Knowledge, Attitude, And Practice Towards Antibiotic Resistance Among General Practitioners in Polyclinics in Yerevan, Armenia

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ABSTRACT

Aim: The objectives of the study were measuring knowledge, attitude, and practice scores among general practitioners on antibiotic resistance; exploring associations between antibiotics prescribing practice score among general practitioners and their knowledge and attitude scores after adjusting for other factors; and identifying barriers for rational antibiotics prescription by general practitioners.

Methods: A cross-sectional study design was used. A self-administered survey was conducted among general practitioners employed in private and public polyclinics in Yerevan, Armenia. All general practitioners, working in Yerevan polyclinics and fluent in the Armenian language, were eligible for the study. The study was conducted in primary healthcare facilities of Yerevan, Armenia. All polyclinics (n=18) serving 30,000 or more populations were included in the study. All general practitioners available in selected polyclinics at the time of the survey were invited to take part in the survey, to target 20 general practitioners from each polyclinic.

Results: Overall, 291 general practitioners participated in the study. Knowledge, attitude, and practice mean percent scores were 58.3%, 67.5%, and 63.0%, respectively. In the adjusted analysis, the practice percent score was significantly associated with the attitude percent score, though the relationship between the practice and knowledge scores was insignificant. The main barriers reported by general practitioners: lack of rapid diagnostic tests, high costs of laboratory tests, high costs of some antibiotics, and lack of guidelines.

Conclusion: Identified low knowledge, attitude, and practice mean percent scores suggest a need for improvements in these areas. Availability of rapid and inexpensive diagnostic tests, enforcement of prescriptions could potentially prevent the development of antibiotic resistance.

Keywords: drug resistance, general practitioners, polyclinics, prescribing

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Introduction

Antibiotic resistance is a global problem and an important public health issue. In 1945, scientists first noted the formation of resistance to penicillin when a low or high dose was administered, or when the period of treatment was inappropriate (1,2). Elevated antibiotic use was registered in many countries, such as Russia, China, India, Brazil, and South Africa in 2000-2010; specifically, high use of carbapenems and polymixins was reported (3). According to the data of the Eurobarometer, antibacterial drugs were used by around 40% of Europeans for the treatment of different diseases in 2016 (4). In Bulgaria (31%) and Greece (28%) the antibacterial drug use was intended for the treatment of influenza, while in Sweden (1%) and the Netherlands (4%) a very low percentage of participants took antibiotics in these circumstances. Antibiotics were used to treat bronchitis by around 27% of Italians and Slovakians, whereas this percentage was significantly lower in Denmark (3%) and Sweden (5%) (4).

Improper use of antibiotics involves self-medication by the general population and inadequate prescribing by providers, the latter includes prescribing antibiotics with an incorrect spectrum and dose, for an improper duration of treatment, or making an inappropriate choice of medications. In settings where there are scarce resources, antibiotics prescribing practice may be influenced by the social conditions of the patient, his/her demand or pressure for antibacterial drugs, and competition among physicians (5,6). The high cost of laboratory diagnostic procedures which makes them unaffordable for poor people may also change physicians' prescribing practice (7).

Many studies are showing poor prescribing practices by physicians (5,7-9). Insufficient knowledge about antibiotics prescribing among physicians, as well as lack of awareness of the population about antibiotics use, may lead to bacterial resistance (10-12). Antibacterial drugs are considered the most commonly utilized medicines, and to gain the optimal benefit, they should be used rationally, which is a big problem in many countries (13,14). According to the World Health Organization, rational use of drugs is when "patients receive medications appropriate to their clinical needs, in doses that meet their requirements, for an adequate period, and at the lowest cost to them and their community" (15). Rational prescription of antibiotics is related to the type of health care facility, use of guidelines, availability of medicines, physicians' training, their educational background, and years of experience (14,16).

For the majority of patients, the first contact with health care services happens in primary care settings (e.g., polyclinics), where the service is more affordable. Therefore, the greatest part of antibiotics prescription is carried out in primary health care facilities. Chung A et al. (17) showed an association between bacterial resistance and antibiotics prescribing at the primary care level. Consequently, interventions are necessary to reduce the misuse of antibiotics by health care providers working at primary care facilities (18,19).

