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ORIGINAL ARTICLE

ANTIBIOTIC PRESCRIBING PRACTICES TO CHILDREN AMONG IN- AND OUTPATIENT PHYSICIANS IN BULGARIA

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Abstract. *Assessing the particular trends and factors influencing antibiotic prescription practices for pediatric patients by inpatient and outpatient physicians in Bulgaria is essential for pinpointing areas needing improvement and devising strategies to encourage judicious use of antibiotics. The aim of this study is to offer practical insights for both hospital and outpatient care. By recognizing and comprehending the specific details of antibiotic usage in pediatric healthcare, this study seeks to facilitate the creation of tailored stewardship strategies to address the growing challenge of antimicrobial resistance. A cross-sectional, multicenter survey was conducted between September and November 2022, involving specialists from various medical fields. The study used a 4-point Likert scale to evaluate the most prevalent clinical scenarios in which antibiotics were prescribed. A total of 222 physicians participated in the survey, with 108 respondents chosen for analysis. Their primary patient population consisted of at least 25% children. The study's results highlight notable variations in antibiotic prescription patterns between general practitioners and outpatient physicians in Bulgaria. Specifically, general practitioners were found to have a higher tendency to prescribe antibiotics before holidays or weekends compared to outpatient physicians. Moreover, GPs in Bulgaria displayed an increased likelihood of prescribing antibiotics when they had personal familiarity with the patient and did not consider further tests necessary. They also exhibited lower rates of prescribing antibiotics based on antibiogram and blood test results compared to outpatient physicians. Healthcare providers play a crucial role in addressing antimicrobial resistance, highlighting the necessity of their proactive participation in combating this global health concern. Despite being aware of the issue, there is need for additional education and interventions to enhance appropriate prescribing practices. The authors underline the significance of adopting a well-balanced approach to antibiotic prescription, taking into account both individual patient requirements and potential public health implications associated with antibiotic misuse.*

Key words: *antibiotic prescribing practices, antimicrobial resistance, pediatricians, inpatient and outpatient settings, general practitioners*

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INTRODUCTION

Antibiotics are often prescribed to treat bacterial infections in children. They are commonly used for respiratory tract infections such as bronchitis, tonsillitis, and bronchopneumonia in children below the age of 6 [1]. A study highlighted the issue of unwarranted antibiotic use in children, particularly for ear and dental infections [2]. There is an increasing worry about the excessive use of antibiotics, including overprescribing and inappropriate selection, which can lead to antimicrobial resistance (AMR) and the emergence of drug-resistant bacteria [3]. AMR is defined as the ability of microorganisms, particularly bacteria, to resist the effects of antimicrobial drugs. This can occur with individual drugs or across multiple drug classes, and can spread rapidly, affecting the treatment of a wide range of infections and diseases [4]. The rise and spread of AMR have become a pressing global health concern, often exacerbated by different factors.

A range of studies have highlighted the overuse and inappropriate prescribing of antibiotics in pediatric outpatient settings, leading to a significant burden of antimicrobial resistance [5-9]. This is particularly concerning given the high prevalence of antibiotic prescriptions in this population, with preschool children being the most exposed [8].

Recent research has highlighted significant variations and gaps in antibiotic prescribing practices among physicians, underscoring the need for effective antibiotic stewardship [10]. Antibiotic stewardship refers to the coordinated efforts and strategies aimed at promoting the appropriate use of antimicrobials. This includes ensuring the selection of the most suitable antimicrobial drug, accurate dosage, appropriate duration of antibiotic treatment, and timely administration to effectively treat infections. According to LeSaux (2014), antimicrobial stewardship embodies the practical, judicious use of antimicrobials to decrease adverse outcomes from these drugs while optimizing the treatment of bacterial infections to reduce the emergence of resistant pathogens.

In Asia, a multinational survey involving 367 physicians revealed distinct differences in prescribing behavior across various specialties, signaling an urgent requirement for harmonized prescribing standards [10]. In Indonesia, hospital physicians have reported suboptimal local practices and conflicting views on antibiotic decision-making despite acknowledging the critical importance of combating AMR [12]. These findings point to a discrepancy between the recognition of AMR dangers and the practical application of antibiotic stewardship in clinical settings.

