Original Article

A Silent Siege: Knowledge, Attitudes, and Practices Regarding Antibiotic Use and Antimicrobial Resistance Among Patients Attending a Tertiary Care Hospital in Lahore, Pakistan

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Abstract

Background: Antimicrobial resistance (AMR) is considered as one of the greatest public health and modern medicine threats. This bacterial AMR is responsible for millions of deaths world-wide.
Objectives: To measure the knowledge, attitude and practices in the use of antibiotics and antimicrobial resistance among patients of a tertiary care hospital.
Methods: This is an analytical cross-sectional study on a sample of Central Park Teaching Hospital Lahore, Pakistan from October 2025 to March 2026. The technique used in recruiting participants was non-probability consecutive sampling. 225 adult patients visiting the outpatient department and ward of the hospital were selected. The data were obtained by using a structured interviewer-administered questionnaire. A score of ≥60% of the items was considered a good knowledge. The data were analysed with SPSS version 29. The following statistical methods were used: frequencies, percentages, mean ± standard deviation, chi-square test and logistic regression. A p-value ≤0.05 was considered statistically significant.
Results: Mean age was 36.8 ± 12.6 years. Good knowledge was noted in 94(41.8%) and poor knowledge was noted in 131(58.2%). 86(38.2%) correctly identified that antibiotics will not help with viral infections. Self-medication was reported by 105(46.7%) participants and 88(39.1%) discontinued antibiotics after they felt better. Higher education was significantly associated with good knowledge (p=0.002). Poor knowledge was significantly linked with self-medication (p=0.004), early discontinuation (p=0.011), leftover antibiotic use (p=0.009) and purchase of antibiotic without prescription (p=0.006). Higher education (AOR 2.4; 95% CI 1.4–4.2) and urban residence (AOR 1.8; 95% CI 1.1–3.1) independently predicted the good knowledge of participants.
Conclusion: Many patients lacked knowledge about antibiotic usage and antimicrobial resistance. Unsafe use of antibiotics was frequent and was significantly associated with poor knowledge. To encourage rational use of antimicrobials, interventions in public education, prescription regulation and antimicrobial stewardship are needed.
Keywords: Antimicrobial resistance; Antibiotics; Self-medication; Health literacy; Drug resistance
Received: 15-03-2026 Revision: 29-06-2026 Accepted: 05-07-2026
How to cite: Aftab F, Iqbal M, Mughal HA, Azhar A, Khan SU, Kashaf. A Silent Siege: Knowledge, Attitudes, and Practices Regarding Antibiotic Use and Antimicrobial Resistance Among Patients Attending a Tertiary Care Hospital in Lahore, Pakistan. Avicenna J Health Sci. 2026;03(02): 57-63 **DOI:** https://doi.org/10.71158/ajhs.v3i2.183

Introduction

Antimicrobial resistance (AMR) is considered as one of the greatest public health and modern medicine threats. Recent global estimates indicate that bacterial AMR is responsible for millions of deaths around the world, with the impact anticipated to grow unless action is taken to prevent, monitor and optimise the use of antimicrobial medicines.[1,2] One of the most modifiable factors contributing to AMR is inappropriate use of antibiotics. Antibiotics are often prescribed without a prescription for viral infections, also stopped when symptoms clear up, shared with family members or kept for another time.[3,4] Whilst highlights of antimicrobial stewardship are often directed to prescribers and hospitals, patient behaviour is also a key contributor to antibiotic consumption patterns.[5]

Irrational use of antibiotics is more difficult to control in low and middle income countries.[6] It is driven by weak regulation of antibiotic sales, lack of access to good quality diagnostic services, inconsistent prescribing and lack of public awareness. Inappropriate antimicrobial use has been acknowledged as a national public health threat in Pakistan and it is highlighted in the National Action Plan for AMR 2.0,

which focuses on rational antimicrobial use, public awareness, surveillance, infection prevention and a One Health approach.[7] Knowledge and attitude and practice (KAP) studies can be helpful to detect misconceptions and unsafe practices concerning antibiotic use. Patients may want to be given antibiotics when they don't need them, or they may get them themselves from a pharmacy, because they think they are the right treatment for their fever, cough or sore throat, or if they think they need antibiotics for a viral infection. Likewise, if patients are unaware of what AMR is, they might discontinue antibiotic treatment prematurely, take remaining doses of prescribed antibiotics, or self-medicate.[8,9] Local evidence in the patient population is crucial as awareness of antimicrobial resistance and its practices are found to be different based on literacy, availability of healthcare services and socioeconomic conditions of the people.[10-14] The tertiary care hospitals are used to take patients from a variety of backgrounds and are also useful to monitor patient awareness and behaviours related to antibiotics.

