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Assessment of Knowledge, Attitudes, And Practices Regarding Antibiotic Use and Resistance Among Community Pharmacistsin Sana'a (Yemen)

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Abstract:

Introduction: Antimicrobials are widely sold without prescriptions, accounting for two-thirds of global sales. However, abuse, misuse, and improper usage contribute to antibiotic resistance, leading to treatment failure, increased morbidity, and healthcare costs. In Yemen, inadequate knowledge, misguided attitudes, and misconduct contribute to the rise of antibiotic resistance. Pharmacists can help rationalize community antibiotic usage and limit resistance development.

Methods: A cross-sectional descriptive study was conducted using self-administered questionnaire for pharmacists in Sana'a of Yemen.

Results: The rate of knowledgeregarding antibiotic use and resistance among community pharmacists in Sana'a (Yemen) was lowly rated, as it obtained an arithmetic mean and a standard deviation.The rate of attitudes regarding antibiotic use and resistance among community pharmacists in sana'a (Yemen)was medium rated, as it obtained an arithmetic mean and a standard deviation .The rate of practices regarding antibiotic use and resistance among community pharmacists in sana'a (Yemen)was medium rated, as it obtained an arithmetic mean and a standard deviation . No significant differences found in age, educational level, years of experience among community pharmacists, but significant differences were found in gender. However, there is a significant correlation between gender and attitude, and a weak inverse correlation between gender and practice variables.

Conclusion: The rate of knowledge, attitudes, and practices regarding antibiotic use and resistance among community pharmacists in sana'a (Yemen) was lowly rated.The rate of attitudes regarding antibiotic use and resistance among community pharmacists in sana'a (Yemen) was medium rated.

Key words: Knowledge, Attitude, Practice, Community Pharmacist, Antibiotic, Resistance.

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Introduction

It is now well acknowledged that antibiotic resistance and irresponsible antibiotic usage pose a hazard. Antibacterial resistance is a growing hazard that has gotten stronger despite recent worldwide worries and warnings about it[1]. The World Health Organization (WHO) claimed in 2014 that antibiotic-resistant bacteria had expanded and were now causing diseases all over the world, and that only 33 out of 133 nations surveyed had an action plan in place to combat the problem.

Misuse of antibiotics has a number of detrimental effects, including raising treatment costs, quickening the incidence of antibiotic resistance, which results in treatment failures, and raising death rates3-5. Unfortunately, in Yemen, there are no publicly declared data on the impact of antibiotic resistance on healthcare and public health; however,according to estimates, there are 23,000 and 25,000 people who pass away each year in the US and the EU due to germs that are resistant to several drugs, respectively.[2, 3] . While in Asia, these figures more than tripled, rising to 96,000 fatalities annually. Drug resistance diseases are predicted to be the cause of 10 million yearly deaths worldwide by the year 2050 [4]. Antibiotic overuse and irrational usage are caused by a variety of circumstances, including the overuse of antibiotics, their availability without a prescription, and the absence of sufficient public understanding of such treatments.[5-7]. Antibiotic overuse, including usage for unwarranted ailments, is a significant issue in Yemen. 93% of patients in a WHO multi-country study from 2015 said they bought their antibiotics from a drugstore. [8]. Before sending a patient to a doctor or before administering the prescriptions, the community pharmacist is thought of as the patient's first and last point of contact with the medical team.[9]. This would suggest that community pharmacists play a crucial part in avoiding or spreading such a problem[10]. At Yemen, you must have a current pharmacist license and an acting pharmacist on duty at the pharmacy before you may open one.However, in practice, assistants who lack a license and adequate training perform the majority of the services and responsibilities normally performed bypharmacists. The issue extends beyond simple pharmaceutical administration and includes patient prescriptions as well.[7, 11]. Additionally, in rare circumstances, particularly in rural areas, assistants may work unsupervised by a

licensed pharmacist. Additionally, antibiotics are regarded as prescription drugs under Yemeni legislation.

One can easily purchase antibiotics from community pharmacies with or without a prescription due to the low compliance and poor enforcement of this law, as well as the absence of any active governmental policy to monitor and regulate antibiotic dispensing in community pharmacies[12, 13].

There are many research on the knowledge, attitudes, and self-reported behaviors of Yemeni community pharmacists on antibiotic dispensing and antibiotic resistance, despite the significant role that community pharmacists play in ensuring the safe use of antibiotics in the community. The purpose of this study was to interview community pharmacists in Sana'a City to determine their attitudes and behaviors about the administration of antibiotics as well as their level of basic knowledge regarding antibiotic overuse and resistance

Methods

Using a self-administered questionnaire, this study is cross-sectional and descriptive. This methodology was chosen since it can be carried out quite quickly and is less expensive than alternative strategies. Face-to-face interviews, for instance, might raise travel expenses, and it is challenging to ask and compensate people to participate in the study.Population in this study is community pharmacists working in Sanaa city.

