetown, which is the capital city of Sierra Leone. It is situated in the western area of urban and holds a population of 1, 347, 560 as of 2021 [22]. Freetown was chosen due to its high density of pharmacies.

Sampling Design

Sampling was conducted using simple random sampling, as it is the most reliable and unbiased statistical sampling technique. Pharmacies were selected using simple random sampling from the Freetown Pharmacy Registry. If a selected pharmacy declined participation, another was randomly chosen. However, since pharmacy workers are mostly busy attending to customers throughout the day, some requested to have the questionnaire sent to them online so they could fill it out when they were less busy.

Data Collection

Data were collected in July 2024 using a semi-structured questionnaire (Google Forms, English). The questionnaire was pilot-tested for clarity, but formal validation was not conducted. Respondents completed the survey either in person or online. Written informed consent was obtained

Data Coding

A researcher-developed scoring system was applied to categorize responses on knowledge, attitude, and practice (KAP). Scores were grouped into five ordinal categories: 0-10 = 1, 11-20 = 2, 21-30 = 3, 31-40 = 4, and 41-50 = 5. This system was designed to provide a structured ranking of participants' responses for subsequent correlation analysis. While the scoring framework was not adapted from a validated instrument, it was applied consistently across all respondents and is acknowledged as a limitation.

Data Analysis

Data were cleaned and analyzed in Microsoft Excel. Descriptive statistics summarized demographics. Spearman's rank correlation was used to assess associations between KAP scores. Statistical significance was set at $p<0.05$.

Results

Socio-demographic characteristics of respondents

Age of respondents

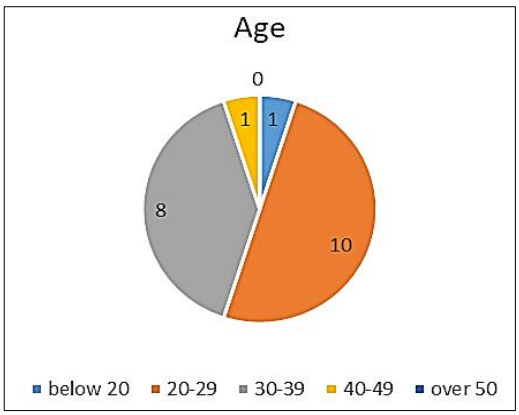

Fig 1: The age distribution among respondents

As illustrated in figure 1 above, 10 respondents were within the age range 20-29 years which made up 50% of respondents in this study. Followed by 30-39 years representing 40% of the sample population, with 2 respondents belonging to 40-49 and 50-years age range representing 5% of the population.

Level of Education of respondents

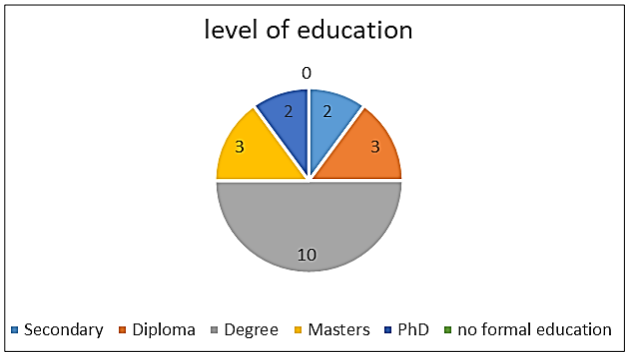

Fig 2: The level of education of the respondents

As illustrated in figure 2, 10 of the respondents have a bachelor's Degree, with 3(15%) respondents having a master's degree and diploma each, 2 respondents with PhD, 2 respondents from secondary school and 0 respondents having no formal education.

Occupation

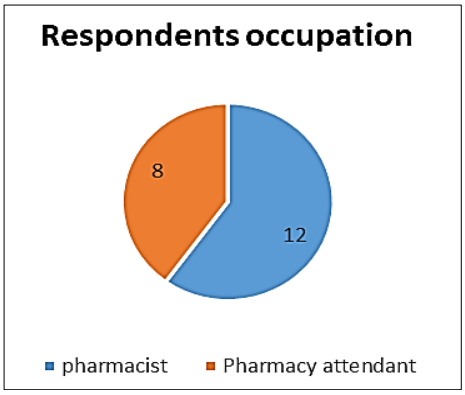

Fig 3: The profession of respondents

As illustrated in figure 3 above, 12(60%) of the respondents were Pharmacists and 8(40%) of them were pharmacy attendants. The pharmacy attendants in this study includes assistants at the pharmacy who also dispense drugs to customers.

