Clinical and Experimental Health Sciences

Emergency Department Physicians' Knowledge, Attitudes, and Behaviors Regarding Antimicrobial Use, Resistance, and Stewardship: A Cross-Sectional Study

İbrahim Korkmaz[1], Özge Eren Korkmaz[2]

[1] İzmir City Hospital, Emergency Medicine, İzmir, Türkiye.
[2] Dokuz Eylül University, Faculty of Medicine, Department of Epidemiology, İzmir, Türkiye.

Correspondence Author: Özge Eren Korkmaz
E-mail: ozge.erenkorkmaz@deu.edu.tr
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ABSTRACT

Objective: Antimicrobial resistance (AMR) is a global public health threat. In our country, emergency departments, where antibiotics are most frequently prescribed, have limited data regarding physicians' knowledge, attitudes, and behaviors related to antibiotic use (AMU), AMR, and antibiotic stewardship (AMS).

Methods: A cross-sectional survey was conducted among emergency department (ED) physicians in a major city in western Turkey. The online survey assessed their knowledge, attitudes, and behaviors regarding AMU, AMR, and AMS. The internal consistency of the questionnaire was validated with a Cronbach's alpha of 0.77.

Results: Among the 141 participating physicians, 54.6% were assistants, 34.0% specialists, 7.09% faculty members, and 4.26% general practitioners. The median knowledge score was 90.0 [Q1; Q3: 80.0; 100], and 69.5% had good knowledge, but a lack of knowledge about antimicrobial agents' (AMA) pharmacology was observed. The median attitude score was 59.4 [Q1; Q3: 56.2; 68.8], and 48.2% had correct attitudes. Wrong attitudes were observed in the AMA administration. The median behavior score was 53.0 ± 16.6, with 53.9% of physicians exhibiting appropriate behavior regarding the use of AMA. The most important factors affecting behavior were patient insistence and errors in empirical AMA administration. A positive correlation was observed between attitudes and behaviors ($r = 0.397$, $p<.001$), and it was found that the level of knowledge wasn't reflected in behaviors.

Conclusions: Our results showed that although physicians working in EDs have high levels of knowledge about AMU, AMR, and AMS, this knowledge isn't reflected in attitudes and behaviors. To increase the effectiveness of AMS programs, special education programs that shape attitudes and behaviors and public awareness are needed.

Keywords: Antimicrobial Stewardship; Emergency Service, Hospital; Health Knowledge, Attitudes, Practice; Anti-Infective Agents; Drug Resistance, Bacterial

1. INTRODUCTION

Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi, and parasites evolve to resist medications, making infections harder to treat and increasing the risk of severe disease and death (1). In the United States, over 2.8 million AMR infections occur annually, with the CDC reporting more than 35,000 deaths in 2019 (2). It has been projected that AMR could cause 10 million deaths per year by 2050 (3). The World Health Organization (WHO) has identified AMR as an urgent issue requiring a global, coordinated response (4).

The overuse of antimicrobial agents (AMAs), inappropriate prescribing, extensive agricultural use, and limited new antibiotic development are key factors driving AMR (5). Inappropriate prescribing is often linked to inexperienced physicians, diagnostic challenges, and patient interference (6). Physicians' knowledge, attitudes, and behaviors (KAB) regarding antimicrobial use (AMU) are crucial for controlling AMR and ensuring the success of antimicrobial stewardship programs (AMS-P) (7).

Antimicrobial stewardship (AMS) is a coordinated program that promotes appropriate AMU, improves patient outcomes, reduces AMR, and limits the spread of multidrug-resistant infections (8). It systematically educates and supports healthcare professionals in following evidence-based guidelines for AMA prescribing. Studies show that AMS programs enhance

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healthcare professionals' awareness and knowledge of AMR and AMU, leading to better prescribing practices (9).

In Turkey, national action plans and guidelines aligned with WHO recommendations have been developed to combat AMR. The Prescription Information System (PIS) analyzes physicians' prescriptions and provides feedback. Medication production, distribution, and disposal processes are closely monitored, and AMAs are prescription-only. Hospital infection control committees, led by infectious disease specialists and trained nurses, oversee AMA use and monitor resistant bacteria. Despite these efforts, healthcare costs related to AMR in Turkey remain 63 high, and the country faces a potential economic loss of $220 billion to $1.4 trillion by 64 2050 due to high antibiotic resistance (10,11).