Similar challenges are observed in the United States, where primary care physicians exhibit mixed attitudes toward antibiotic stewardship, further highlighting the necessity for robust outpatient antibiotic stewardship programs [13]. The situation is mirrored in Egypt, where, although physicians display a sound knowledge of AMR, their prescribing practices remain in need of improvement [14]. The diverse antibiotic prescribing attitudes and practices are not confined to Asia and the Middle East. In Iran, concerns over antibiotic over-prescription and the overuse of antibiotics in healthcare settings have prompted surveys to understand physician behaviors and incentives for prescription standards [15]. Similarly, in resource-poor settings, physicians face ethical challenges in balancing the immediate needs of patients against the long-term public health threat of AMR [16].

The establishment of dedicated staff for antimicrobial stewardship activities has been shown to positively influence physicians' attitudes towards antibiotic prescribing and to reduce antibiotic use, emphasizing the effectiveness of targeted interventions [17]. In France, education and medical specialty are identified as key factors associated with appropriate antibiotic prescribing practices among junior physicians, suggesting that targeted educational programs may be instrumental in fostering prudent prescribing behaviors [18].

Furthermore, a study in South India revealed that while a majority of physicians recognized the overprescription of antibiotics as an issue, nearly half of the hospitals lacked an infection control policy, pointing towards systemic gaps that need to be addressed [19].

This body of evidence highlights the intricate nature of antibiotic prescribing practices and the multitude of factors that influence them. Assessing the specific patterns and determinants of antibiotic prescribing practices to children among inpatient and outpatient physicians in Bulgaria is crucial for identifying areas needing improvement and devising strategies to promote rational use of antibiotics in pediatric patients. This study aims to provide actionable insights for both inpatient and outpatient settings. By identifying and understanding the nuances of antibiotic use in pediatric care, this research seeks to facilitate the development of tailored stewardship strategies to combat the looming threat of AMR.

MATERIALS AND METHODS

Study design and setting

A cross-sectional, multicenter survey was conducted between September and November 2022. General prac-

titioners and specialist physicians from inpatient and outpatient settings were invited to participate by self-administering an anonymous Google form questionnaire.

Participants

Participants included specialists from all medical fields, including, but not limited to, general practitioners and specialists in pediatrics, otorhinolaryngology, internal medicine, microbiology, surgery, etc., holding postgraduate degrees/diplomas in the respective fields, as well as non-specialists with only a Master's medical degree. They practiced in different regions of Bulgaria and were eligible and invited to participate. The study was distributed nation-wide through various channels, including the Bulgarian Medical Association. Participation was voluntary and an informed consent form was required to be signed by all physicians who completed the survey.

Survey development

The self-administered questionnaire consisted of five sections: (i) demographics and other occupation-related data; (ii) common practices related to antimicrobial prescribing and administration; (iii) changes in antimicrobial use associated with the COVID-19 pandemic; and (iv) attitudes and perceptions about possible overprescription in the country as a whole.

The demographics section solicited information on gender, age, occupation, ethnicity, current status of training, years of practice, field of medicine, number of specializations, age range of patients, and utilization of integrative medicine techniques. Twelve statements on clinical practices of prescribing antibiotics were evaluated using a 4-point Likert scale, ranging from 1 (not applying this practice at all) to 4 (always applying this practice). Respondents indicated their agreement or disagreement with each statement, representing the most prevalent clinical scenarios in which antibiotics are prescribed. The mean score of the responses provided insight into the practice of doctors and their approach to antibiotics prescription. A question on the frequency of antibiotic usage before and after the COVID-19 pandemic was included in the COVID-19-related sector.

Sample size

The study involved a total of 222 physicians who participated in the survey. Out of these, 108 respondents were chosen for the analysis based on a specific criterion. The criterion required that their primary patient population consist of at least 25% children.

