Infection and Drug Resistance

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Knowledge of community pharmacists about antibiotics, and their perceptions and practices regarding antimicrobial stewardship: a cross-sectional study in Punjab, Pakistan

This article was published in the following Dove Press journal:
Infection and Drug Resistance

Muhammad Rehan Sarwar[1,2]
Anum Saqib[1]
Sadia Iftikhar[2]
Tayyaba Sadiq[3]

[1]Department of Pharmacy, Islamia University of Bahawalpur, Bahawalpur, [2]Akhtar Saeed College of Pharmaceutical Sciences, Lahore, [3]Department of Pharmacy, University of Sargodha, Sargodha, Pakistan

Objective: To evaluate the knowledge of community pharmacists about antibiotics, and their perceptions and practices toward antimicrobial stewardship (AMS) in Punjab, Pakistan.

Materials and methods: A descriptive cross-sectional study was conducted among community pharmacists in Punjab, Pakistan from April 1, 2017 to May 31, 2017. A self-administered and pretested questionnaire was used for data collection. A simple random-sampling method was used to select community pharmacies. Independent-sample Mann–Whitney *U* tests, independent sample Kruskal–Wallis tests, and logistic regression analysis were performed with SPSS version 21.0.

Results: Of the 414 pharmacists, 400 responded to the survey (response rate 96.6%). The participants had good knowledge about antibiotics. They showed positive perceptions, but poor practices regarding AMS. All of the participants were of the view that AMS program could be beneficial for health care professionals for improvement of patient care, and 78% (n=312) of participants gave their opinion about incorporation of AMS programs in community pharmacies. Collaboration was never/rarely undertaken by pharmacists with other health care professionals over the use of antibiotics (n=311, 77.8%), and a significant proportion of participants (n=351, 87.8%) never/rarely participated in AMS-awareness campaigns. Logistic regression analysis revealed that male sex (OR 0.204, 95% CI 0.104−0.4; $P<0.001$), age 20–29 years (OR 0.172, 95% CI 0.05−0.595; $P=0.005$), and <1 year of experience (OR 0.197, 95% CI 0.083−0.468; $P<0.001$) were the factors associated with poor practices regarding AMS.

Conclusion: Pharmacists had good knowledge about antibiotics. There were some gaps in perceptions and practices of community pharmacists regarding AMS. In the current scenario, it will be critical to fill these gaps and improve perceptions and practices of community pharmacists regarding AMS by developing customized interventions.

Keywords: antimicrobial stewardship, community pharmacist, antibiotics

Introduction

Antibiotic resistance has threatened the entire globe. This public health concern is associated with clinical and economic burden and has also increased the mortality rate. According to the World Health Organization (WHO), the mortality of 25,000 people per year in European hospitals is associated with this health concern. This has increased health expenditure up to €1.5 billion.[1] Nowadays, the misuse of antibiotics is a common issue in almost all regions of the world, including Pakistan, due to frequent use of antibiotics.[2–4] The untoward outcome of this issue is emergence of

Correspondence: Muhammad Rehan Sarwar
Department of Pharmacy, Islamia University of Bahawalpur, Railway Road, Bahawalpur 63100, Pakistan
Tel +92 334 456 6000
Email rehansarwaralvi@gmail.com

resistant strains of bacteria.[5,6] Causative factors for misuse of antibiotics are prescriber- as well as patient related. First, inappropriate prescribing of prescribers can be considered a leading cause.[7–9] Furthermore, prescriber-related factors also hinder good clinical practices. These factors may include doubts of prescribers to possible health complications of patients and objective of prescribers to accomplish the patient's expectations of health outcomes.[1,10] Patient-related factors may include unprescribed medication usage and lack of appropriate knowledge.[1,11–15] As such, these factors are major contributors to bacterial resistance against antibiotics.

The high prevalence of multidrug resistance is a global concern. According to a study conducted by the WHO in Pakistan, 95% of participants tested positive for multidrug-resistant bacteria.[16] This problem has worsened the situation by making therapy more complicated for sufferers of infectious diseases like tuberculosis, acute respiratory tract infections, and malaria in Pakistan.[17] Several attempts have been made to implement quality-improvement activities for antimicrobial drugs, eg, "antimicrobial stewardship" (AMS) programs have been introduced for the prevention and treatment of various infectious diseases. In 2016, the Medical Microbiology and Infectious Diseases Society of Pakistan initiated the AMS program in Pakistan.[18] The main focus of this initiative was to ensure the use of AM agents in an appropriate manner.[19] Implementation and introduction of majority of AMS programs has been successfully conducted in institutional settings. However, community practices are deprived of such efforts. Important strategies for implementing AMS programs in community settings must include raising awareness of regional antibiotic-resistance patterns, improving knowledge of health care professionals about the latest treatment guidelines, and limiting and adjusting the inventory of antibiotics. Moreover, the AMS program should be taught to medical students at undergraduate level. Such initiatives can be beneficial in spreading awareness about the rational prescribing of AM drugs.[20] Moreover, special emphasis must be put on education and training new generations of prescribers, since their ample knowledge will yield fruitful results related to health outcomes of the patients.[1,21,22]

Improvement in prescribing AM agents would lessen the risk of resistance, thus leading to improved patient care.[23] In 2009, the European Surveillance of Antimicrobial Consumption network revealed variation among European countries to be by a factor of 3.8, with highest (38.6 defined daily doses in Greece) and lowest (10.2 in Romania) consumption of antibiotics per 1,000 inhabitants per day.[24] According to a US estimate, 1.4 billion antibiotics were dispensed for outpatients from 2000 to 2010. Antibiotic-prescription rates had remained stable in the USA in that decade, ie, of 1,000 persons, 382–384 individuals were prescribed antibiotics.[25] Similarly, survey reports of AM use in secondary- and tertiary-care hospitals of Pakistan have shown high AM-prescribing rates of 48.9%,[26] 51.5%,[26] and 52%.[27] Therefore, community pharmacists can play a crucial role in the development and execution of AMS programs in community settings.