Patient level awareness is of great importance because at times inappropriate antibiotic use starts before formal medical consultation. Some people take antibiotics without professional advice, based on past prescriptions, advice from others or convenient medications from the pharmacy. While such actions might seem insignificant on a personal level, they all add up to avoidable antibiotic use and the growth of antibiotic resistance. The understanding of such patterns in the hospital attendees can be helpful in recognizing the practical aspect of areas that can be improved by implementing counselling, public education and antimicrobial stewardship programs.

However, while there is growing awareness about AMR in Pakistan, there is still a lack of hospital reported evidence that assesses patient's knowledge, attitudes and antibiotic use practices at the same time. This is a gap that can be addressed to help identify priority areas for patient education and antimicrobial stewardship interventions. The present study was designed to evaluate the knowledge, attitude and practice of antibiotic use and antimicrobial resistance among patients at a tertiary care hospital in Lahore. Pakistan. The objective of this study was to measure the knowledge, attitude and practices in the use of antibiotics and antimicrobial resistance among patients of a tertiary care hospital.

Methods

This analytical cross sectional study was done at Central Park teaching hospital Lahore, Pakistan from October 2025 to March 2026. The study population was adult patients who attended the outpatient departments and inpatient wards during the study period. Subjects were aged 18 years and older, able to comprehend and answer the questionnaire, and gave written informed consent. Professional knowledge bias and incomplete data bias were minimized by excluding healthcare workers, medical students, nursing students, critically ill patients who cannot express consent, patients with cognitive impairment that impairs the ability to communicate, and patients who refuse consent as well as patients whose questionnaires were not completed. Sample size was calculated with the OpenEpi version 3.01. The expected frequency was set at 45% which is based on the literature from the region, 95% confidence interval and a margin of error of 5%. A sample size of 217 participants was calculated. The final sample size was expanded to 225 to make up for the number of items that were not completely answered and for greater reliability. The sampling was non-probability consecutive sampling, and all the subjects who were eligible were interviewed continuously until the required sampling size was reached.

Ethical approval was taken from Institutional Review Board Central Park Medical College Lahore with the IRB approval number CPMC/IRB-No/1548. The questionnaire was structured and developed after conducting an extensive literature review on the use of antibiotics, self-medication and awareness about AMR in English, and then translated into Urdu for the participants. This contained four sections: Demographic characteristics, knowledge about antibiotic use and AMR, attitudes about antibiotic use, and practices associated with the use of antibiotics. Minor wording changes were made after pilot testing with 20 participants for clarity and comprehensibility who were not included in the final analysis. The knowledge section consisted of questions related to the purpose of antibiotics, their use for bacterial and viral infections, incompleteness of antibiotic courses, antibiotic misuse, AMR, and prescription of antibiotics by the physician. The possible answers were scored as either 1 or 0 for "correct" and "incorrect/do not know" respectively. The percentage of participants

with scores of 60% or greater was grouped together as having good knowledge, and those with less than 60% were grouped together as having poor knowledge. Attitude was measured through the beliefs about antibiotic use for fever, sore throat, recovery from common illness, careful use of antibiotics, and importance of AMR. The practice section measured self-medication, buying antibiotics without a prescription, discontinuing antibiotics early after they have started to work, using unused antibiotics, sharing antibiotics, and finishing the course of antibiotics as prescribed. All participants gave written informed consent and confidentiality was ensured.

