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# Pharmacists' perceptions on antibiotic prescription and utilization in Bulgaria

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#### Abstract

Antibiotic resistance poses a critical global health threat, largely driven by inappropriate antibiotic use. Pharmacists, as accessible healthcare providers, play an essential role in antimicrobial stewardship. This study aimed to assess the attitudes, practices, and awareness of Bulgarian pharmacists regarding antibiotic use and antimicrobial resistance (AMR). A cross-sectional survey was conducted from February 2023 to June 2024, involving 117 pharmacists from various practice settings across Bulgaria. Participants were divided into two groups based on their agreement with the statement that antibiotics are overprescribed. Results showed that 69.8% of participants agreed that antibiotics are overprescribed. This group demonstrated significantly greater awareness of the public health risks associated with irrational antibiotic use, stronger beliefs in the importance of pharmaceutical consultations, and higher concern over dispensing antibiotics without a prescription. No significant differences were found in beliefs regarding antibiotic resistance linked to animal use or patient adherence to medication instructions. The findings suggest that while Bulgarian pharmacists recognize key aspects of their role in combating AMR, certain knowledge gaps remain. Their strong support for pharmaceutical consultations underscores the potential to enhance antibiotic stewardship efforts through pharmacist-led interventions. Addressing gaps through targeted education and training may further strengthen pharmacists' contributions to rational antibiotic use and AMR mitigation.

Keywords: Antimicrobial Resistance; AMR; Antibiotic Over Prescription; Pharmacists; Antibiotic Stewardship

#### 1. Introduction

Antibiotic resistance is one of the most pressing global public health challenges of the 21st century [1-5]. It is driven largely by the misuse and overuse of antibiotics, which has accelerated the emergence of resistant bacteria [6]. Antimicrobial resistance (AMR) leads to increased morbidity, mortality, and healthcare costs, making it essential to identify effective strategies for reducing inappropriate antibiotic use [7-9]. Improving antibiotic usage is essential, especially in outpatient settings [10-17]. Regulatory measures aimed at curbing the spread of antibiotic resistance nationally vary significantly, often encompassing enhanced training for healthcare professionals, including doctors and pharmacists, focused on the responsible use of medications and the specific challenges of antibiotic resistance. Additionally, public awareness campaigns are commonly implemented to educate the community about the issues related to medication use and to encourage the careful application of antibiotics [18-22].

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Pharmacists, as key healthcare professionals who are often the first point of contact for patients, have a critical role in antimicrobial stewardship, including ensuring the rational use of antibiotics and educating the public on the risks associated with their misuse [23-26]. As the most accessible healthcare professionals, pharmacists can significantly impact antibiotic use by providing feedback to physicians on prescription errors, limiting the use of antibiotics without a doctor's prescription, and advising patients on proper usage, such as taking them with probiotics, avoiding adverse interactions, and ensuring treatment continuity. The perspectives and attitudes of pharmacists regarding antibiotic use play a crucial role in their use. The European Union advocates for Member States to limit the use of systemic antibiotics and advises that these medications should only be taken with a medical prescription; however, the practice of dispensing antibiotics without a prescription remains widespread [27-32]. The premature discontinuation of antibiotics and incomplete treatment and use of leftovers is a common issue related to the irrational use of antibiotics, which pharmacists can address through appropriate education for patients [33-35].

Across various studies, pharmacists have consistently expressed a strong awareness of AMR and their role in combating it [36-43]. However, their practices and opinions on antibiotic prescription vary based on regional and systemic factors, which affect their ability to manage antibiotic use effectively. Research has shown that pharmacists generally possess good knowledge of antibiotics and AMR, and there is a positive correlation between their level of knowledge and responsible antibiotic dispensing practices [44]. Despite this, the gap between knowledge and practice remains, particularly in settings where systemic barriers hinder optimal antimicrobial stewardship.

Community pharmacists in low and middle-income countries face several challenges in initiating antimicrobial stewardship, including a lack of education and training, pressure to dispense antibiotics, and weak regulatory enforcement [42,45-47].