Physicians working under heavy workloads, such as in emergency departments (EDs), may be more prone to unnecessary AMA use due to patient pressure, potentially undermining the effectiveness of the AMS program. This study aimed to evaluate the KAB of ED physicians regarding AMU, AMR, and AMS. The findings will provide valuable insights to enhance AMS programs and develop strategies to combat AMR, serving as a guide for planning and implementing interventions to reduce AMR in healthcare delivery.

2. METHODS

2.1. Study Design

This study is an observational descriptive study with a cross-sectional design. Between September 2024 and October 2024, 141 physicians consisting of general practitioners, assistants, specialists, and faculty members working in the EDs of hospitals (private, public, university,and education and research hospitals) located in the 3rd metropolitan area in western Turkey were included. The survey was distributed via online forms to a group of physicians in all hospitals across the province, who were then asked to forward it to their colleagues. Data collection lasted 7 days and concluded after 10 consecutive days with no new responses. The minimum required sample size was calculated as 97 participants, based on a 95% confidence interval (Z=1.96), an expected prevalence rate (p=0.5), and a margin of error (d=0.1). No sampling was conducted, as the aim was to reach the entire population. Ethics committee approval was obtained. (Date: 21/08/2024; Decision No. 2024/100)

2.2. Data Collection Tool

The survey was conducted in three stages. In the first stage, a systematic search of the PubMed, ScienceDirect, Google Scholar, and SCOPUS databases was performed for literature published from 2020 onwards using search terms such as "Antimicrobial stewardship," "knowledge, attitude, behavior," "physician," and "antimicrobial resistance." Six relevant studies were identified (12–17). The CDC's "Core Elements of Antibiotic Stewardship" and the 'WHO Bacterial Priority Pathogens List, 2024' reports were also analyzed (18,19). Survey questions were developed based on these sources. The final survey consists of four sections: (i) demographic information, including sociodemographic and occupation-related details and AMR/AMS training status; (ii) a knowledge section with 10 multiple-choice questions assessing correct knowledge of AMU, AMR, and AMS (score range: 0-10); (iii) an attitude section with 8 questions using a 5-point Likert scale to evaluate views and beliefs on AMU and AMR (score range: 8-40); and (iv) a behavior section with 8 questions using a 5-point Likert scale to assess prescribing and usage behaviors concerning AMAs (score range: 8-40). Attitude responses ranged from "certainly agree" to "certainly disagree," and behavior responses from "never" to "always," with scores adjusted for positive or negative wording. Although a single survey instrument was used, it was structured into three distinct sections specifically designed to assess knowledge, attitudes, and behaviors following methods used in prior validated studies. Each section had its own scoring system and was independently evaluated.

In the second stage, a pilot test was conducted with 20 physicians to assess the survey's clarity. The data from the pilot test were not included in the main study. Feedback was used to refine the questions for clarity before distribution. Physicians were provided with a direct line to the research team via mobile phone for any survey-related questions, and the survey took approximately 10-15 minutes to complete. In the third stage, before data analysis, calculations were made to convert the KAB scores into a general score ranging from 0 (worst) to 100 (best): Total score = [(obtained score – minimum possible score) / (maximum possible score – minimum possible score)] x 100.

The survey's internal consistency was assessed using Cronbach's alpha, resulting in a coefficient of 0.77 (95% CI: 0.72-0.82 using the Duhachek method). This indicates that the survey has excellent internal consistency and is a reliable tool for evaluating the relevant topic. The full questionnaire is provided as Supplementary Materia.

2.3. Statistical Analysis

Statistical analyses were performed using the R programming language (Version 2024.04.1+748). The Kolmogorov-Smirnov test assessed data normality. For normally distributed data, mean and standard deviation were calculated, while median, Q1, and Q3 were reported for non-normally distributed data. Descriptive statistics analyzed demographic data using the "dplyr" and "psych" packages. Pearson and Spearman correlation tests examined the relationships between KAB scores. The effects of demographic variables on these scores were assessed using the Kruskal-Wallis test or one-way ANOVA, depending on the distribution of the data. The impact of training was evaluated using the independent samples T-test or Mann-Whitney U test. Correlation analyses were conducted with the "Hmisc" package, and comparative analyses were performed using the "stats" package. Visualizations were created with the "ggplot2" package. A p-value of < .05 was considered statistically significant.

