DEVELOPMENTAL MEDICO-LIFE-SCIENCES

ISSN (P): 3007-2786, (E): 3007-2794 DOI: https://doi.org/10.69750/dmls.01.08.065

ORIGINAL RESEARCH ARTICLE Open Access

Irrational use of antibiotics: Prevalence and factors in the general population of Pakistan

Shehnaz Akhtar [1], Ibtesam Zulfiqar [1], Komail [1], Zain Akbar [1], Adnan Arshad [1], Waheed Aslam [1], Ahmed [1]*

1- Rashid Latif khan university medical & dental college (RLKU), Pakistan.

***Corresponding Author:** Ibtesam Zulfiqar **Email:** ibtesamarshman@gmail.com **Cell:** +923246281001

ABSTRACT

Background: Antibiotic resistance is a critical global health threat, primarily driven by the misuse and overuse of antibiotics. Comparing awareness and practices related to antibiotic use across demographic groups can inform strategies to combat this issue, particularly in regions like Pakistan where resistance is escalating.

Objectives: This study compares knowledge, attitudes, and practices regarding antibiotic use between the general population and medical students in Pakistan and identifies key socio-demographic predictors of misuse.

Methods: A comparative cross-sectional study was conducted with 220 participants (110 general population, 110 medical students). Data were collected via structured surveys capturing demographics, awareness, attitudes, and practices concerning antibiotics. Statistical analyses included chi-square tests and multivariate logistic regression to identify significant predictors, with $p<0.05$ considered statistically significant.

Results: Medical students demonstrated greater awareness of antibiotic resistance (71.8% recognizing decreased efficiency) compared to the general population (58.2%, $p=0.049$). Self-medication was significantly higher in the general population (51.8%) than among medical students (26.4%, $p=0.038$). Regression analysis revealed that education level (OR=3.09, $p<0.001$), previous antibiotic use ($p<0.001$), and income (OR=-0.01, $p=0.022$) were significant predictors of misuse.

Conclusion: Targeted public health interventions are urgently needed to enhance awareness of antibiotic resistance, particularly among the general population. Educational campaigns, stricter over-the-counter sales regulations, and improved access to healthcare are essential to reduce misuse and curb resistance development.

Keywords: Antibiotic Resistance, Self-Medication, Health Knowledge, Health Behavior, Socioeconomic Factors, Health Education, Healthcare Disparities

Received: 21/10/2024
Revised: 25/11/2024
Accepted: 26/11/2024
Published: 27/11/2024

INTRODUCTION

Antibiotic resistance is a pressing global health crisis exacerbated by self-medication and over-the-counter availability in Pakistan. In the early 20th century, antibiotics were discovered, leading to the treatment of bacterial infections and reducing morbidity and mortality rates [1]. But widespread and often irrational use of antibiotics has spawned antibiotic resistant bacteria threatening to renege on these medical advances [2]. Bacteria have developed the ability to resist it, that is, to adapt to the environment where they're exposed to antibiotics that should kill them or at least slow down their growth. Infections become increasingly difficult to treat over time as bacteria can acquire new genetic material, become mutated, or express genes differently to avoid the effects of antibiotics [3]. This is a prime example of bacterial adaptation in 'survival of the fittest' response to antibiotic pressures, as described by Khan FU et al. (2022). In Pakistan, irrational use of antibiotics is a serious public health issue. Studies highlight the significant misuse of antibiotics, with cultural and socio-economic factors playing a central role , mainly due to easily accessible over the counter distribution, unawareness, improper prescriptions and self-medication [4]. The research shows that antibiotics are often prescribed unnecessarily, especially for children, and that adults often take them without prescriptions. Purchasing antibiotics and not completing the full course of antibiotics is common, as is sharing leftover medications with others [5]. Moreover, socio-demographic factors such as gender, age, and level of education influence self-medication behavior, and urban populations tend to self-medicate more than their rural counterparts. Rational or irrational use of antibiotic has consequences that extend beyond the individual. Antibiotic resistance occurs in humans, animals and the environment because bacteria that are resistant can transfer resistance genes to other species making the management of bacterial infection more difficult [6]. This phenomenon of the development of MDR strains is accelerated by indiscriminate and inappropriate use of antibiotics. The World Health Organization (WHO) [7] warns we are rapidly approaching a 'post antibiotic era' with basic antibiotics no longer used to treat common infections. In many low- and middle-income countries (LMICs) such as Pakistan, the prevalence of self medication with antibiotics is common. All these behaviours are influenced by convenience, cost, cultural beliefs, and the presence of antibiotics without prescriptions. In Jordan and Nigeria, over 40–53 percent of respondents stated that they self medicate for convenience and cost saving as main drivers.[8]. Also, in Pakistan, antibiotics are often misused for conditions that do not require them, such as viral infections, like colds and flu, which reflects a lack of understanding of which drugs are appropriate for which condition.[9].There are multiple studies that have shown that a large percentage of the population (including medical students) have misconceptions about antibiotics. For instance, individuals generally stop taking antibiotics when they begin to feel better rather than finishing the course, thus creating resistant strains.[10]. In addition, urban residents and males are more knowledgeable about antibiotics than are their rural and female counterparts, although that knowledge does not necessarily translate into appropriate usage. However, even among medical students awareness of antibiotic resistance is higher than in the general population, but gaps in understanding, and practices remain.[11]. Comprehensive strategies are needed to address the problem of irrational use of antibiotics including regulation of over-the-counter sale of antibiotics, public campaigns and development of antibiotic stewardship programs. All these parts are integral part of public health education