In Europe, community pharmacists also face specific challenges that impact their role in antimicrobial stewardship. Barriers such as limited interaction with prescribers, lack of access to patient records, and time constraints hinder their ability to participate fully in antimicrobial stewardship efforts [37,39,48]. These barriers prevent pharmacists from engaging in more proactive interventions and often limit their role to dispensing medications rather than actively participating in patient care decisions related to antibiotic use. The role of pharmacists in antibiotic prescribing is another important aspect of their contribution to combating AMR. In Malta, a majority of pharmacists support the idea of prescribing selected antibiotics, believing it would enhance their role in patient care, particularly if conducted in a protocol-based manner [48]. Such prescribing authority, combined with proper guidelines, could empower pharmacists to take on a more active role in managing antibiotic use, thus contributing significantly to antimicrobial stewardship initiatives. Furthermore, collaborative approaches between pharmacists and medical practitioners have been suggested as a way to improve antibiotic prescribing practices and enhance patient outcomes [49].

Only 10–20% of all antibiotics are utilized in hospitals, highlighting the critical role pharmacists play in promoting and monitoring the rational use of these medications [50]. Ensuring the rational use of antibiotics must involve pharmacists, and the development of programs and projects aimed at improving antibiotic usage is essential. This requires studying their attitudes towards antibiotic use, as well as their willingness and readiness to engage in interventions.Recent studies highlight the varied perceptions of pharmacists in different settings regarding antibiotic prescribing and AMR. For example, a study in developing countries reported that community pharmacists held mixed opinions on their role in combating AMR, often influenced by patient expectations and a lack of systemic support [51]. Another study emphasized the need for better training and clearer protocols to enable pharmacists to take a more active role in AMR management [52]. In community settings, limited collaboration between healthcare professionals and a lack of access to patient records have also been identified as significant barriers to the effective role of pharmacists in AMR efforts [38]. Hospital pharmacists have also been recognized for their crucial role in optimizing antibiotic use, particularly in settings where antibiotic resistance is a growing concern [52]. These pharmacists play a critical role in ensuring the quality use of medicines, including the proper selection, dosing, and duration of antibiotic therapy. However, they too face challenges, such as limited authority in decision-making processes and the need for better integration into the broader healthcare team.

While pharmacists are generally knowledgeable and aware of AMR, systemic challenges, regional practices, and patient expectations significantly influence their ability to effectively manage antibiotic prescriptions. Enhanced collaboration between pharmacists and other healthcare providers, ongoing education, and legislative measures are necessary to optimize their role in antimicrobial stewardship. There is also a need for targeted interventions aimed at bridging the gap between pharmacists' knowledge and their actual dispensing practices, particularly in regions where antibiotics are frequently dispensed without prescriptions.

The present study aims to explore the current attitudes, practices, and awareness of pharmacists in Bulgaria regarding antibiotic use and AMR. By assessing the behaviors and perspectives of pharmacists from both community and hospital settings, this study provides a valuable snapshot of their role in addressing AMR and highlights potential areas for intervention and professional development. The findings will contribute to a better understanding of how pharmacists can be supported in their efforts to promote rational antibiotic use, ultimately aiding in the fight against antimicrobial resistance.

# 2. Materials and Methods

#### 2.1. Study Design and Setting

The study employed a cross-sectional survey design, conducted between February 25, 2023, and June 25, 2024, to explore the attitudes, practices, and awareness of pharmacists in Bulgaria regarding antibiotic use and antimicrobial resistance. The study targeted pharmacists across different regions of Bulgaria, including both community and hospital settings. By using a cross-sectional approach, the study aimed to provide a snapshot of current pharmacist practices and perceptions concerning antibiotic use, enabling a comprehensive understanding of the factors that influence these practices.

The survey was conducted online using Google Forms, allowing for broad and accessible participation. The survey link was distributed through various professional networks, including pharmacy student associations, social media groups, and emails. The choice of an online survey format ensured anonymity and increased convenience for participants, encouraging honest responses. The survey period spanned one year and four months ensuring ample time for participant recruitment. In addition to this, pharmacists from all over the country were invited through a nationwide distribution effort facilitated by the Bulgarian Pharmaceutical Union. Participation in the survey was voluntary, and informed consent was obtained from each participant prior to the commencement of the survey. All data were collected anonymously, with no identifiable information recorded to protect participants' privacy.

#### 2.2. Participants

The survey population consisted of licensed pharmacists working in Bulgaria, including those in community pharmacies, hospital pharmacies, and managerial roles. Eligibility criteria included holding a Master's degree in pharmacy and practicing actively as a pharmacist. Both newly graduated and experienced pharmacists were included to ensure a diverse representation of perspectives.