3. RESULTS

3.1. Sociodemographic, Occupational, and Education Information

A total of 141 physicians participated in the study. The median age was 31 years (Q1-Q3: 28.0-37.0), with 59.6% male (n=84) and 40.4% female (n=57). Of the participants, 54.6% were assistants (n=77), 34.0% were specialists (n=48), 7.09% were faculty members (n=10), and 4.26% were general practitioners (n=6). Employment duration was 0-5 years for 50.4% (n=71), 6-10 years for 20.6% (n=29), 11-15 years for 11.3% (n=16), and 16 years or more for 17.7% (n=25). Most worked in education and research hospitals (75.2%, n=106), followed by state hospitals (17.7%, n=25), private hospitals (3.55%, n=5), and university hospitals (3.55%, n=5).

Patient load during a 24-hour shift was: 45.4% saw 51-100 patients (n=64), 29.8% saw 0-50 (n=42), 17.0% saw 101-149 (n=24), and 7.80% saw ≥150 patients (n=11). The number of AMA prescriptions written during a shift was: 33.3% wrote 0-10 prescriptions (n=47), 25.5% wrote 11-20 (n=36), 22.0% wrote ≥30 (n=31), and 19.1% wrote 21-29 prescriptions (n=27) (Table 1).

***Table 1.Demographic** and Occupational Characteristics of Emergency Department Physicians (n=141)*

Parameters	n(%)
Age (years) (median [Q1;Q3])	31.0 [28.0;37.0]
Gender	
Male	84 (59.6%)
Female	57 (40.4%)
Profession Title	
Assistant	77 (54.6%)
Specialist	48 (34.0%)
Faculty Member	10 (7.09%)
General Practitioner	6 (4.26%)
Employment duration	
0-5 years	71 (50.4%)
6-10 years	29 (20.6%)
11-15 years	16 (11.3%)
≥ 16 years	25 (17.7%)
Hospital	
Education Research Hospital	106 (75.2%)
State Hospital	25 (17.7%)
Private Hospital	5 (3.55%)
University Hospital	5 (3.55%)
Total number of patients seen in a 24-hour shift	
0-50	42 (29.8%)
51-100	64 (45.4%)
101-149	24 (17.0%)
≥150	11 (7.80%)
Number of prescriptions containing AM written during a 24-hour shift	47 (33.3%)
0-10	36 (25.5%)
11 – 20	27 (19.1%)
21-29	31 (22.0%)
≥30	
AMA: Antimicrobial agent	

Of the physicians, 60.3% (n=85) had received training on AMU and AMR, while 39.7% (n=56) had not. Additionally, 24.8% (n=35) had AMS training, while 75.2% (n=106) had not. Furthermore, 64.5% (n=91) felt their AMA therapy education in medical school was sufficient (Table 2).

***Table 2.** Antimicrobial Use and Rezistance Training Status of Emergency Department Physicians (n=141)*

Parameters	n(%)
History of AMR training	
Have	85 (60.3%)
None	56 (39.7%)
History of AMS training	
Have	35 (24.8%)
None	106 (75.2%)
Finding the AMA education received at the medical faculty adequate	91 (64.5%)
Yes	50 (35.5%)
No	
AMR:Antimicrobial resistance, AMS: Antimicrobial stewardship, AMA: Antimicrobial agent	

3.2. Knowledge

In the knowledge section, the median overall score for physicians was 90.0 [Q1; Q3: 80.0; 100]. Of the participants, 69.5% (n=98/141) had good knowledge, while 30.5% (n=43/141) had poor knowledge. Physicians demonstrated a high level of knowledge about the place of AMU (99.3%), the causes of AMR (99.3%), and the purpose of AMS programs (100%). Their understanding of the consequences of AMA overuse (97.9%) and the transmission routes of resistant bacteria (92.9%) was also strong.

Knowledge of empirical antibiotics (87.2%) and the de-escalation strategy (83.0%) was substantial, and they correctly identified priority pathogens 75.2% of the time. However, knowledge about broad-spectrum AMAs was lower, at 56.0%. The distribution of correct and incorrect responses to the knowledge questions is illustrated in Figure 1.