and it is essential to correct the misconceptions about antibiotics, use them responsibly and take prescribed treatment. Studies [12] show that interventions, such as stewardship programs that educate healthcare professionals and the public about how to use antibiotics properly, are needed to reverse the trend of increasing resistance. The aim of this study was to analyse the prevalence of irrational antibiotic use in Pakistan and the socio cultural and economic factors that contribute towards irrational antibiotic use. The goal of this research was to provide actionable insights that will inform policy intervention, public health strategies, and educational programs to reduce the growing threat of antibiotic resistance by understanding patterns of misuse, and the underlying reasons. [13]. Previous research has shown that tackling this issue will require a multi pronged approach, including better healthcare access, regulatory enforcement and better public education to curtail the issue and ensure future generations have access to effective antibiotics. Therefore, this study supports the need for immediate intervention of public education, regulation enforcement and sustainable strategies to avert antibiotic resistance to protect the health of the population[14] This study is unique in comparison of antibiotic use behaviours between medical students and general population in Pakistan, and the effect of education and socio demographic factors on antibiotic use behaviours. It provides a critical perspective employing a broad reaching lens to help predict and anticipate strategies that may be targeted at reducing antibiotic misuse and resistance.

MATERIALS AND METHODS

This study employed a comparative cross-sectional design to assess antibiotic resistance awareness, behaviours, and socio-demographic characteristics between two groups: the population in Pakistan and medical students. This design was selected because it could give a snapshot of what differences there were in awareness and practices between these two very distinct groups in one moment in time. The comparison that is made by the study is consistent in identifying associations and predictors of antibiotic misuse. Participants were divided into two groups: The population were adults aged 18 years and above in the general population and medical students in medical institutions at the time of the study. The socio-demographic diversity of the sample group comprised people from diverse age groups, different levels of income and education from four provinces of Pakistan (Punjab, Sindh, Baluchistan and Khyber Pakhtunkhwa). Participants included medical student group sizes across multiple academic years to achieve a broad range of perspectives in this cohort. There were 220 participants (110 per group) in the study. The power analysis was based on an 80% probability of detecting significant differences with a 5% significance level, and an expected effect size of 0.3, as determined from previous studies. This was done to make sure we had enough statistical power to make reliable comparisons. Recruitment was stratified random sampling to be diverse by age, gender, and educational background in each group. Looking for a broad range of participants, recruitment took place in community settings (e.g., universities, clinics, pharmacies, and public spaces), as well as online platforms. Data was collected through a self administered and structured questionnaire, both in English and Urdu versions to accommodate participants of different linguistic backgrounds. The questionnaire was divided into four sections: knowledge, attitudes, practices (KAP) and demographics. Questions included age, gender, education, income, and affiliation (public or private institutions). The knowledge section measured participants' understanding of antibiotic resistance and awareness of commonly used