For comparative analysis, the sample was divided into two groups based on their responses regarding the perceived overprescription of antibiotics in Bulgaria. Those who completely agreed were classified as acknowledging overprescription, while those with varying levels of doubt (somewhat agree, disagree, neither agree nor disagree, completely disagree) formed the second group. This classification enabled a structured analysis of differences in attitudes, knowledge, and practices related to antibiotic use.

#### 2.3. Survey Development

The self-administered questionnaire was developed to capture comprehensive data across several sections:

Demographics and Professional Data: This section gathered detailed information on age, gender, region of practice, type of pharmacy (community or hospital), years of professional experience, additional specializations, and current professional roles.

Attitudes Toward Antibiotic Use: Participants were asked about their attitudes toward the appropriateness of antibiotic use, with questions designed to gauge their views on common issues such as overprescription, patient expectations, and the perceived necessity of antibiotics in different clinical scenarios. A 5-point Likert scale was used, ranging from 1 (strongly disagree) to 5 (strongly agree), to assess participants' agreement with various statements regarding antibiotic use. This scale allowed for a nuanced understanding of pharmacists' attitudes, capturing the degree of their beliefs on different topics.

Practices Regarding Antibiotic Dispensation: This part explored the frequency and circumstances under which pharmacists dispense antibiotics without a prescription, including the impact of patient requests and the influence of perceived public demand. Pharmacists were asked to report on their experiences with dispensing practices in both routine and emergency situations. Responses were captured using a 5-point Likert scale ranging from 1 (never) to 5 (always) to quantify the frequency of these practices.

Awareness of Antimicrobial Resistance (AMR): This section focused on pharmacists' understanding of AMR, including the mechanisms of resistance, contributing factors, and the role of pharmacists in combating AMR. Additionally, participants were asked about their involvement in public education initiatives related to responsible antibiotic use. Responses were assessed using both multiple-choice questions and a Likert scale to gauge the extent of their awareness and involvement.

The questionnaire was initially drafted based on existing literature and input from experts in antimicrobial stewardship. A group of four experts reviewed the questionnaire for content validity and provided feedback on the clarity, relevance, and phrasing of the questions. This review process ensured that the questions were appropriate for the target audience and that the data collected would be reliable and informative. No formal pilot testing was conducted; however, minor adjustments were made based on the reviewers' comments to enhance comprehensibility and relevance.

To explore variations in pharmacists' perceptions of antibiotic overprescription, participants were categorized into two groups: those who strongly agreed that overprescription exists (n=82) and those who expressed doubts (i.e., somewhat agreed (n=27), somewhat disagreed (n=3), neither agreed nor disagreed (n=1), or completely disagreed (n=4)). This grouping allowed for a clearer examination of how attitudes toward antibiotic use and antimicrobial resistance differed based on levels of agreement with overprescription concerns.

# 2.4. Sample Size

The study aimed to include a broad sample of pharmacists across different regions in Bulgaria. A total of 117 pharmacists participated in the survey. Though the sample was not designed to be fully representative of all pharmacists in Bulgaria, the researchers made efforts, with the assistance of the Bulgarian Pharmaceutical Union, to include participants from a diverse array of practice settings in order to capture a range of perspectives. The sample size provided valuable insights into the current practices and attitudes of pharmacists regarding antibiotic use, although the voluntary nature of participation and the online format may have introduced selection biases. These biases limit the generalizability of the findings; however, the sample still reflects a diverse array of views from both community and hospital pharmacists.

#### 2.5. Statistical Methods

Descriptive statistics, such as means, standard deviations, and percentages, were used to summarize the demographic characteristics and attitudes toward antibiotic use. Chi-square tests were employed to identify associations between demographic factors (e.g., years of experience, type of pharmacy practice) and attitudes toward antimicrobial resistance. The significance level was set at  $p \le 0.05$  to determine statistical significance. Logistic regression analysis was also conducted to explore the relationship between professional characteristics and the likelihood of dispensing antibiotics without a prescription. Data analysis was performed using Jamovi software version 2.2.2 for Windows.

The use of both descriptive and inferential statistical methods allowed for a comprehensive analysis of the survey data, enabling identification of trends and relationships between pharmacists' characteristics and their antibiotic dispensing practices. By applying these statistical techniques, the study aimed to highlight key factors that could be addressed through targeted interventions to improve antimicrobial stewardship in Bulgaria.