Before incorporating community pharmacists in the development and implementation of AMS programs, it is necessary to understand their perceptions and current practices regarding this program. To the best of our knowledge, this is the first study in Pakistan that aims to assess pharmacists' knowledge about antibiotics and their perceptions and practices regarding AMS in community pharmacy settings.

Materials and methods

Study design

A descriptive cross-sectional survey was carried out to assess community pharmacists' knowledge about antibiotics and their perceptions as well as practices regarding AMS in community-pharmacy settings of Punjab, Pakistan.

Study settings

Registered pharmacists working at community pharmacies from different areas of Punjab province were included in the study. This is one of the most prosperous provinces in Pakistan, with a population of 101,391,000 individuals.[28] According to the Punjab Pharmacy Council, a total of 9,011 pharmacists are registered, and a study revealed that only 10% (n=901) of the pharmacists are working in community-pharmacy settings in this region.[29]

Study sample size

The minimum sample size calculated through Raosoft sample-size calculator[30] was 383, in which the population was taken as 901. Power was kept at 80% and response distribution 50%, with 99% CI and 5% margin of error:

$$n = N\frac{x}{(N-1)E2+x} \quad (1)$$

where N is the population size, x the CI, and E the margin of error. With an added contingency of 5% for nonresponse and inappropriate responses, the final sample was calculated to be 400 pharmacists.

Data collection

Data were collected from pharmacists working at community pharmacies and evaluated as per objectives of the study. A total of 414 community pharmacists were approached in a 2-month period (April 1, 2017 to May 31, 2017), with a response rate of 96.6%. The investigators used a simple random-sampling technique for selection of community pharmacies. Prior to data collection, registered pharmacists gave consent for participation. Assistant pharmacists fell under exclusion criteria of the study.

Data collection tool

Investigators thoroughly reviewed the available literature from relevant published studies for designing a self-administered questionnaire[3,23,31–34] (Figure S1). The initial version of the questionnaire was subjected to content and face validation. The content was validated on the basis of the opinions of two experts. These experts gave their views about the importance and relativity of the content. Efforts were made to develop a questionnaire that was brief and simple. For this purpose, investigators made required adjustments and then administered it to a small group of ten community pharmacists. The recommended changes were incorporated in the questionnaire. SPSS version 21.0 was used for calculation of reliability coefficients. Internal consistency was measured by Cronbach's α, while reproducibility was evaluated using intraclass correlation for each item in the knowledge, perceptions, and practices scales, with acceptable values ≥0.6. Calculation for Cronbach's α was set at 0.71 for knowledge, 0.72 for perceptions, and 0.74 for practices. The final version of the questionnaire had 31 items. These items were divided into four sections. The first section comprised four questions on the demographic history of the participants. The second section had eight questions on the knowledge of participants about antibiotics. The third section had eight questions to give a clear assessment of the perceptions of participants regarding AMS. A 5-point Likert scale was utilized to record the knowledge and perceptions of the participants. In this scale, scoring was 1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree, and 5 for strongly agree. The fourth section had eleven questions on practices of participants regarding AMS and was rated with a 5-point Likert scale. In this section, scoring was 1 for never, 2 for rarely, 3 for occasionally, 4 for often, and 5 for always. For negatively worded statements, reverse coding was done, as shown in the questionnaire (Figure S1). Overall scoring for knowledge, perception, and practice was done in such a way that 0.5–1 was assigned "very poor", 1.5–2 "poor", 2.5–3 "acceptable", 3.5–4 "good", and 4.5–5 "very good". Outcomes regarding practices were dichotomized as "good" versus "poor". For this, scores for practices (range 11−55) were summed, scores ≥28 considered good, and scores <28 considered poor.

Statistical analysis

Data were analyzed using SPSS version 21.0 (IBM, Armonk, NY, USA). Descriptive statistics – frequencies, percentages, and medians – were used to analyze the data. Kolmogorov–Smirnov and Shapiro–Wilk tests were carried out to test the normality of the data. Independent-sample Mann–Whitney *U* tests were employed to assess differences in knowledge of the community pharmacists about antibiotics, as well as their perceptions and practices regarding AMS between sexes and education level. Independent-sample Kruskal–Wallis tests were used to check differences among age groups and experience of the community pharmacists with regard to knowledge about antibiotics as well as their perceptions and practices regarding AMS. Furthermore, logistic regression analysis was performed to figure out factors associated with poor practices regarding AMS. Results are expressed as ORs accompanied by 95% CIs, and $P<0.05$ was used for statistical significance of differences.

Ethics approval

Ethical approval was obtained from the Pharmacy Research Ethics Committee at Akhtar Saeed College of Pharmaceutical Sciences (06-2017/PREC, March 13, 2017). The purpose and protocols of the study were thoroughly explained to participants, and written consents were obtained prior to commencement of the study.

Results

Characteristics of participants

A total of 400 pharmacists were investigated. Most of the respondents were male (n=328, 82%) and had a bachelor's level of education (n=334, 83.5%). Among the respondents, the age group 20–29 years constituted the highest proportion (n=221, 55.2%), followed by 30–39 years (n=144, 36%); 61.2% had experience of <1 year (n=245), followed by those who had 1−4 years of experience (n=84, 21%) (Table 1).