Statistical analysis

The data were entered, and analysed using SPSS version 29. For continuous variables, e.g., age, the data were presented as mean ± standard deviation. Categorical variables such as gender, residence, educational status, knowledge level, attitudes and practices were represented as frequencies and percentages. Chi-square test was used to assess associations between categorical variables. A logistic regression was done to determine the factors associated with good knowledge. Variables that had statistical significance in the bivariate analysis and associated demographic variables (age, sex, residence, education) were included in the multivariable logistic regression model. Odds Ratios (ORs) with 95% confidence intervals (CIs) were derived. P values were quoted and $p \leq 0.05$ was deemed statistically significant.

Results

The final analysis included a total of 225 participants. The mean age was 36.8 ± 12.6 years. There were 105(46.7%) males and 120(53.3%) females. The urban residents comprised 142(63.1%) and 83(36.9%) of the participants were from rural areas. As far as education is concerned, 52 (23.1%) had primary education or less, 76 (33.8%) had secondary education and 97 (43.1%) had intermediate or higher education. Demographic characteristics and knowledge responses are shown in Table 1. Overall, 94(41.8%) had good knowledge, and 131(58.2%) had poor knowledge. Misconceptions were found more frequently for viral infections, with only 86(38.2%) correct that antibiotics are not effective against viral diseases.

Table 1: *Demographics and Knowledge of Participants*

Variable	n(%)
Gender- Male	105 (46.7)
Gender- Female	120 (53.3)
Residence- Urban	142 (63.1)
Residence- Rural	83 (36.9)
Education- Primary or less	52 (23.1)
Education- Secondary	76 (33.8)
Education-Intermediate and above	97 (43.1)
Antibiotics are effective in treating bacterial infections.	139 (61.8)
Correctly knew antibiotics are not effective in treating viral infections	86 (38.2)
Knew that the incomplete course of antibiotics leads to resistance	112 (49.8)
Understood that the use of antibiotics can lead to resistance to the drugs	118 (52.4)
Acknowledged that antibiotics should be used only by prescription	132 (58.7)

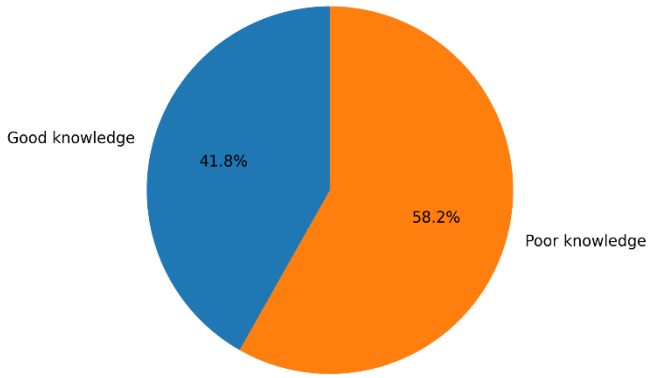


Figure 1: *Distribution of Knowledge Level about Antibiotic Use and Antimicrobial Resistance.*

Of the 121 (53.8%) who responded yes to the question "Antibiotics help when you have a fever", 109(48.4%) said they felt they needed antibiotics for a sore throat. But 147(65.3%) believed there was a need to be careful when using antibiotics and 116(51.6%) acknowledged that AMR was a serious health issue. Unsafe use of antibiotics was prevalent. 105 participants (46.7%) self-medicated and 102 (45.3%) bought antibiotics without prescription. 88(39.1%) participants reported early discontinuation due to symptom improvement. 73(32.4%) said they had retained some of their antibiotics and 49(21.8%) gave their antibiotics to family and/or friends. Attitudes and practices are shown in Table 2.