antibiotics, and their perceptions about antibiotic effectiveness. The attitudes and practices section examined behaviours including self-medication, leftover antibiotic use, and a desire to seek medical advice about using antibiotics. To ensure clarity and cultural relevance, the questionnaire was adapted from existing validated surveys. It was piloted with a small group of participants to test its clarity, relevance, and comprehensibility. Feedback from the pilot study was incorporated to refine the final questionnaire before deployment. Data collection occurred between January till September 2024 main centre of study was Rashid Latif Khan University Medical and Dental College (RLKU). The surveys were coded and analyzed using SPSS (Statistical Package for the Social Sciences). Demographic characteristics and responses regarding knowledge, attitudes, and practices were summarized using descriptive statistics (frequencies and percentages). Chi-square tests were conducted to analyse associations between practices (e.g., self-medication) and categorical variables such as age, gender, and education level. Logistic regression was used to identify significant predictors of antibiotic misuse and adherence to prescribed practices. Variables for regression were selected based on clinical relevance and prior literature, and assumptions were tested to confirm the robustness of the model. Multicollinearity checks, using variance inflation factors (VIF), ensured the independence of predictor variables. Statistical significance was set at $p \leq 0.05$. The study was conducted in accordance with ethical standards and approved by the Institutional Review Board (IRB) approval ref no. RLKUMC/IRB/0031/24 of Rashid Latif Khan University Medical and Dental College (RLKU). Participants were informed about the study's purpose and provided written consent to participate. Confidentiality and anonymity were assured, and participation was entirely voluntary. Despite its strengths, the study has certain limitations. The reliance on self-reported data introduces the possibility of recall bias or social desirability bias. Additionally, the cross-sectional design limits the ability to infer causality, as the findings represent a single point in time and may not capture changes in behaviour over extended periods. Nonetheless, the study provides valuable insights into the patterns of antibiotic use and misuse, offering a basis for future interventions and policy development.

RESULTS

Comparisons between the general population and medical students show large differences in awareness, behaviour, and demographic antibiotic use and resistance factors. In general, medical students have a better understanding of antibiotic resistance and are more likely to correctly identify a decrease in antibiotic efficiency and to behave responsibly (i.e., not sharing leftover antibiotics). Medical education seems to play an important role in shaping better health-related behaviours as p values indicate statistically significant differences in several categories such as age distribution, income levels, and self-medication practice. Income also seems to shape antibiotic usage patterns, and lower income groups are more likely to self-medicate, an indication of barriers to care.

Table-1: Comparative Analysis of Antibiotic Resistance Awareness, Behaviour, and Demographics

Category	General Population (n=110)	Medical Students (n=110)	p-value
Gender Distribution			
Male	59 (53.6%)	53 (48.2%)	0.072
Female	51 (46.4%)	57 (51.8%)	
Age Groups			
18-22 years	49 (44.5%)	83 (75.5%)	0.045
23-30 years	44 (40.0%)	22 (20.0%)	
Above 30 years	17 (15.5%)	5 (4.5%)	
Income Level			
< 30,000 PKR	37 (33.6%)	15 (13.6%)	0.041
30,000 - 70,000 PKR	52 (47.3%)	59 (53.6%)	
> 70,000 PKR	21 (19.1%)	36 (32.7%)	
Educational Qualification			
High School	33 (30.0%)	-	0.082
Undergraduate Degree	55 (50.0%)	88 (80.0%)	
Postgraduate Degree	22 (20.0%)	22 (20.0%)	
Affiliations			
Private Institutes	77 (70.0%)	71 (64.5%)	0.073
Public Institutes	33 (30.0%)	39 (35.5%)	
Understanding Antibiotic Resistance			
Decreased efficiency	64 (58.2%)	79 (71.8%)	0.049
Increased efficiency	33 (30.0%)	20 (18.2%)	
Don't understand	13 (11.8%)	11 (10.0%)	
Opinions on Leftover Antibiotics			
Leftover antibiotics should be reused	23 (20.9%)	10 (9.1%)	0.050
Sharing leftovers is safe	26 (23.6%)	8 (7.3%)	
Comfort Discussing With Doctor			
Comfortable	50 (45.5%)	86 (78.2%)	0.048
Uncomfortable	33 (30.0%)	13 (11.8%)	
Self-Medication Behavior			
Uses without prescription	57 (51.8%)	29 (26.4%)	0.038
Buys without prescription	53 (48.2%)	17 (15.5%)	
Shared prescribed antibiotics	24 (21.8%)	11 (10.0%)	

The show plots the differences in key practices and awareness levels between medical students and the population as a whole. They found that medical students are much more aware of the deleterious effects of decreased antibiotic efficiency and feel more comfortable speaking with doctors about antibiotic use and self-medication rates are much lower than in the general population.

