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RATIONAL USE OF ANTIBIOTICS: PUBLIC ATTITUDES AND BEHAVIOR

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Abstract

Antibiotics are one of the most important tools in modern medicine for treating bacterial infections, but antimicrobial resistance (AMR) poses an ever-increasing threat to their effectiveness. The World Health Organization identifies antimicrobial resistance as one of the most significant threats to public health. The problem of antimicrobial resistance remains a pressing issue both in Europe and in Lithuania; therefore, promoting the rational use of antibiotics is one of the key priorities of European public health policy. However, antibiotic use practices and public knowledge vary significantly across different European countries. The aim of the study presented in this article is to assess public attitudes and behaviors related to the rational use of antibiotics. The study results showed that most people take antibiotics as prescribed by a doctor and complete the full course; however, the study also reveals systemic risks of inappropriate use due to a lack of diagnostic testing and misconceptions about the treatment of viral illnesses. To control antimicrobial resistance, it is essential to develop targeted educational campaigns, focusing on resistance mechanisms, responsible waste management, and highlighting the role of the agricultural and environmental sectors.

Keywords: antibiotics, antimicrobial resistance, public knowledge, health education.

INTRODUCTION

Antimicrobial resistance (AMR) poses an ever-increasing threat to the effectiveness of antibiotics; the World Health Organization identifies it as one of the most significant threats to public health. In 2023, approximately one in six laboratory - confirmed bacterial infections worldwide were resistant to antibiotics, and resistance increased by more than 40 percent between 2018 and 2023. Since the inappropriate and excessive use of antibiotics is one of the main factors driving the spread of AMR, their rational use remains a key public health priority (Tosas Auguet et al., 2025). The urgency of this issue in Europe is confirmed by 2022 Eurobarometer data: only about half of EU residents knew that antibiotics do not work against viruses, and 62 percent knew that they are not effective in treating the common cold. This reveals gaps in the public's knowledge about the proper use of antibiotics (European Commission, 2022).

The public's knowledge, attitudes, and behavior regarding antibiotic use are widely examined in international scientific literature, with a primary focus on antibiotic use behavior, knowledge about antibiotic use and antimicrobial resistance, and self-medication (Kosiyaporn et al., 2020). A recent review of scientific studies showed that only 42.1 percent of the population knew that antibiotics are ineffective against viral infections, although 72.5 percent understood the consequences of their unnecessary use (Auta et al., 2026). This reveals a persistent gap between general awareness and the knowledge necessary for the rational use of antibiotics.

This issue is also relevant in Lithuania. According to the 2022 Eurobarometer data, 40 percent of Lithuanian respondents

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incorrectly believed that antibiotics kill viruses, highlighting gaps in public knowledge about the appropriate use of antibiotics. Furthermore, a study by Pavydė et al. (2015) found that 61.1 percent of respondents had insufficient knowledge about antibiotics, while 31 percent reported having used antibiotics for self-medication. Therefore, it is important to examine the public's attitudes and behaviors regarding the rational use of antibiotics. The objective of the study presented in this article is to assess the public's attitudes and behaviors regarding the rational use of antibiotics.

PUBLIC ATTITUDES AND BEHAVIOR IN THE CONTEXT OF RATIONAL ANTIBIOTIC USE

Rational antibiotic use involves taking antibiotics only when there is a justified indication, selecting the appropriate medication, dose, and duration of treatment, and following the doctor's recommendations. At the public level, rational behavior is primarily associated with taking antibiotics only as prescribed by a doctor, not discontinuing a course of treatment without medical advice, not using leftover antibiotics later, and not sharing them with others. Adherence to these principles is important not only for the treatment outcomes of individual patients but also for reducing antimicrobial resistance. According to data from the European Centre for Disease Prevention and Control, approximately 90 percent of antibiotics prescribed to people in Europe are consumed in the outpatient sector; therefore, public behavior is a key factor in ensuring the rational use of antibiotics (ECDC, 2024).

