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ORIGINAL RESEARCH ARTICLE

Community pharmacists' knowledge of and attitudes toward antibiotic use, resistance, and self-medication in Jordan

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Abstract

Background Antibiotic resistance (AR) is a major global concern. Indiscriminate use of antibiotics may contribute to treatment failure and AR. Data about community pharmacists' (CPs) knowledge of and behaviour toward antibiotic use and AR are limited.

Objective Our objective was to evaluate the knowledge of and attitudes towards antibiotic use and AR in CPs in Jordan.

Methods A large cross-sectional face-to-face survey of a random sample of 500 CPs in Jordan was conducted over a 2-month period. A representative sample was collected using the proportionate random sampling technique, which enabled us to geographically categorize the study population. Reliability and validity measures were taken to ensure a comprehensive and appropriate study tool. We used the Statistical Package for Social Science (SPSS®) version 24 to conduct descriptive analysis and logistic regression.

Results The majority (86.6%) of respondents thought it was legal to dispense antibiotics without a prescription in Jordan. Only 24.2% had good knowledge regarding amoxicillin dosages for upper respiratory tract infections, and 66.2% did not know that bacteria are the predominant causative pathogens of acute otitis media. The majority (71.6%) knew that overuse of antibiotics is considered the principal cause of AR. However, only 34.4% were familiar with the definition of cross resistance, and 85.6% had misconceptions regarding patient compliance and its causal relationship with AR. Knowledge of antibiotic use was likely to be better in CPs who worked in urban areas than in those working in rural areas (odds ratio [OR] 1.2; 95% CI 0.74–2.31; $p=0.02$) and in CPs with a postgraduate degree than in those without (OR 2.6; 95% CI 1.89–4.56; $p=0.04$).

Conclusion As many CPs in Jordan have poor knowledge of antibiotics and AR, continual educational interventions to improve this situation are necessary.

Introduction

Antibiotics are medicines that inhibit the growth of or destroy bacteria [1]. Worldwide, they are one of the most commonly prescribed medication classes [2]. However, well-known antibiotics, such as β-lactams and quinolones, are becoming ineffective because of the emergence of antibiotic-resistant (AR) bacteria, and novel antibiotics are not often developed, leading to negative health and economic consequences [3].

In his Nobel Prize-winning speech, Alexander Fleming, who discovered penicillin, predicted these negative outcomes [4–6]. Inappropriate antibiotic prescribing by healthcare professionals (HCPs) has been blamed for the development of AR [7, 8]. Combined efforts from all HCPs and patients is necessary to limit the misuse of antibiotics, which is a leading cause of AR [7, 9–11]. To do this, a radical

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shift in the global attitude toward antibiotic consumption is required [12]. Pharmacists are responsible for providing proper patient counselling on appropriate antibiotic use [13]. Therefore, well-educated pharmacists can have a significant influence on patients' and HCPs' behaviour regarding antibiotic consumption [14].

Pharmacists' attitudes towards and knowledge about antibiotic use and AR have been assessed in many countries. In Saudi Arabia, the majority of pharmacists thought that dispensing antibiotics without a prescription was legal [15]. In Spain, Syria, and Portugal, dispensing antibiotics without a prescription was noticed among community pharmacists (CPs) [8, 16]. In Pakistan, pharmacists had good knowledge of antibiotics but many misconceptions regarding antimicrobial stewardship [17]. A study of Australian pharmacists found that the majority were highly confident in treating simple infections and prescribing different antibiotics [6, 18].

Although Jordan has made the selling of antibiotic medication in community pharmacies without a prescription illegal, the Jordanian public can easily access antibiotics without prescriptions and other medicines except for controlled drugs [19]. No penalties exist for the direct sale of prescription drugs by pharmacists in Jordan [20–23]. A previous Jordanian study found that approximately 43 in every 100 dispensed antibiotics in community pharmacies were without prescriptions [24]. In addition, misuse of antibiotics was reported in both community pharmacy [25] and public [26] settings. Many Jordanian hospital pharmacists have reported that dispensing antibiotics without a prescription is the leading cause of AR [27]. However, data about the knowledge of and behaviour toward antibiotic use and AR in CPs in Jordan are limited. Therefore, we believe exploring this area will be a key factor in controlling irrational use of and behaviours toward antibiotics.