Statistical analysis

This study employed a comprehensive analytical approach to investigate demographic characteristics and disparities in prescription practices among three distinct physician groups: General Practitioners (GPs), Physicians Working in Outpatient Units (POU), and Physicians Working in Hospital Units (PHU). Statistical analyses were conducted using Jamovi Statistical Software v2.3.28 for Windows. Reporting of descriptive statistics for numerical variables included mean (M) and standard deviation (SD), while for categorical variables, numbers and percentages were presented. Differences between groups were determined by Chi-square test for categorical data and One-way ANOVA for continuous data. The Shapiro-Wilk test was employed to verify the normality of the data, ensuring the appropriateness of parametric statistical analyses. To discern variations in antibiotic prescription practices, one-way ANOVA post-hoc comparisons (Games-Howell) were executed to pinpoint specific group disparities, ensuring a robust examination of potential variations. Additionally, the non-parametric Kruskal-Wallis test was employed for a rigorous analysis of post-COVID-19 antibiotic prescription practices, striving to ascertain the statistical significance of differences among physician groups. A significance level below 0.05 was deemed acceptable for declaring statistical significance.

RESULTS

Across all three groups, practitioners consistently practiced in predominantly urban environments and self-identified as Bulgarians. The age distribution revealed mean ages of 50.8 years (SD = 11.1) for General Practitioners (GPs), 43 years (SD = 12.3) for Physicians Working in Outpatient Units (POU), and 50.7 years (SD = 10.7) for Physicians Working in Hospital Units (PHU) ($p = 0.001$). Gender diversity was evident, with female practitioners prevailing in all groups ($p = 0.655$). Regarding professional experience duration, there was variability, ranging from 15.5 years (SD = 12.2) for POU, 19.9 years (SD = 10.6) for GPs, to 22.9 years (SD = 11.1) for PHU ($p = 0.001$). Specialization patterns indicated that all GPs specialized in General Medicine, while 67% (n = 33) of POU specialized in Pediatrics. PHU displayed diverse specializations (91%, n = 21), with a minority specializing in Pediatrics (9%, n = 2) ($p = 0.001$) (Table 1).

Comparative analysis with one-way ANOVA showed notable differences in mean scores among physician groups, with GP exhibiting a reduced likelihood (M = 2.26, SD = 0.780) to prescribe antibiotics based on antibiogram compared to POU (M = 2.76, 0.771) and PHU (2.39, SD = 0.891) ($F = 4.43$, $p = 0.014$). Post-hoc comparisons revealed a significant difference

Table 1. Description of the sample

	GP (n = 35)	POU (n = 50)	PHU (n = 23)	p-value
Age	M = 50.8, SD = 11.1	M = 43, SD = 12.3	M = 50.7, SD = 10.7	p = 0.001
Gender Male Female	 17.1% (n = 6) 82.9% (n = 29)	 24% (n = 12) 76% (n = 38)	 21.7% (n = 5) 78.3% (n = 18)	p = 0.655
Years of Experience	M = 19.9, SD = 10.6	M = 15.5, SD = 12.2	M = 22.9, SD = 11.1	p = 0.001
Place of work Urban area Rural area	 97%(n = 34) 3% (n = 1)	 100% (n = 50)	 100% (n = 23)	p = 0.001
Ethnicity Bulgarian Other	 91.4% (n = 32) 5.7% (n = 2)	 98% (n = 48) 2% (n = 1)	 100% (n = 22)	p = 0.319
Main Specialization General Medicine Pediatrics Other	 100% (n = 32)	 67% (n = 33) 23% (n = 17)	 9% (n = 2) 91% (n = 21)	p = 0.001

Legend: GP – general practitioners; PHU – physicians working in hospital units; POU – physicians working in outpatient units.