The minimal sample size is 323 participants. This research uses 95% Confidence interval. Proportion expected to respond is 50% or 0.5, margin error use 5% or 0.05 and population is 2000. Consequently, the minimal sample size is 323 participants. Sample random sampling was used to select participants.

Inclusion criteria

1. Participant must be a pharmacist who graduated in pharmacy degree on undergraduate level (BSc in Pharm, B.Pharm or PharmD).

Exclusion criteria

1. Other pharmacy workers such as assistant pharmacist, pharmacy technician or owners who have not graduated with a pharmacy degree.

Questionnaire design

The first draft of the questionnaire contains thirty- eighth questions. It was divided into four sections to assess the pharmacists ‘knowledge, attitude and practice regarding antimicrobial

use and resistance.

Demographics section

This section was developed to describe characteristics of community pharmacists and confirm inclusion criteria of sampling. Three main questions about personal background, educations qualification, professional experiences.

• Personal background (age, gender); to describe general characteristic of participants and confirm inclusion criteria (age over than 18 years)

• Education profiles (Pharmacy degree, highest education): to examine various types of pharmacy degree in Yemen and confirm that the participants have graduated with a pharmacy degree as per inclusion criteria.

• Professional Experiences: to examine experiences of community pharmacists that might be influence their knowledge, attitude and practice.

3.7.2 The axes of the questionnaire, which included (28) items, were distributed as follows:

- The first axis is the Knowledge of participants towards antibiotics and antimicrobial resistance.
- The second axis is the Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship.
- The Third axis is the Practices of participants in regard of antibiotic use

The Statistic Package for the Social Science (SPSS) software version 24 was used for analysis.

Descriptive statistical analysis such as Mean, Standard division (SD), Chi-square test were used to describe demographics in relation to knowledge, attitude and practice of participants. T-test and ANOVA test It was used to find differences between the averages of the research sample responses with demographic variables.Spearman's correlation coefficient statistic was used to determine relationships of knowledge-attitude, attitude - practice and practice-knowledge.

Demographic characteristic

Result

Variable	Types	Frequency(N)	Column N %
Gender	Male	247	76.5%

	Female	76	23.5%
Age	≤20 Years	4	1.2%
	21-30 years	226	67%
	31-40 years	95	28.2%
	41-50 years	12	3.6%
	Mean ± SD	29.19 ±5.4	
Level of Education	Diploma in Pharmacy	102	31.6%
	Bachelor in Pharmacy	199	61.6%
	Master in Pharmacy	22	6.8%
Years of professional experience	Less than 5 years	154	47.7%
	From 5 to 9 years	108	33.4%
	From 10 to 14 years	32	9.9%
	From 15 to 19 years	16	5 %
	From 20 to 25 years	13	4 %

Table1: Participants' Demographic characteristic

Table 1presents that the majority of the respondents in this study(67%) were young pharmacists in their early years of their career (21–30 years), 28.2 % were within the age bracket of 31 and 40 years while 3.6 % of the respondents were between the age of 41–50 years. Majority of the respondents were males (76.5%) with women taking a minority status in the community pharmacy circles (23.5 %). To a large extent, the samples collected represented the opinion of pharmacists on all the blocks of the country. Majority of the pharmacists working in the country have a minimum qualification of a bachelor's degree, (61.6 %). For years of practice, 33.4 % of the surveyed population had 5–9 years of experience as pharmacists,47.7 % had 1–4 years of experience, 18.9 % of the population had over ten years of experience as CPs.