Work experience

Fig 4: Years of work experience of respondents

As illustrated in figure 4 above, 10(50%) of the respondents have a work experience of 1-5 years, while 5(25%) had work experience between 5-10 years, 4(20%) with working experience below 1 year, and only 1 respondent having over 10 years of experience.

Knowledge assessment

Respondent awareness of Anti-microbial resistance

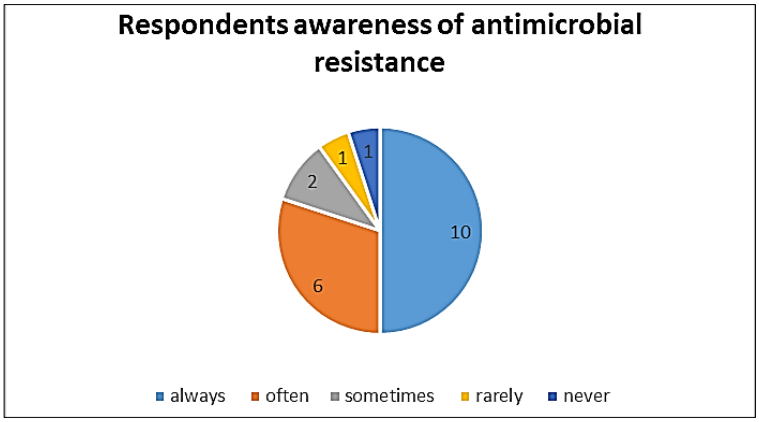

Fig 5: The frequency of how often respondents come across the term antimicrobial resistance

As illustrated in Figure 5, when asked how frequently they encounter the term "antimicrobial resistance," 10 (50%) of the respondents said they do so always, 6 (30%), 2 (10%) said they do sometimes, 1(5%) rarely and 1(5%) never. Overall, the findings indicate that a higher proportion of participants were aware of the term "antimicrobial resistance". This might be the case since 90% of the respondents had formal schooling, which enables them to have encountered this subject either as part of their course of study or other means of information.

Respondents Perceived definition of antimicrobial resistance

From table 1, when asked the question "which of the following best describes antimicrobial resistance" 14(70%) chose the "it is when bacteria or germs become resistant to antimicrobial medicines", meanwhile, 4(20%) of the respondents responded as when the body becomes resistant to antimicrobial drugs. Interestingly, 1(5%) of the respondents chose that it is when the body stops responding to medicine and 1(5%) said none of the options best described AMR. The definition of AMR is most often misunderstood by several individuals as when the body becomes resistant to antimicrobial drugs, however, according to the WHO and CDC, it is described as when bacteria, viruses, fungi and parasites (collectively called germs) no longer respond to antimicrobial medicines that were originally designed to kill them.

Respondent's source of information regarding AMR

Table 2 as illustrated shows that respondents mostly get their information about AMR from a doctor 8 (42.1%) and from social media 8 (42.1%). Meanwhile, radio and TV stations 5 (26.3%) as well as AMR campaigns on the street 5 (26.3%) were recorded the second highest sources of information for the respondents. 1 (5%) respondent's source of information was from a friend, meanwhile a total of 7 (37.1%) had other sources like Pharmacists, AMR champions in hospitals, BNF and related journals, training and academic research. This result shows that many sources of information regarding AMR and the use of antibiotics are made available for pharmacy professionals which should help improve their practices.

Causes of AMR

As shown in table 3, 17 (89.5%) and 10 (52.6%) of respondents respectively, believe that AMR is caused by the misuse and overuse of antibiotic and not following doctor's prescription as directed. 8 (42.1%) believe it is caused by sharing antibiotics with others. Meanwhile, 1 (5.3%) respondent chose it is personal resistance to medication and buying medicine without prescription that causes AMR.