Public Knowledge and Attitudes. Scientific studies show that one of the most important prerequisites for the rational use of antibiotics is adequate public knowledge about the purpose of antibiotics and how they work. However, the misconception that antibiotics can be used to treat viral infections remains widespread in various countries. Auta et al. (2026), in their review of studies published between 2015 and 2025, found that 73.2 percent of the population was aware of the effectiveness of antibiotics in treating bacterial infections, but only 42.1 percent correctly stated that antibiotics do not work against viruses. Although 72.5% of respondents understood that unnecessary use of antibiotics reduces their effectiveness, only 39.1% knew that antibiotic-resistant bacteria can spread among people (Auta et al., 2026). This suggests that general awareness of the problem of antibiotic resistance does not yet ensure a thorough understanding of the principles of rational antibiotic use. Kosiyaporn et al., who analyzed the methodology of studies on the public's knowledge of antibiotics, (2020), who analyzed the methodology of surveys on public knowledge of antibiotics, found that public opinion surveys most often examine four interrelated areas: antibiotic use behavior, knowledge about antibiotic use, knowledge about antimicrobial resistance, and access to information about antibiotics and self-medication. The authors also emphasize that the assessment of knowledge and awareness should be linked to actual population behavior, as mere knowledge of the principles of antibiotic use does not necessarily lead to their proper use (Kosiyaporn et al., 2020).

Antibiotic Use Patterns. Irrational antibiotic use can take various forms—such as taking antibiotics without a doctor's prescription, using leftover medication from a previous course of treatment, sharing antibiotics with family members or others, stopping the course of treatment once one feels better, or taking antibiotics for viral infections. A review of studies from Europe and other Western countries has shown that self-medication with antibiotics is not solely the result of a lack of individual knowledge. It is influenced by the supply of antibiotics kept at home, the accessibility of healthcare services, previous experience with antibiotic use, an individual's intention to self-treat, and the characteristics of the healthcare system (Lescure et al., 2018). Therefore, irrational antibiotic use is viewed as a

complex phenomenon influenced by individual, social, and health system factors. In Lithuania, the relationship between residents' knowledge and behavior was revealed by a survey of 1,005 adults conducted by Pavydė et al. (2015). The study found that 61.1 percent of respondents had insufficient knowledge about antibiotics, and 31 percent of those surveyed reported having used antibiotics for self-medication. In addition, some respondents mistakenly believed that antibiotics are effective in treating viral infections or infections caused by both bacteria and viruses. A lower level of knowledge was more frequently observed among respondents with lower levels of education and those living in rural areas. Self-medication with antibiotics was also associated with certain social and demographic characteristics (Pavydė et al., 2015). These results confirm that it is appropriate to examine the issue of rational antibiotic use in Lithuania without separating the population's knowledge, attitudes, and actual behavior.

Factors Influencing the Rational Use of Antibiotics. The scientific literature emphasizes that antibiotic use is shaped by several groups of factors. At the individual level, these include knowledge, health literacy, previous experience with antibiotics, and personal beliefs about the effectiveness of antibiotics. At the social level, the habits of family members and others in the individual's social circle, as well as sources of information, are significant; at the healthcare system level, communication between physicians and patients, the accessibility of healthcare services, and practices regarding the prescribing and dispensing of antibiotics are key (Lescure et al., 2018). Therefore, promoting the rational use of antibiotics cannot be limited to simply disseminating information about antimicrobial resistance. It is important to identify specific misconceptions that persist in society, assess actual antibiotic use practices, and identify population groups characterized by greater gaps in knowledge or behavior. The latest results from international studies show that even as public awareness increases, a significant portion of the population still misunderstands the purpose of antibiotics (Auta et al., 2026). European data on antibiotic use also confirm the importance of prudent use: in 2024, the total use of systemic antibacterial drugs in the EU reached 20.3 defined daily doses per 1,000 population per day, an increase of 2% compared to 2019, therefore, progress toward the EU's 2030 antibiotic use reduction targets remains insufficient (ECDC, 2025).

In summary, it can be said that the rational use of antibiotics is determined not only by the population's level of knowledge, but also by their attitudes, past experiences, sources of information, social environment, and factors within the healthcare system. Therefore, when assessing the rational use of antibiotics, it is advisable to conduct a comprehensive analysis of what the public knows about antibiotics, how they view their use, and how they behave in practice. This approach makes it possible to identify discrepancies between knowledge and behavior and to develop targeted measures for public education and the promotion of rational antibiotic use.