Increasing bacterial resistance is a public health challenge in Armenia (20). Data about antibiotics misuse in Armenia is scarce. Two studies were conducted in Yerevan, the capital city, regarding antibiotic resistance, one of which measured the prevalence of self-treatment with antibacterial drugs in 2005, and the other measured knowledge, attitude, and practice of antibiotics use among the adult population in Yerevan in 2016 (11,21). Insufficient data about knowledge of antibiotic resistance among general practitioners in Armenia, their attitude towards this issue, and their antibiotics prescribing practices justified the need for this research.

The objectives of the study were 1) measuring knowledge, attitude, and practice scores among general practitioners (GPs) on antibiotic resistance; 2) exploring associations between antibiotics prescribing practice score among GPs and their knowledge and attitude scores after adjusting for other factors; and 3) identifying barriers for rational antibiotics prescription by GPs.

Methods

Primary healthcare services (PHC) in Armenia are

provided through 363 public and 141 private/other health facilities. These include urban polyclinics, health centers, and rural ambulatories, which work with 552 rural health posts. All PHC facilities are run by physicians except rural health posts that are located in small villages and supervised by physicians from a nearby ambulatory/polyclinic. All PHC services are publicly funded and provided to all Armenian citizens free of charge. The customers have a right to choose their primary health care providers and facilities. Depending on the population size in each community, a population of 1200-2000 adults or 700-800 children are served by each general practitioner or family physician (22).

This study targeted GPs employed in public and private polyclinics in Yerevan, the capital city of Armenia where over one-third of the country's population resides. A cross-sectional study design was used for this self-administered survey. All GPs, working in Yerevan polyclinics and fluent in the Armenian language, were eligible for the study.

Multistage cluster sampling technique was used to select the study participants. The list of primary health care facilities and the number of people served by each of them was obtained from the Yerevan Municipality website and through the National e-Health operator. From the list of 26 public and 12 private polyclinics in Yerevan, the 18 largest polyclinics, each serving a population of at least 30,000, were selected. In each participating polyclinic, 20 GPs were targeted for the survey.

A self-administered survey tool was used. The questionnaires were distributed to the physicians and collected back in closed envelopes. All GPs available in selected polyclinics at the time of the survey were invited to take part in the survey. Due to the unavailability of all 20 physicians at the same time in several selected polyclinics, we approached those GPs who were available, introduced the study, and obtained their verbal consent to participate. Since many GPs were not able to allocate time for the survey on the day of the survey, the questionnaires were left with them and collected back during the next day. Data collection took place during February and March 2020.

A structured questionnaire based on similar cross-sectional study instruments was developed (23-27). The survey instrument contained the following sections: 1) demographic characteristics of GPs, 2) their professional experience, 3) attitude of GPs towards antibiotic resistance, 4) knowledge of GPs about antibiotics and antibiotic resistance, 5) antibiotic prescribing practice of GPs, and 6) barriers to rational prescribing of antibiotics. The questionnaire included mainly Likert scale answer options. The survey instrument was translated into Armenian and pretested before the start of the fieldwork.

The primary outcome variable was the practice score of GPs. Their attitude and knowledge scores were the secondary outcome variables. GPs' age, gender, the average number of patients they served per day, their years of professional experience, professional education after graduation, and training regarding antibiotic resistance during the last three years were included as independent variables.

The knowledge score was calculated by giving one point for each correct answer, and zero point for incorrect answers, "do not know", or missing value to each of the six knowledge statements included in the instrument, resulting in a knowledge score ranging from 0-6, which was later converted to a knowledge percent score. The attitude score was calculated by giving from the maximum of four points to the most desired response option to the minimum of zero point to the most non-desired response option to each of the 14 attitude-measuring items, which resulted in a score ranging from 0 to 56, which was later converted to a percentage score. The practice score was calculated by giving one point if a participant reported correct practice and zero if a participant reported incorrect practice or in case of a missing value. The range for prescribing practice score was from 0 to 9; it was later converted to a practice percent score.