Scope of antibiotic usage

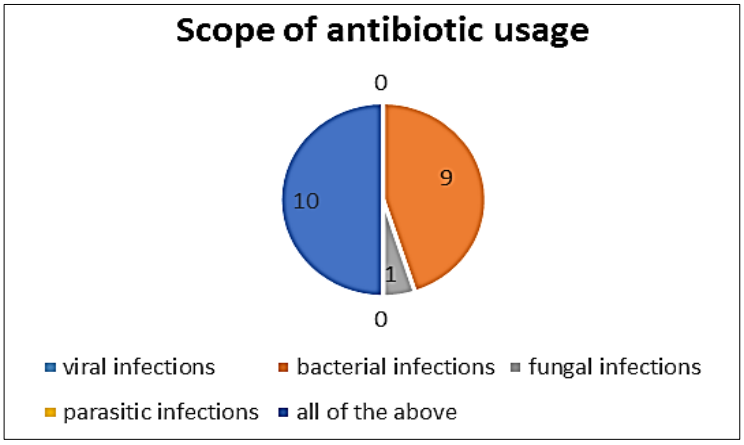

Fig 6: The scope of infections respondents believe antibiotics can treat

As illustrated in figure 8, 10(50%) of the respondents believe antibiotics can treat viral, bacterial, fungal, and parasitic infections. Meanwhile, 42.1% say antibiotics can be used to treat only bacterial infections. Only 1(5%) respondent believes antibiotics can treat fungal infections.

The above percentages show that the misconception "antibiotics can treat all infection" is also observed among pharmacy professionals/vendors.

Respondent's knowledge regarding AMR and antibiotic use

As shown in table 4, the statement that "antibiotics are used to treat all infections" is believed to be false by 12 (60%) of the respondents, while 8 (40%) believe it is true. The above statement is one common misconception that is observed among various groups of individuals including some health professionals, however it is a false statement as antibiotics were made only to treat bacterial infections and using them to treat other types of infections not only causes damage to the normal bacterial flora of the body but also contributes to the emergence of bacterial resistance. The statement "it is safe to use leftover antibiotics" was believed to be false by 18 (90%) of the respondents, 1 (5%) believed it to be true and 1 (5%) said they do not know. "Leftover antibiotics can be shared with relatives" 17 (85%) of respondents said it is false, while 2(10%) said it is true. Interestingly, all the respondents (100%) responded "false" to the statement "patients should stop taking their antibiotic as soon as they start feeling better" and this was indeed true as antibiotics can only work properly when the full dose is administered or taken. This is because bacteria replicate very fast and can share genes that make them resistant, not completing a full course of antibiotics makes it easier for the bacteria to develop resistance against the drug, making the infection harder to treat in subsequent times. The meaning of antimicrobial resistance is often confusing to a lot of people, in this study, the statement "AMR occurs when organisms become resistant to antimicrobial drugs and they no longer work" was believed to be true by majority of the respondents (75%), while 3 (15%) said it is false and 2

(10%) said they do not know. This shows a slight gap in the knowledge about what AMR is among some pharmacy professionals. Lastly, the statement that "AMR is only a problem for people who use antibiotics" was believed to be false by 13 (65%) of respondents, while 7 (35%) believed it to be true, this also showing a knowledge gap among the respondents.

Attitude assessment

As shown in table 5, majority of the respondents either strongly agree or agree (65% and 20% respectively) to the statement that "AMR is a public health threat", while 3(15%) remained neutral about it. Meanwhile, all of respondents either strongly agree/agree (80% and 20% respectively) to the statement "antibiotics should be prescribed only when necessary" a slightly proper understanding of when antibiotics should be made available for use by patients. With regards to educating patients about the use of antibiotics, a large amount of the respondents either strongly agree or agree (75% and 25% respectively) to the statement "patients should be educated on the proper use of antibiotics" and this shows the willingness of these professionals to educate their customers as it is quite an important part of their job. Putting proper control measures in place is crucial in combating the spread of resistance, and majority of the respondents strongly agree (65%) and agree (35%) that "Antimicrobial resistance is a problem that can be controlled with proper control measures". However, when it comes to their roles as pharmacy professionals in fight against AMR, some respondents either strongly agree/agree (45% and 30% respectively) to the statement "Pharmacy attendants play a significant role in preventing further spread of resistance", while 4(20%) were neutral and 1(5%) disagree with the statement. This shows that there is a slight gap in the respondent's knowledge about their roles in preventing the further spread of AMR. With regards to the availability of antibiotics, majority of the respondents strongly disagree/agree (45% and 35% respectively) to the statement "antibiotics should be made available without the need for a prescription", 2(10%) agree and 2(10%) remained neutral about the statement.