METHODOLOGY AND SURVEY PARTICIPANTS

According to data from the Lithuanian Population Register (https://www.registrucentras.lt/bylos/dokumentai/gr/20250101_Gyventoju_skaicius_savivaldybese.pdf) as of January 1, 2025, the population of Panevėžys City Municipality is distributed by age as follows: 59.6% of the city's residents are of working age and 40.4% are of retirement age. The distribution of Panevėžys residents is influenced by social and demographic trends such as emigration, declining birth rates, and an increase in the number of older people. The study reflects these changes indirectly, but focuses more on the analysis of the working-age population. The study involved 433 residents of Panevėžys aged 18-65 and older.

More than two-thirds of the study participants (72.7%) were in the 30-64 age group. This age group is naturally larger and easier to include in studies because they are more active and more likely to participate in social activities or surveys. Slightly less than a fifth belonged to the 18-29 age group (16.9%) and the 65+ age group (10.4%). As the survey was based on voluntary participation, younger and older respondents were less likely to participate for various reasons, including lack of time, lack of motivation, or health conditions, more difficult accessibility due to limited mobility, technological skills, or less involvement in surveys. Four-fifths of respondents (81.5%) were women, and one-fifth (18.5%) were men. This gender distribution of respondents reflects the fact that there are 1,234 women for every 1,000 men in Panevėžys. In Panevėžys, as in the rest of Lithuania, the number of women significantly exceeds the number of men. In addition, it is common in Lithuania for women to participate more often in various surveys and studies. This may be related to their greater interest in social, health, and other public issues, as well as their greater willingness to express their opinions. Men, on the other hand, tend to participate less in surveys, mostly due to less interest or lack of time. Since the study is based on voluntary participation, this gender imbalance is quite common. Women tend to respond more actively to invitations to participate in studies and devote their time to them, while men are more likely to ignore such invitations. As many as 50.1 percent of respondents have a higher education degree, and another 32.3 percent have a higher or vocational education, meaning that more than 80 percent of the study participants have a specialized education. This shows that the study involved a more educated segment of society, which may be more active in surveys.

RESEARCH RESULTS

The survey sought to determine whether respondents had taken antibiotics in the past 12 months. The results showed that more than half (62.4 percent) of people had not taken antibiotics during the year, which may indicate responsible use or simply a lower incidence of infections. One-third (33.9 percent) of people had taken antibiotics during the past year. This is a significant number and may raise questions about the appropriateness of their prescription and the effectiveness of preventive measures. A small proportion (3.7 percent) do not remember or do not know whether they took antibiotics, which suggests that a certain segment of the population is not sufficiently informed or does not keep track of their medication history. Respondents were also asked who had prescribed the antibiotics to them. The main purpose of this question was to identify the sources of antibiotic prescriptions. 67 percent of respondents stated that a doctor had prescribed antibiotics, indicating that most people follow official medical recommendations. This is a positive indicator, as the proper use of antibiotics prescribed by a doctor reduces unnecessary use and the development of resistance. 24.9 percent responded that they had not taken antibiotics, indicating that some of the respondents did not need these medications in the past year. Only 3 percent stated that they had taken antibiotics left over from a previous course of treatment. This may be a cause for concern, as the use of antibiotics without a doctor’s supervision may be inappropriate and contribute to the development of resistance. It was also important to determine the appropriateness of antibiotic use, so respondents were asked why they had last taken antibiotics. The results showed that bronchitis (15.2 percent) and urinary tract infections (13.2 percent) were the two most cited specific illnesses. Urinary tract infections are usually bacterial, so antibiotics are appropriate in this case. Bronchitis is often viral, but in some cases (especially with bacterial bronchitis), antibiotics may be justified. 7.2 percent of people took antibiotics for a cough, 6.7 percent for the flu, 5.8 percent for a cold, 5.5 percent for a sore throat, and 5.1 percent for COVID-19. All these conditions are most