Table 2: *Attitudes and Practices of Participants Regarding Antibiotic Usage*

Variable	n(%)
Thought that antibiotics aid recovery from fever	121 (53.8)
Thought that antibiotics aid recovery from Sore throat	109 (48.4)
Recognised AMR as a serious health issue.	116 (51.6)
Thought that antibiotics should be used wisely	147 (65.3)
Practice Self-medication with antibiotics	105 (46.7)
Bought antibiotics without prescription	102 (45.3)
Discontinued antibiotics when symptoms improved	88 (39.1)
Used leftover antibiotics	73 (32.4)
Share antibiotics with family/friend	49 (21.8)

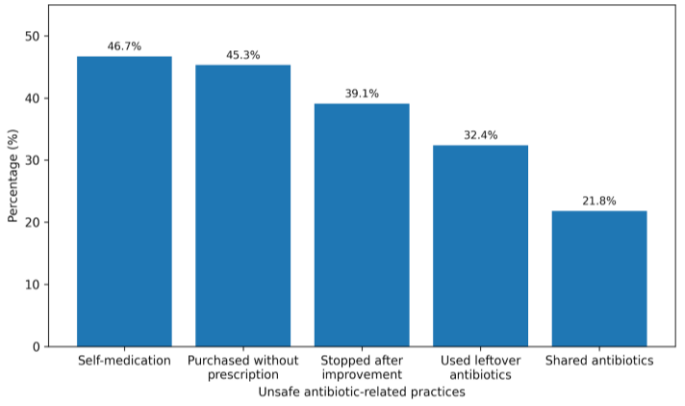


Figure 2: *Unsafe antibiotic-related practices of the participants*

Figure 2 shows self-medication, obtaining antibiotics without prescription, early stopping of antibiotic use after improvement, use of leftover antibiotics, and sharing of antibiotics were the most common unsafe practices. Good knowledge was significantly associated with higher level of education (p=0.002). Of the participants who had an intermediate or higher level of education, 52 (of 97) had good knowledge (53.6%) while 13 (25.0%) had primary education or less. Furthermore, knowledge level was also significantly associated with antibiotic-related practices. Participants with poor knowledge about the drugs were more likely to self-medicate compared to those who have good knowledge, 75(57.3%) and 30(31.9%) respectively, p=0.004. Participants with poor knowledge were also significantly more likely to discontinue treatment early, to not finish the course of antibiotics and to buy antibiotics without a prescription. These are summarised in Table 3.

Predictors of Good Knowledge:

Multivariable logistic variation demonstrated that both higher education and urban residence were independently associated with good knowledge (AOR 2.4, 95% CI 1.4–4.2 and AOR 1.8, 95% CI 1.1–3.1 respectively).

Table 3: *Association of knowledge level with antibiotic practices and predictors of good knowledge*

Variable	Poor knowledge (%)	Good knowledge (%)	p-value
Self-medication	75 (57.3)	30 (31.9)	0.004
Early discontinuation	61 (46.6)	27 (28.7)	0.011
Leftover antibiotic use	52 (39.7)	21 (22.3)	0.009
Purchase without prescription	70 (53.4)	32 (34.0)	0.006
Higher education	-	OR 2.4; 95% CI 1.4-4.2	0.003
Urban residence	-	OR 1.8, 95% CI 1.1-3.1	0.028

**Logistic regression analysis of predicting good knowledge. OR: Odds ratio; CI: Confidence interval.*

Table 3 shows association of knowledge level with antibiotic practices and those that predict good knowledge.

Discussion

The present study evaluated the Knowledge, Attitude and Practice of antibiotic usage and AMR among patients visiting a tertiary care hospital. The findings revealed that only 94(41.8%) participants had good knowledge while 131(58.2%) had poor knowledge. Self-medication, buying antibiotics without prescription and early termination of antibiotics were frequent. The results are significant because patient behaviour is a significant factor in the development of irrational use of antibiotics and resistance. The major gap in knowledge found in this study was about viral infections. 86(38.2%) participants correctly answered that antibiotics do not work for viral diseases. Such a misconception is clinically important as fever, cough, sore throat and influenza-like symptoms are common indications for unnecessary use of antibiotics. A lack of information with regard to antibiotics has also been reported in other LIMC settings, where the antibiotics are commonly believed to be general medicines and are used for a quick recovery, not specifically for bacterial infections. [6,8,9,15]