between GP and POU (p = 0.012), suggesting that GPs were less inclined to prescribe based on antibiogram results than outpatient physicians. However, no significant difference was found between GP and PHU (p = 0.827), indicating comparable prescription tendencies between GPs and hospital-based physicians in this specific context. Similarly, in the context of blood test results indicating bacterial infection, the mean scores revealed significant differences among the physician groups (F = 7.71, p = 0.001). Post-hoc comparisons highlighted a notable contrast between GP and POU (p = 0.001), suggesting that GPs exhibited a lower inclination to prescribe antibiotics based on blood test results compared to their outpatient counterparts. In prescribing antibiotics before holidays or weekends, a significant difference in mean scores emerged among physician groups (F = 8.44, p = 0.0001). Post-hoc comparisons indicated a notable contrast between GP and POU (p = 0.004), highlighting a higher inclination for GPs (M = 1.43, SD = 0.698) to prescribe antibiotics in anticipation of holidays or weekends compared to outpatient physicians (M = 1.02, SD = 0.141). Significant differences were also observed in prescribing antibiotics before holidays (F = 8.44, p = 0.0001). Post-hoc comparisons indicated a notable contrast between GPs (M = 1.43, SD = 0.698) and POU (M-1.02, SD = 0.141) (p = 0.004), emphasizing a higher proclivity for GPs to prescribe antibiotics in anticipation of holidays or weekends compared to outpatient physicians. Finally, a noteworthy distinction in mean scores surfaced as physicians contemplated their familiarity with the patient and refrained from conducting further tests (F = 5.54, p = 0.005). Post-hoc comparisons unveiled a significant contrast between General Practitioners and POU (p = 0.009), signifying that GPs (M = 2.00, SD = 0.804) exhibited a greater propensity to prescribe antibiotics when well-acquainted with the patient compared to outpatient physicians (M = 1.50, SD = 0.647). However, no significant difference was observed between GPs and PHU (p = 0.918) (Table 2).

Table 2. Results of the one-way ANOVA with post-hoc comparison for practice of antibiotic prescription

	One-way ANOVA				Post-hoc comparison		
	GP	POU	PHU		GP vs. PHU	GP vs. POU	PHU vs. POU
	M (SD)	M(SD)	M(SD)	ANOVA F/p	p	p	p
After antibiogram is made.	M = 2.26, (SD = 0.780)	M = 2.76, (SD = 0.771)	M = 2.39, (SD = 0.891)	F = 4.43, p = 0.014	0.827	0.012	0.214
After blood test showing bacterial infection.	M = 2.66, (SD = 0.906)	M = 3.34, (SD = 0.688)	M = 2.87, (SD = 0.891)	F = 7.71, p = 0.001	0.664	0.001	0.088
When I judge clinically that it is a bacterial infection.	M = 2.89, (SD = 0.832)	M = 2.68, (SD = 0.768)	M = 2.87, (SD = 0.869)	F = 0.814, p = 0.446	0.997	0.482	0.645

Continuation of Table 2

Due to the patient's expressed desire for antibiotic treatment.	M = 1.26, (SD = 0.443)	M = 1.14, (SD = 0.405)	M = 1.26, (SD = 0.449)	F = 1.037, p = 0.358	0.999	0.094	0.519
Due to incentives from pharmaceutical companies.	M = 1.09, (SD = 0.373)	M = 1.00, (SD = 0.000)	M = 1.09, (SD = 0.288)	F = 1.595, p = 0.208	0.999	0.374	0.335
Due to lack of time.	M = 1.17, (SD = 0.453)	M = 1.08, (SD = 0.444)	M = 1.22, (SD = 0.422)	F = 0.899, p = 0.410	0.918	0.628	0.419
When I know the patient well; no further tests.	M = 2.00, (SD = 0.804)	M = 1.50, (SD = 0.647)	M = 1.57, (SD = 0.662)	F = 5.54, p = 0.005	0.073	0.009	0.918
I prescribe when I worry about possible complications regardless the results from the clinical analysis.	M = 2.14, (SD = 1.03)	M = 1.90, (SD = 0.763)	M = 1.96, (SD = 0.825)	F = 0.822, p = 0.442	0.729	0.468	0.958
I prescribe more often before holidays/weekends.	M = 1.43, (SD = 0.698)	M = 1.02, (SD = 0.780)	M = 1.22, (SD = 0.422)	F = 8.44, p = 0.0001	0.330	0.004	0.093
I prescribe more often at the end of the work day.	M = 1.14, (SD = 0.430)	M = 1.04, (SD = 0.198)	M = 1.09, (SD = 0.288)	F = 1.14, p = 0.323	0.825	0.391	0.760
I prescribe more often at the beginning of the work day.	M = 1.29, (SD = 0.710)	M = 1.16, (SD = 0.584)	M = 1.04, (SD = 0.209)	F = 1.26, p = 0.287	0.152	0.660	0.429
I prescribe because I worry that another colleague will do it after me.	1.23 ±. 598 M = 1.23, (SD = 0.598)	M = 1.06, (SD = 0.424)	M = 1.09, (SD = 0.288)	F = 1.42, p = 0.246	0.456	0.331	0.946