- **Gender**

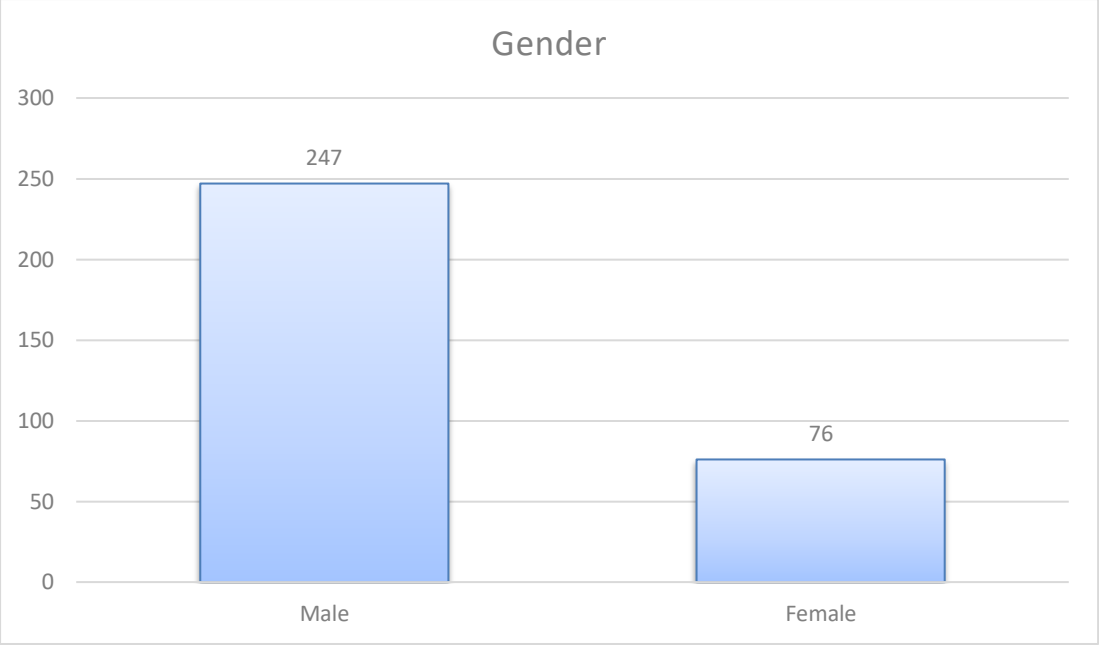
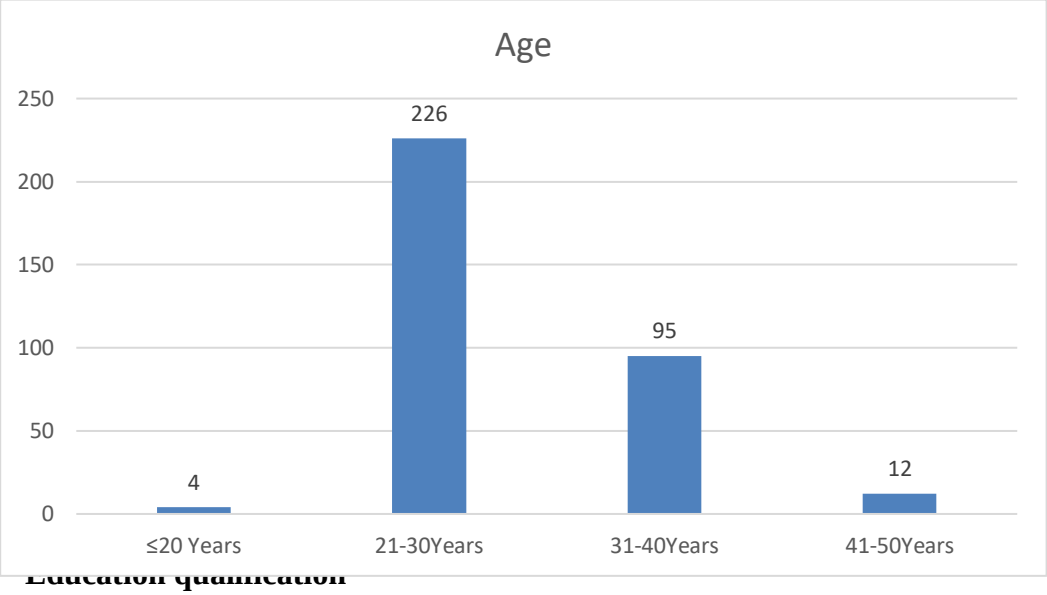