# 3. Results

Of the 117 participants in the study, 82 (69.8%) agreed that antibiotics are overprescribed, while 35 (30.2%) expressed doubts. Among those who agreed (n = 82), the majority were female (74.1%), Bulgarian (97.4%), and worked in a regional town (84.1%). This group had a mean age of 34.1 years (SD = 8.91) and an average of 9.13 years (SD = 8.38) of work experience.

In contrast, those who had doubts (n = 35) were also predominantly female (77.1%) and Bulgarian (94.1%), with most working in a regional town (88.6%). However, they were older (M = 41.6 years, SD = 11.4) and had significantly more work experience (M = 15.7 years, SD = 11.6) (Table 1).

	Overprescription of antibiotics				
Characteristics	Agree n (%)	Have doubts n (%)			
<i>Gender</i> Male Female Total n (%)	21 (25.9%) 60 (74.1%) 81 (100%)	8 (22.9%) 27 (77.1%) 35 (100%)			
<i>Ethnicity</i> Bulgarian Turk Other Total n (%)	75 (97.4%) 2 (2.6%) 0 (0.0%) 77 (100%)	32 (94.1%) 1 (2.9%) 1 (2.9%) 34 (100%)			
<i>Place of work</i> Regional town Small town Village Total n (%)	69 (84.1%) 12 (14.6%) 1 (1.2%) 82 (100%)	31 (88.6%) 4 (11.4%) 0 (0.0%) 35 (100%)			
Years of work experience	9.13 ±8.38	15.7±11.6			
Age of participants	34.1±8.91	41.6±11.4			

#### 3.1. Knowledge and attitudes towards antibiotic prescribing

The data reveal significant differences between those who agreed and those who expressed doubts regarding key statements about antibiotic use and public health implications.

Pharmacists who acknowledged the significant public health implications of irrational antibiotic use in Bulgaria exhibited substantially stronger agreement (Mean = 3.902, SD = 0.404) compared to those who expressed doubts (Mean = 3.20, SD = 1.023; U = 758, p = 0.001). Similarly, those agreeing that there is a practice of overprescribing antibiotics in Bulgaria scored higher (Mean = 3.841, SD = 0.508) compared to those who had doubts (Mean = 3.17, SD = 1.098; U = 887, p = 0.001) (Table 2).

The belief that dispensing antibiotics without a prescription negatively affects public health and individual treatment was also stronger among those who agreed (Mean = 3.512, SD = 0.972) than those who doubted (Mean = 2.71, SD = 1.202; U = 747, p = 0.001). Likewise, participants who recognized inappropriate antibiotic use as a source of additional costs scored higher (Mean = 3.841, SD = 0.598) compared to those who were skeptical (Mean = 3.26, SD = 1.039; U = 871, p = 0.001).

There was no statistically significant difference in responses to statements about dispensing antibiotics leading to irrational use and resistance (U = 1179, p = 0.110), the association between antibiotic use in animals and antimicrobial resistance in humans (U = 1394, p = 0.802), or whether patients adhere to instructions in the leaflet (U = 1334, p = 0.505).

Interestingly, a significant difference was found in attitudes toward the role of pharmaceutical consultations. Pharmacists who agreed that pharmaceutical consultations are as important as doctors' advice in ensuring rational antibiotic use scored significantly higher (Mean = 3.780, SD = 0.609) than those who doubted (Mean = 3.43, SD = 1.008; U = 1150, p = 0.016).

Other statements, including the adequacy of doctors' explanations, the influence of patient characteristics on dispensing practices, and the importance of patient education, showed no statistically significant differences (Table 2).