Methods

The aim of the cross-sectional, questionnaire-based study was to assess the knowledge and attitudes of CPs in Jordan regarding antibiotic use, AR, and antibiotic self-medication. The study received ethics approval (no. 14H-11-2019) from the institutional review board of the University of Petra, Jordan.

The study was conducted over a 2-month period (1 November 2019 to 31 December 2019) in 12 governorates in Jordan (Table 1).

Licensed CPs who were Arabic speakers and lived permanently in Jordan were eligible to participate. Those who had practiced for <3 months or were not willing to participate were excluded. CPs were randomly selected to participate and completed the questionnaire during face-to-face interviews with a data collector.

Table 1 Proportionate random sampling calculation from Jordanian regions ($n = 500$)

Region	Areas	Pharmacies, *N* (%)	Calculated sample size
North	Irbid, Ajloun, Jerash, Mafraq	588 (21)	105
Central	Balqa, Amman, Zarqa, Madaba	2103 (75)	375
South	Karak, Tafilah, Ma'an, Aqaba	110 (4)	20

Sampling technique and size

Of the 13,554 licensed pharmacists working in Jordan, 6000 are estimated to work in community pharmacies. The minimum recommended sample size for our survey was calculated using the Raosoft sample size calculator [28] and the below formula, where n is the sample size required, N is the population size, x the confidence interval (CI), which was considered to be 95%, and E the margin of error, which is 5%.

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

The recommended sample size was calculated to be 362. We decided to approach participants until 500 CPs had completed the questionnaire.

The study population was divided using proportionate random sampling into three geographical regions, each with four governorates (Table 1). Each governorate was stratified geographically into areas based on the study population density. The northern and central regions were divided into nine and eight areas (districts), respectively, and the southern region was divided into 12 areas. Areas from each region were listed in decreasing order, coded with numbers, and entered into the computer program, from which three areas from each region were selected randomly. Pharmacists from each area were listed alphabetically and then coded with numbers. A random sample of community pharmacists was invited from each area, proportionate to the relative number of pharmacists in the region

Study instrument

For the purpose of our research, we developed a self-administered questionnaire based on analyses of relevant published articles on pharmacists' knowledge of and attitudes toward antibiotics [5, 8, 29, 30].

The questionnaire was originally written in English and then translated into Arabic by an expert in linguistics who validated the translation, accounting for both cultural and social differences. Then, the questionnaire was delivered to the participants in both languages.

The questionnaire was constructed to elicit the following information:

- Socio-demographic characteristics: Details of age, sex, education, years of experience as a CP and employment region.
- Knowledge of antibiotic use: Respondents answered 'yes/no/I don't know' to questions related to antibiotic common use, categorization, dispensing legality, and effects on viruses and allergies.
- Knowledge of AR: Respondents answered 'yes/no/I don't know' to questions regarding AR risk factors, patient compliance, and common resistant bacterial strains.
- Attitude toward antibiotic dispensing: Using a four-choice rating scale (strongly agree, agree, disagree, and strongly disagree), respondents answered questions regarding pharmacists' qualifications to prescribe antibiotics, patient counselling on antibiotics, the potential role of proper education in minimizing the spreading of AR, and the effect on profits of dispensing antibiotics without prescriptions.
- Pharmacists' self-medication practice: Respondents answered 'yes/no' to questions regarding the prevalence of self-medication among CPs and the reasons and disease conditions related to self-medication.

Reliability and validity

The reliability of the pilot version was evaluated by collecting questionnaire answers from a sample of 30 CPs in each governorate. Data collected were analysed using the Statistical Package for Social Sciences (SPSS) version 24 (IBM, Chicago, USA). We used Cronbach's α to test our instrument reliability as it is the most commonly used measure of internal consistency reliability [31, 32]. An α-coefficient of <0.5 was considered to show poor reliability, >0.5 and <0.7 moderate reliability, >0.7 good reliability, and >0.8 great reliability [33]. Our results showed good and significant reliability ($\alpha = 0.74$; $p < 0.05$). Data from the pilot testing are not included in our study results.