About 105(46.7%) participants said they were self-medicating and 102(45.3%) bought medicines that required a prescription. The results are consistent with previous evidence that non-prescription antibiotic access, self-medication, and public misconceptions are contributing factors to inappropriate antibiotic use.[10-19] These can result in incorrect antibiotic selection, inadequate dosage, inappropriate duration, adverse drug effects, and unnecessary antimicrobial exposure. It also decreases the chance for health care workers to know if an antibiotic is indicated. 88(39.1%) reported that treatment with antibiotics was interrupted early. Whilst in some clinical circumstances, the shorter course of antibiotics is now supported by modern stewardship, using antibiotics without expert advice is still not safe. Patients might discontinue treatment without knowing the diagnosis, severity or length of treatment. This emphasizes the importance of good prescription counselling at all encounters involving an antibiotic. Higher educational status was significantly associated with good knowledge. Those with intermediate and higher levels of education were more likely to know about antibiotic use and AMR. Education alone may not be enough to stop inappropriate antibiotic use, as some educated participants engaged in unsafe practices, though this finding is consistent with other studies that found that education alone is not the only way to increase health literacy, antibiotic knowledge, and awareness of antimicrobial risks.[12,15,20,21] Antibiotic availability and previous encounters, price of the product, and cultural belief may also have an impact on behaviour. The positive association of urban residence with good knowledge remained after controlling for these variables. Urban participants may be more likely to have access to skilled health care providers, health campaigns, information on the internet, and health counselling in a pharmacy than rural residents. The combined effect of exposure to health facilities, to counselling in pharmacies, to digital information on health, and to public awareness campaigns in urban areas can help to increase knowledge levels relative to rural areas. This implies that awareness creation campaigns should be focused on rural communities and the less literate people. Poor knowledge was significantly linked to unsafe antibiotic practices such as self-medication, discontinuation of antibiotic use before they were used to their full capacity, antibiotic use due to leftovers, and purchasing antibiotics without prescription. The results indicate that education of patients may be a way to decrease inappropriate antibiotic use. But education must be integrated with an overall strategy to improve antimicrobial stewardship, such as prescription regulation, the role of the pharmacy, surveillance, stewardship education, and framing the message for public health.[22-25] The results of this study reinforce the need to add structured patient education to hospital antimicrobial stewardship initiatives. Inappropriate antibiotic use may be reduced by standardised physician and pharmacists counselling combined with educational resources in both outpatient and inpatient settings. The results have real-world implications in terms of antimicrobial stewardship. Patient counselling and public education should be incorporated into the hospital based stewardship programmes as well as prescriber behaviour. Physicians and pharmacists should explain the necessity of antibiotics, not using them in viral diseases, the dangers of self-medication, and the importance of following advice of the physician. Low cost interventions such as educational posters, leaflets, videos in the waiting areas and pharmacist-led counselling can be helpful.

The use of antibiotics needs to be regulated at the policy level. Antibiotics must be dispensed only on

valid prescription and pharmacists should be trained to advise patients on good antibiotic usage. It is also important to raise awareness of AMR in the public by using media, schools, hospitals, and community health programmes.

Limitations: The findings of this study may not be generalisable due to the focus on a single tertiary care hospital. Recall bias and social desirability bias are potential sources of error in self-reported data. The study did not measure actual antibiotic purchases or usage, but rather reported behaviour.

Conclusion

A significant number of patients lacked knowledge about the use of antibiotics and antimicrobial resistance. Misconceptions about antibiotic use for viral diseases were prevalent, as were risks of self-medication, buying antibiotics without a prescription, early stopping, leftover antibiotic use, and sharing antibiotics. Poor knowledge was related to unsafe antibiotic practices and higher education and urban residence were associated with better knowledge. The results endorse the necessity of patient-centred antimicrobial stewardship interventions, public awareness campaigns, more strict drug prescription regulations, and better counselling by healthcare professionals. The need for future multicentre studies to evaluate the relationship with the knowledge and practices of antibiotics in different regions and populations.

Ethical Approval: The Institutional Ethical & Review Board, Central Park Medical College & Teaching Hospital, Lahore approved this study vide letter No. CPMC/IRB-No/ 1548.

Conflict of Interest / Disclosure: Nil.

Funding Source: Nil.