# Table 2 Pharmacists' Knowledge and Attitudes Regarding Antibiotic Prescribing

	Group	N	Mean	SD	Mann Whitney U/p- level
Do you agree with the statement that the irrational use of antibiotics in Bulgaria is a public health problem that needs to be addressed adequately?	Agree Have doubts	82 35	3.902 3.20	0.404 1.023	U=758, p=0.001
Do you agree with the statement that there is a practice of overprescribing antibiotics in Bulgaria?	Agree Have doubts	82 35	3.841 3.17	0.508 1.098	U=887, p=0.001
I believe that the dispensing of antibiotics without a prescription has a negative effect on public health and the treatment of the individual patient.	Agree Have doubts	82 35	3.512 2.71	0.972 1.202	U=747, p=0.001
The inappropriate use of antibiotics (including dispensing them without a prescription) is associated with additional costs.	Agree Have doubts	82 35	3.841 3.26	0.598 1.039	U=871, p=0.001
The dispensing of antibiotics without a prescription is a prerequisite for their irrational use and the development of antibiotic resistance.	Agree Have doubts	82 35	2.915 2.51	1.317 1.401	U=1179, p=0.110
The use of antibiotics in animals is associated with the development of antimicrobial resistance in the treatment of infections in humans.	Agree Have doubts	82 35	1.768 1.69	1.125 1.105	U=1494, p=0.802
Patients use antibiotics according to the instructions in the leaflet.	Agree Have doubts	82 35	0.976 1.11	0.942 1.022	U=1334, p=0.505
Patients do not need additional pharmaceutical consultations on the correct use of antibiotics.	Agree Have doubts	82 35	3.683 3.43	0.752 1.145	U=1298, p=0.263
Patients respond positively and appreciate the consultation I provide before dispensing an antibiotic	Agree Have doubts	82 35	2.976 3.06	1.088 1.027	U=1388, p=0.767
Doctors do not explain in detail how patients should use antibiotics properly.	Agree Have doubts	82 35	3.110 2.69	1.018 0.993	U=1174, p=0.109
Personal characteristics and behavior of patients influence my practice of dispensing medicines, including antibiotics.	Agree Have doubts	82 35	2.537 2.17	1.425 1.361	U=1174, p=0.109
Appropriate patient education will improve the use of antibiotics in a rational direction.	Agree Have doubts	82 35	3.098 2.77	1.253 1.239	U=1145, p=0.064
If pharmacists had more time for relevant consultations, the use of antibiotics would be more rational.	Agree Have doubts	82 35	3.073 2.97	1.184 1.317	U=1392, p=0.785
Pharmaceutical consultations (care) are just as important in ensuring the rational use of antibiotics as the advice of doctors.	Agree Have doubts	82 35	3.780 3.43	0.609 1.008	U=1150, p=0.016

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The Mann-Whitney U test was also conducted to examine differences in pharmacists' perspectives on factors influencing physicians' antibiotic prescribing practices, comparing those who agreed with the statement and those who had doubts (Table 3). Pharmacists who agreed that the patient's strong desire for antibiotics influenced prescribing practices reported significantly higher scores (Mean = 2.90, SD = 1.10) than those who had doubts (Mean = 2.20, SD = 1.26; U = 967, p = 0.003). However, no significant difference was found regarding the influence of incentives from pharmaceutical companies (U = 1209, p = 0.159 Similarly, while pharmacists who agreed that the lack of time to wait for blood test results influenced prescribing practices reported higher scores than those who had doubts, this difference was not statistically significant. Additionally, no significant differences were found regarding the stress and strain experienced by physicians when prescribing antibiotics.

Pharmacists who agreed that physicians' familiarity with their patients influenced prescribing practices reported lower scores compared to those who had doubts, although this difference approached statistical significance (U = 1125, p = 0.054). In contrast, pharmacists who agreed that prescribing to reassure the prescribing doctor was a factor showed significantly higher scores than those with doubts (U = 1090, p = 0.022). No significant differences were observed regarding the influence of subsequent vacations or weekends on prescribing, or prescribing at the beginning or end of the workday.

Additionally, there were no significant differences between the groups concerning concerns that a subsequent doctor might prescribe antibiotics or the accepted practice for treating the condition (Table 3).

Physicians usually prescribe:	Group	N	Mean	Median	SD	Mann Whitney U/p-level
Because of the patient's strong desire for antibiotic	Agree	82	2.90	3.00	1.096	U=967,
treatment.	Have doubts	35	2.20	3.00	1.256	p=0.003
Because of incentives from pharmaceutical	Agree	82	2.79	3.00	1.063	U=1209,
companies/representatives.	Have doubts	35	2.54	3.00	0.980	p=0.159
Because of lack of time to wait for blood test results.	Agree	82	3.26	4.00	1.016	U=1171,
	Have doubts	35	2.91	3.00	1.173	p=0.088
Because of the stress and strain that doctors	Agree	82	2.51	2.50	1.298	U=1308,
experience while prescribing antibiotics.	Have					p=0.437
	doubts	35	2.31	3.00	1.207	
Because doctors know the patient well.	Agree	82	1.68	1.50	1.041	U=1125,
	Have doubts	35	2.09	2.00	1.067	p=0.054
To reinsure the prescribing doctor.	Agree	82	3.45	4.00	0.877	U=1090,
	Have doubts	35	3.11	3.00	0.993	p=0.022
Because of subsequent vacation or weekends.	Agree	82	2.59	3.00	1.342	U=1267,
	Have doubts	35	2.37	3.00	1.262	p=0.301
It is done more often at the end of the workday.	Agree	82	1.56	1.00	1.483	U=1427,
	Have doubts	35	1.51	2.00	1.314	p=0.963
It is done more often at the beginning of the workday.	Agree	82	1.11	1.00	1.054	U=1370,
	Have doubts	35	1.51	2.00	1.314	p=0.683