The validity of the questionnaire content was assessed during a face-to-face meeting between the primary investigator (DAQ) and a panel of seven experts: an infectious disease specialist, a family medicine specialist, a respiratory medicine specialist, a senior clinical pharmacist, a paediatrician, an internist, and an infectious disease nurse. Each expert was asked to score all questions from 0 to 10 with regard to appropriateness, importance, and phrasing (higher numbers indicated better quality) and provide any additional comments. Overall mean scores for appropriateness, importance, and phrasing were 8.2 ± 1.23, 8.45 ± 1.47, and 8.81 ± 1.74, respectively. Amendments to the survey included adding extra information to knowledge- and attitude-related questions.

Data collection

The final questionnaire was used in face-to-face interviews between interviewers and willing CPs who met the inclusion criteria. Interviews were conducted by eight pharmacy students in their 5th year of academic study at the University of Petra, Jordan. The interviewers received one 2-h lecture on the topic and five training sessions by the main investigator (DAQ) on completing the study questionnaire.

The data collectors briefed the study participants on the study aims and time needed to complete the survey, and verbal consent was obtained from eligible respondents. Participants could withdraw from the interview at any time and had the right to refuse to answer any question without providing a reason. The data obtained with the questionnaire were anonymous and confidential.

Data analysis

Data were coded and entered into the SPSS® program by the investigator. Descriptive results are presented as percentages with 95% CIs. Multiple variable logistic regression was used to determine predictors of good knowledge about antibiotic use and AR. Dependent variables were statements with 'yes/no' answers; however, 'I do not know' answers were excluded. All predictors were based on data in the demographic and personal information section. Predictors were tested against two dependent variable statements chosen based on our results. Results are presented as adjusted odds ratios (ORs) with 95% CIs; p values <0.05 were considered statistically significant.

Results

Of the 571 CPs approached, 500 completed the questionnaire (87.6% response rate): 45.2% were aged 25–30 years, 38.2% were aged 31–40 years, and 16.6% were aged >41 years. Around two-thirds (61.4%) were female, more than half (57.2%) worked in urban areas, and most (80.2%) had a Bachelor's degree (Table 2).

As shown in Table 3, around two-thirds of respondents (76.2%) knew that antibiotics are the most commonly prescribed anti-infective agents in Jordan. The majority (84.6%) knew that common colds and coughs should not be treated with antibiotics. The majority (86.2%) knew that

Table 2 Demographic characteristics of community pharmacists in Jordan (n=500)

Statement	Multiple choice answers	Responses, *N* (%)
How old are you? (years)	25–30	226 (45.2)
	31–40	191 (38.2)
	> 41	83 (16.6)
Where do you work?	Urban area	286 (57.2)
	Rural area	214 (42.8)
What's your gender?	Male	193 (38.6)
	Female	307 (61.4)
What is your education level?	BSc (Pharmacy)	401 (80.2)
	Doctor of Pharmacy	52 (10.4)
	Masters	43 (8.6)
	PhD	4 (0.8)
What is your job status?	Staff pharmacist	411 (82.2)
	Manager	54 (10.8)
	Owner	35 (7.0)
No. of years of experience as pharmacist	< 2	31 (6.2)
	2–5	99 (19.8)
	5–10	296 (59.2)
	> 10	74 (14.8)
No. of courses of antibiotics without prescriptions dispensed per day in your pharmacy	< 10	339 (67.8)
	11–20	91 (18.2)
	21–30	46 (9.2)
	> 30	24 (4.8)
No. of courses of antibiotics with prescriptions dispensed per day in your pharmacy	< 10	132 (26.4)
	11–20	308 (61.6)
	21–30	46 (9.2)
	> 30	14 (2.8)