Knowledge about antibiotics

All the 400 participants gave their responses to eleven questions regarding their knowledge about antibiotics. Of a

maximum score of 5 (100%) for knowledge about antibiotics, respondents obtained a median score of 3.5 (IQR 1). Therefore, participants had good knowledge about antibiotics. A total of 338 (84.5%) participants strongly agreed/agreed that "Antibiotics are useful for bacterial infections" (median 5, IQR 1). On the other hand, just 28.5% (n=114) of participants strongly agreed/agreed that "Antibiotics can kill 'normal flora' of the human body" (median 3, IQR 2), and 37.8% (n=174) of participants strongly disagreed/disagreed that "Antibiotics are useful for viral infections (eg, flu)" (median 3, IQR 2). For details, please refer to Table 2.

Perceptions of AMS

All respondents gave responses to all eight parameters on their perceptions of AMS. Of a maximum score of 5 (100%) for perceptions of AMS, respondents obtained a median score of 5 (IQR 0.5). Therefore, participants demonstrated strongly positive perceptions regarding AMS. All participants strongly agreed/agreed that "Pharmacists have a responsibility to take prominent role in AMS and infection-control programs in the health care system" (median 5, IQR 0). Similarly, all participants strongly disagreed/disagreed that "health-care professionals other than prescribers do not need to understand AMS" (median 5, IQR 0). On the other hand, 78% (n=312) of participants strongly agreed/agreed that "AMS should be incorporated at the community-pharmacy level" (median 4, IQR 1), and 87.3% (n=349) of participants strongly agreed/agreed that "Individual efforts at AMS have minimal impact on the AM-resistance problem" (median 5, IQR 1). Please refer to Table 3.

Practices with regard to AMS

All participants supplied responses to all eleven statements regarding their practices in AMS. Of a maximum score of 5 (100%), respondents obtained a median score of 2 (IQR 0). Therefore, participants demonstrated poor practices regarding AMS: 53.8% (n=215) of participants never took part in AM-awareness campaigns to promote the optimal use of AMS (median 1, IQR 1), 40.3% (n=161) of participants never collaborated with other health care professionals for infection control and AMS (median 2, IQR 1), and 34% (n=136) of participants often/always dispensed AMs without a prescription (median 3, IQR 2). Please refer to Table 4.

Table 1 Characteristics of participants (n=400)

Variable	Category	Frequency (%)
Sex	Male	328 (82)
	Female	72 (18)
Age (years)	20–29	221 (55.2)
	30–39	144 (36)
	40–49	16 (4)
	≥50	19 (4.8)
Educational level	Bachelor's	334 (83.5)
	Master's	66 (16.5)
Experience (years)	<1	245 (61.2)
	1–4	84 (21)
	5–9	29 (7.2)
	≥10	42 (10.5)

Table 2 Community pharmacists' knowledge about antibiotics and median scores of respondents

Variable	Responses					Median (IQR)
	SD (%)	D (%)	N (%)	A (%)	SA (%)	
Antibiotics are useful for bacterial infections (eg, tuberculosis)	0 (0.0)	0 (0.0)	62 (15.5)	68 (17)	270 (67.5)	5 (1)
Antibiotics are useful for viral infections (eg, flu)	63 (15.8)	88 (22)	93 (23.3)	93 (23.3)	63 (15.8)	3 (2)
Antibiotics are indicated to reduce any kind of pain and inflammation	87 (21.8)	124 (31)	113 (28.3)	51 (12.8)	25 (6.3)	4 (1)
Antibiotics can kill "normal flora" of the human body	62 (15.5)	112 (28)	112 (28)	58 (14.5)	56 (14)	3 (2)
Antibiotics can cause secondary infections after killing the normal flora of the human body	51 (12.8)	75 (18.8)	131 (32.8)	81 (20.3)	62 (15.5)	3 (2)
Antibiotics can cause allergic reactions	25 (6.3)	50 (12.5)	107 (26.8)	119 (29.8)	99 (24.8)	4 (1)
Misuse of antibiotics can lead to a loss of sensitivity of an antibiotic to a specific pathogen	76 (19)	50 (12.5)	118 (29.5)	106 (26.5)	50 (12.5)	3 (2)
Before the completion of a full course of antibiotic therapy, if symptoms improve then you can stop taking it	81 (20.3)	157 (39.3)	87 (21.8)	50 (12.5)	25 (6.3)	4 (1)
Knowledge score overall						3.5 (1)

Notes: Knowledge assessed by scoring 1 for SD, 2 for D, 3 for N, 4 for A, and 5 for SA; for variables 2, 3, and 8, knowledge assessed by scoring 5 for SD, 4 for D, 3 for N, 2 for A, and 1 for SA.

Abbreviations: A, agree; D, disagree; N, neutral; SA, strongly agree; SD, strongly disagree.

Table 3 Community pharmacists' perceptions of AMS and median scores of respondents

Variable	Responses					Median (IQR)
	SD (%)	D (%)	N (%)	A (%)	SA (%)	
AMS programs improve patient care	0 (0.0)	0 (0.0)	50 (12.5)	80 (20)	270 (67.5)	5 (1)
AMS should be incorporated at the community-pharmacy level	0 (0.0)	0 (0.0)	88 (22)	113 (28.3)	199 (49.8)	4 (1)
AMS programs reduce the problem of antimicrobial resistance	0 (0.0)	6 (1.5)	24 (6)	150 (37.5)	220 (55)	5 (1)
Adequate training should be provided to community pharmacists on antimicrobial use	0 (0.0)	0 (0.0)	26 (6.5)	99 (24.8)	275 (68.8)	5 (1)
Relevant conferences, workshops, and other educational activity are required to be attended by community pharmacists to enhance understanding of AMS	0 (0.0)	0 (0.0)	0 (0.0)	125 (31.3)	275 (68.8)	5 (1)
Individual efforts at AMS have minimal impact on the antimicrobial-resistance problem	0 (0.0)	0 (0.0)	51 (12.8)	144 (36)	205 (51.3)	5 (1)
Health care professionals other than prescribers do not need to understand AMS	332 (83)	68 (17)	0 (0.0)	0 (0.0)	0 (0.0)	5 (0)
Pharmacists have a responsibility to take a prominent role in AMS and infection-control programs in the health system	0 (0.0)	0 (0.0)	0 (0.0)	24 (6)	376 (94)	5 (0)
Perception score overall						5 (0.5)

Notes: Knowledge assessed by scoring 1 for SD, 2 for D, 3 for N, 4 for A, and 5 for SA; for variable 7, perception assessed by scoring 5 for SD, 4 for D, 3 for N, 2 for A, and 1 for SA.
Abbreviations: A, agree; AMS, antimicrobial stewardship; D, disagree; N, neutral; SA, strongly agree; SD, strongly disagree.