In addition, 12 questions were included to identify perceived barriers to rational antibiotics prescribing by physicians.

SPSS 22.0 statistical software was used for data entry and analysis. Univariate and multivariable linear regression analyses were done to estimate the crude

and adjusted associations between the dependent and independent variables. The distribution of residuals for the final models was explored to check its randomness and normality, using normal probability plots of residuals and scatterplots of residuals versus predicted values. Multicollinearity was checked between independent variables, which revealed a high correlation between two independent variables: age and years of professional experience of GPs (VIF=4.6). A decision to use one of these two variables in the linear regression analysis (years of experience) was made.

The Institutional Review Board of the American University of Armenia approved the proposal (AUA 2020-001). Verbal consent was obtained from GPs participating in the study.

Results

To reach the required sample size, 18 public and private polyclinics in Yerevan were approached and one of them refused to participate. Hence, 17 polyclinics (12 public and 5 private) were included in the study. Out of 318 approached GPs, 27 refused to participate, resulting in a response rate of 91.5%.

Table 1. Descriptive statistics on the main variables of interest among GPs working in Yerevan (n=291)

Variable	% (n)
Gender	
Male	1.7 (5)
Female	98.3 (286)
Working in public polyclinics	86.9 (253)
Received any 6-month postgraduate education	84.5 (245)
Received any training on antibiotic resistance during three years prior to survey	80.1 (233)
Desire to receive training on antibiotics	87.3 (254)
	Mean (SD)
Age in years	55.1 (9.9)
Years of professional experience	28.2 (11.5)
Average number of patients served per day	14.1 (5.1)
Knowledge percent score	58.3 (20.1)
Attitude percent score	67.5 (10.9)
Practice percent score	63.0 (16.9)

Table 1 presents the descriptive statistics of GPs working in polyclinics of Yerevan. The mean age of the GPs was 55.1 years, ranging from 27 to 79 years. The mean duration of GPs' professional experience was 28.2 years and the average number of patients served by a GP per day was 14.1. The knowledge means percent score of GPs was 58.3% (SD 20.1). The attitude and practice mean percent scores among GPs were 67.5% (SD 10.9) and 63.0% (SD 16.9), respectively.

Some specific findings on knowledge: The vast majority of GPs knew that there was no need to prescribe antibiotics for non-febrile diarrhea. A low proportion of them (25.4%) knew that methicillin-resistant Staphylococcus aureus was resistant to beta-lactam antibiotics. More than 75% of the GPs knew about the ineffectiveness of antibacterial drugs for upper respiratory tract viral infections. More than half (56.0%) of them knew that amoxicillin was safe to prescribe to pregnant women. Less than half (39.9%) of the GPs mentioned metronidazole as the best medication against anaerobes (Table 2).

Some specific findings on attitude: More than half of the GPs believed that improper hand disinfection by physicians could not cause the spread of drug-resistant bacteria. In addition, 69.3% mentioned that antibiotic guidelines were obstacles rather than a help for prescribing antibiotics, and almost half of the GPs noted that the development of local guidelines on preventing antibiotic resistance would not be as helpful as using the international ones. Besides, 60.5% of the GPs considered that dispensing antibiotics without a prescription could not drive antibiotic resistance (Table 2).

Some specific findings on practice: Only about 30% of the GPs did not follow recommendations made by pharmaceutical companies while prescribing antibiotics. Wide spectrum antibiotics were prescribed by 82.1% of the GPs when results of the bacteriological analysis were absent. Moreover, 32% of the GPs considered shortening the recommended duration of treatment if the patient's condition got better. The same antibiotic was prescribed by 58.4% of the GPs in case of recurrence of the same disease and 12% of the GPs prescribed an antibiotic if patients insisted on it (Table 2).