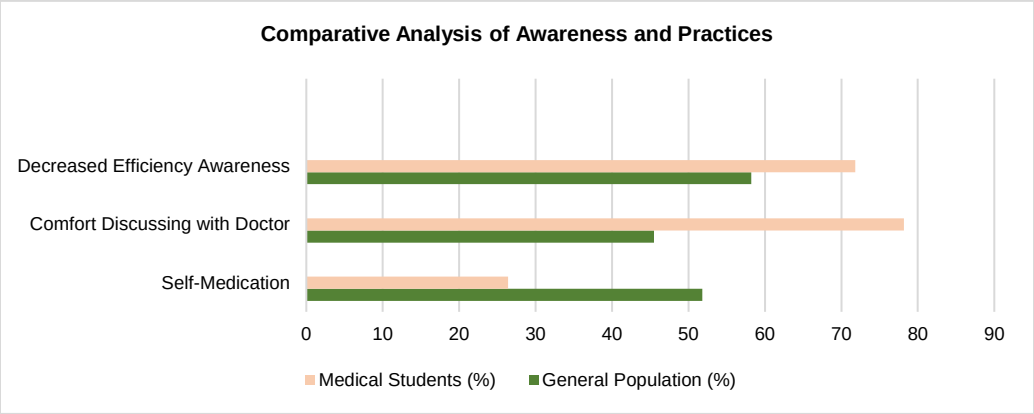

Fig-1: Comparative Awareness and Practices

Table 2 shows a comparison of antibiotic usage patterns revealing that both groups of antibiotic use are similar, but while both groups use the same antibiotics, such as Amoxicillin and Augmentin, medical students use a wider variety more frequently. The reason could be because they know when and how to use these medications. For example, there were 45.5% of medical students and 40.9% of the general population regarding the usage of Amoxicillin, and a similar trend was noted with antibiotics such as Azithromycin and Ciprofloxacin. This demonstrates the relevance of education to promote the appropriate use of antibiotics and to mitigate the risks of resistance.

Table 2: Comparison of Antibiotics Used Between General Population and Medical Students

Antibiotic Name	General Population (n=110)	Medical Students (n=110)
Amoxicillin	45 (40.9%)	50 (45.5%)
Azithromycin	30 (27.3%)	40 (36.4%)
Ciprofloxacin	20 (18.2%)	25 (22.7%)
Metronidazole	15 (13.6%)	20 (18.2%)
Cefixime	10 (9.1%)	15 (13.6%)
Doxycycline	5 (4.5%)	8 (7.3%)
Augmentin	35 (31.8%)	42 (38.2%)
Clarithromycin	18 (16.4%)	22 (20.0%)
Erythromycin	12 (10.9%)	14 (12.7%)
Levofloxacin	8 (7.3%)	10 (9.1%)

Fig-2 shows chart shows how different antibiotics were used by the groups. Despite using similar antibiotics such as Amoxicillin and Augmentin, medical students utilize a broader range of antibiotics, as they are better at understanding when to use antibiotics.