Figure 5: Illustrate the sample distribution by gender

❖ **Age**



❖ **Education qualification**

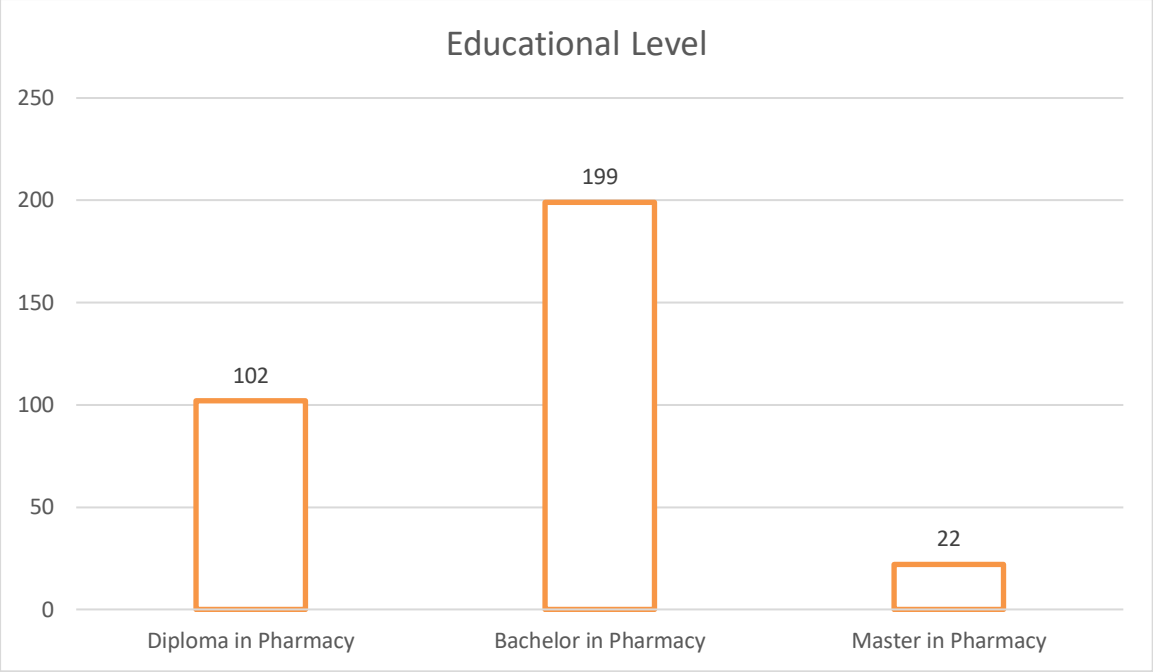


Figure 7: Illustrate the sample distribution by Educational Level

❖ **Years of professional experience**

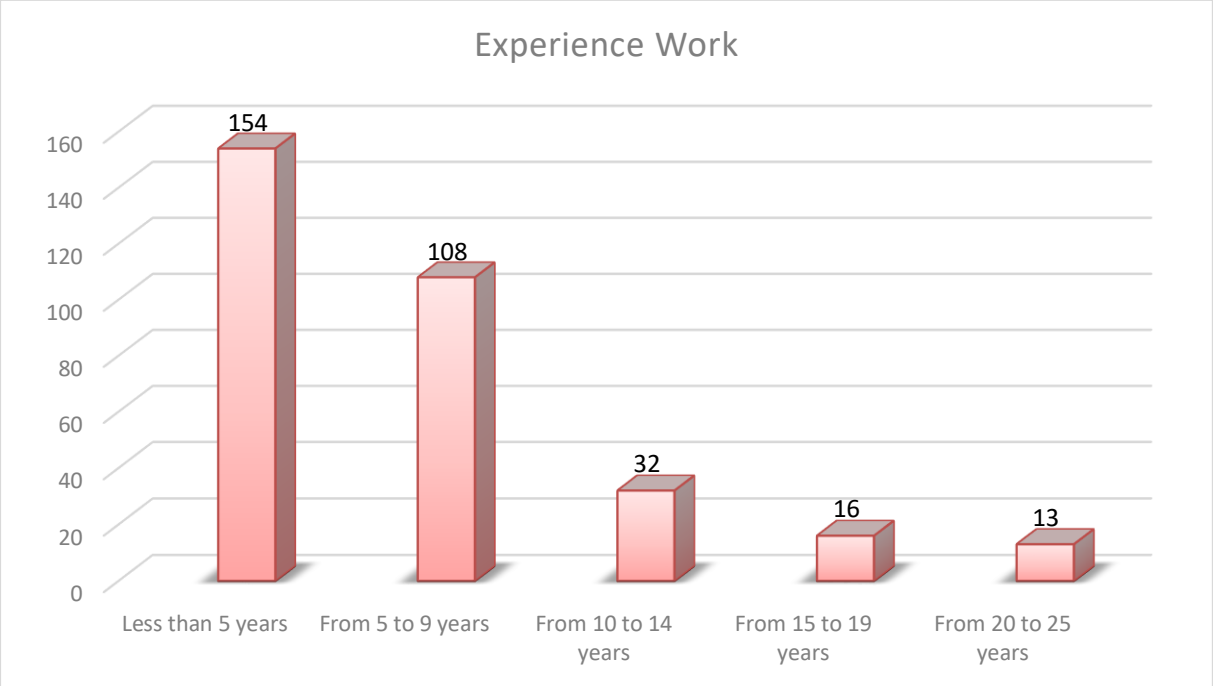


Figure 8: Illustrate the sample distribution by experience

4.2 Knowledge of participants towards antibiotics and antimicrobial

resistance

Table2: Means and standard deviations of knowledge

no	Items	Mean	Std. Deviation	Rank	Level
1	Antibiotics help treat common cold, cough and flu	2.94	1.35	2	Medium
2	Microorganisms can develop resistant to antibiotics, whereas human bodies cannot develop resistance towards antibiotics	2.30	1.1	7	Low
3	Antibiotics can be used to alleviate pain	3.45	1.33	1	High
4	Antibiotics can cause secondary infections after killing normal flora	2.67	1.14	5	Medium
5	Antimicrobial resistance is perceived as	2.74	1.6	4	Medium
6	Wrong choice of antibiotics may lead a pathogen to lose its sensitivity towards a specific antibiotic	2.17	1.3	8	Low
7	Antibiotics can be used as prophylaxis	2.64	1.3	6	Medium
8	The aim of antibiotic use for	1.77	1.08	9	Low
9	Antibiotic resistance is due to	1.57	0.95	10	Low
10	An antibiotic will always be effective in the treatment of same infection in the future	2.76	1.3	3	Medium
	Mean	2.5	1.25		Low

It is clear from the previous table (2) that the rate of Knowledge of participants towards antibiotics and antimicrobial resistance came with a Low degree, as it obtained an arithmetic mean (2.5), and a standard deviation (1.25). Paragraph No. (3) ranked first, represented by (Antibiotics can be used to alleviate pain.), with a mean of (3.45)., with a standard deviation of (1.33) and a high degree, while Paragraph No. (9) got the last rank represented by (Antibiotic resistance is due to) with a high degree, with an arithmetic mean of (1.57), and a standard deviation of (0.95).

4.3 Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship

Table3: Means and standard deviations of attitude

no	Items	Mean	Std. Deviation	Rank	Level
1	I make efforts to prevent or reduce the transmission of infections within the community (health campaigns, social media)	3.39	0.98	3	Medium
2	I dispense antibiotics for duration longer than prescribed by the physician if patient wishes so	3.02	1.53	4	Medium
3	Antimicrobial Stewardship is perceived as	2.6	0.958	6	Medium
4	Do you agree with the policy of not dispensing antibiotics without prescription	3.40	1.205	2	High
5	Regarding antimicrobial stewardship, do you expect its use to be regulated when it is dispensed	2.8	0.951	5	Medium
6	How can antimicrobial resistance be reduced	3.9	1.89	1	High
	Mean	3.18	1.25		Medium