Table 2. Percentages of accurate/desirable answers to the items measuring knowledge, attitude, and practice of GPs regarding rational use of antibiotics in Yerevan polyclinics, 2020

	Knowledge	n	%
1.	Antibiotics should not be prescribed for non-febrile diarrhea	262	90.0
2.	Methicillin resistant Staphylococcus aureus is resistant to betta-lactam antibiotics	74	25.4
3.	Antibiotics are ineffective for upper respiratory tract viral infections	221	75.9
4.	Amoxicillin is safe to prescribe to pregnant women	163	56.0
5.	Metronidazole has the best activity against anaerobes	116	39.9
6.	Antibiotics are effective in patients with cystitis caused by Escherichia coli	182	62.5
	Attitude	**N**	**%**
1.	Inappropriate use of antibiotics drives antibiotic resistance	280	96.2
2.	Broad-spectrum antibiotics do not increase antibiotic resistance when equally effective narrower-spectrum antibiotics are available	109	37.5
3.	Lack of hand disinfection by healthcare workers causes spread of antibiotic resistance	138	47.4
4.	In primary care, microbiological results are not useful when treating infectious diseases	165	56.7
5.	Widespread use of antibiotics contributes to generation of antibiotic resistance	269	92.4
6.	Antibiotic prescribing practice influences the antibiotic resistance development	250	86.2
7.	Physicians should not change their antibiotic prescribing pattern if patients are satisfied with the treatment	103	35.4
8.	Too low antibiotic dosages do not contribute to the development of antibiotic resistance	198	68.0
9.	Self-medication contributes to the development of antibiotic resistance	259	89.0
10.	Interrupted antibiotic treatment does not contribute to the development of antibiotic resistance	181	62.4
11.	Antibiotic guidelines are rather obstacles than a help for prescribing antibiotics	201	69.3
12.	Development of local guidelines on preventing antibiotic resistance would be more useful than using international ones	143	49.1
13.	Dispensing antibiotics without a prescription cannot drive antibiotic resistance	176	60.5
14.	Prescribing antibiotics when the patient does not need them does not cause harm to the patient	266	91.4
	Practice	**N**	**%**
1.	Selection of antibiotics based on infection cause rather than medication expiration date or availability	251	86.3
2.	Delaying antibiotics prescription in case of viral infections	262	90.0
3.	Discussing antibacterial resistance with patients while prescribing antibiotics	193	66.3
4.	Not taking into account the recommendations made by pharmaceutical companies while prescribing antibiotics	96	33.0
5.	Not prescribing wide spectrum antibiotics when results of bacteriological analysis are absent	52	17.9
6.	Not prescribing antibiotics to patients with acute viral infections for preventing secondary bacterial infections	220	75.6
7.	Not considering shorter-than-recommended duration of treatment with antibiotics if the patient's condition gets better	198	68.0
8.	Not prescribing the same antibiotic in case of recurrence of the same disease in a patient previously successfully treated with that antibiotic	121	41.6
9.	Not prescribing antibiotics based of patient's desire	256	88.0

The multivariable linear regression model with the outcome of practice percent score showed that the attitude percent score was the only variable significantly related to the practice: each one-unit increase in the attitude percent score was associated with a 0.58 unit increase in the practice percent score (95% CI: 0.41 to 0.75; p<0.001) (Table 3).

In the fitted model with the outcome of attitude percent score, when holding all the other variables in the model constant, each one-unit increase in the knowledge percent score was associated with a 0.11 unit increase in the attitude percent score (95% CI:0.05 to 0.18; p<0.001). Also, each one-unit increase in the number of patients served per day was associated with a 0.25 unit increase in the attitude percent score (95% CI:0.01 to 0.49; p=0.042), and each one-year increase in the professional experience was associated with 0.27 unit decrease in the attitude percent score (95% CI:-0.38 to -0.17; p<0.001) (Table 3 and Figure 1).