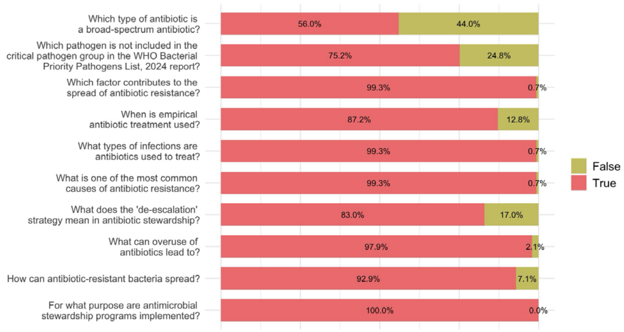

***Figure 1.** Percentage of emergency department physicians answering knowledge questions correctly and ıncorrectly regarding antimicrobial use, antimicrobial resistance, and antimicrobial stewardship.*

3.3. Attitudes

A total of 62.4% (n=88/141) avoided prescribing AMAs based on patient requests. However, 72.3% (n=102/141) believed that patients would obtain AMAs from another physician if they did not prescribe them. The majority (96.5%, n=136/141) believed in the importance of public education on the proper use of AMAs. While 44.0% (n=62/141) supported using broad-spectrum AMAs in case of uncertainty, 59.6% (n=84/141) emphasized the need for a definitive diagnosis before prescribing. Most physicians (71.7%, n=101/141) felt that AMAs could be initiated in suspected bacterial infections without waiting for microbiological results. Additionally, 86.5% (n=122/141) considered AMAs unsafe and did not support their widespread use. Finally, 73.0% (n=103/141) expressed a desire for further education to combat AMR more effectively (Figure 2).

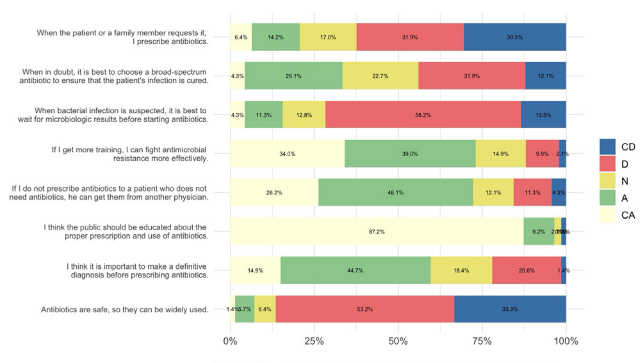

Figure 2. Attitudes of emergency department physicians on the use of AMA: Distribution of opinions on education, diagnosis, and patient requests

3.4. Behaviors

In the behavior section, physicians had a mean score of 53.0 ± 16.6. More than half (53.9%, n=76/141) exhibited correct behavior when administering AMA treatment. A significant portion (60.3%, n=85/141) reported sometimes prescribing AMAs based on patient requests to avoid conflicts, while 21.3% (n=30/141) never fulfilled such requests. Only 20.6% (n=29/141) regularly followed clinical guidelines when prescribing AMAs.

While 66% (n=93/141) sometimes or often preferred broad-spectrum AMAs to prevent potential complications, 39.0% (n=55/141) primarily preferred narrow-spectrum AMAs. Nearly all physicians (92.2%, n=130/141) provided education about prescribed AMAs whenever possible. A small percentage (5%, n=8/141) never considered bacterial resistance mechanisms before prescribing. While 26.9% (n=38/141) always reviewed the patient's past culture results before empirical AMA treatment, 17.0% (n=24/141) never did so. Most physicians (70.2%, n=99/141) were cautious to prevent unnecessary AMA use (Figure 3).

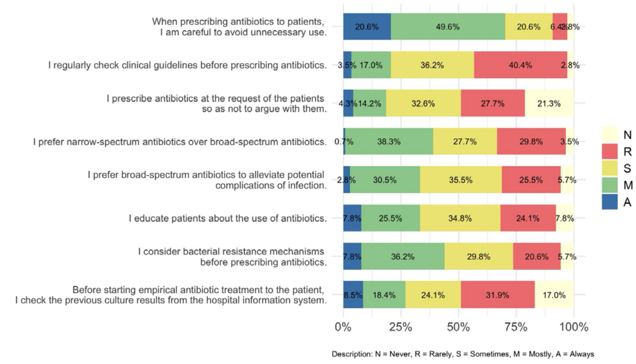

Figure 3. Emergency physicians' AMA use behaviors: unnecessary use, guideline follow-up and approaches to patient requests

3.5. Correlations between Knowledge Attitude and Behavior Scores

There is a weak, statistically insignificant positive correlation between physicians' knowledge and attitudes (r=0.114, p= .174) and a very weak negative correlation between knowledge and behavior (r=-0.038, p= .646). There is a statistically significant (r=0.397, p< .001) moderate positive correlation between attitudes and behaviors (Table 3).