Legend: GP – general practitioners; PHU – physicians working in hospital units; POU – physicians working in outpatient units

The data presented in Table 3 illuminates the post-COVID-19 antibiotic prescription practices among three distinct physician groups, revealing a statistically significant difference among them ($\chi^2 = 6.52$, df = 2, p = 0.038). Despite this overall difference, a predominant 75% of physicians across the board reported no change in their prescription practices, emphasizing a certain stability in the prescription landscape post-COVID-19. Noteworthy, approximately 20% of GPs and PHU participants reported an increased frequency in antibiotic prescriptions. Specifically, 21.7% (n = 5) of PHU participants and 20% (n = 7) of GPs indicated this trend. In contrast, a smaller subset of POU participants (8%, n = 4) reported prescribing antibiotics more frequently (Table 3).

DISCUSSION

The findings of the study shed light on significant differences in antibiotic prescribing practices between general practitioners and outpatient physicians in Bulgaria. In particular, GPs were more likely to prescribe antibiotics before holidays or weekends when compared to outpatient physicians. Studies from Ireland and Germany indicate that GPs tend to prescribe more antibiotics on Fridays and weekends, possibly due to increased patient concern and uncertainty [20, 21]. Cotter & Daly (2007) found that Irish GPs are aware of the issue of antibiotic resistance and over-prescription, yet a significant number still feel pressured by patients to prescribe antibiotics. This pressure leads to unnecessary prescriptions, especially among younger and rural GPs. A similar pattern is observed in South Australia where, however, dental practitioners are involved. They have the tendency to over-prescribe antibiotics and lack knowledge about adverse reactions and prophylaxis [23]. Studies from Bulgaria emphasize the critical role of education and awareness in promoting the rational use of antibiotics [24, 25]. Petrov (2018) focuses on the education of medical students, particularly in the assessment of their competencies in prescribing antibiotics rationally. The results of the study indicate a significant disparity between the students' self-assessed con-

Table 3. Prescription practices after Covid-19

Prescription practice of antibiotics	GP (n = 35)	POU (n = 50)	PHU (n = 23)	Total (n = 108)
I prescribe more often	20 % (n = 7)	8 % (n = 4)	21.7 % (n = 5)	14.8 % (n = 16)
I prescribe less often	11.4% (n = 4)			3.7% (n = 4)
No change	62.9% (n = 22)	84% (n = 42)	73.9% (n = 17)	75% (n = 81)

fidence and their actual prescribing abilities, underscoring the need for improved educational strategies within medical curricula to enhance rational prescribing practices. Similarly, Belcheva et al. (2022) highlight the critical role of pharmacists in guiding and educating both prescribers and patients to use antibiotics appropriately to combat AMR. These insights shed light on vital areas for improvement within healthcare education and practice.