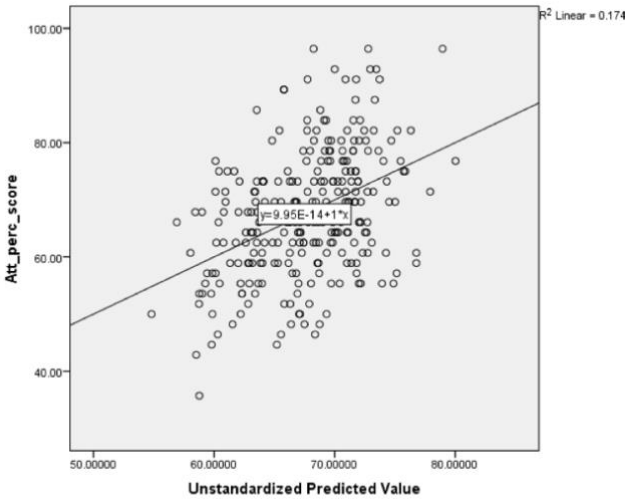

Figure 1. Multivariable regression model scatterplot for the outcome variable of attitude

In the fitted model with the outcome of knowledge percent score, when holding all the other variables in the model constant, each one-unit increase in the number of patients served per day was associated with a 0.61 unit increase in the knowledge percent score (95% CI: 0.14 to 1.07; p=0.011) and each one-year increase in the professional experience was associated with 0.32 unit decrease in the attitude percent score (95% CI: -0.52 to -0.12; p=0.002) (Table 3).

Table 3. Multivariable linear regression models with the outcome of practice, attitude and knowledge percent scores.

Variable	Regression coefficient	95% CI	p
Practice percent score			
Attitude percent score	0.58	(0.41; 0.75)	<0.001
Attitude percent score			
Knowledge percent score	0.11	(0.05; 0.18)	<0.001
Number of patients per day	0.25	(0.01; 0.49)	0.042
Years of experience	-0.27	(-0.38; -0.17)	<0.001
Knowledge percent score			
Number of patients per day	0.61	(0.14; 1.07)	0.011
Years of experience	-0.32	(-0.52; -0.12)	0.002

The main perceived barriers to rational antibiotics prescribing reported by the GPs were the lack of rapid diagnostic tests, followed by the high costs of laboratory tests, high costs of some antibiotics, and lack of guidelines on rational antibacterial therapy (Table 4).

Table 4. Barriers to rational antibiotics prescribing reported by GPs in Yerevan polyclinics, 2020

	Not a barrier % (n)	Somewhat a barrier % (n)	Moderate barrier % (n)	Significant barrier % (n)
Lack of rapid diagnostic tests	21.0 (61)	14.4 (42)	25.4 (74)	39.2 (114)
High cost of laboratory tests	19.6 (57)	20.6 (60)	27.8 (81)	32.0 (93)
High cost of some antibiotics	21.0 (61)	25.8 (75)	32.3 (94)	21.0 (61)
Lack of clear guidelines	27.1 (79)	26.5 (77)	23.4 (68)	23.0 (67)
Difficulty of making an accurate diagnosis	26.8 (78)	27.5 (80)	25.8 (75)	19.9 (58)
Lack of free/affordable quality courses on optimal antibiotic therapy	30.1 (87)	28.4 (82)	26.6 (77)	14.9 (43)
Fear of missing the bacterial infection	36.1 (105)	27.5 (80)	27.8 (81)	8.6 (25)
Lack of time to search for information	38.5 (112)	27.1 (79)	22.0 (64)	12.4 (36)
Pressure from patients	56.7 (165)	23.7 (69)	10.7 (31)	8.9 (26)
Lack of motivation of physicians to provide quality services because of their inadequate remuneration	70.4 (205)	10.0 (29)	9.6 (28)	10.0 (29)
Pressure from pharmaceutical companies interested in selling their antibiotics	71.8 (209)	11.3 (33)	8.6 (25)	8.2 (24)

Discussion

According to the conceptual framework of antibiotics smart use, patients' health may be affected by prescribing practices of health care providers and self-medication by patients (28). Knowledge and attitudes of physicians on rational use of antibiotics are included in the predisposing factors influencing prescribing practice. The antibiotics smart use framework did not completely fit with our data, which was demonstrated by the weak positive correlation between the practice and knowledge percent scores – insignificant in the fitted linear regression model. On the other hand, the strong correlation between practice and attitude percent scores present in our study showed that, in this respect, our findings were in line with the conceptual framework. In contrast to our study, Liu et al. (29) demonstrated that attitude did not predict prescribing practice. Our study reported a weak but significant positive correlation between knowledge and attitude, which corresponded to the conceptual framework. This result was consistent with the study conducted by Abdel Wahed et al. (30). In contrast to our study, Wester et al. (31) found an insignificant association between attitude and knowledge.