Table 3. Correlations between Knowledge, Attitudes and Behaviors of Emergency Physicians

Variables	s	p value
Knowledge vs Attitude	0.114	.174
Attitude vs Behavior	0.397	< .01*
Knowledge vs Behavior	-0.038	.646

*s: spearman correlation coefficient, *p<.005 statistically significant*

3.6. Factors Related to Knowledge, Attitudes, and Behaviors

Knowledge scores were similar across profession titles. Faculty members had slightly higher attitude scores, but the difference was not statistically significant (p= .232). Behavior scores of specialists and faculty members were higher than those of general practitioners and residents, but the difference was not statistically significant (p= .109). There was no significant difference in knowledge scores based on the employment duration (p= .229). Physicians with ≥16 years of employment had higher attitude scores, though the difference was not statistically significant (p= .140). Similarly, physicians with 11-15 years and ≥16 years of employment had higher behavior scores than those with ≤10 years, but the difference was not statistically significant (p= .063) (Table 4).

No significant differences were found in knowledge and attitude scores between physicians trained in AMU, AMR, and those who were not. Although behavior scores were higher among those who received training, the difference was not statistically significant (p= .350). Similarly, no significant differences were observed in knowledge and attitude scores between those who received AMS training. While behavior scores were higher among trained physicians, this difference was also not statistically significant (p= .319) (Table 5).

Table 4. *Comparison of Knowledge, Attitude, and Behavior Scores Based on Profession Title and Duration of Employment: Associated p-Values and Effect Sizes (Eta Squared)*

	Knowledge		Attitude		Behavior	
	Median (Q1;Q3)	p value η²*	Median (Q1;Q3)	p value η²*	Mean ±SD	p value η²*
Profession title						
Practitioner	90 (90;97.5)	.873	59.4 (57; 61.7)	.232	51.6 ± 16.6	.109
Assistant	90 (80;100)	-0.01*	59.4 (53.1; 65.6)	0.00*	50.4 ± 14.2	0.04*
Specialist	90 (80;100)		62.5 (56.2; 75)		57.2 ± 17.4	
Faculty member	90 (82.5;97.5)		68.8 (60.9; 68.8)		57.9 ± 21.2	
Employment duration						
0-5 years	90 (80;100)	.229	59.4 (54.7; 65.6)	.140	50.7 ± 14.3	.063
6-10 years	90 (90;100)	0.00*	62.5 (59.4; 68.8)	0.01*	52.1 ± 15.2	0.05*
11-15 years	90 (80;92.5)		57.8 (53.1; 69.5)		56.6 ± 18.5	
≥ 16 years	90 (80;100)		68.8 (59.4; 75)		60.2 ± 18.9	

*η²: Eta Squared , effect size between groups

Table 5. *History of AMR and AMS Training: Comparison of Knowledge, Attitude, and Behavior Scores with Associated p-Values and Effect Sizes (Rank-Biserial Correlation and Cohen's d)*

	Knowledge		Attitude		Behavior	
	Median (Q1;Q3)	p value rB*	Median (Q1;Q3)	p value rB*	Mean ±SD	p value Cohen's d**
History of AMR training						
Yes	90 (80;100)	.501	59.4 (56.1;65.6)	.270	54.1 ±15.1	.350
No	90 (80;100)	0.056*	62.5 (56.2; 69.5)	0.092*	52.1 ± 17.7	0.123**
History of AMS training						
Yes	90 (80;100)	.964	59.4 (56.2; 71.9)	.744	56.1 ±15.8	.319
No	90 (80;100)	0.003*	59.4 (56.2;68.8)	0.027*	52.4 ±16.2	0.229**

**rB: Rank-Biserial Correlation and **Cohen's d = effect size between groups*
AMR:Antimicrobial resistance, AMS: Antimicrobial stewardship

4. DISCUSSION

National and International AMS programs are vital in combating AMR, but identifying the most effective interventions for each country or setting is challenging. Evaluating the knowledge and awareness of AMR among those who prescribe and dispense AMAs is crucial for developing national strategies and ensuring the success of AMS programs. Our study is significant as it evaluates the KAB of physicians in EDs, where AMAs are frequently used and prescribed, providing valuable feedback to policymakers and implementers regarding AMU, AMR, and AMS.