Table 4 Community pharmacists' practices of AMS and median scores of respondents

Variable	Responses					Median (IQR)
	Never (%)	Rarely (%)	Occasionally (%)	Often (%)	Always (%)	
I dispense antimicrobials on prescription with complete clinical information	126 (31.5)	193 (48.3)	56 (14)	25 (6.3)	0 (0.0)	2 (1)
I dispense antimicrobials without a prescription	25 (6.3)	101 (25.3)	138 (34.5)	99 (24.8)	37 (9.3)	3 (2)
I dispense antimicrobial agents for durations longer than prescribed by the physician on patient request	37 (9.3)	100 (25)	151 (37.8)	100 (25)	12 (3)	3 (2)
I screen antimicrobial prescriptions in accordance with local guidelines before dispensing	151 (37.8)	136 (34)	101 (25.3)	12 (3)	0 (0.0)	2 (2)
I collaborate with other health care professionals for infection control and AMS	161 (40.3)	150 (37.5)	89 (22.3)	0 (0.0)	0 (0.0)	2 (1)
I communicate with prescribers if I am unsure about the appropriateness of an antibiotic prescription	120 (30)	218 (53.5)	62 (15.5)	0 (0.0)	0 (0.0)	2 (1)
I have sought additional clinical information (eg, drug interaction, ADRs, allergy) before deciding to dispense the antibiotic prescribed	126 (31.5)	226 (56.5)	36 (9)	12 (3)	0 (0.0)	2 (1)
I take part in antimicrobial-awareness campaigns to promote the optimal use of antimicrobials	215 (53.8)	136 (34)	49 (12.3)	0 (0.0)	0 (0.0)	1 (1)
I educate patients on the use of antimicrobials and resistance-related issues	25 (6.3)	227 (56.8)	123 (30.8)	25 (6.3)	0 (0.0)	2 (1)
I make efforts to prevent or reduce the transmission of infections within the community	25 (6.3)	127 (31.8)	150 (37.5)	86 (21.5)	12 (3)	3 (1)
I ask the patients about their knowledge of prescribed antimicrobial agents and usage	0 (0.0)	76 (19)	219 (54.8)	93 (23.3)	12 (3)	3 (1)
Practice score overall						2 (0)

Notes: Practice assessed by scoring 1 for never, 2 for rarely, 3 for occasionally, 4 for often, and 5 for always; for variables 2 and 3, practice assessed by scoring 5 for never, 4 for rarely, 3 for occasionally, 2 for often, 1 for always.
Abbreviations: ADRs, adverse drug reactions; AMS, antimicrobial stewardship.

Differences in community pharmacists' knowledge about antibiotics and perceptions and practices of AMS

Differences in median knowledge about antibiotics and perceptions and practices regarding AMS of participants were checked. According to independent-sample Mann–Whitney *U* tests, sex showed a statistically significant difference ($P<0.05$). Male pharmacists had higher perception scores (median 5, $P<0.001$) than female pharmacists. Pharmacists with master's degrees had higher practices scores (median 3, $P<0.001$) than those with bachelor's degrees (Table 5). In independent-sample Kruskal–Wallis tests, age and experience were found to have statistically significant differences ($P<0.05$) (Table 5). Logistic regression analysis revealed that male sex (OR 0.204, 95% CI 0.104−0.4; $P<0.001$), age 20–29 years (OR 0.172, 95% CI 0.05−0.595; $P=0.005$), and <1 year of experience (OR 0.197, 95% CI 0.083−0.468; $P<0.001$) were the factors associated with poor practices regarding AMS (Table 6).

Discussion

The current study highlighted that pharmacists had good knowledge about antibiotics. It also aimed to evaluate the perceptions and practices of pharmacists regarding AMS programs in community-pharmacy settings in Punjab, Pakistan. With few exceptions, more than 60% of participants answered all the administered queries correctly, though 43.5% (n=174) of respondents were not aware that antibiotics can kill the normal flora of the human body, 39% (n=136) of participants were not aware that antibiotics are not effective against viruses, 31.5% (n=126) of participants were not aware that AM drugs can cause secondary infections, and 31.5% (n=126) of participants were not aware that the misuse of

Table 5 Variation in community pharmacists' knowledge, perceptions, and practices concerning antimicrobial stewardship by characteristic

Variable	Category	Knowledge			Perceptions			Practices		
		Median	Rank	*P*-value	Median	Rank	*P*-value	Median	Rank	*P*-value
Sex*	Male	3.5	207.8	0.005	5	210.4	<0.001	2	202.6	0.271
	Female	3	162.2		4.5	155.3		2	190.8	
Age (years)**	20–29	3.5	181.8	0.003	5	230.6	<0.001	2	212.7	<0.001
	30–39	4	224.6		4.5	148		2	157.5	
	40–49	3.5	221.8		5	251.7		3	307.5	
	50–59	3.5	217.7		5	205.7		3	294.3	
Educational level*	Bachelor's	3.5	198.7	0.473	5	203.6	0.145	2	186.84	<0.001
	Master's	3	209.6		5	185.1		3	269.62	
Experience** (years)	<1	3.5	188.8	<0.001	5	214.5	<0.001	2	181.2	<0.001
	1–4	3.5	231.3		5	165.3		2	193.2	
	5–9	4	252.2		5	212.9		3	288.5	
	≥10	3.5	171.5		5	180.9		2	267	

Note: *Independent-sample Mann–Whitney *U* test; **independent-sample Kruskal–Wallis test.