often viral in origin, and antibiotics do not work against viruses; therefore, their use is unjustified in most cases. This suggests that some respondents may have taken antibiotics without a clear medical reason, which encourages unnecessary medication use and increases the risk of antibiotic resistance. The survey examined how respondents understand when to finish a course of antibiotics-whether they follow their doctor's instructions or stop taking the medication based on how they feel. 91 percent of respondents stated that antibiotics should be taken until all the medication prescribed by the doctor has been used up. This is the correct approach, as stopping treatment too early can leave viable bacteria behind, increase the risk of antibiotic resistance, and cause the infection to recur. This result indicates a high level of awareness and a good understanding of responsible antibiotic use. Nineteen respondents (4.4 percent) stated that they would stop taking antibiotics once they felt better. This is the right choice, because stopping treatment too early can leave viable bacteria behind, increase the risk of antibiotic resistance, and cause the infection to recur. This result indicates a high level of awareness and a good understanding of responsible antibiotic use. Is harmful practice because even if symptoms disappear, bacteria may remain in the body, and stopping antibiotics too early can make them more resistant. It was important to find out where people store leftover antibiotics. Nearly half of the respondents (46.9 percent) said they save antibiotics for future use. This is a risky practice because antibiotics should not be taken on one's own without a doctor's supervision. Inappropriate antibiotics may be used to treat an infection, as not every infection is bacteria. Interrupting and then resuming treatment can contribute to the development of resistant bacteria. This indicator is high and highlights the need to raise awareness about the responsible use of antibiotics. 36.5 percent of respondents properly dispose of leftover antibiotics by returning them to a pharmacy. At pharmacies, medications are recycled and disposed of in an environmentally safe manner, preventing environmental pollution and the problem of antibiotics entering groundwater.

Respondents were presented with several different statements about antibiotic use and asked to evaluate them. This allows for an assessment of their understanding of the effectiveness of antibiotics, the risks associated with them, and their impact on the development of bacterial resistance. Most respondents (73.7 percent) agree that the more frequently we use antibiotics, the greater the likelihood of developing an antibiotic-resistant infection; however, there is still a portion of respondents who are unsure or believe the opposite. The survey results showed that many respondents still believe that antibiotics can help treat colds. The main problem: although people have a good understanding of the issues surrounding antibiotic resistance and inappropriate use, too many of them still believe that antibiotics can be effective in treating viral infections, which is one of the main causes of unnecessary antibiotic use (Fig. 1).

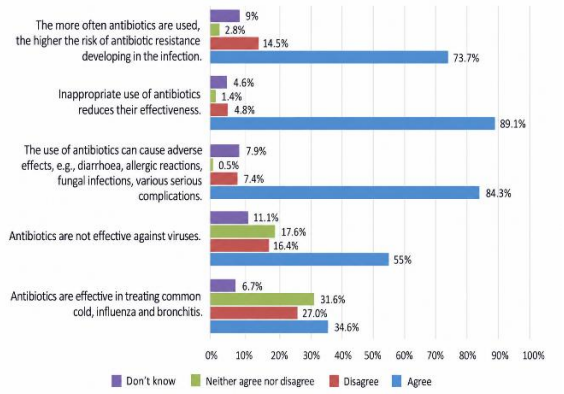


Fig. 1. *Respondents' understanding of the effectiveness and effects of antibiotics*

The study sought to understand how respondents assess the severity of the problem of antibiotic resistance in Lithuania, Europe, and around the world. Many respondents (28.9 percent) indicated that they knew nothing about it. This is the largest group of respondents, indicating that

nearly one-third of people lack information about the threat of antibiotic resistance. 24.9 percent believe that antibiotic resistance has reached a dangerously high level worldwide. This segment of respondents understands the seriousness of the problem and views it on a global scale, which is a positive indicator. 21.5 percent identified antibiotic resistance as a major problem in Lithuania. 7.6 percent believe that this threat is spreading across Europe. Only 4.4 percent of respondents are not concerned about this issue. The main problem is that nearly one - third of people know nothing about the threat of antibiotic resistance, and most do not perceive this problem as relevant to Lithuania. This indicates a lack of information dissemination and the need to strengthen it (Fig. 2).