Studies showing high levels of knowledge among physicians regarding AMU and AMR emphasize the importance of comprehensive education and continuous medical training. Taborda et al. reported that physicians with adequate university training were more conscientious in their AMU practices (20). AMS programs in hospitals also enhance knowledge and promote appropriate AMU (21). Salsgiver et al. found that ED physicians often felt inadequate when selecting antibiotics under pressure and expressed a need for more AMS training, highlighting post-prescription review and feedback as valuable interventions (22). In our study, 69.5% of physicians had good knowledge of AMU, AMR, and AMS. Nearly everyone was aware of the causes and consequences of AMR, transmission routes for resistant bacteria, and the purpose of AMS programs. More than half had knowledge of empirical AMU and de-escalation strategies, but knowledge of broad-spectrum AMAs was lower. These findings suggest that while physicians have good awareness of AMU, AMR, and AMS, there are gaps in their AMA pharmacology knowledge. Since most participants were assistants with 0-5 years of experience, refreshing basic AMA knowledge during specialty training or in the final year of medical school could enhance AMU knowledge and aid in combating AMR.

Patient pressure and emphasis on patient satisfaction is one of the main reasons for inappropriate AMA prescribing (23). Sirota et al. showed that patient expectations heavily influence physicians' prescribing decisions (24), and Ashworth et al. found that the volume of AMA prescriptions strongly predicts overall patient satisfaction (25). In our study, only 48.2% of physicians exhibited attitudes consistent with AMS programs. This low percentage appears to be due to patient persistence and a lack of patient education. While physicians recognize that prescribing based on demand is inappropriate, they believe patients will obtain the medication elsewhere if denied. Detailed examination and patient education could help mitigate this issue.

EDs, with their high patient volumes and limited consultation times, make it difficult to dissuade patients from unnecessary AMU. Our study also found that over 80% of physicians do not consider AMAs safe and believe their widespread use is inappropriate, yet they feel compelled to prescribe them to avoid conflict with patients. As a result, physicians agree that public education is crucial for effectively combating AMR. Miller et al. demonstrated that providing patients with information about the potential harms of AMAs significantly reduced their likelihood of requesting them (26). Public education is vital in reducing AMR, but AMR is a complex concept that can be difficult for patients to understand, with comprehension varying by education level and health literacy. To raise AMR awareness across all levels of society, comprehensive educational initiatives and supportive health policies are needed.

When selecting empirical AMA therapy, it is crucial to assess the severity of the infection and the timing of intervention. In life-threatening conditions like septic shock, rapid action can significantly reduce mortality (27). However, in more stable patients, a "wait and see" approach may effectively reduce unnecessary AMA use, especially in upper respiratory tract infections (28). In our study, more than half of the physicians stated that it is important to administer AMAs without waiting for microbiological results in cases of suspicion. However, some physicians believe it is wrong to prescribe antibiotics without a definitive diagnosis. The best approach depends on the patient's condition. Additionally, rapid microbiological diagnostic kits can help quickly distinguish between infection and inflammation, identifying the causative agent and making them valuable tools in the fight against AMR.

In our study, 54% of physicians demonstrated appropriate behavior when selecting and prescribing AMAs. While they are generally conscientious about AMA use, they sometimes yield to patient demands. Inconsistent adherence to clinical guidelines contributes to confusion, especially in choosing between broad and narrow-spectrum AMAs. In some cases, an AMA initiated by one physician is altered by another before completion. To address these issues, ongoing education is necessary, as highlighted in the literature (12,17,22,29,30). Regular training sessions, improved access to current guidelines, and the development of national/regional guidelines with up-to-date local surveillance data could enhance awareness and promote more consistent and effective AMA management, thereby reducing AMR and unnecessary AMU.

Studies show that while healthcare workers are well-informed about AMR, their behavior is also influenced by social norms, attitudes, and beliefs (31). Despite high levels of knowledge, external pressures, time constraints, and structural issues often prevent translating knowledge into appropriate behavior (32). Chatterjee et al. found that knowledge alone may not strongly influence behavior, highlighting the importance of attitudes in clinical practice (33). Other studies similarly emphasize that attitudes significantly impact clinical behaviors and AMS protocol implementation (34).