As observed from table 6, most respondents (45% and 30% respectively) perceive the issue of AMR as either very serious or serious, while 4(20%) and 1(5%) rated theirs as 3 which was neutral and 1 which was not serious. Meanwhile majority of them considered pharmacy professionals very important in preventing further spread of AMR, a few did not consider them as important. Majority (70% and 15% respectively) considered it either very important or important to educate patients on the proper use of antibiotics. When asked to rate their perception of antimicrobial resistance and antibiotic use, more than half of the respondents chose higher rates, showing that they believe they have better perception of the subject, but a few were a bit skeptical about theirs.

Practice Assessment

Factors respondents consider before dispensing antibiotics

From table 7, when the respondents were asked the question "how often do you dispense antibiotics without a prescription?" 10% and 25%, respectively, said they rarely and never do it. Meanwhile, 6 (30%) say they sometimes do so and interestingly quite a few of them (20% and 15% respectively) said they do so always and often. Previously, a larger proportion of the respondents agreed that it is important to advice patients on the proper use of antibiotics, however, their practice does not reflect that attitude as only 4 (20%) said they always do so and 8 (40%) said they do so often, 5 (25%) sometimes and 3 (15%) rarely.

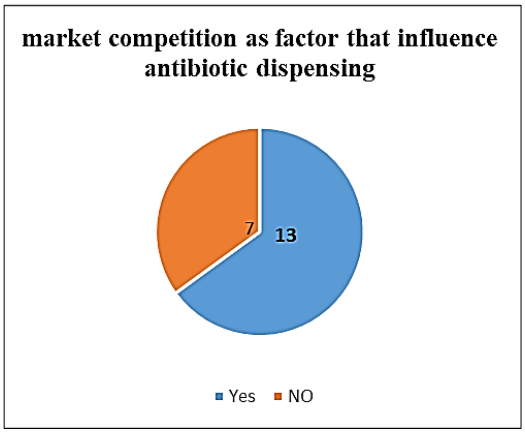

Fig 7: Respondents perception about market competition as a factor that influences their antibiotic dispensing practices

Table 8 shows the various factors the respondents consider before dispensing antibiotics, the factor with the highest frequency (55%) was "Doctor's prescription" which is accurate, as antibiotics should be sold to customers based on the availability of prescription from a doctor. The patient's health condition (25%) and the type of antibiotic being requested 5 (25%) where also factors considered some respondents. Interestingly, 8 (40%) considered all as factors for dispensing antibiotics. Meanwhile, 1 (5%) respondent chose the socioeconomic status of the customer. Aside from having a doctor's prescription, no other factor should be considered when selling antibiotics to customers, as that would mean self-medication, which is most times related to misuse and abuse. Also, as illustrated in figure 9, more than half of the respondents (65%) considered market competition as factor that influences their antibiotic dispensing practices. This means that most of them dispense antibiotics with the fear that if they ask for a prescription as a prerequisite for getting an antibiotic, they might lose customers to other competitors.

Control measures

As shown in the table 9 above, a larger proportion of the respondents 18(90%) chose educating health professionals and members of the public on rational antimicrobial use as a control measure that can help control AMR in the country. Developing national and institutional antimicrobial usage policies was second highest (55%), meanwhile 6 (30%) and 8 (40%) respectively, believed that reducing antimicrobial use in animal livestock and among humans were also possible control measures. A few believed that developing new antimicrobial drugs could control the spread of AMR.