diphenhydramine is not an antibiotic used in the treatment of upper respiratory tract infections (URTIs), but only two-thirds (68.8%) knew that antibiotics cannot treat influenza. Around two-thirds (64.8%) knew that antibiotics can eradicate all sensitive bacteria in the human body. Most respondents (86.6%) were not aware of the illegality of dispensing antibiotics without prescriptions. Only one-quarter (24.2%) gave the correct answer for "In URTIs (otitis media, sinusitis, pharyngitis), the first-line amoxicillin dosage is 40–50 mg/kg/day", which is not completely true. Around two-thirds of respondents (66.2%) wrongly thought that viral infection is the most common cause of all URTIs, and 77.2% wrongly thought there would be no need for re-evaluation of treatment if signs and symptoms worsened or did not improve 72 h after taking antibiotics. Only 18.2% could differentiate between type 1 and non-type 1 penicillin allergy.

With regard to knowledge on AR (Table 3), most respondents (71.6%) correctly answered "Overuse of antibiotics appears to be the principal risk factor for emergence of antibiotic-resistant bacteria". The majority (60.8%) knew that resistant strains can transfer from infected patients to uninfected patients via healthcare workers, and most (75.8%) knew that resistant bacteria can spread in healthcare institutions and communities. Less than one-third of respondents knew that poor patient compliance (14.4%) and inadequate duration of therapy (31.4%) are not the principal factors for AR or were aware of the cross-resistance definition (34.4%). The majority (74.8%) did not know *Streptococcus pyogenes* is not (to date) resistant to penicillins, and only 7.4% knew that Enterococcus can be resistant to vancomycin. Two-thirds (68.2%) thought that the use of broad-spectrum antibiotics as initial therapy for mild infection is not linked to an increased risk of AR.

Respondents also lacked knowledge on cephalosporin categorization, as only 9–28.2% knew the correct generation for five different cephalosporins.

Responses regarding the attitude of CPs toward antibiotic dispensing and resistance are listed in Table 4. Respondents agreed (72.8%) or strongly agreed (24.2%) that CPs were qualified (at the time of study) to prescribe antibiotics to patients with bacterial infections. Most either disagreed (46.2%) or strongly disagreed (43.6%) that "Patients should be advised to keep part of the antibiotic course for another occasion, which will also be an added advantage for them

Table 3 Pharmacists' knowledge of antibiotic use and resistance (n=500)

Statement	Response (bolded response is correct)	Responses, N (%)
Antibiotics are the most commonly prescribed anti-infective agents by both public and private healthcare sectors in Jordan	**Yes** No I don't know	381 (76.2) 119 (23.8) 0
Antibiotics can be legally obtained without prescriptions in Jordan	Yes **No** I don't know	433 (86.60) 62 (12.4) 5 (1.0)
Common colds and coughs should always be treated with antibiotics as this will make the patient recover more quickly	Yes **No** I don't know	41 (8.2) 423 (84.6) 36 (7.2)
Diphenhydramine is an antibiotic used in treating upper respiratory infections	Yes **No** I don't know	69 (13.8) 431 (86.2) 0
Antibiotics can treat influenza	Yes **No** I don't know	156 (31.2) 344 (68.8) 0
In URTIs (otitis media, sinusitis, pharyngitis), first-line amoxicillin dosage is 40–50 mg/kg/day	Yes **No** I don't know	379 (75.8) 121 (24.2) 0
Viral infection is the most common cause of URTIs (otitis media, sinusitis, pharyngitis)	Yes **No** I don't know	331 (66.2) 169 (33.8) 0
In urinary tract infections, if there is worsening or no improvement in signs and symptoms after 72 h of antibiotics, therapy should be re-evaluated	**Yes** No I don't know	114 (22.8) 386 (77.2) 0
Antibiotics treatment can eliminate all the sensitive bacteria in your body	**Yes** No I don't know	324 (64.8) 176 (35.2) 0
I can give cephalosporins to patients who have non-type I penicillin allergy	**Yes** No I don't know	91 (18.2) 369 (73.8) 40 (8.0)
Resistant bacteria cannot spread in healthcare institutions and communities	Yes **No** I don't know	122 (24.2) 378 (75.8) 0
Healthcare workers often serve as vectors carrying resistant strains from infected patients to uninfected patients	**Yes** No I don't know	203 (60.8) 152 (30.2) 45 (9.0)
Overuse of antibiotics appears to be the principal risk factor for emergence of antibiotic-resistant bacteria	**Yes** No I don't know	358 (71.6) 117 (23.4) 25 (5.0)
Poor patient compliance when taking antibiotics (skipping doses) appears to be the principal risk factor for emergence of antibiotic-resistant bacteria	Yes **No** I don't know	428 (85.6) 72 (14.4) 0
Inadequate duration of therapy appears to be the principal risk factor for emergence of antibiotic-resistant bacteria	Yes **No** I don't know	343 (68.6) 157 (31.4) 0
Antimicrobial resistance can be minimized by changing empiric therapy to narrow-spectrum therapy in response to the availability of culture and sensitivity results	**Yes** No I don't know	396 (79.2) 104 (20.8) 0
Cross resistance is the condition in which the resistance occurs to a particular antibiotic that often results in resistance to other antibiotics, usually from a similar chemical class	**Yes** No I don't know	172 (34.4) 328 (65.6) 0
To date, there is no resistance to penicillin for *Streptococcus pyogenes* bacterium	**Yes** No I don't know	121 (24.2) 374 (74.8) 5 (1.0)