It is clear from the previous table (3) that the rate of Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship came with a

Mediumdegree, as it obtained an arithmetic mean (3.18), and a standard deviation (1.25). Paragraph No. (6) ranked first, represented by (How can antimicrobial resistance be reduced), with a mean of (3.9)., with a standard deviation of (1.89) and a high degree, while Paragraph No. (3) got the last rank represented by (Antimicrobial Stewardship is perceived as) with a Medium degree, with an arithmetic mean of (2.6), and a standard deviation of (0.958).

4.4 Practices of participants in regard of antibiotic use

Table4: Means and standard deviations of practice

no	Items	Mean	Std. Deviation	Rank	Level
1	Number of antibiotics you dispense per day is	3.20	1.107	3	Medium
2	How many antibiotics have been dispensed prescription only	1.46	0.499	12	Low
3	In your opinion, which factor has the greatest Influence on increasing the incidence of bacterial resistance	5.65	0.5	1	High
4	The patient must terminate his/her treatment with the antibiotic once he/ she feels better	3.05	1.15	4	Medium
5	If a patient asks you to dispense an antibiotic without a prescription, you	2.16	0.952	9	High
6	Before I dispense an antibiotic, I seek additional clinical information like drug interactions, ADRs, allergy	2.39	1.35	7	Low
7	In case you were unsure about the appropriateness of the antibiotic in the patient's case, you communicate with prescribers	2.87	1.39	5	Medium
8	I check if antibiotic prescriptions are prescribed in accordance with local guidelines before dispensing	2.32	1.31	8	Low
9	I educate patients about the appropriate use of antibiotics and resistance-related issues	1.94	1.29	10	Low
10	If a patient you to dispense one blister of the antibiotic course, you	1.78	0.936	11	Medium
11	What is your advice for an adult patient suffering from a sore throat, runny nose and cough	3.25	1.249	2	Medium
12	Which antibiotic group do you prescribe the most	2.40	1.24	6	Low
	Mean	2.7	1.08		Medium

It is clear from the previous table (4) that the rate of Practices of participants in regard of antibiotic usecame with a Medium degree, as it obtained an arithmetic mean (2.7), and a standard deviation (1.08). Paragraph No. (1) ranked first, represented by (In your opinion, which factor has the greatest Influence on increasing the incidence of bacterial resistance), with a mean of (5.65)., with a standard deviation of (0.5) and a high degree, while Paragraph No. (2) got the last rank represented by (How many antibiotics have been dispensed prescription only) with a Low degree, with an arithmetic mean of (1.46), and a standard deviation of (0.499).In general, the practice was satisfactory to some extent, and it seems that they are safe in terms of practice.