Table 3 Pharmacists' Perspectives on Physicians' Prescribing Practices

Because of concern that a subsequent doctor will do	Agree	82	1.48	1.50	1.279	U=1314,
it.	Have doubts	35	1.29	2.00	1.250	p=0.454
Because of the accepted practice for treating this	Agree	82	3.11	3.00	1.077	U=1254,
condition.	Have doubts	35	2.91	3.00	1.095	p=0.249

# 4. Discussion

The Mann-Whitney U test revealed a statistically significant difference (U=887,p=0.001) between the scores of pharmacists classified as "confident" and those identified as "hesitant". This confirms that the variation in attitudes is not due to random variability but rather reflects a genuine divergence in perspectives. Notably, the standard deviation in the hesitant group (SD = 1.098) was higher than in the confident group (SD = 0.508), indicating that opinions among hesitant pharmacists were more varied, ranging from mild skepticism to strong doubts, while the confident group exhibits more uniform agreement.

Pharmacists who recognized irrational antibiotic use as a public health issue demonstrated significantly higher agreement scores (Mean = 3.902) compared to those expressing doubts (Mean = 3.20, p = 0.001). This suggests a broad consensus among those concerned about public health regarding the risks of inappropriate antibiotic use. Similarly, pharmacists who acknowledged the over prescription of antibiotics scored significantly higher (Mean = 3.841) than those who doubted this issue (Mean = 3.17, p = 0.001), reflecting a shared belief in the prevalence of this practice.

Research indicates that pharmacists widely acknowledge the public health risks associated with uncontrolled antibiotic use, recognizing it as a significant contributor to antimicrobial resistance [53-55]. A review of multiple studies shows that the proportion of pharmacists identifying this issue as a major public health threat ranges from 61.5% to 99.6% [52-60]. Key concerns include ineffective treatment due to improper use, excessive prescription of broad-spectrum antibiotics, self-medication, and patient pressure to obtain antibiotics.

However, despite high awareness of the risks associated with antibiotic resistance, gaps in knowledge and inappropriate dispensing practices persist. While many pharmacists demonstrate a strong understanding of antibiotic resistance [55, 61], some continue to dispense antibiotics without a prescription [59] or lack sufficient awareness of appropriate antibiotic use [62]. Abu Al-Halawa et al. (2023) found that although 75.6% of pharmacists recognize antibiotic resistance as a serious public health issue, 60% still dispense antibiotics without a prescription, highlighting a concerning gap between awareness and practice [56]. Factors contributing to these issues include regulatory shortcomings, economic pressures, patient demand, and a lack of practical guidelines, highlighting the need for targeted interventions to bridge the gap between awareness and practice [53-60].

Approximately 70.8% of pharmacists reported regularly educating the public about the risks of antibiotic resistance. Those with more years of experience were more likely to provide this information, whereas pharmacy directors and those who believed they did not need further education on the topic were less likely to engage in such discussions [53]. Pharmacists in managerial and specialized roles exhibited better knowledge compared to their peers in other settings, highlighting an existing knowledge gap across different work environments [55].

A significant difference was also observed in attitudes toward the negative impact of dispensing antibiotics without a prescription. Pharmacists agreeing with this concern scored higher (Mean = 3.512) than skeptics (Mean = 2.71, p = 0.001). Although community pharmacies in most European Union countries are not legally allowed to dispense antibiotics without a prescription, this is a common practice at least in some of the countries. A study on antimicrobial resistance and the causes of non-prudent use of antibiotics carried out as part of the EU-funded project ARNA, estimates that 7% of antibiotics taken in the EU are taken without a prescription. The highest rates of non-prescription use of antibiotics are in Romania (20%) and Greece (16%) with high rates also found in Cyprus, Hungary, Italy, Romania and Spain. Over the counter selling of antibiotics in pharmacies and the use of leftover antibiotics were found to be the main causes [35,63]. Recognizing that the dispensing of antibiotics without a prescription poses a public health issue and contributes to the development of resistance would aid in improving the use of these medications.