Although knowledge about antibiotics and antibiotic resistance should influence the responses of the GPs to the various questions measuring their attitude and practice, this study showed that knowledge was not associated with prescribing practice, which was identical to the results of the study performed by Liu et al. (29). A possible explanation might be the influence of pharmaceutical companies or representatives, offering GPs gifts or samples of medication, which affected the prescribing practice of GPs. Another reason might be the patient pressure, which can "force" GPs to make a wrong prescription. Unlike our study, Gonzalez-Gonzalez et al. (32) found that antibiotic use was closely associated with knowledge and attitudes of GPs.

Our study showed a significant positive association between both knowledge and attitude scores and the number of patients served per day and a significant negative association between both these scores and the years of GP's professional experience. The latter might be explained by insufficient education on antibacterial resistance at the time when the older generation of physicians studied at medical universities, unlike the more recent times when the younger generation graduated (33). Unlike this study, similar studies in other countries reported either improved attitude with more experience or no relationship between the two factors (29,31).

The results of our study showed that the majority of the GPs received training on antibiotic resistance within the last three years. However, there was no significant association between GPs' training and their attitude towards antibiotic resistance, a finding identical to the results of the study done by Wester et al. (31). Furthermore, the results of our study demonstrated that training, being a basis of knowledge, was not associated with the knowledge percent score, which is consistent with the study by Abdel Wahed et al. (30). Despite the received training, knowledge among GPs remained poor in our study. The fact that training was associated neither with knowledge nor with prescribing practice of the GPs might be connected with their use of alternative, and often, incorrect information sources like the internet or different online educational materials regarding antibiotics use and prevention of antibacterial resistance (30).

Overall, our study demonstrated rather low average knowledge, attitude, and practice percent scores among GPs regarding antibiotics and antibiotic resistance. For comparison, a similar study conducted among physicians in India reported considerably higher average knowledge, attitude, and practice percent scores (23).

Among some specific findings, it should be noted that the majority of the study participants demonstrated good levels of knowledge about the ineffectiveness of antibacterial drugs for upper respiratory viral infections, unlike the participants of studies performed in different countries that demonstrated a knowledge gap in this respect (29,34,35). Almost half of our study participants valued local guidelines over international ones that

take into account the local microbial resistance, a finding consistent with the study in Lao (36). However, around 70% of the participants believed that antibiotic-therapy guidelines were obstacles rather than help for prescribing antibiotics, which is much higher than the percentage of GPs (22%) stating the same in the study in Lao (36). The majority of GPs demonstrated correct prescribing practices in some areas, for example, delaying antibiotics prescription in case of viral infections, discussing antibacterial resistance with patients when prescribing antibiotics, and not prescribing antibiotics based on patients' desire (24,25,37).

Most participants considered the lack of rapid diagnostic tests and the high cost of some antibiotics as significant barriers to rational antibiotic prescribing (27).

One of the limitations of this study was the inclusion of only larger polyclinics each serving a population of at least 30000, to meet the cluster size requirement, and leaving out small polyclinics, which could affect the generalizability of the findings. Another limitation could have been the contamination of the study, since the questionnaire was often left with physicians and collected back during the next day, creating a possibility for GPs to discuss the answers with peers. However, apparent similarities between GPs' responses were not detected.

Conclusion

Based on the findings of this study, several recommendations can be made to help prevent the development of antibiotic resistance: focus on the older generation of primary health care physicians when planning training programs; improve the content and delivery of training courses on antibiotic resistance in medical universities; increase the availability of rapid and inexpensive diagnostic tests; enforce antibiotics prescriptions only by physicians, and regulate prices of antibiotics.

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