4.5 Difference results depending on demographic variables

A) The Gender Variable:

The T-test was used to find out the significance of the statistical differences between the averages of the answers of the research sample, which are attributed to the difference in gender (male, female), as in the following table:

Table5: T-test result

The Gender Variable			Mean	Std. Deviation	T value	Sig. value	Decision
Knowledge of participants towards antibiotics and antimicrobial resistance	Male	247	2.6247	.43404	1.201	.231	There are no differences
	Female	76	2.6927	.42216			
Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship	Male	247	1.9334	.24291	3.052	.002	There are differences
	Female	76	2.0299	.23491			
Practices of participants in regard of antibiotic use	Male	247	2.1107	.25281	2.160	.032	There are differences
	Female	76	2.1806	.22555			
The tool as a whole Knowledge, Attitudes and Practices	Male	247	2.2229	.19633	2.972	.003	There are differences
	Female	76	2.3010	.21297			

From Table No.5 It appears the value of (T) is statistically significant, as the values of the significance probability (0.003) were lower than the value of the level of significance (0.05), and this means that there are differences between the averages of the responses of the participants of the research sample. The differences were in favor of male because they were greater in the mean.

B) Age variable:

The ANOVA test was used to find out the significance of the statistical differences between the averages of the answers of the research sample, which are attributed to the difference in Age, as in the following table:

Table6: ANOVA test result

The Gender Variable	N	Sum of squares	df	Mean square	F value	Sig. value	Decision
Knowledge of participants towards antibiotics and antimicrobial resistance	Between groups	5.632	33	.171	.908	.617	There are no differences
	Within groups	54.347	289	.188			
	Total	59.979	322				
Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship	Between groups	3.322	33	.101	1.832	.005	There are differences
	Within groups	15.874	289	.055			
	Total	19.196	322				
Practices of participants in regard of antibiotic use	Between groups	3.063	33	.093	1.601	.023	There are differences
	Within groups	16.758	289	.058			
	Total	19.822	322				
The tool as a whole	Between groups	1.490	33	.045	1.110	.317	There are

	Within groups	11.749	289	.041	no differences
	Total	13.239	322		

From Table No.6 It appears the value of (F) is not statistically significant, as the values of the significance probability (0.317) were greater than the value of the level of significance (0.05), and this means that there are no differences between the averages of the responses of the participants of the research sample. However, it appears that there are differences between the respondents in terms of attitude and practice only. As for knowledge, there are no differences.

C)Education Level:

The ANOVA test was used to find out the significance of the statistical differences between the averages of the answers of the research sample, which are attributed to the difference in Education Level, as in the following table:

Table7: ANOVA test result

The Gender Variable	N	Sum of squares	df	Mean square	F value	Sig. value	Decision
Knowledge of participants towards antibiotics and antimicrobial resistance	Between groups	.232	2	.116	.620	.539	There are no differences
	Within groups	59.747	320	.187			
	Total	59.979	322				
Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship	Between groups	.287	2	.144	2.432	.089	There are no differences
	Within groups	18.908	320	.059			
	Total	19.196	322				
Practices of participants in regard of antibiotic use	Between groups	.829	2	.414	6.984	.001	There are differences
	Within groups	18.993	320	.059			
	Total	19.822	322				
The tool as a whole	Between groups	.191	2	.096	2.347	.097	There are no differences
	Within groups	13.047	320	.041			
	Total	13.239	322				

From Table No.7 It appears the value of (F) is not statistically significant, as the values of the significance probability (0.097) were greater than the value of the level of significance (0.05), and this means that there are no differences between the averages of the responses of the participants of the research sample. However, it appears that there are differences between the respondents in terms of practice only. As for knowledge, and attitude there are no differences.