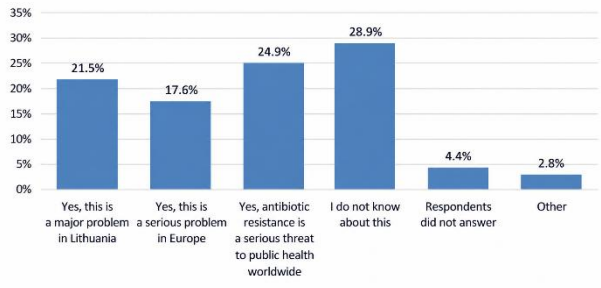


Fig. 2. *Respondents' views on the threat of antibiotic resistance*

Antibiotic resistance is not only a medical problem but also a global challenge for the environment, food safety, and public health. When antibiotics are used in animal husbandry, bacteria in the animals' bodies can become resistant to these drugs. Such bacteria can enter the human body through food (meat, milk, eggs) if the products are not properly processed. Antibiotic residues also end up in water and soil, leading to the spread of resistant bacteria in the environment. If people are unaware that antibiotics are used in agriculture, they may assume that the overuse of antibiotics is solely a problem for patients or doctors, rather than a systemic issue. Therefore, the aim was to determine the extent to which the public understands that the use of antibiotics in agriculture and livestock farming, and their release into the environment, also contributed to the rise in antibiotic resistance. Most of the study participants learned about this topic through the press (63.9 percent). The press is the primary channel through which people obtain information on this topic. TV programs also contribute to public awareness (26.1 percent). However, there is still a significant proportion of people who have not heard about the use of antibiotics in agriculture and their impact on the environment. Nearly one-fifth of respondents know nothing about this (20.5 percent). Survey data show that only 3.9 percent of respondents have discussed this with a doctor, while 6.9 percent learned about it in lectures. This indicates that healthcare professionals typically focus on the use of antibiotics in a medical context, but do not always explain their impact on the environment and public health.

The problem of antibiotic resistance is not solely the responsibility of doctors or government agencies - everyone can help reduce this problem. The question of how each of us can help reduce the development of antimicrobial-resistant microorganisms helps determine whether people understand their role and know how they can mitigate the consequences of inappropriate antibiotic use. This question helps assess the extent to which people recognize their responsibility and whether they know what actions can help reduce the problem of resistance. High approval rates across most categories indicate that respondents generally understand how to reduce the problem of resistance. Most people adhere to the principles of proper antibiotic use. 91.7 percent of respondents agree that antibiotics should be taken only when prescribed by a doctor after evaluating test results. 74.1 percent state that antibiotics left over from a previous course of treatment should not be taken. 88 percent believe that antibiotics should not be shared with others. It is important to note that 17.6 percent of people are not entirely sure about the use of leftover antibiotics - this suggests they may lack information regarding the expiration dates of antibiotics or their suitability for treating

other illnesses. Conclusion: Although most people understand the rules for proper antibiotic use, there are still areas where clearer communication is needed, particularly regarding the importance of vaccinations, the treatment of viral illnesses, and the risks of using leftover antibiotics (Fig. 3).

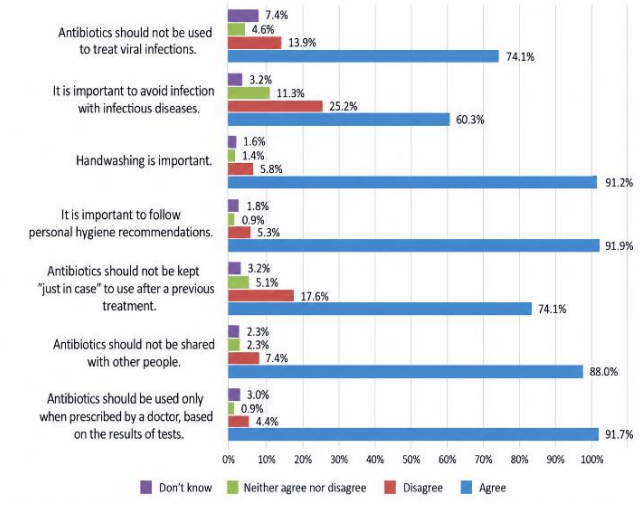


Fig. 3. *Respondents' knowledge and habits that help reduce antibiotic resistance*

Antibiotic resistance is a complex problem that requires the involvement of many sectors - not only doctors and scientists, but also patients, the pharmaceutical industry, policymakers, and the public. The question of responsibility for reducing antimicrobial resistance helps us understand whether people recognize their own and others' responsibilities in this area. It is often assumed that only doctors control antibiotic use, but the problem of resistance is much broader. Antibiotic resistance is a shared problem that must be addressed not only by doctors but also by the public, the pharmaceutical industry, policymakers, and the agricultural sector. This question helps determine the extent to which people understand this and whether they feel responsible (Fig. 4).