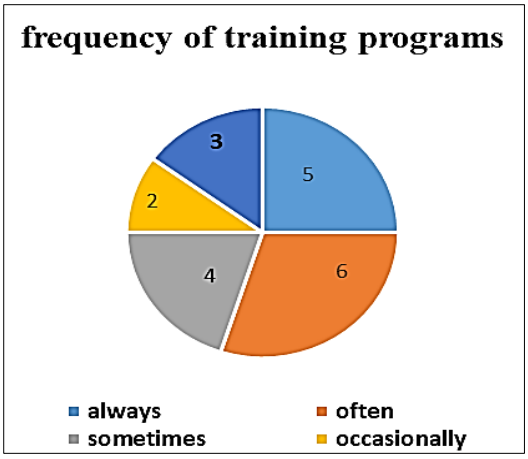

Fig 8: Respondent's frequency of encounter training programs on AMR

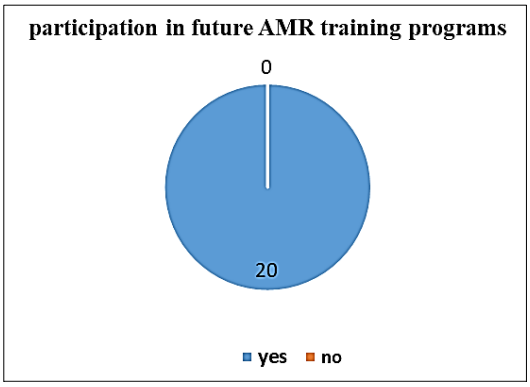

Fig 9: The respondent's willingness to participate in future AMR training programs

As illustrated in figures 9 and 10, a large proportion of the respondents (30% and 25% respectively) often and always encounter training programs on AMR, meanwhile a few encounters them sometimes (20%), occasionally (10%) and never (15%). However, all of them responded they are willing to participate if they are opportune to be part of such programs.

Most frequently ordered antibiotics

According to table 10, 80% of the participants stated that customers most frequently order amoxicillin, ampicillin, and metronidazole. Ciprofloxacin was mentioned by 75%, Ceftriaxone by 60%, Erythromycin (55%), Tetracycline (50%,) Gentamicin and Chloramphenicol (45%), and Doxycycline (5%) meanwhile, 1 respondent said it depends on the patient condition.

Interpretation

According to table 11 and 12, given Coefficient (r): -0.10644, the negative sign indicates a negative correlation. This means that as the knowledge score of pharmacy professionals increases, their practice score tends to slightly decrease, and vice versa. The value 0.10644 is very close to 0, indicating that the relationship between knowledge and practice is very weak. This suggests that there is not a strong monotonic relationship between these variables. In practical terms, this means that higher knowledge does not necessarily correlate strongly with better practice among the professionals in this study.

Interpretation

According to table 13 and 14, given Coefficient (r): -0.10644, the negative sign indicates a negative correlation, meaning that as the attitude scores increase, the practice scores tend to decrease, and vice versa. The value −0.33628 is not as close to 0, indicating a moderate negative correlation. This suggests that there is a noticeable, though not strong, inverse relationship between the attitude and practice of pharmacy professionals.

Interpretation

According to table 15 and 16, the negative sign indicates a negative correlation. This means that as the education level of pharmacy professionals increases, their practice scores tend to decrease slightly, and vice versa.
The value −0.17774 is relatively close to 0,
suggesting that the correlation is weak. This means
there is a slight inverse relationship between education level and practice, but the association is not strong.

Interpretation

According to table 17 and 18, the negative sign indicates a negative correlation. This means that as work experience increases, practice scores tend to decrease, and vice versa. The value −0.35125 indicates a moderate negative correlation. This suggests that there is a noticeable, but not very strong, inverse relationship between work experience and practice among pharmacy professionals

Discussion

The majority of respondents are relatively young (20-39 years), with a significant proportion holding at least a bachelor's degree. Most of the respondents are male, and pharmacists outnumber pharmacy attendants. Most respondents have between 1-10 years of work experience, indicating a mix of early to mid-career professionals. There is a high level of awareness of AMR, with most respondents encountering the term frequently. In studies from other low- and middle-income countries (LMICs) this is not the case, as most have no training in pharmacy and are mostly unaware of AMR [14, 16]. However, there are significant misconceptions about AMR, particularly regarding what it entails, and the scope of infections antibiotics can treat, which is widespread among several groups of individuals, medical and non-medical professionals alike. Among OPD attendants at a clinic in Ghana, [17] reported similar findings among their study participants with several of them having the misconception that antibiotics can cure all infections. It is believed that most people who get counselling from pharmacists about the proper use of antibiotics tend to use them prudently, however, if the professionals are having misconceptions, then passing on the correct information about proper antibiotic use will be hard. [23]. the respondents get information from a variety of sources, including doctors and social media, highlighting the need for accurate and consistent messaging across all platforms. While most respondents understand that AMR is a public health threat and agree on the need for proper antibiotic use, there are still gaps in their knowledge, particularly regarding the use of leftover antibiotics and the role of antibiotics in treating different types of infections. In this present study pharmacy professionals had low knowledge score regarding AMR, compared to studies from other LMICs like Thailand, community pharmacists showed high levels of knowledge