D) Years of Work:

The ANOVA test was used to find out the significance of the statistical differences between

the averages of the answers of the research sample, which are attributed to the difference in Years of experience, as in the following table:

Table8: ANOVA test result

The Gender Variable	N	Sum of squares	df	Mean square	F value	Sig. value	Decision
Knowledge of participants towards antibiotics and antimicrobial resistance	Between groups	.349	4	.087	.465	.761	There are no differences
	Within groups	59.630	318	.188			
	Total	59.979	322				
Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship	Between groups	.952	4	.238	4.150	.003	There are differences
	Within groups	18.243	318	.057			
	Total	19.196	322				
Practices of participants in regard of antibiotic use	Between groups	.337	4	.084	1.377	.242	There are no differences
	Within groups	19.484	318	.061			
	Total	19.822	322				
The tool as a whole	Between groups	.303	4	.076	1.860	.117	There are no differences
	Within groups	12.936	318	.041			
	Total	13.239	322				

From Table No.8 It appears the value of (F) is not statistically significant, as the values of the significance probability (0.117) were greater than the value of the level of significance (0.05), and this means that there are no differences between the averages of the responses of the participants of the research sample. However, it appears that there are differences between the respondents in terms of attitude only. As for knowledge, and practice there are no differences.

4.6 Correlation between research variables

A) Correlation between Sociodemographic and Knowledge, Attitude and practice

Table9: Spearman's correlation coefficient result

Research variable		Correlation Coefficient	Sig. (2-tailed)
Knowledge of participants towards antibiotics and antimicrobial resistance	Gender	0.054	0.330
	Age	0.019	0.728
	Level of Education	-0.117	0.36
	Years of experience	-0.037	0.509

Attitudes of participants in regard of antibiotic use, antimicrobial resistance and antimicrobial stewardship	Gender	0.158	0.005
	Age	0.084	0.133
	Level of Education	0.03	0.585
	Years of experience	-0.042	0.453
Practices of participants in regard of antibiotic use	Gender	0.023	0.683
	Age	-0.112	0.044
	Level of Education	-0.040	0.457
	Years of experience	0.127	0.023

From Table No.9 it is clear that there is no correlation between demographic variables and knowledge. As for attitude, there is a correlation with gender, but it is a weak correlation, where the value of r = 0.158. As for practice, there is a correlation with age, but an inverse correlation, that is, the higher the age, the safer the practice, and there is a weak direct correlation with the years of experience, the value of r = 0.127.

B) Correlation of Knowledge and attitude

Table10: Spearman's correlation coefficient result

Research variable	Correlation Coefficient	Sig. (2-tailed)
Knowledge-Attitude	0.297	0.001

From Table No.10 it is clear that there is a correlation between knowledge and Attitude. A weak direct correlation, statistically significant, and the significance value is 0.001.

C) Correlation of Attitude and Practice

Table11: Spearman's correlation coefficient result

Research variable	Correlation Coefficient	Sig. (2-tailed)
Attitude -Practice	-0.039	0.490

From Table No.11 it is clear that there is no correlation between Attitude and Practice. As the significance value was greater than 0.05.

D) Correlation of Knowledge and practice

Table12: Spearman's correlation coefficient result

Research variable	Correlation Coefficient	Sig. (2-tailed)
knowledge- practice	0.092	0.098

From Table No.12 it is clear that there is no correlation between knowledge and Practice. As the significance value was greater than 0.05.

Discussion

This is the first study to evaluate community pharmacists' knowledge, attitude, and practices

towards antibiotic use and AMR in Yemen. The current work shows that generally Yemen community pharmacists had Low knowledge about proper antibiotics use. 22.6% of the participants believed that antibiotics would never treat cold, cough and flu and 32.5% of them know that antibiotics can never be used to alleviate pain. This study contradicts findings of recent studies including one from Thailand [76]. which showed that over 90% of participant have good knowledge, attitude, and practice regarding antimicrobial use and AMR. It also conflicted with another study on knowledge of community pharmacists in Pakistan showed that almost all participants were aware of the harmful aspects of inappropriate use of antibiotics on patient health and association with AMR [77].A multicenter cross-sectional study in China showed that almost half the respondents were aware that antibiotics are not effective in viral infections and that the majority knew that antibiotics are not indicated in any type of pain and inflammation. In this Chinese study 58.6% of the participants knew that antibiotics can kill normal fora, and thus can cause secondary infection, almost the same percentage was noticed in the current study (83.4 %). A study by Gajdács et al. on pharmacists in Hungary showed similar results with 58.6% respondents agreeing that antibiotics can cause secondary infections after affecting normal fora [78].It also showed that most participants had high level of knowledge regarding AMR and the vast majority (87%) approved that antibiotics should not be dispensed without medical prescription which is in contradicts with the current study. A study by Waseem et al. on community pharmacists in Pakistan showed that 48.1% of the participants perceived AMR as a global problem [79].while a lower percentage (35.9%) in the current study had the same belief, this might indicate unawareness of the interviewed pharmacists in regard of AMR.