In our study, consistent with the literature, we found a weak relationship between knowledge and behavior but a strong, statistically significant correlation between attitude and behavior. High knowledge levels do not always lead to correct behavior, especially in EDs, where patient care is intensive, time is limited, and healthcare violence is common. These conditions may shape physicians' behaviors, such as prescribing unnecessary AMAs due to patient pressure or choosing broad-spectrum AMAs to avoid repeat visits. While AMS programs can improve knowledge and behavior, policymakers should also focus on improving working conditions for physicians and raising public awareness.

In our study, knowledge levels regarding AMU, AMR, and AMS did not differ by professional rank or experience. However, specialists and faculty members scored higher in attitude and behavior compared to assistants and general practitioners. While increased professional experience appeared to positively influence attitudes and behaviors, the effect was not statistically significant, likely due to individual differences, workload, burnout, and personal or economic factors. Similar findings have been reported in other studies, showing that faculty members generally exhibit higher knowledge, attitudes, and behaviors (34). In our study, those who received AMU and AMR training had higher behavior scores, though not statistically significant. While educating physicians can improve knowledge, behavior is not solely driven by knowledge; its practical application in daily practice is crucial. Therefore, alongside raising awareness of AMU, AMR, and AMS, strategies to foster positive attitudes should be developed.

Our study has several limitations. Since it was conducted in a specific geographic region, the results may not fully represent the knowledge, attitudes, and behaviors of all physicians. Voluntary participation could have led to volunteer bias, with more interested physicians being more likely to participate. Additionally, as a survey-based study, participants may have provided socially acceptable responses rather than reflecting their actual behaviors. Additionally, although behaviors and attitudes are ideally assessed through observational or longitudinal methods, cross-sectional surveys with well-structured items have been widely used in previous literature to assess self-reported behaviors and attitudes, which was also the approach in our study.

Our study's strength is the high internal consistency of the survey, as demonstrated by a strong Cronbach's alpha value. This suggests that the survey accurately measured knowledge, attitudes, and behaviors.

5. CONCLUSION

In conclusion, although emergency department physicians possess good knowledge of AMU, AMR, and AMS, this does not consistently translate into their attitudes and behaviors. Barriers such as patient demands, inadequate health policies, and the need to manage a high patient load hinder the practical application of this knowledge. Physicians may struggle to stay updated with guidelines, often relying on outdated knowledge from medical school.

Our findings suggest that improving AMS program effectiveness requires addressing not only education but also attitudes and behaviors. Training programs tailored to high-pressure environments like EDs, where patient pressure is significant, may be beneficial. More importantly, raising public awareness about AMR and reducing non-critical visits to emergency departments should be a primary focus of health policy.

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Author Contributions:

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Design of the study: İK, ÖEK

Acquisition of data for the study: İK, ÖEK

Analysis of data for the study: ÖEK

Interpretation of data for the study: İK, ÖEK

Drafting the manuscript: İK, ÖEK

Revising it critically for important intellectual content: İK, ÖEK

Final approval of the version to be published: İK, ÖEK

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Supplementary Material

The questionnaire used in this study, including all knowledge, attitude, and behavior items, is available as Supplementary Material.

Demographic Information

Age: ______

Gender: ______

Professional Title:

Assistant
Specialist
Faculty Member
General Practitioner

Years of Professional Experience:

0–5 years
6–10 years
11–15 years
16 years and above

Type of Hospital:

Education Research Hospital
State Hospital
Private Hospital
University Hospital

Number of Patients Seen per 24-Hour Shift:

0–50
51–100
101–149
150

Number of Antimicrobial Prescriptions Written per 24-Hour Shift:

0–10
11–20
21–29
≥30

Have you received education on antimicrobial resistance (AMR) and use (AMU)?

Have / None

Have you participated in any antimicrobial stewardship (AMS) program?

Have / None

Do you think the antimicrobial education you received during medical school was sufficient to prescribe correctly?

Yes / No

Knowledge Section (Multiple Choice)

What types of infections are antibiotics used to treat?

A) All types of infections
B) Bacterial infections
C) Viral infections
D) Fungal infections
E) Parasitic infections

What is one of the most common causes of antibiotic resistance?

A) Overuse of antibiotics
B) Correct dosing of antibiotics
C) Sale of antibiotics without a prescription
D) Inappropriate use of antibiotics
E) Natural mutation of bacteria

Which factor contributes to the spread of antibiotic resistance?