with regards to AMR. Meanwhile in Zambia, they demonstrated moderate knowledge about the topic. It is mostly expected of pharmacy professionals to have greater knowledge, hence good attitude towards the AMR as they play a crucial role in disseminating information to their customers. [16] in their study reported most of the participants in cluster 2 (pharmacists) recognized their role in helping control antibiotic resistance, meanwhile, the proportion of participants in cluster 2 (95.8%) who agreed/strongly agreed that there is a connection between their dispensing practice and the emergence of resistance and that they have a key role in helping control resistance was smaller than those in Cluster and 3 (98.4%) and 1 (97.8%).

Dispensing practices vary, with some respondents admitting to giving antibiotics without prescriptions and varying in how often they advise on proper antibiotic use. The role of pharmacy professionals is mainly to dispense medication, but also to educate their customers of how those medications can be properly used. Antibiotics are known to be prescription only drugs, however, it is one of the most sold over-the-counter drugs in pharmacies. In this study, some respondents admit to selling antibiotics without prescriptions, and this is consistent with several studies [24, 25]. This according to findings from some studies is as a result of several factors. One of those factors found in this present study is market competition which in some studies was also discovered to influence dispensing practices for a significant proportion of pharmacy professionals. For instance, in India, over the counter sales of antibiotics and their use in self-medication was due to the pharmacy vendors' fear of losing customers to other pharmacies [26]. This is not only observed in LMICs, in developed countries, like Hungary, the main reason for over the counter (OTC) antibiotic sales is patient demand and a fear of losing customers [23]. The most commonly ordered antibiotic medications by customers are amoxicillin, ampicillin, and metronidazole, with significant mentions of ciprofloxacin, ceftriaxone, erythromycin, and others. This indicates a high demand for a range of antibiotics from customers.

The weak negative correlation (R) = −0.10644 between knowledge and practice scores suggests that increased knowledge among pharmacy professionals slightly correlates with lower practice scores. This indicates that higher knowledge levels do not necessarily translate into better practical application of that knowledge, as reported in studies from countries in the African region as well as some other LMICs [25]. According to [27], community pharmacists had good knowledge, but poor practices towards AMR, highlighting that demographic factors such as age, job status and work experience are all factors associated with inappropriate dispensing practices. The moderate negative correlation (R) = −0.35125 indicates a noticeable, but not very strong, inverse relationship between work experience and practice scores, disagreeing with the previous findings from [27]. As work experience increases, practice scores tend to decrease moderately, suggesting that experience alone does not guarantee better practice.

Since work experience was not found to have much influence on practices, the education levels were correlated with the practice scores of the respondents and results showed that higher education levels are slightly associated with lower practice scores, meaning that more advanced education does not strongly predict better practice among the professionals. This calls for further training as well as proper monitoring of pharmacy professionals on proper dispensing practices especially in relation to AMR.

The moderate negative correlation (R) = −0.33628 indicates that as attitude scores increase, practice scores tend to decrease, though the relationship is not strong. This highlights that positive attitudes towards certain practices may not always lead to better execution of those practices.

Table 1: The different perceived definitions of AMR and corresponding frequency of respondents

Definition	Frequency (%)
It is when the body becomes resistance to antimicrobial drugs	4(20%)
It is when the bacteria/germs become resistance to antimicrobial medicine	14(70%)
It is when the body stops responding to medicine	1(5%)
None of the above	1(5%)
I don't know	0(0%)

Table 2: The different sources of information for the respondents

Definition	Frequency (%)
Radio and TV station	5(26.3%)
Social media	8(42.1%)
AMR campaigns on the street	5(26.3%)
From a doctor	8(42.1%)
From a friend	1(5.3%)
Others	7(37.1%)

*Percentages may exceed 100% due to multi choice answers

Table 3: The causes of AMR

Causes	Frequency (%)
Misuse and overuse of antimicrobial drugs	17(89.5%)
Not following doctor's prescription	10(52.6%)
Sharing antibiotics with others	8(42.1%)
Personal resistance to medication	1(5.3%)
Buying medicine without prescription	1(5.3%)

Table 4: True/false questions with corresponding responses regarding AMR and antibiotic use