Studies showed that reasons for pharmacists to dispense non-prescription antibiotics include pressure from customers, lack of education and lack of legal enforcement [13].This is concurrent with the results of the current study that showed community pharmacists to be under pressure imposed by patients who insist on having antibiotics. Participants also believe that inappropriate patient education of proper uses of antibiotics might be one of the causes of self-medication. The socio-economic status of patients may reflect their health literacy level, which is expected to be strongly correlated with the level of education and income.

Yemen is classified as low middle income country by the World Bank and its population are mostly middle class. However, there is variation in the level of education which might reflect on the understanding the value of proper use of antibiotics.

Patients in quest of antibiotics from pharmacies directly without prescription and

pharmacists giving advice and dispensing antibiotics directly as indicated by the participants is well noticed in the study. This is in agreement with a study from Egypt, a lower middle income country, which showed that non-prescription antibiotics comprised 27% of dispensed antibiotics[13].Another study done in Pakistan,classified as low middle income country, stated that 50% of non-medical university students declared self-medicating themselves with antibiotics [80].Self-medication is not restricted to low income countries, some studies from Northern and Western Europe, in which people have higher income, showed rates of self-medication ranging from 0.1–0.9% while in Southern and Eastern Europe rates were much higher (0.7–20%) [81].Many studies performed worldwide [80-82].revealed that low income and absence of health insurance were among the major contributors to self-medication. A study in Spain showed that this misconduct is not correlated with age, gender, or years of professional experience [83].which agrees with our finding's. In our study, in spite of apparent tendencies for dispensing antibiotics without prescription, more than half of the participants educated patients on appropriate use of antibiotics, resistance-related issues and advised patients with runny nose and cough to use symptomatic treatment using OTC medication. Further, the study showed that pharmacists seek additional clinical information and look for drug interactions, this contradict findings by Al Mayyatah et al. [83]which showed that these enquiries were practiced by a very small group of pharmacists (5.3–17.3%). This good pharmaceutical practice is important and should be stressed upon as it would minimize risks of side/adverse effects.

A study done in Pakistan [84]showed 32% of pharmacist would communicate with prescribers if unsure about appropriateness of antibiotics prescriptions, this is in agreement with results of the current study which showed 41.8% of the participants communicate with prescribers in the same case. Having said that some of the participants do not refer to physicians because of poor physician responsiveness, this might reflect the importance of emphasizing on interprofessional relations among healthcare team probably starting from university curriculum. Pharmacists and other health care professionals should work together in multidisciplinary teams to reduce irrational and inappropriate use of antimicrobials and thus AMR.

The present findings revealed that beta lactams and beta Lactams with beta lactamase inhibitors were the most commonly dispensed antibiotics, in consistence with findings of Haddadin et al. 2019 [85] who reported amoxicillin/ clavulanate to be the most commonly prescribed antibiotic in Yemen.

Results were in agreement with reports from Saudi Arabia [11, 86]and Egypt [13]where the most widely dispensed antibiotics were penicillins and cephalosporins followed by fouroquinolones. Also in Europe, penicillins were the most frequently used antibiotics for self-medication [81].These antibiotics in general have low side effects that is probably why pharmacists are encouraged to recommend them. Moreover, these antibiotics are widely prescribed [13, 81] which makes most people familiar with them and they might even recommend them to family and friends[81, 87].

The study showed most participants to have positive attitude towards implementing policies that limit dispensing of antibiotics to prescription only. In addition, to adopting antimicrobial stewardship to regulate better use of antibiotics. Also, more than half the participants would make efforts to prevent or reduce transmission of infections within the community through health campaigns and social media. These are in agreement with findings by Rahman et al. [84]were more than 80% of pharmacists agreed that antimicrobial stewardship is essential to improve patient care and 39.8% would make efforts to prevent or reduce transmission of infections within the community.

In general, lack of awareness about seriousness of AMR is obvious, probably because of absence of compulsory continuous education programs. Such programs would keep pharmacists updated with latest information regarding microbial resistance and how to tackle them [88].The finding's also call for reinforcing laws that prevent prescribing antibiotics without prescription which would eventually lead to better control of AMR. Moreover, implementation of antimicrobial stewardship would aid in slowing the development and spread of AMR.

Conclusion

The rate of knowledge, attitudes, and practices regarding antibiotic use and resistance among community pharmacists in sana'a (Yemen)was lowly rated.The rate of attitudes regarding antibiotic use and resistance among community pharmacists in sana'a (Yemen) was medium rated. The rate of practices regarding antibiotic use and resistance among community pharmacists in sana'a (Yemen)was medium rated. However, there are statistically significant differences within the Gender variable.Also, there is a statistically significant correlation within the gender variable and a correlation with attitude. There is a correlation between the gender and practice variables, but there is a weak inverse correlation. There is a statistically significant correlation between knowledge and practice.

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