Table 6 Logistic regression analysis of factors associated with poor practices of antimicrobial stewardship

Variable	Category	Practices		OR	95% CI	*P*-value
		Good	Poor			
Sex	Male	73 (18.2)	255 (63.8)	0.204	0.104–0.4	<0.001
	Female	37 (9.2)	35 (8.8)	1	–	–
Age (years)	20–29	60 (15)	161 (40.2)	0.172	0.05–0.595	0.005
	30–39	22 (5.5)	122 (30.5)	0.066	0.017–0.256	<0.001
	40–49	13 (3.2)	3 (0.8)	0.92	0.141–5.985	0.93
	≥50	15 (38)	4 (1)	1	–	–
Educational level	Bachelor's	73 (18.2)	261 (65.2)	0.51	0.251–1.035	0.062
	Master's	37 (9.2)	29 (7.2)	1	–	–
Experience (years)	<1	41 (10.2)	204 (51)	0.197	0.083–0.468	<0.001
	1–4	18 (4.5)	66 (16.5)	0.294	0.11–0.783	0.014
	5–9	21 (5.2)	8 (2)	2.764	0.84–9.097	0.094
	≥10	30 (7.5)	12 (3)	1	–	–

Abbreviation: OR, odds ratio.

antibiotics can lead to a loss of sensitivity of an antibiotic toward a specific pathogen.

These results confirm findings of recent studies on this topic. A survey-based study[35] performed in the USA showed that almost all participants were aware of harmful aspects of the inappropriate use of antibiotics on patient health and the association with microbial resistance against antibiotics. In 2013, the Eurobarometer report[5] on antibiotic resistance was published. This report was based on a study conducted in an Italian population. The results of this study were comparable to those of Eurobarometer's report. That report pointed out that 58% of participants were of the opinion that antibiotics can kill viruses, while 40% believed in the effectiveness of antibiotics against cold and flu. The results of this study are backed by the Napolitano et al,[36] in which approximately half the participants were not aware of the ineffectiveness of antibiotics against fever, flu, and sore throat. A meta-analysis of 24 studies was conducted at an international level, and it gave comparable results.[15] With regard to perceptions and practices of AMS, this study demonstrated that community pharmacists had strong positive perceptions regarding AMS, practices of AMS in community settings were poor, and male sex, age 20–29 years, and <1 year of experience were factors associated with poor practices regarding AMS.

In this study, participants were familiar with the importance of AMS, because the majority of them agreed upon its importance in improvement of patient care. The core importance of AMS in AM-prescribing optimization for better patient care is overwhelmingly verified by supportive evidence.[37] A cross-sectional study in Malaysia reported positive perceptions among a majority of pharmacists (96.8%) regarding the importance of AMS in improving patient care.[31] In combating the issue of microbial resistance against antibiotics, the dispensing of antibiotics must be closely monitored by community pharmacists. There is limited literature available on optimizing the use of antibiotics. There is a need for further studies for identification of antibiotics dispensed by community pharmacists routinely. Knowledge about incentives is crucial, not merely for avoiding inappropriate dispensing practices regarding antibiotics but also for designing new intervention strategies.[23]

Pharmacists are solely responsible for processing medication orders, so can act as an effective means for successful conduction of AMS programs.[38] The results of another study[39] also justify our findings such that a majority of participants considered the role of pharmacists a crucial part of establishing and developing AMS programs in health care settings. In the current scenario, a large number of health care professionals support the notion of incorporating AMS programs at the level of community pharmacies.[40] Currently, community-pharmacy settings in Pakistan have no well-established AMS programs, but fortunately community pharmacists of Pakistan are well aware of their roles in AMS programs. Positive understanding of AMS must be utilized for the betterment of patients. Therefore, pharmacists must work alongside other health care professionals. Stakeholders must provide recommendations for improving the role of community pharmacists as AMS proponents.

For the implementation of an AMS program, team efforts and interdisciplinary involvement of different health care professionals are mandatory. Unfortunately, such practices were not being performed by the participants of this study. This study highlighted AMS as a relevant local issue among community pharmacists. In contrast, the findings of another study[23] revealed that pharmacists were more in agreement to introduce a specialist multidisciplinary team giving advice on AM prescribing. Similarly, an Ethiopian study revealed that more than half the pharmacists worked in collaboration with other health care professionals.[41] The collaboration between pharmacists and other health care professionals could be improved by activities like shared decision making. Without teamwork, it is not feasible for pharmacists to improve the process of prescribing antibiotics. The findings of this study draw attention toward interprofessional issues that must be resolved. Otherwise, the positive attributes of AMS programs will be difficult to achieve.

Findings showed that a majority of community pharmacists dispensed antibiotics without a prescription. Similarly, cross-sectional studies conducted in Saudi Arabia[42] and China[43] demonstrated the common practice of dispensing antibiotics without prescription, which leads to greater risk of developing AM resistance. Such irrational dispensing trends of antibiotics by various community pharmacists might be the result of a thirst for financial incentives and business orientations.[44,45] There is an urgent need for further studies to relate the financial benefits with the current dispensing practices of community pharmacists.

Other researchers have also suggested that effective communication between the pharmacist and the physician is a core feature of a successful AMS program.[19] In this study, a majority of participants did not communicate with the prescribers in cases of uncertainty about the appropriateness of antibiotic prescription. This communication gap could be a possible reason for irrational antibiotic usage.