A) Adhering to hygiene rules
B) Inappropriate use of antibiotics
C) Regular vaccination
D) Proper use of antibiotics
E) Use of antibiotics only for bacterial infections

What can overuse of antibiotics lead to?

A) Decreased treatment effectiveness
B) Faster recovery
C) Fewer side effects
D) Complete eradication of the infection
E) Strengthening of the immune system

For what purpose are antimicrobial stewardship programs implemented?

A) To increase antibiotic use
B) To reduce antibiotic resistance
C) To encourage over-the-counter use of antibiotics
D) To prolong antibiotic treatment duration
E) To increase the cost of antibiotics

Which type of antibiotic is a broad-spectrum antibiotic?

A) Penicillin
B) Amoxicillin/Clavulanic acid
C) Erythromycin
D) Amikacin
E) Metronidazole

How can antibiotic-resistant bacteria spread?

A) Only through direct contact
B) Only from animals to humans
C) Through person-to-person contact and contaminated surfaces
D) Only during surgical procedures
E) Through airborne transmission

When is empirical antibiotic treatment used?

A) When a definitive diagnosis is made
B) After bacterial culture results are obtained
C) When the physician suspects a bacterial infection
D) When antibiotic resistance is detected
E) When the infection is known to be viral

What does the 'de-escalation' strategy mean in antibiotic stewardship?

A) Not initiating antibiotic treatment
B) Shifting from broad-spectrum to narrow-spectrum antibiotics
C) Increasing the antibiotic dose
D) Using antibiotics prophylactically

Which pathogen is not included in the critical pathogen group in the WHO Bacterial Priority Pathogens List, 2024 report?

A) Carbapenem-resistant Enterobacterales
B) Third-generation cephalosporin-resistant Enterobacterales
C) Rifampicin-resistant Mycobacterium tuberculosis
D) Macrolide-susceptible Streptococcus pneumoniae

Attitude Section (5-Point Likert Scale)

When the patient or a family member requests it, I prescribe antibiotics.

Strongly Agree (1), Agree (2), Neutral (3), Disagree (4), Strongly Disagree (5)

If I do not prescribe antibiotics to a patient who does not need antibiotics, he can get them from another physician.

Strongly Agree (1), Agree (2), Neutral (3), Disagree (4), Strongly Disagree (5)

I think the public should be educated about the proper prescription and use of antibiotics.

Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), Strongly Disagree (1)

When in doubt, it is best to choose a broad-spectrum antibiotic to ensure that the patient's infection is cured.

Strongly Agree (1), Agree (2), Neutral (3), Disagree (4), Strongly Disagree (5)

When bacterial infection is suspected, it is best to wait for microbiologic results before starting antibiotics.

Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), Strongly Disagree (1)

If I get more training, I can fight antimicrobial resistance more effectively.

Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), Strongly Disagree (1)

Antibiotics are safe, so they can be widely used.

Strongly Agree (1), Agree (2), Neutral (3), Disagree (4), Strongly Disagree (5)

I think it is important to make a definitive diagnosis before prescribing antibiotics.

Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), Strongly Disagree (1)

Behavior Section (5-Point Likert Scale)

I prescribe antibiotics at the request of the patients so as not to argue with them.

Never (5), Rarely (4), Sometimes (3), Mostly (2), Always (1)

I regularly check clinical guidelines before prescribing antibiotics.

Never (1), Rarely (2), Sometimes (3), Mostly (4), Always (5)

I prefer broad-spectrum antibiotics to alleviate potential complications of infection.

Never (5), Rarely (4), Sometimes (3), Mostly (2), Always (1)

I prefer narrow-spectrum antibiotics over broad-spectrum antibiotics.

Never (1), Rarely (2), Sometimes (3), Mostly (4), Always (5)

I educate patients about the use of antibiotics.

Never (1), Rarely (2), Sometimes (3), Mostly (4), Always (5)

I consider bacterial resistance mechanisms before prescribing antibiotics.

Never (1), Rarely (2), Sometimes (3), Mostly (4), Always (5)

Before starting empirical antibiotic treatment to the patient, I check the previous culture results from the hospital information system.

Never (1), Rarely (2), Sometimes (3), Mostly (4), Always (5)

When prescribing antibiotics to patients, I am careful to avoid unnecessary use.

Never (1), Rarely (2), Sometimes (3), Mostly (4), Always (5)