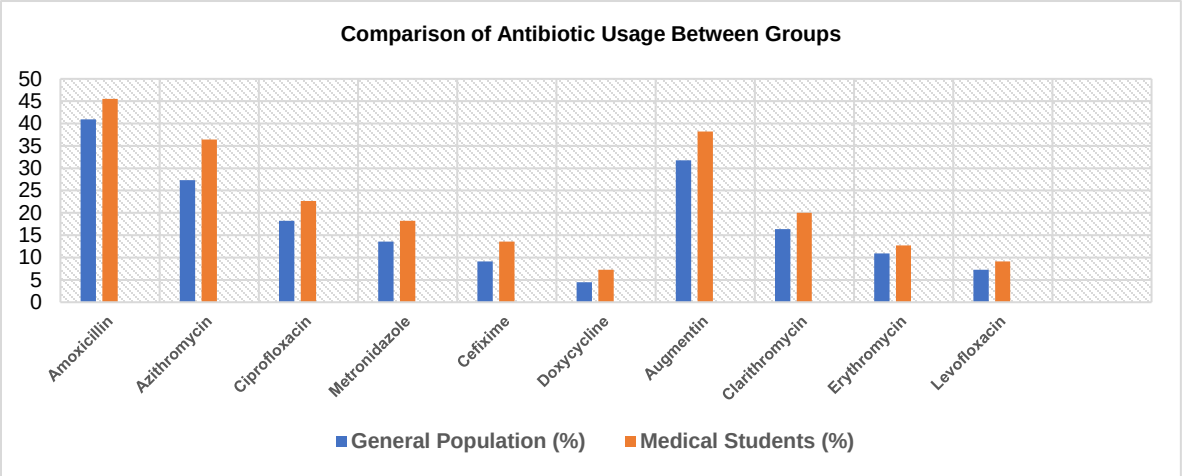

Fig-2: Comparison of Antibiotic Usage Between Groups

Multivariate Logistic Regression:

Several factors are identified by the logistic regression analysis that are significantly associated with responsible antibiotic use. Strong predictors were education level and previous antibiotic usage — those with higher education or a history of using antibiotics are more likely to follow responsible use. A negative relationship between income and responsible antibiotic practices suggested that cost factors may drive self-medication behaviours. These results underscore the need for targeted educational interventions to encourage appropriate antibiotic usage and reduce the risk of resistance among the general population.

Table-3: Multivariate Logistic Regression Results

Variable	Coefficient	95% CI (Lower, Upper)	p-value
Intercept (Constant)	1.88	(0.55, 3.21)	0.003
Age	0.02	(0.01, 0.04)	0.041
Education Level	0.30	(0.15, 0.45)	0.001
Income (per 1,000 PKR increment)	-0.01	(-0.015, -0.005)	0.022
Previous Antibiotic Usage	3.09	(2.12, 4.06)	<0.001
Antibiotic Awareness Level	0.25	(0.10, 0.40)	0.015

In general, differences in antibiotic knowledge and related behaviors between the general population and medical students were evident. Responsible use seems to depend on education, although income disparities may limit access to adequate care and promote self-medication. The findings can inform future public health initiatives to promote better antibiotic stewardship in different populations.

DISCUSSION

This comparative cross-sectional study finds significant differences in antibiotic resistance awareness,[15] Behaviours and socio-demographic characteristics of the general population and medical students. Medical students appear to know more and be more aware of antibiotic resistance than the average person, a result that may be the result of their education and their exposure to medical training. The heightened awareness of medical students was evidenced by their practices: a lower predisposition to self-medicate, and a greater propensity to consult health professionals before using antibiotics. [16].

A major finding of this study was that medical students have a greater awareness of the consequences of inappropriate antibiotic use (e.g. development of resistance). The responses of this group showed better adherence to prescribed antibiotic practices concerning not sharing leftover antibiotics and knowing the importance of completing the full course of prescribed medication. [17] These findings are supported by the statistical analysis which shows significant differences in practice between both groups, with p values indicating that practices such as self-medication, sharing antibiotics, and reusing leftover medication were more prevalent in the general population. That could be explained by the fact that the risks of antibiotic misuse are not widely known in public health.[18].We also found that income level was a factor in antibiotic use behaviours. Those with lower income may have engaged in practices including self-medication, which may be a result of financial constraints, and limited access to healthcare services. [19]. Further logistic regression analysis found that income, educational level, and previous antibiotic use were significant predictors of inappropriate antibiotic use. If higher income and education are associated with less misuse of antibiotics, as our results suggest, then targeted educational interventions are needed, that address the gaps in knowledge held by the non–socioeconomically advantaged, such as the general public. [20].