Table 3 (continued)

Statement	Response (bolded response is correct)	Responses, *N* (%)
Enterococcus can be a vancomycin-resistant bacterium	**Yes**	37 (7.4)
	No	361 (72.2)
	I don't know	102 (20.4)
The use of broad-spectrum antibiotics (e.g., fourth-generation cephalosporins) as initial therapy for mild infection may increase the risk of antibiotic resistance	**Yes**	63 (12.6)
	No	341 (68.2)
	I don't know	96 (19.2)

URTI upper respiratory tract infection

Table 4 Pharmacists' attitude towards antibiotic dispensing and resistance ($n = 500$)

Statements	Items	Responses, *N* (%)
Currently, community pharmacists are qualified to prescribe antibiotics to patients with bacterial infections (mild-moderate upper respiratory infections, skin infections, etc.)	Strongly agree	121 (24.2)
	Agree	364 (72.8)
	Strongly disagree	7 (1.4)
	Disagree	8 (1.6)
In the future, community pharmacists will be qualified to prescribe antibiotics to patients with bacterial infections (mild-moderate upper respiratory infections, skin infections, etc.)	Strongly agree	11 (24.2)
	Agree	14 (2.8)
	Strongly disagree	345 (69.0)
	Disagree	130 (26.0)
Patients should be advised to keep part of the antibiotic course for another occasion, which will also be an added advantage for them in cutting down their medical costs	Strongly agree	6 (1.2)
	Agree	45 (9.0)
	Strongly disagree	218 (43.6)
	Disagree	231 (46.2)
Educating health professionals in greater coverage of appropriate antibiotic prescribing and antibiotic resistance may reduce the chance of antibiotic resistance	Strongly agree	161 (32.2)
	Agree	278 (55.6)
	Strongly disagree	0
	Disagree	61 (12.2)
Formal teaching on proper usage of antimicrobial agents among healthcare students may minimize the phenomena of antibiotic resistance	Strongly agree	322 (64.4)
	Agree	174 (34.8)
	Strongly disagree	0
	Disagree	4 (0.8)
Refusing to dispense antibiotics without prescriptions will negatively affect sales and profits of pharmacies	Strongly agree	132 (26.4)
	Agree	221 (44.2)
	Strongly disagree	48 (9.6)
	Disagree	99 (19.8)
Current pharmacy students in Jordan require proper clinical training to help them prescribe antibiotics to patients with bacterial infections (mild-moderate upper respiratory infections, skin infections, etc.)	Strongly agree	247 (49.4)
	Agree	221 (44.2)
	Strongly disagree	0
	Disagree	32 (6.4)

in cutting down their medical costs." The majority (87.8%) considered educating HCPs on proper antibiotic use as a possible solution for AR. The majority (70.6%) believed that selling antibiotics without a prescription was a major part of CP revenue. They also strongly agreed (49.4%) or agreed (44.2%) that pharmacy students in Jordan required proper clinical training to help them prescribe antibiotics to patients with bacterial infections.