Two studies[46,47] revealed that prolonged duration of antibiotic therapy could promote the development of bacterial

resistance against antibiotic agents. Wrong dispensing practices were also observed in this study, where 28% (n=112) of participants admitted that they often or always dispensed antibiotics for longer durations than prescribed by physicians. Attempts must be made to ensure better adherence to dispensing guidelines for AM agents.

Our results showed that 53.8% (n=215) of pharmacists never participated in AM-awareness campaigns. These findings were in accordance with Cotta et al.[23] Therefore, it is recommended that pharmacists be encouraged to participate in AM-awareness programs to enhance awareness about beneficial aspects of AM surveillance among health care professionals and the public.

Our findings suggest that practices of community pharmacists regarding AMS programs in Pakistan are poor. It is crucial to incorporate AMS programs in community-pharmacy settings, so that the issue of microbial resistance against AM agents can be alleviated. People are unaware of the effects of AMS programs on microbial resistance against AM agents in various regions across the globe.[48] This study strongly recommends the need for large-scale studies to evaluate the effects of AMS programs on clinical outcomes.

Strengths and limitations

No study was found in previously published literature that highlighted this issue solely in Pakistan. Furthermore, the current study was conducted on a provincial level. Data were collected via a self-administered questionnaire. The major disadvantage of self-administered questionnaires is bias due to differences in accuracy or completeness of recollections of participants and to under- or overreporting of knowledge, perceptions, and practices.

Conclusion and recommendations

The present study concludes that the knowledge of pharmacists about antibiotics is good and their perceptions regarding AMS positive. Unfortunately, practices regarding AMS were poor. This situation can be improved by the incorporation of AMS programs in community settings, involving pharmacists and other health care professionals in collaborative interdisciplinary teamwork, and increased participation of pharmacists in AM-awareness campaigns. It is recommended that further studies be carried out in order to evaluate the knowledge and perceptions of community pharmacists regarding AM therapy and AMS programs across provinces of Pakistan. Furthermore, this study demands interventions for the betterment of practices of community pharmacists regarding AMS.

Data sharing statement

The raw data on which conclusions of this manuscript rely are available upon request. Please contact Muhammad Rehan Sarwar at rehansarwaralvi@gmail.com.

Acknowledgments

We would like to express wholehearted thankfulness to participants of the study. We wish to express gratitude to Dr Muhammad Atif (Assistant Professor, Islamia University of Bahawalpur), Dr Fahad Saleem (Assistant Professor, University of Balochistan), and Dr Shane Scahill (Senior Lecturer, Massey University, New Zealand) for reviewing and editing the paper and for valuable comments. Also, a note of thanks to all pharmacy students who acted as data collectors.

Author contributions

MRS conceptualized and designed the study. AS, TS, and SI analyzed and interpreted the data. MRS and AS drafted the manuscript. SI, TS, and MRS critically revised the manuscript. All authors read and approved the final version of the manuscript.

Disclosure

The authors report no conflicts of interest in this work.

References

1. World Health Organization. *The Evolving Threat of Antimicrobial Resistance: Options for Action*. Geneva: WHO; 2012.
2. Brunton LL, Lazo JS, Parker KL. *Goodman and Gilman's The Pharmacological Basis of Therapeutics*. 11th ed. New York: McGraw-Hill; 2006.
3. Scaioli G, Gualano MR, Gili R, Masucci S, Bert F, Siliquini R. Antibiotic use: a cross-sectional survey assessing the knowledge, attitudes and practices amongst students of a school of medicine in Italy. *PLoS One*. 2015;10(4):e0122476.
4. Shaikh BT. Anti-microbial resistance in Pakistan: a public health issue. *J Ayub Med Coll Abbottabad*. 2017;29(2):184–185.
5. European Commission. Special Eurobarometer 407: Antimicrobial Resistance. 2013. Available from: http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_407_en.pdf. Accessed December 6, 2017.
6. Atif M, Azeem M, Saqib A, Scahill S. Investigation of antimicrobial use at a tertiary care hospital in southern Punjab, Pakistan using WHO methodology. *Antimicrob Resist Infect Control*. 2017;6:41.
7. Tonkin-Crine S, Yardley L, Little P. Antibiotic prescribing for acute respiratory tract infections in primary care: a systematic review and meta-ethnography. *J Antimicrob Chemother*. 2011;66(10):2215–2223.
8. Butler CC, Rollnick S, Pill R, Maggs-Rapport F, Stott N. Understanding the culture of prescribing: qualitative study of general practitioners' and patients' perceptions of antibiotics for sore throats. *BMJ*. 1998;317(7159):637–642.
9. Kumar S, Little P, Britten N. Why do general practitioners prescribe antibiotics for sore throat? Grounded theory interview study. *BMJ*. 2003;326(7381):138.