GPs in Bulgaria were also more likely to prescribe antibiotics when they had a personal familiarity with the patient and did not perceive the necessity for additional tests. Additionally, they were less likely to prescribe antibiotics based on antibiogram results as well as blood test results compared to outpatient physicians. A study in France highlights the need for improved diagnostic practices and antibiotic use in the general practice. The findings share that a significant portion of antibiotic prescriptions by French GPs were inappropriate or unnecessary, with a lack of essential laboratory or imaging investigations contributing to the issue [26]. A range of factors influence GPs' antibiotic prescribing decisions, including patient expectations, diagnostic variability, and the general practitioner's own attitudes and behaviors [27-29, 31, 32]. GPs often face challenges in balancing patient demands and public health concerns, and may rely on "rules-of-thumb" and risk assessments in their decision-making [29]. Interestingly, they may consider contextual circumstances and non-medical issues such as routines and clinical expertise in the decision-making process, highlighting the complexity of the issue and the need for further exploration of these factors [32]. In the Czech Republic, GPs often prescribed antibiotics unnecessarily due to fear of treatment failure and patient requests, leading to non-adherence to clinical recommendations [33].

However, there is a need for better management of patient expectations, particularly for self-limiting conditions, through shared decision making, which involves discussing expectations and the benefits and harms of antibiotics, and delayed prescribing [28]. GPs' prescribing patterns may also deviate from therapeutic guidelines, with antibiotics often being prescribed for viral infections and broad-spectrum antibiotics being used inappropriately [30]. Boyanova (2022) discusses that although there are guidelines advising against their regular use for COVID-19 pneumonia, a substantial number of COVID-19 patients, estimated to be between 50% and 75%, received antimicrobial treatment, primarily involving antibiotics. This widespread use, frequently categorized as overuse and misuse, has led to increased rates of antimicrobial resistance and the emergence of multidrug-resistant bacteria and fungi. The magnitude of the pandemic has exacerbated these issues, posing a significant challenge in managing infections effectively and safely [31].

Furthermore, the slight increase in antibiotic prescriptions post-COVID-19 by some general practitioners and physicians working in hospital units could be viewed as a response to the heightened health concerns and potential complications arising from the pandemic. The pandemic has presented a significant challenge for physicians in terms of treatment options. While supportive care remains the mainstay of therapy, the use of antibiotics has been posing a significant concern due to the potential for antimicrobial resistance [33, 34]. Abelenda-Alonso (2020) highlights the potential impact of the pandemic on antibiotic prescription patterns, noting a biphasic pattern in which initial high rates of antibiotic use are followed by a decrease. This is significant in the context of the existing antimicrobial resistance crisis and the need for appropriate antibiotic stewardship. LeSaux (2014) emphasizes the importance of antibiotic stewardship in daily practice, particularly in the context of pediatric care. The paper emphasizes the importance of appropriate testing to differentiate between viral and bacterial infections, as well as the use of clinical follow-up in less severe cases. It also highlights the significance of optimizing the choice and dosage of antimicrobials to reduce the risk of treatment failure and subsequent courses of antibiotics. Therefore, it is vital to ensure that antibiotic prescriptions are based on evidence-based guidelines and thorough patient assessments.

CONCLUSION

In conclusion, this study provides valuable insights into the differences in antibiotic prescribing practices to children among in- and outpatient physicians in Bulgaria. These results indicate that general practitioners might have a higher tendency to prescribe antibiotics excessively in specific circumstances. For instance, prescribing antibiotics before holidays or weekends without further tests or relying heavily on familiarity with the patient rather than objective diagnostic measures could be seen as potentially leading to unnecessary antibiotic use and contributing to the development of antimicrobial resistance. This is a cause for concern due to the potential for overprescribing, which has already been highlighted as an issue among GPs [22, 36]. However, further studies show that GPs are generally aware of the problem of antibiotic resistance and the need for rational prescription [36, 37]. Physicians play a vital role in the

prevention and management of AMR, making their active involvement essential in addressing this global health threat [38]. Despite the physicians' awareness of the issue, there is a need for further education and interventions to improve rational prescription practices [36, 39].

The authors would like to emphasize the need for a balanced approach to antibiotic prescribing practices, considering both the individual patient's needs and the potential public health impact of antibiotic overuse. To address these discrepancies targeted educational interventions should focus on raising awareness about AMR and reinforcing evidence-based prescribing guidelines. Additionally, initiatives aimed at enhancing public awareness are important for promoting responsible prescribing practices among healthcare providers and improving patient outcomes in the long run.

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