This holds especially true for the differences observed in the understanding of antibiotic resistance. A larger proportion of medical students correctly identified a decreased antibiotic efficiency due to resistance, but a large portion of the general population had misconceptions, such as that antibiotics get stronger over time or that they don’t know what that concept means at all. [21]. This shows the need for improved, broader educational campaigns that can help improve public awareness of antibiotic resistance.

\One interesting finding relates to the types of antibiotics most commonly used. Both groups had been on antibiotics such as Amoxicillin and Augmentin, which are widely prescribed drugs.[22]. However medical students' slightly higher usage rates could be explained by their greater awareness of when they should use these antibiotics. Moreover, medical students were more likely to use less common antibiotics (e.g. Ciprofloxacin, Doxycycline) which may reflect a more targeted education regarding antibiotic treatments. [23].

\These results, said the study, highlight the significance of advocating for rational antibiotic use and the persistence of self-medication, especially among the general population. This necessitates a multi-faceted range of interventions such as public education campaigns to reduce self-medication, stricter regulation on antibiotic sales, and improved access to healthcare services to reduce the need for self-medication. In addition, the importance of healthcare professionals’ role in reinforcing the appropriate use of antibiotics was emphasized because they must be proactive in educating patients about the importance of following the prescribed regimens and the consequences of misuse. [24, 25].

However, the study has limitations which should be considered. Self-reported data are the source of recall and social desirability bias (i.e. participants might underreport behaviours such as self-medication).

Limitations of the study include the cross-sectional nature of the study, which does not allow for inferences of a causal relationship between socio-demographic factors and antibiotic misuse behaviours. Longitudinal studies would be beneficial to track changes in behaviours over time and assess educational interventions. [26].

Overall, this study reveals substantial information regarding patterns of antibiotic use and differences between medical students and the general population. It emphasizes the importance of continued education regarding antibiotic resistance and the harmful repercussions of improper use, especially among nonmedical groups. However addressing these knowledge gaps and spreading good practices could help public health initiatives mitigate the risk of antibiotic resistance, a major global public health threat.[27].

CONCLUSION

This study finds marked discrepancies in antibiotic resistance awareness and behavior between the general public and medical students. As a result of their educational background, medical students showed greater knowledge and more responsible practices in the use of antibiotics, including adherence to prescribed regimens and reduced self-medication. In contrast, the general population had higher rates of self-medication and misconceptions about antibiotic resistance highlighting the need for targeted educational initiatives. To address this gap, public health campaigns, tighter regulation of the sale of antibiotics, and better access to healthcare services are needed to reduce antibiotic misuse and fight antibiotic resistance.

Funding:
Nill

Conflict of interest:
None declared

Acknowledgement:
The authors would like to thank the administration and staff of Rashid Latif Khan University Medical & Dental College for their support in facilitating this research. Special thanks are extended to the study participants for their valuable time and responses. We also acknowledge the contributions of our colleagues, whose constructive feedback greatly enriched the quality of this study.

Authors Contribution:
SA: Conceptualization and supervision.
IZ: Literature review and data analysis.
K: Participant recruitment and data accuracy.
ZA: Manuscript drafting and result interpretation.
AA: Statistical analysis and formatting.
WA: Critical revisions and technical insights.
A: Final manuscript review and approval.
All authors approved the final version of the manuscript.

REFERENCES

1. Aslam A, Zin CS, Jamshed S, Rahman NS, Ahmed SI, Pallós P, et al. Self-Medication with Antibiotics: Prevalence, Practices and Related Factors among the Pakistani Public. Antibiotics [Internet]. 2022; 11(6).doi: 10.3390/antibiotics11060795
2. Khadka S, Hashmi FK, Yadav GK, Lamichhane S, Giri S, Tariq F, et al. Rational use of antimicrobials: a nationwide cross-sectional survey among people of Pakistan. IJS Global Health. 2023;6(1).doi: 10.1097/GH9.0000000000000103
3. Akhund R, Jamshed F, Jaffry HA, Hanif H, Fareed S. Knowledge and Attitude of General Pakistani Population Towards Antibiotic Resistance. Cureus. 2019;11(3):e4266.doi: 10.7759/cureus.4266