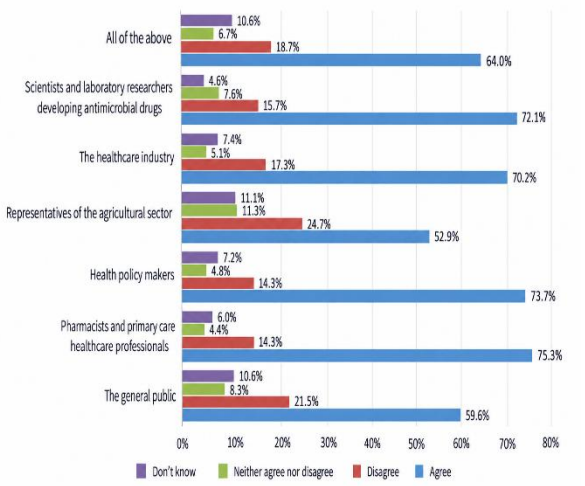


Fig. 4. *Respondents' knowledge and habits that help reduce antibiotic resistance*

Most respondents to the survey believe that responsibility is a collective one. 64 percent of them agree that all sectors must work together to address the problem of antibiotic resistance. The public recognizes that reducing antibiotic resistance is not the responsibility of a single institution - it requires collaboration among the medical, scientific, political, and public sectors. Respondents attribute the greatest responsibility to the healthcare sector. 75.3 percent believe that pharmacists and healthcare professionals bear significant responsibility. 73.7 percent identify health policymakers as key players in solving this problem. 72.1 percent assign responsibility to scientists and laboratories developing new antibiotics. 70.2 percent attribute responsibility to the healthcare industry. The agricultural sector is less frequently cited as responsible. Only 52.9 percent of respondents agree that representatives of the agricultural sector are responsible for solving the problem of antibiotic resistance. This indicates that a portion of the public still does not fully realize that the use of antibiotics in animal husbandry and agriculture contributes to the emergence of antibiotic-resistant bacteria. More than half

of the respondents understand that the public also bears responsibility for reducing antibiotic resistance, but this is still not emphasized enough. Some people are unsure who should be making the decisions - this indicates that more active public education is needed regarding antibiotic use and the problem of resistance. Although people recognize that the problem of antibiotic resistance must be addressed through collective efforts, there are still areas - particularly agriculture and the role of society - where more education is needed.

To summarize the results of the study, it can be said that respondents generally understand the principles of rational antibiotic use and the importance of reducing antimicrobial resistance; however, significant gaps in knowledge and behavior remain. These gaps are particularly evident when assessing the storage of leftover antibiotics, their potential use in cases of viral infections, and an insufficient understanding of the threat posed by antibiotic resistance. Therefore, it is essential to strengthen public education and promote the responsible use of antibiotics, as well as shared responsibility across various sectors for reducing antimicrobial resistance.

CONCLUSION

In summary, it can be said that the rational use of antibiotics is determined not only by the public's knowledge of the purpose of antibiotics and antimicrobial resistance, but also by their attitudes, previous experience with antibiotic use, social environment, and access to health care services. Research data indicate that there are still misconceptions in the public regarding the effectiveness of antibiotics in treating viral infections, and insufficient knowledge may be linked to irrational use patterns, including self-medication and failure to follow treatment recommendations properly. Therefore, promoting the rational use of antibiotics should involve not only informing the public but also assessing public attitudes and actual behavior, considering social and health system factors. A comprehensive analysis of these aspects is essential for identifying the main barriers to the rational use of antibiotics and for planning targeted interventions that help reduce inappropriate antibiotic use and the spread of antimicrobial resistance.

The survey results revealed that most respondents understand the principles of rational antibiotic use, but their actual behavior does not always align with their knowledge. Although 91 percent of respondents indicated that antibiotics should be taken as prescribed by a doctor, 46.9 percent keep leftover antibiotics for future use, and some respondents take antibiotics for illnesses that are most often caused by viruses. This indicates that it is necessary to strengthen the public's ability to apply their knowledge in practice.

The survey showed that respondents recognize the importance of shared responsibility for reducing antimicrobial resistance, but do not fully understand certain aspects of this issue. Nearly one-third of those surveyed were unaware of the threat posed by antibiotic resistance, and a smaller proportion of respondents recognized the role of the agricultural sector than they did the responsibility of healthcare professionals. Therefore, it is advisable to strengthen public awareness regarding the causes, spread, and prevention of antimicrobial resistance, emphasizing both individual and inter-institutional responsibility.

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