Almost all respondents (95.2%) practised antibiotic self-medication. Reasons for antibiotic self-medication were previous experience with the disease (34.8%), followed by simplicity of a disease (32.8%), and lack of adjacent medical facility (6.8%) [Fig. 1]. Gastrointestinal (29.6%) and respiratory diseases (24.8%) were the most common conditions associated with antibiotic self-medication (Fig. 2). Around one-third of respondents (36.2%) would use or recommend antibiotics for sore throat and/or a fever (temperature > 38 °C).

The following were determined to be significant predictors of good knowledge about antibiotic use and AR using multiple variable logistic regression. Significant predictors

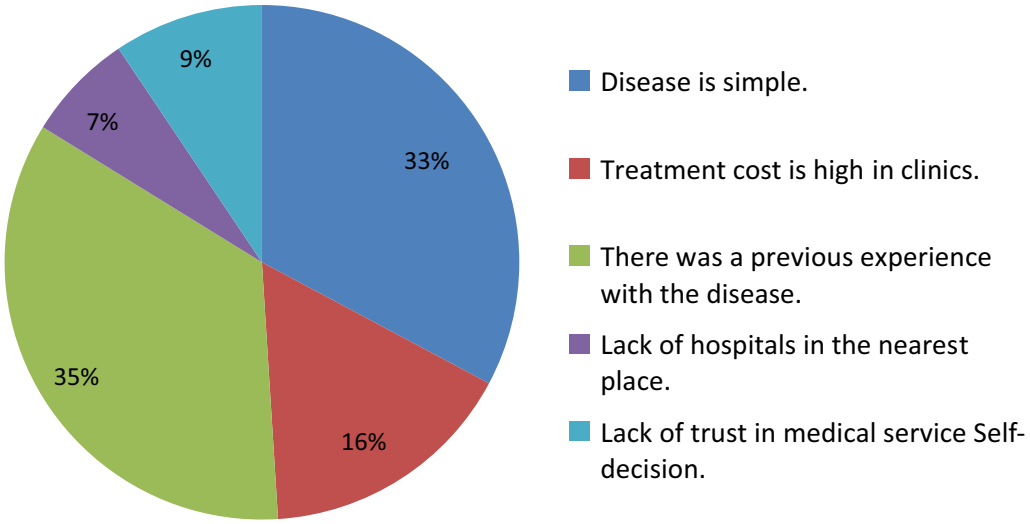

Fig. 1. Reasons community pharmacists gave for self-medicating with antibiotics

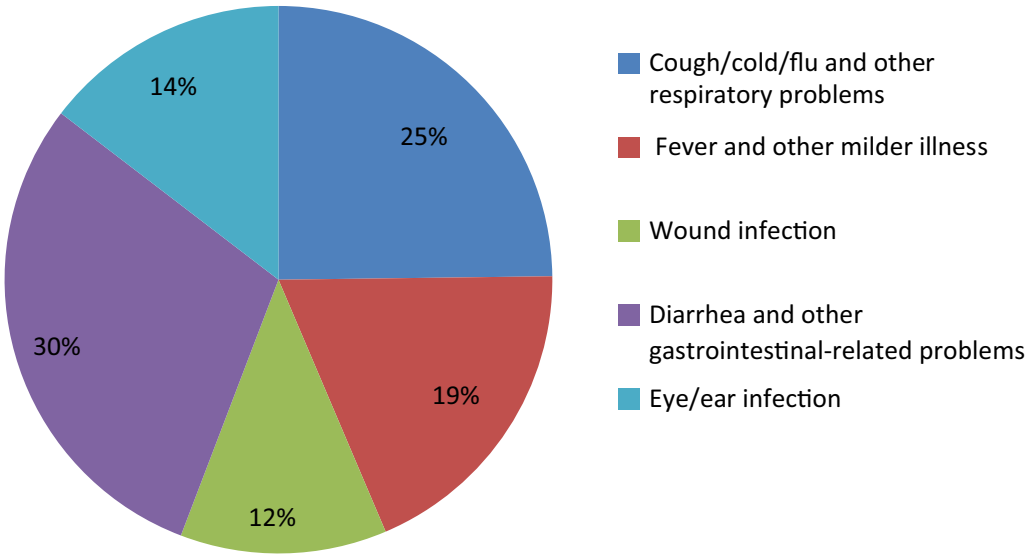

Fig 2. Disease conditions associated with community pharmacists self-medicating with antibiotics