4. Gillani AH, Chang J, Aslam F, Saeed A, Shukar S, Khanum F, et al. Public knowledge, attitude, and practice regarding antibiotics use in Punjab, Pakistan: a cross-sectional study. Expert Review of Anti-infective Therapy. 2021;19(3):399-411.doi: 10.1080/14787210.2021.1823216
5. Atif M, Asghar S, Mushtaq I, Malik I, Amin A, Babar Z-U-D, et al. What drives the inappropriate use of antibiotics? A mixed methods study from Bahawalpur, Pakistan. Infection and Drug Resistance. 2019;12(null):687-99.doi: 10.2147/IDR.S189114
6. Momina I, Muhammad Aaliyan K, Haris J, Muhammad Asif S, Iqra M, Muhammad Ashraf C. Knowledge, Attitude, and Perception regarding antibiotic use and its associated resistance among the general public in Lahore, Pakistan. Journal of University Medical & Dental College. 2024;15(2).doi: 10.37723/jumdc.v15i2.892
7. Khan FU, Khan FU, Hayat K, Ahmad T, Khan A, Chang J, et al. Knowledge, Attitude, and Practice on Antibiotics and Its Resistance: A Two-Phase Mixed-Methods Online Study among Pakistani Community Pharmacists to Promote Rational Antibiotic Use. International Journal of Environmental Research and Public Health [Internet]. 2021; 18(3).doi: 10.3390/ijerph18031320
8. Saleem Z, Hassali MA, Versporten A, Godman B, Hashmi FK, Goossens H, et al. A multicenter point prevalence survey of antibiotic use in Punjab, Pakistan: findings and implications. Expert Review of Anti-infective Therapy. 2019;17(4):285-93.doi: 10.1080/14787210.2019.1581063
9. Bilal H, Khan MN, Rehman T, Hameed MF, Yang X. Antibiotic resistance in Pakistan: a systematic review of the past decade. BMC Infectious Diseases. 2021;21(1):244.doi: 10.1186/s12879-021-05906-1
10. Ali M, Naureen H, Tariq MH, Farrukh MJ, Usman A, Khattak S, et al. Rational use of antibiotics in an intensive care unit: a retrospective study of the impact on clinical outcomes and mortality rate. Infection and Drug Resistance. 2019;12(null):493-9.doi: 10.2147/IDR.S187836
11. Arifa S, Tahir Mehmood K, Allah B, Muhammad Osama Y, Alia S. Cross-sectional survey to explore knowledge, attitude, practices, and impact of an intervention program related to antibiotic misuse and self-medication among general population of Pakistan. BMJ Public Health. 2024;2(1):e000758.doi: 10.1136/bmjph-2023-000758
12. Khan FU, Mallhi TH, Khan Q, Khan FU, Hayat K, Khan YH, et al. Assessment of antibiotic storage practices, knowledge, and awareness related to antibiotic uses and antibiotic resistance among household members in post-conflict areas of Pakistan: Bi-central study. Frontiers in Medicine. 2022;9.doi: 10.3389/fmed.2022.962657
13. Khan FU, Mallhi TH, Khan FU, Hayat K, Rehman AU, Shah S, et al. Evaluation of Consumers Perspective on the Consumption of Antibiotics, Antibiotic Resistance, and Recommendations to Improve the Rational use of Antibiotics: An Exploratory Qualitative Study From Post-Conflicted Region of Pakistan. Frontiers in Pharmacology. 2022;13.doi: 10.3389/fphar.2022.881243
14. Zeb S, Mushtaq M, Ahmad M, Saleem W, Rabaan AA, Naqvi BS, et al. Self-Medication as an Important Risk Factor for Antibiotic Resistance: A Multi-Institutional Survey among Students. Antibiotics [Internet]. 2022; 11(7).doi: 10.3390/antibiotics11070842
15. Haseeb A, Bilal M. Prevalence of using non prescribed medications in economically deprived rural population of Pakistan. Archives of Public Health. 2016;74(1):1.doi: 10.1186/s13690-015-0113-9
16. Muhammad Abrar Y, Hafsa Z, Zumama K, Abeedha Tu-Allah K, Misbah N, Tayyaba S, et al. Knowledge, Attitude and Practices of University Students of Pakistan towards Antibiotic Use and Resistance: Questionnaire Based Assessment. BioScientific Review. 2021;3(3).doi: 10.32350/BSR.0303.05
17. Gillani AH, Ji W, Hussain W, Imran A, Chang J, Yang C, et al. Antibiotic Self-Medication among Non-Medical University Students in Punjab, Pakistan: A Cross-Sectional Survey. International Journal of Environmental Research and Public Health [Internet]. 2017; 14(10).doi: 10.3390/ijerph14101152
18. Majid Aziz M, Haider F, Rasool MF, Hashmi FK, Bahsir S, Li P, et al. Dispensing of Non-Prescribed Antibiotics from Community Pharmacies of