Authors' Contribution:

FA: Conception and design; acquisition of data, analysis and interpretation of data

MI: Conception and design, drafting of article

HAM: Acquisition of data

AA: Acquisition of data

SUK: Analysis and interpretation of data, critical revisions for important intellectual content

K: Final approval of the version to be published, critical revisions for important intellectual content

References

1. World Health Organization. Antimicrobial resistance. Geneva: World Health Organization; 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance
2. Naghavi M, Vollset SE, Ikuta KS, Swetschinski LR, Gray AP, Wool EE, et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. The Lancet. 2024; 404(10459):1199-226.
   Doi https://doi.org/10.1016/S0140-6736(24)01867-1
3. Centers for Disease Control and Prevention. Antibiotic use and stewardship in the United States: 2025 update. Atlanta: CDC; 2025. Available from: https://www.cdc.gov/antibiotic-use/hcp/data-research/stewardship-report.html
4. Centers for Disease Control and Prevention. Core elements of hospital antibiotic stewardship programs. Atlanta: CDC; 2024. Available from: https://www.cdc.gov/antibiotic-use/core-elements/index.html
5. Ministry of National Health Services, Regulations and Coordination Pakistan. Pakistan: National action plan for antimicrobial resistance 2.0 (2024–2028). Islamabad: Government of Pakistan; 2024. Available from: https://www.who.int/publications/m/item/pakistan--national-action-plan-for-antimicrobial-resistance-2.0-(2024-2028)
6. Otaigbe II, Elikwu CJ. Drivers of inappropriate antibiotic use in low- and middle-income countries. JAC Antimicrob Resist. 2023;5(3):dlad062.
   Doi: 10.1093/jacamr/dlad062.
7. Qiu Y, Ferreira JP, Ullah RW, Flanagan P, Zaheer MU, Tahir MF et al. Assessment of the Implementation of Pakistan's National Action Plan on Antimicrobial Resistance in the Agriculture and Food Sectors. Antibiotics (Basel). 2024;13(3):206. Doi: 10.3390/antibiotics13030206.
8. Mustafa ZU, Iqbal S, Asif HR, Salman M, Jabbar S, Mallhi TH et al. Knowledge, Attitude and Practices of Self-Medication Including Antibiotics among Health Care Professionals during the COVID-19 Pandemic in Pakistan: Findings and Implications. Antibiotics (Basel). 2023;12(3):481.
   Doi: 10.3390/antibiotics12030481
9. Faisal R, Khan FA, Khan MA, Ahmad H. Prevalence of self medication with antibiotics and knowledge about antibiotic resistance: a cross-sectional study at a medical school of Pakistan: Prevalence of self medication with antibiotics in medical students. J Rehman Med Inst.. 2025;11(3):107-12.
   Doi: https://doi.org/10.52442/jrmi.v11i3.808