No	Statements	True n (%)	False n (%)	I don't know n (%)
1	Antibiotics are used to treat all infections	8(40%)	12(60%)	0 (0%)
2	It is safe to use leftover antibiotics	1(5%)	18(90%)	1(5%)
3	Leftover antibiotics can be shared with relatives	2(10%)	17(85%)	1(5%)
4	Patients should stop taking antibiotics as soon as they start feeling better	0 (0%)	20(100%)	0 (0%)
5	AMR occurs when organisms become resistant to antimicrobial drugs and they no longer work	15(75%)	3(15%)	2(10%)
6	AMR is only a problem for people who use antibiotics	7(35%)	13(65%)	0 (0%)

Table 5: Statements and corresponding responses with regards to AMR and antibiotic use

No	Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Antimicrobial resistance is a public health threat	13(65%)	4(20%)	3(15%)	0 (0%)	0 (0%)
2	Antibiotics should be prescribed only when necessary	16(80%)	4(20%)	0 (0%)	0 (0%)	0 (0%)
3	Patients should be educated on the proper uses of antibiotics	15(75%)	5(25%)	0 (0%)	0 (0%)	0 (0%)
4	Antimicrobial resistance is a problem that can be controlled with proper control measures	13(65%)	7(35%)	0 (0%)	0 (0%)	0 (0%)
5	Pharmacy professionals play a significant role in preventing further spread of resistance	9(45%)	6(30%)	4(20%)	1(5%)	0 (0%)
6	Antibiotics should be made available without the need for a prescription	0(0%)	2(10%)	2(10%)	9(45%)	7(35%)

Table 6: Statements and corresponding responses from respondents regarding their perception of AMR

No	Statements	1	2	3	4	5
1	How serious do you perceive the issue of AMR	1 (5%)	0 (0%)	4(20%)	6(30%)	9(45%)
2	How important do you consider pharmacists and pharmacy attendants to be in preventing further spread of AMR?	2 (10%)	2(10%)	0 (0%)	3(15%)	13(65%)
3	How important do you think it is to educate patients on the proper use of antibiotics?	2 (10%)	1 (5%)	0 (0%)	3(15%)	14(70%)
4	How would you rate your perception of antimicrobial resistance and antibiotic use?	0(0%)	2(10%)	3 (15%)	5(25%)	10(50%)

Table 7: Statements and corresponding responses with regards to the respondents' practices in relation to AMR and antibiotic use

No	Statements	Always	Often	Sometimes	Rarely	Never
1	How often do you dispense antibiotics without a prescription?	4(20%)	3(15%)	6(30%)	2(10%)	5 (25%)
2	How often do you give advice to customers on which antibiotics to use and how to use them?	4(20%)	8(40%)	5(25%)	3(15%)	0(0%)

Table 8: The factors respondents consider before dispensing antibiotics

Factors	Frequency (%)
Doctor's prescription	11 (55%)
Patient's socioeconomic status	1 (5%)
The patient's health condition	5 (25%)
The type of antibiotic that is being requested	5 (25%)
All of the above	8 (40%)

*Percentages may exceed 100% due to multi choice answers

Table 9: Possible control measures and their corresponding respondent frequencies

Control measures	Frequency (%)
Developing new antimicrobial medicines	3 (15%)
Developing national and institutional antimicrobial usages policies	11 (55%)
Reducing antimicrobial use in animal livestock	6 (30%)
Reducing antimicrobial use among humans	8 (40%)
Educating health professionals and members of the public on rational antimicrobial use	18 (90%)
None of the above	0 (0%)

*Percentages may exceed 100% due to multi choice answers

Table 10: Antibiotics and the frequency of respondents who chose them as the most requested antibiotics

Antibiotics	Frequency (%)
Amoxicillin/Clavulanate (Amoxiclav)	16 (80%)
Ampicillin/Cloxacillin (Ampiclox)	16 (80%)
Ceftriaxone	12(60%)
Tetracycline	10(50%)
Metronidazole	16(80%)
Ciprofloxacin	15(75%)
Erythromycin	11(55%)
Gentamicin	9(45%)
Chloramphenicol	9(45%)
Depends on the patient's condition	1(5%)
Doxycycline	1(5%)