Pakistan: A Cross-Sectional Survey of Pharmacy Staff's Opinion. Antibiotics [Internet]. 2021; 10(5).doi: 10.3390/antibiotics10050482

19. Mustafa ZU, Nazir M, Majeed HK, Salman M, Hayat K, Khan AH, et al. Exploring Knowledge of Antibiotic Use, Resistance, and Stewardship Programs among Pharmacy Technicians Serving in Ambulatory Care Settings in Pakistan and the Implications. Antibiotics [Internet]. 2022; 11(7).doi: 10.3390/antibiotics11070921

Programs: A Cross-Sectional Study from Punjab, Pakistan. Antibiotics [Internet]. 2021; 10(1).doi: 10.3390/antibiotics10010066

22. Sarwar MR, Saqib A, Iftikhar S, Sadiq T. Antimicrobial use by WHO methodology at primary health care centers: a cross sectional study in Punjab, Pakistan. BMC Infectious Diseases. 2018;18(1):492.doi: 10.1186/s12879-018-3407-z

23. Ul Mustafa Z, Khan AH, Salman M, Harun SN, Meyer JC, Godman B. Assessment of rational antibiotic use among children being treated in primary care facilities in Punjab, Pakistan: findings and implications. Drugs & Therapy Perspectives. 2024;40(4):160-71.doi: 10.1007/s40267-024-01059-8

24. Abdul Salam SWLAHAMMABAMNS. Parental Self-Medication with Antibiotics in Pakistan. Pakistan Journal of Medical & Health Sciences. 2023;17(04):228.doi: 10.53350/pjmhs2023174228

20. Khan FU, Khan FU, Hayat K, Chang J, Saeed A, Khan Z, et al. Knowledge, attitude and practices among consumers toward antibiotics use and antibiotic resistance in Swat, Khyber-Pakhtunkhwa, Pakistan. Expert Review of Anti-infective Therapy. 2020;18(9):937-46.doi: 10.1080/14787210.2020.1769477

21. Hayat K, Jamshed S, Rosenthal M, Haq NU, Chang J, Rasool MF, et al. Understanding of Pharmacy Students towards Antibiotic Use, Antibiotic Resistance and Antibiotic Stewardship

25. Hussain I, Shukar S, Subhan Arshad M, Rasool MF, Chang J, Fang Y. Relation of poverty with treatment-seeking behavior and antibiotic misuse among UTI patients in Pakistan. Frontiers in Public Health. 2024;12.doi: 10.3389/fpubh.2024.1357107

26. Khursheed N, Ahsan Q, Rattani S, Fatima M, Raza A, Tariq S, et al. Point prevalence probing of antimicrobial prescription patterns from a developing country. Expert Review of Anti-infective Therapy. 2023;21(11):1269-76.doi: 10.1080/14787210.2023.2259098

27. Saleem Z, Faller EM, Godman B, Malik MSA, Iftikhar A, Iqbal S, et al. Antibiotic consumption at community pharmacies: A multicenter repeated prevalence surveillance using WHO methodology. Medicine Access @ Point of Care. 2021;5:23992026211064714.doi: 10.1177/23992026211064714

This Article May be cited As: *Akhtar S, Zulfiqar I, Komail, Akbar Z, Arshad A, Aslam W, et al. Irrational use of antibiotics: Prevalence and factors in the general population of Pakistan: Antibiotic Misuse in Pakistan: Patterns and Predisposing Factors. DEVELOPMENTAL MEDICO-LIFE-SCIENCES.1(8): 48-58.doi: 10.69750/dmls.01.08.065*