10. Memon SM, Samoo H, Lohana BD, Khan S, Kumar C, Kumari A et al. Self-Medication Knowledge, Attitude and Practice among the Population of Jamshoro City: A Cross-Sectional Study. JHRR. 2024;4(1):984-9. Doi: https://doi.org/10.61919/jhrr.v4i1.556.
11. Nasir N, Mehmood BK, Awan S, Sattar S, Tajuddin S. Evaluation of hospital antibiotic prescription patterns using WHO AWaRe Classification in Karachi, Pak J Glob Antimicrob Resist.. 2024;39:29. Doi: 10.1016/j.jgar.2024.10.091.
12. Mumtaz F, Summan MG, Kalsoom A, Altaf A, Shabbir G. Assessment of Recent Knowledge, Attitude, and Practice Towards Antimicrobial Resistance and Their Consumption During COVID-19 in Balochistan. Biol Clin Sci Res J. 2025;6(7):95-100. Doi: https://doi.org/10.54112/bcsrj.v6i7.1919
13. Demsie DG, Addisu ZD, Tefera BB, Gebrie D, Tsegay EW, Yehualaw A, et al. Knowledge, and attitude as determinants of healthcare professionals' self-medication practice to antibacterials in Tertiary Care hospitals, North West Ethiopia. Sci Rep. 2025;15(1):5241. Doi: 10.1038/s41598-025-88979-1.
14. Shitindi L, Issa O, Poyongo BP, Horumpende PG, Kagashe GA, Sangeda RZ. Comparison of knowledge, attitude, practice and predictors of self-medication with antibiotics among medical and non-medical students in Tanzania. Front Pharmacol. 2024;14:1301561. Doi: 10.3389/fphar.2023.1301561.
15. Bonna AS, Mazumder S, Manna RM, Pavel SR, Nahin S, Ahmad I et al. Knowledge attitude and practice of antibiotic use among medical students in Bangladesh: A cross-sectional study. Health Sci Rep. 2024;7(9):e70030. Doi: 10.1002/hsr2.70030.
16. Ajulo S, Awosile B. Global antimicrobial resistance and use surveillance system (GLASS 2022): Investigating the relationship between antimicrobial resistance and antimicrobial consumption data across the participating countries. PLoS One. 2024;19(2) :e0297921. Doi: 10.1371/journal.pone.0297921.
17. World Health Organization. Global Antimicrobial Resistance and Use Surveillance System (GLASS) report: antibiotic use data for 2022. InGlobal Antimicrobial Resistance and Use Surveillance System (GLASS) report: antibiotic use data for 2022 2025. Available from: https://www.who.int/publications /i/item/9789240108127
18. Aljalamdeh R, Barakat M, Mosleh R, H Abdel-Qader D. Knowledge, attitude, and practices of self-medication with antibiotics among senior undergraduate pharmacy students: A cross-sectional study in Jordan. SAGE Open Med. 2025; 13: 20503121251404848. Doi: 10.1177/20503121251404848
19. Brian B, Goruntla N, Bommireddy BR, Mopuri BM, Easwaran V, Mantargi MJS, et al. Knowledge, Attitude, and Practice Towards Responsible Self-Medication Among Pharmacy Students: A Web-Based Cross-Sectional Survey in Uganda. Drug Healthc Patient Saf. 2025;17:7-23. Doi: 10.2147/DHPS.S496924.
20. Homsi SR, Alkhaldi SM, Taha HA, Homsi ZR. Healthcare Students' Knowledge, Attitudes, and Practices Related to Antibiotic Resistance and Use in Jordan: A Cross-Sectional Study. J Med Educ Curric Dev. 2025;12:23821205251344732. Doi: 10.1177/23821205251344732.
21. Ahmad S, Khan A, Iqbal J, Ihtisham S, Iqbal A, Iqbal A, et al. Knowledge, Attitude, and Practices of Self-Medication Among Undergraduate Nursing Students in Malakand Division, Pakistan. J Health Wellness Community Res. 2025:e671-. Doi: https://doi.org/10.61919/bf4byq35
22. Patel J, Harant A, Fernandes G, Mwamelo AJ, Hein W, Dekker D, et al. Measuring the global response to antimicrobial resistance, 2020-21: a systematic governance analysis of 114 countries. Lancet Infect Dis. 2023; 23(6):706-718. Doi: 10.1016/S1473-3099(22) 00796-4.
23. Johnson T, Mason LCE, Wilson HJ, Price JR, Hopkins KL, Chattaway MA, et al. The role of microbial genomics in delivering the UK's national action plan for confronting antimicrobial resistance 2024-29. Lancet Microbe. 2026;7(6):101372. Doi: 10.1016/j.lanmic.2026.101372.
24. Turner RR, Coupe N, Griffiths S, Cheng K, Byrne-Davis L, Shallcross L, et al. A systematic review and meta-analysis to identify behavioural content and active ingredients of antimicrobial stewardship education and training interventions in hospital-based care settings. Antimicrob Resist Infect Control. 2025;15(1):10. Doi: 10.1186/s13756-025-01660-0.
25. Rehman S, Sarfraz MR, Bano S, Ismail A, Naveed A, Malik A. Assessing the Impact of Self-Medication with Antibiotics Among Medical Students: Assessing the Impact of Self-Medication with Antibiotics. Pak. J. Health Sci. 2024:35-9. Doi: https://doi.org/10.54393/pjhs.v5i02. 1242.

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