for correct answers to the statement "In URTIs, if there is worsening or no improvement in signs and symptoms after 72 h of antibiotics, therapy should be re-evaluated" were educational level (postgraduate degree vs no postgraduate degree: OR 2.61; 95% CI 1.89–4.56; $p = 0.04$) and place of work (urban vs rural areas: OR 1.2; 95% CI 0.74–2.31; $p = 0.02$). The predictors for correct answer to the statement "The use of broad spectrum antibiotics (e.g., fourth-generation cephalosporins) as initial therapy for mild infection may increase the risk of antibiotic resistance" was also educational level (postgraduate degree vs no postgraduate degree: OR 2.3; 95% CI 1.64–3.61; $p = 0.001$).

Discussion

Many studies have assessed HCP behaviour toward antibiotic use and AR in secondary care. Our study is the first in Jordan to investigate CPs' knowledge of and attitudes toward antibiotic dispensing and AR. Other studies have targeted hospital pharmacists [27], pharmacy students [6], nurses and physicians [27, 34], paramedical staff [35], and emergency surgeons [36]. CPs' antibiotic self-medication was also assessed for the first time in our study. Comparing the results of our study with those of others is difficult because of discrepancies between the research instruments

used, each country's pharmacy regulations, target sample experience, and cultural background. Our results could be generalized to pharmacists in community settings in Jordan, since our study included a representative sample of CPs from all major areas of Jordan.

The vast majority of CPs in our study thought the dispensing of antibiotics without a prescription was legal in Jordan. Similarly, around two-thirds of CPs in Saudi Arabia did not know that dispensing antibiotics without prescriptions was illegal [15]. These findings from two Arabic countries indicate that CPs may well have insufficient knowledge about drug-dispensing regulations. Health authorities are responsible for updating HCPs about the recent rules and regulations. To the best of our knowledge, there is no such approach in Jordan. In the UAE, telepharmacy services were effective in regulating antibiotic dispensing [37, 38].

Overall, CPs had satisfactory knowledge of the basics of antibiotic use. However, results showed some misconceptions and gaps in CPs' knowledge of bacterial infection management, antibiotic use, and dosages. For instance, only a minority of the CPs in our study knew that the dose of amoxicillin for patients diagnosed with acute otitis media (90 mg/kg/day) differs from that in people with pharyngitis or sinusitis, and $<20\%$ of CPs could differentiate between type 1 penicillin allergy and non-type 1 penicillin allergy. CPs' inadequate antibiotic knowledge was also evident, in that only a minority correctly differentiated cephalosporin generations. As mentioned, results from other studies could not be compared in detail as research instruments vary between studies. Our study used comprehensive statements that covered multiple levels of antibiotic knowledge. In Pakistan, CPs had overall good knowledge about antibiotics, with few gaps [17]. A major drawback of previous studies was that they focused on measuring only the attitude of pharmacists rather than both knowledge and attitudes; furthermore, even studies that did measure knowledge did not test knowledge on antibiotic use, dose, and infection management; they may have assumed pharmacists had good knowledge of the basics [39, 40].

CPs had overall good knowledge of the prime evidence-based cause of AR and transfer of resistant bacteria. However, they had poor knowledge of AR risk factors. Our findings showed almost complete lack of awareness of recent updates of sensitive and resistant strains of bacteria as $<10\%$ of the participants knew that *Enterococcus* can be vancomycin resistant. Less than 15% of CPs knew that poor patient compliance when taking antibiotics is not the principal cause for the development of AR. Similar to our results, the majority of pharmacists in Ethiopia stated that poor patient adherence causes AR [34]. There is no evidence that, generally speaking, early cessation of antibiotic course enhances AR [41]. However, so far, many researchers have designed their questionnaires under the assumption that patient non-adherence to the antibiotic course encourages AR [40, 42, 43]. In a study conducted in Jordan a decade ago, 42 hospital pharmacists indicated that the use of antibiotics without prescription was a significant reason for the development of AR [27]; we could not interpret pharmacists' knowledge of overuse or wrong use of antibiotics in relation to AR.