10. Rodrigues AT, Roque F, Falcão A, Figueiras A, Herdeiro MT. Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative studies. *Int J Antimicrob Agents*. 2013;41(3):203–212.
11. Cars O, Mölstad S, Melander A. Variation in antibiotic use in the European Union. *Lancet*. 2001;357(9271):1851–1853.
12. Corbett KK, Gonzales R, Leeman-Castillo BA, Flores E, Maselli J, Kafadar K. Appropriate antibiotic use: variation in knowledge and awareness by Hispanic ethnicity and language. *Prev Med*. 2005;40(2):162–169.
13. McNulty CA, Boyle P, Nichols T, Clappison P, Davey P. Don't wear me out: the public's knowledge of and attitudes to antibiotic use. *J Antimicrob Chemother*. 2007;59(4):727–738.
14. Grigoryan L, Burgerhof JG, Haaijer-Ruskamp FM, et al. Is self-medication with antibiotics in Europe driven by prescribed use? *J Antimicrob Chemother*. 2006;59(1):152–156.
15. Gualano MR, Gili R, Scaioli G, Bert F, Siliquini R. General population's knowledge and attitudes about antibiotics: a systematic review and meta-analysis. *Pharmacoepidemiol Drug Saf*. 2015;24(1):2–10.
16. [No authors listed]. Antibiotic Resistance [editorial]. *Dawn*. 2016. Available from: https://www.dawn.com/news/1296345. Accessed December 6, 2017.
17. Hasan R, Zafar A, Khan E. Status of Antibiotic Resistance. 2014. Available from: http://emerald.tufts.edu/med/apua/intl_chapters/pakistan.shtml. Accessed December 6, 2017.
18. Afzal MF. Antibiotic stewardship: battle to defeat superbugs. *Ann King Edward Med Univ*. 2017;23(2):97.
19. Viale P, Giannella M, Bartoletti M, Tedeschi S, Lewis R. Considerations about antimicrobial stewardship in settings with epidemic extended-spectrum β-lactamase-producing or carbapenem-resistant Enterobacteriaceae. *Infect Disease Ther*. 2015;4(1):65–83.
20. McNulty CA, Lecky DM, Farrell D, et al. Overview of e-Bug: an antibiotic and hygiene educational resource for schools. *J Antimicrob Chemother*. 2011;66 Suppl 5:v3–v12.
21. Ohl CA, Luther VP. Health care provider education as a tool to enhance antibiotic stewardship practices. *Infect Dis Clin North Am*. 2014;28(2):177–193.
22. Pulcini C, Gyssens IC. How to educate prescribers in antimicrobial stewardship practices. *Virulence*. 2013;4(2):192–202.
23. Cotta MO, Robertson MS, Tacey M, et al. Attitudes towards antimicrobial stewardship: results from a large private hospital in Australia. *Healthc Infect*. 2014;19(3):89–94.
24. Adriaenssens N, Coenen S, Versporten A, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient antibiotic use in Europe (1997-2009). *J Antimicrob Chemother*. 2011;66 Suppl 6:vi3–vi12.
25. Lee GC, Reveles KR, Attridge RT, et al. Outpatient antibiotic prescribing in the United States: 2000 to 2010. *BMC Med*. 2014;12:96.
26. Atif M, Sarwar MR, Azeem M, Naz M, Amir S, Nazir K. Assessment of core drug use indicators using WHO/INRUD methodology at primary healthcare centers in Bahawalpur, Pakistan. *BMC Health Serv Res*. 2016;16:684.
27. Hafeez A, Kiani AG, ud Din S, et al. Prescription and dispensing practices in public sector health facilities in Pakistan: survey report. *J Pak Med Assoc*. 2004;54(4):187–191.
28. Bureau of Statistics, Punjab [homepage on the Internet]. Available from: http://bos.gop.pk. Accessed December 6, 2017.
29. Azhar S, Hassali MA, Taha A, Khan SA, Murtaza G, Hussain I. Evaluation of the perception of community pharmacists regarding their role in Pakistan's healthcare system: a qualitative approach. *Trop J Pharm Res*. 2013;12(4):635–639.
30. Raosoft. Sample Size Calculator. 2015. Available from: http://www.raosoft.com/samplesize.html. Accessed December 6, 2017.
31. Khan MU, Hassali MA, Ahmad A, Elkalmi RM, Zaidi ST, Dhingra S. Perceptions and practices of community pharmacists towards antimicrobial stewardship in the state of Selangor, Malaysia. *PLoS One*. 2016;11(2):e0149623.
32. Lim KK, Teh CC. A cross sectional study of public knowledge and attitude towards antibiotics in Putrajaya, Malaysia. *South Med Rev*. 2012;5(2):26–33.
33. Alabid AH, Ibrahim MI, Hassali MA. Antibiotics dispensing for URTIs by community pharmacists (CPs) and general medical practitioners in Penang, Malaysia: a comparative study using simulated patients (SPs). *J Clin Diagn Res*. 2014;8(1):119–123.
34. Pawluk S, Black E, El-Awaisi A. Strategies for improving antibiotic use in Qatar: a survey of pharmacists' perceptions and experiences. *Int J Pharm Pract*. 2015;23(1):77–79.
35. Abbo LM, Cosgrove SE, Pottinger PS, et al. Medical students' perceptions and knowledge about antimicrobial stewardship: how are we educating our future prescribers? *Clin Infect Dis*. 2013;57(5):631–638.
36. Napolitano F, Izzo MT, Di Giuseppe G, Angelillo IF. Public knowledge, attitudes, and experience regarding the use of antibiotics in Italy. *PLoS One*. 2013;8(12):e84177.
37. Abbo L, Smith L, Pereyra M, Wyckoff M, Hooton TM. Nurse practitioners' attitudes, perceptions, and knowledge about antimicrobial stewardship. *J Nurse Pract*. 2012;8(5):370–376.
38. MacDougall C, Polk RE. Antimicrobial stewardship programs in health care systems. *Clin Microbiol Rev*. 2005;18(4):638–656.
39. Struelens MJ. Multidisciplinary antimicrobial management teams: the way forward to control antimicrobial resistance in hospitals. *Curr Opin Infect Dis*. 2003;16(4):305–307.
40. Gottlieb T, Nimmo GR. Antibiotic resistance is an emerging threat to public health: an urgent call to action at the Antimicrobial Resistance Summit 2011. *Med J Aust*. 2011;194(6):281–283.
41. Erku DA. Antimicrobial stewardship: a cross-sectional survey assessing the perceptions and practices of community pharmacists in Ethiopia. *Interdiscip Perspect Infect Dis*. 2016;2016:5686752.
42. Hadi MA, Karami NA, Al-Muwalid AS, et al. Community pharmacists' knowledge, attitude, and practices towards dispensing antibiotics without prescription (DAwP): a cross-sectional survey in Makkah Province, Saudi Arabia. *Int J Infect Dis*. 2016;47:95–100.
43. Chang J, Ye D, Lv B, et al. Sale of antibiotics without a prescription at community pharmacies in urban China: a multicentre cross-sectional survey. *J Antimicrob Chemother*. 2017;72(4):1235–1242.
44. Dameh M, Norris P, Green J. New Zealand pharmacists' experiences, practices and views regarding antibiotic use without prescription. *J Prim Health Care*. 2012;4(2):131–140.
45. Chuc NT, Hoa NP, Hoa NQ, et al. Antibiotic sales in rural and urban pharmacies in northern Vietnam: an observational study. *BMC Pharmacol Toxicol*. 2014;15:6.
46. Nasrin D, Collignon PJ, Roberts L, Wilson EJ, Pilotto LS, Douglas RM. Effect of β-lactam antibiotic use in children on pneumococcal resistance to penicillin: prospective cohort study. *BMJ*. 2002;324(7328):28–30.
47. Guillemot D, Varon E, Bernède C, et al. Reduction of antibiotic use in the community reduces the rate of colonization with penicillin G-nonsusceptible *Streptococcus pneumoniae*. *Clin Infect Dis*. 2005;41(7):930–938.
48. Drekonja DM, Filice GA, Greer N, et al. Antimicrobial stewardship in outpatient settings: a systematic review. *Infect Control Hosp Epidemiol*. 2015;36(2):142–152.