*Percentages may exceed 100% due to multi choice answers

Table 11: Knowledge and practice scores with ranks

Knowledge Score	Practice score	Knowledge Rank	Practice Rank
2	5	1.5	20
4	2	10	4.5
5	3	17.5	12
4	3	10	11.5
5	4	17.5	15.5
5	3	17.5	11
3	4	4	14
5	2	17.5	4
5	2	17.5	3.5
4	4	10	11.5
4	3	10	8.5
3	3	4	8
4	3	10	7.5
4	2	10	3
4	4	10	7
4	3	10	6
3	2	4	2.5
2	2	1.5	2
4	2	10	1.5
5	2	17.5	1

Table 12: Correlation and p value of knowledge and attitude

Coefficient (r)	-0.10644
N	20
T- Statistics	0.454183
DF	18
p-value	0.655126

Table 13: Attitude and practice scores with ranks

Attitude Score	Practice score	Attitude rank	Practice rank
4	5	4	20
5	2	13	4.5
5	3	13	12
3	3	1.5	12
5	4	13	17.5
5	3	13	12
4	4	4	17.5
5	2	13	4.5
5	2	13	4.5
5	4	13	17.5
5	3	13	12
5	3	13	12
5	3	13	12
5	2	13	4.5
4	4	4	17.5
5	3	13	12
5	2	13	4.5
5	2	13	4.5
3	2	1.5	4.5
5	2	13	4.5

Table 14: Correlation and p value of attitude and practice

Coefficient (r)	**-0.33628**
N	20
T-Statistics	1.556448
DF	18
p-value	0.137009

Table 15: Education level and practice scores

Education Level	**Practice score**	**Education Ranking**	**Practice ranking**
1	5	1.5	20
3	2	10.5	4.5
3	3	10.5	12
3	3	10.5	12
4	4	17	17.5
5	3	19.5	12
3	4	10.5	17.5
4	2	17	4.5
5	2	19.5	4.5
4	4	17	17.5
3	3	10.5	12
1	3	1.5	12
3	3	10.5	12
3	2	10.5	4.5
2	4	4	17.5
2	3	4	12
3	2	10.5	4.5
2	2	4	4.5
3	2	10.5	4.5
3	2	10.5	4.5

Table 16: Correlation and p-value between education level and practices

Coefficient (r)	**-0.17774**
N	20
T-Statistics	0.76629
DF	18
p-value	0.453437

Table 17: Work experience and practice scores

Work experience	**Practice score**	**Work experience rank**	**Practice rank**
1	5	2.5	20
2	2	9.5	4.5
2	3	9.5	12
3	3	17	12
2	4	9.5	17.5
3	3	17	12
2	4	9.5	17.5
3	2	17	4.5
2	2	9.5	4.5
2	4	9.5	17.5
2	3	9.5	12
3	3	17	12
1	3	2.5	12
2	2	9.5	4.5
1	4	2.5	17.5
2	3	9.5	12
4	2	20	4.5
2	2	9.5	4.5
3	2	17	4.5
1	2	2.5	4.5

Table 18: Correlation and p-value between education level and practices

Coefficient (r)	**-0.35125**
N	20
T-Statistics	1.591666
DF	18
p-value	0.128869

Conclusion

Findings from this study showed that pharmacy professionals have fairly good knowledge about antimicrobial resistance. However, this knowledge does not reflect in their practices as they were found to have poor practices with regards to dispensing antibiotics. An overall good attitude was discovered among the respondents in this study, but as also observed for knowledge, it does not reflect in their practices. This study concludes that having good knowledge and attitude does not necessarily mean having good practices towards the subject. Extra training is required for both pharmacists and pharmacy technicians/attendants/assistants in order to ensure good dispensing practices. To address misconceptions and gaps in knowledge about antimicrobial resistance (AMR), there is a need for targeted educational programs that emphasize the correct use of antibiotics and the true nature of AMR. Accurate and consistent information should be provided across all sources, from healthcare professionals to social media, while stronger regulations must ensure antibiotics are dispensed only with proper prescriptions. Continuous education through workshops, seminars, and training sessions should be encouraged to keep pharmacy professionals updated, with a focus not only on knowledge but also on practical application, attitudes, and behaviors. Public awareness campaigns should extend beyond pharmacy staff to the wider community, and ongoing mentorship should complement work experience to ensure that both new and seasoned professionals adopt and maintain best practices in antibiotic stewardship.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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