The majority of CPs considered themselves qualified to prescribe antibiotics to patients with bacterial infections, and almost all CPs thought that pharmacy students in Jordan needed proper clinical training to help them prescribe antibiotics in their future career. Our CPs thought educating HCPs could be key to solving the problem of AR. Our study highlighted a probable hidden motive for pharmacists to dispense antibiotics without prescriptions: two-thirds of CPs indicated that their pharmacy's profits would be negatively affected if they stopped dispensing antibiotics without prescriptions. Most pharmacists (63.1%; $n=135/214$) who dispensed more than ten antibiotics a day without prescriptions were based in rural areas. Rural areas, with poor patient purchase power and limited access to medical facilities, influenced CPs' antibiotic-dispensing decisions, and this eventually became an important source of revenue for their pharmacies.

In Italy, the majority of pharmacists often or always informed the public about the risks of AR [40]. In Saudi Arabia, almost all pharmacists (93.7%) stated that they encouraged patients to consult a physician before obtaining antibiotics [15].

To the best of our knowledge, this is the first study to investigate pharmacists' antibiotic self-medication. Our findings showed that almost all participants practised self-medication. The most common reasons for this were previous experience with the disease, followed by disease simplicity based on their assessment. Around one-third would use or recommend antibiotics for a sore throat and/or fever. Antibiotic self-medication can be beneficial for those who have known and diagnosed infections [44]. A study that assessed self-medication with antibiotics among the Jordanian public found that more than one-third of the included public were self-medicating with antibiotics [45]. Self-medication behaviours were common among the population in the UAE [46]. Our study confirmed the popularity of self-medication among CPs, who are supposed to play a key role in raising public awareness of the harmful effects of antibiotic self-medication. Pharmacists self-medicating with antibiotics may compromise efforts to educate the public about the risks of self-medication.

Our results showed a strong relationship between CPs' educational level and their knowledge about antibiotic use and AR. To a lesser extent, CPs who worked in urban areas were more knowledgeable about antibiotic use than those in rural

areas. Our findings emphasised the urgent need to assess the appropriateness of the education that led to these conclusions.

Take home messages

- Many Jordanian community pharmacists have poor knowledge of various aspects of antibiotic use, antibiotic resistance, and management of minor infections.
- Although dispensing antibiotics without a prescription is illegal in Jordan, such practice is widespread, and community pharmacists feel qualified to do so.
- Educational interventions are needed to fill knowledge gaps and correct misconceptions about antibiotic resistance in healthcare professionals.
- Policy makers should update antibiotic use regulations and monitor community pharmacist compliance.
- Future studies should assess the effects of pharmacy education and curricula on knowledge about antibiotic resistance.
- Educational level is a significant predictor of good knowledge about antibiotic use and antibiotic resistance.

Author contributions All authors contributed to the study concept and design. DAQ, AZM, and AB prepared the material and collected and analysed the data. NA, OMA, PL, and SH wrote the first draft of the manuscript, and all authors commented on previous versions of it. All authors read and approved the final manuscript.

Declarations

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Ethics approval This study was approved by the institutional review board of the University of Petra (no. 14H-11-2019).

Conflict of interest DH. Abdel-Qader, A Albassam, NS Ismael, AA El-Shara', AZ Al Meslamani, PJ Lewis, S Hamadi, OM Ibrahim, and N Al Mazrouei have no conflicts of interest that are directly relevant to the content of this article.

Consent to participate Verbal informed consent was obtained from all study participants.

Consent for publication Not applicable.

Data availability Data are available upon reasonable request from the corresponding author.

Code availability Not applicable.

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