Supplementary material

We are currently conducting a study in relation to knowledge of community pharmacists about antibiotics, their perceptions and practices regarding antimicrobial stewardship in Punjab.

Antimicrobial stewardship refers to a coordinated intervention designed to enhance and improve the selection of an optimal antimicrobial drug regimen, dose, duration of therapy, and route of administration. It ultimately seeks to achieve an optimal therapeutic outcome in relation to antimicrobial use, thus minimizing toxicity and other adverse events. This in turn reduces costs of health care for infections, thus limiting the occurrence of antimicrobial-resistant strains.

Your participation is highly appreciated. The gathering of information will be kept confidential and used only for research purposes. The estimated completion time for this survey is 15–20 minutes.

Anonymity and confidentiality

The data collected in the study will be treated as strictly confidential. Participants' names will not be revealed, and participant confidentiality will be maintained by the researchers. None of your information will be released to your organization or anyone in a way that could identify you.

Right of withdrawal

Your participation in this research is voluntary. We do not anticipate any risks resulting from participating in this study other than minimal fatigue.

Section A: Personal information

1. Please indicate your sex.

	Male
	Female

2. Please indicate your age-group.

	20–29
	30–39
	40–49
	50–59
	≥60

3. Please indicate the highest educational degree that you have attained at this point in time.

	Bachelor's degree in pharmacy
	Master's degree in pharmacy

4. Please specify the number of years you have been practicing in this sector

	<1
	1–4
	5–9
	≥10

Section B: Knowledge about antibiotics

Strongly disagree–strongly agree (1–5)

1. Antibiotics are useful for bacterial infections (eg, tuberculosis).

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

2. Antibiotics are useful for viral infections (eg, flu).

5	4	3	2	1
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

Figure S1 (*Continued*)

3. Antibiotics are indicated to reduce any kind of pain and inflammation.

5	4	3	2	1
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

4. Antibiotics can kill "normal flora" present in our body.

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

5. Antibiotics can cause secondary infections after killing normal flora present in our body.

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

6. Antibiotics can cause allergic reactions.

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

7. Misuse of antibiotics can lead to a loss of sensitivity of an antibiotic to a specific pathogen.

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

8. If symptoms improve before the full antibiotic course of is completed, you can stop taking it.

5	4	3	2	1
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

Section C: Perception of participants towards antimicrobial stewardship (AMS)

Strongly disagree–strongly agree (1–5)

1. AMS programs improve patient care.

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

2. AMS should be incorporated at the community-pharmacy level.

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

3. AMS programs reduce problems of antimicrobial resistance.

1	2	3	4	5
Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**

Figure S1 (*Continued*)

4. Adequate training on antimicrobial use should be provided to community pharmacists.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

5. Relevant conferences, workshops, and other educational activity are required to be attended by community pharmacists to enhance understanding of antimicrobial stewardship.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

6. Individual efforts at antimicrobial stewardship have minimal impact on the antimicrobial-resistance problem.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

7. I think that prescribing physicians are the only professionals who need to understand antimicrobial stewardship.

5	4	3	2	1
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

8. Pharmacists have a responsibility to take a prominent role in antimicrobial stewardship and infection-control programs in the health system.

1	2	3	4	5
Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Section D: Practices of participants regarding antimicrobial stewardship

Never–always (1–5)

1. I dispense antimicrobial on prescription with complete clinical information.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

2. I dispense antimicrobials without a prescription.

5	4	3	2	1
Never	Rarely	Occasionally	Often	Always

3. I dispense antimicrobials for durations longer than prescribed by the physician on patient request.

5	4	3	2	1
Never	Rarely	Occasionally	Often	Always

4. I screen antimicrobial prescriptions in accordance with local guidelines before dispensing.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

Figure S1 (*Continued*)

5. I collaborate with other health professionals on infection control and antimicrobial stewardship.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

6. I communicate with prescribers if I am unsure about the appropriateness of an antibiotic prescription.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

7. I have sought additional clinical information (eg, drug interaction, adverse drug reactions, allergy) before deciding to dispense the antibiotic prescribed.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

8. I take part in antimicrobial-awareness campaigns to promote the optimal use of antimicrobials.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

9. I educate patients on the use of antimicrobials and resistance-related issues.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

10. I make efforts to prevent or reduce the transmission of infections within the community.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

11. I ask patients about their knowledge of prescribed antimicrobials and their usage.

1	2	3	4	5
Never	Rarely	Occasionally	Often	Always

Thank you!

Figure S1 Letter to participants.