Pharmacists who agreed that inappropriate use leads to additional healthcare costs scored significantly higher (Mean = 3.841) compared to skeptics (Mean = 3.26, p = 0.001), emphasizing the economic burden associated with irrational antibiotic consumption. However, no statistically significant differences were found regarding specific beliefs about

antibiotic resistance due to irrational use (p = 0.110), the contribution of antibiotic use in animals to human resistance (p = 0.802), or patient adherence to medication instructions (p = 0.505). These findings suggest potential gaps in knowledge that could be addressed through targeted educational initiatives.

Pharmacists who valued pharmaceutical consultations as highly as doctors' advice demonstrated higher agreement (Mean = 3.780) than those who doubted the equivalency (Mean = 3.43, p = 0.016). This underscores the role of pharmacists in guiding appropriate antibiotic use and highlights their potential contribution to antimicrobial stewardship programs. However, no significant differences emerged regarding pharmacists' perceptions of doctors' counseling on the rational use of antibiotics, the influence of patient characteristics, or the importance of patient education, suggesting broad consensus in these areas.

Regarding factors influencing prescribing practices, pharmacists who believed that patient demand affects antibiotic prescribing reported significantly higher scores (Mean = 2.90) than skeptics (Mean = 2.20, p = 0.003). Similarly, pharmacists agreeing that reassurance plays a role in prescribing exhibited significantly higher scores (p = 0.022). However, the belief that physician familiarity with patients influences prescribing approached but did not reach statistical significance (p = 0.054). No significant differences were observed regarding the impact of pharmaceutical company incentives (p = 0.159), time constraints, physician stress, or external factors such as vacations and weekends.

Overall, this study provides valuable insights into Bulgarian pharmacists' knowledge, attitudes, and perceptions regarding antibiotic prescription and utilization. The findings highlight areas where pharmacists' perspectives align with existing evidence on factors influencing antibiotic use, as well as areas where further education may be needed. The general recognition of the public health implications of irrational antibiotic use aligns with international research indicating pharmacists' awareness of antimicrobial resistance and their role in antimicrobial stewardship.

The strong endorsement of pharmaceutical consultations as critical to ensuring rational antibiotic use suggests that pharmacists view themselves as key stakeholders in promoting appropriate antimicrobial practices. This aligns with previous findings emphasizing pharmacists' potential role in antimicrobial stewardship initiatives. However, the lack of significant differences in beliefs regarding antibiotic resistance due to animal use and patient adherence suggests potential gaps in knowledge that could benefit from targeted training programs.

The observed differences in pharmacists' perspectives on factors influencing physicians' prescribing decisions are also noteworthy. The recognition of patient demand and reassurance as key influences aligns with findings from other contexts. However, the absence of significant differences regarding pharmaceutical company incentives and time constraints suggests that pharmacists may not fully appreciate the complex socio-behavioral and organizational factors shaping antibiotic prescribing in primary care.

Limitations of this study include its reliance on self-reported data, which may be subject to social desirability bias, and its cross-sectional design, which precludes causal inferences. Further research is needed to explore pharmacists' roles in antimicrobial stewardship programs and to develop targeted educational interventions addressing identified knowledge gaps.

# 5. Conclusion

Pharmacists are uniquely equipped as healthcare professionals to address the challenge of antibiotic resistance. They possess specialized knowledge in medicines and play a crucial role in the effective management of antimicrobial therapies. They are involved in the use of antibiotics, focusing on appropriate indications, selection, dosage, duration, and necessary adjustments. Additionally, they work to minimize drug interactions and adverse effects while providing tailored adherence support for both short- and long-term treatment plans, prioritizing medication safety and responsible usage. It is essential to understand the attitudes and beliefs of pharmacists regarding antibiotic use in order to anticipate the necessary interventions.

# Compliance with ethical standards

# Disclosure of conflict of interest

The authors declare that they have no conflicts of interest related to the publication of this manuscript.

#### Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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