

Unveiling Antibiotic Stewardship in the ICU: A Cross-Sectional Study on Knowledge and Practices among Healthcare Professionals in Pakistan

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ABSTRACT

Objective: To assess and compare the understanding of antimicrobial resistance (AMR) and evaluate the prescribing patterns of antibiotics among healthcare professionals in the intensive care unit (ICU) of a tertiary care hospital in Pakistan.

Study Design: Cross sectional study.

Place and Duration of Study: Intensive Care Units of Combined Military hospital, Quetta Pakistan, from Feb to Jul 2023.

Methodology: Questionnaires were distributed to healthcare workers, including physicians, surgeons, neonatologists, gynecologists, and microbiologists, working in the ICU. Paramedical staff were excluded from the study. Data were collected through Google Sheets and analyzed using SPSS version 27.

Results: A total of 221 participants completed the questionnaire, with 82(35.2%) males and 139(59.7%) females. The majority of respondents 124(43.2%) had a bachelor's degree, while 97(41.6%) were postgraduates. The analysis segregated the responses based on the level of qualification and specialty of the participants. The level of education showed little impact on changes in knowledge and practices related to antibiotic stewardship. However, a significant difference ($p=0.025$) was observed regarding the use of local guidelines for antibiotic prescription. Junior doctors (53.0%) exhibited a higher inclination towards local procedures, while seniors disagreed.

Conclusion: This study revealed that the level of education had limited influence on the knowledge and practices of clinicians regarding antibiotic stewardship in the ICU. However, a significant difference was observed in the use of local guidelines between junior and senior doctors. The majority of participants agreed on the importance of involving microbiologists and organizing regular training sessions and clinical workshops for the successful implementation of an Antibiotic Stewardship Program.

Keywords: Antibiotic Stewardship, Antimicrobial Resistance, Healthcare Professionals, Intensive Care Unit, Prescribing Patterns.

How to Cite This Article: Ansari KS, Nawaz FS, Gul M, Sana F, Sana F, Bakhtawar F, Majeed K. Unveiling Antibiotic Stewardship in the ICU: A Cross-Sectional Study on Knowledge and Practices among Healthcare Professionals in Pakistan. *Pak Armed Forces Med J* 2026; 76(Suppl-7): S1062-S1067. DOI: <https://doi.org/10.51253/pafmj.v76iSUPPL-7.10881>

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INTRODUCTION

As the global concern surrounding bacterial resistance continues to escalate, improving antibiotic prescription practices has become an imperative task. Various interventions have shown success in changing practices for hospital patients.¹ Focusing on adherence to guidelines is essential to optimize therapy, prevent resistance, and enhance stewardship efforts. Continued efforts are needed to develop strategies promoting guideline adherence and evidence-based prescribing practices.² Antibiotic stewardship (ABS) plays a critical role in intensive care units (ICUs), where multidrug-resistant pathogens are common. Empirical treatment regimens are often prolonged unnecessarily or prescribed too broadly. Therefore,

effective ABS program is needed to minimize resistance risks in ICUs.³ In Pakistan, inappropriate antibiotic usage along inadequate infection control and antibiotic stewardship policies contributes to rising multidrug-resistant infections. Guidelines from the World Health Organization's Global Action Plan (GAP) were adopted in 2016 to address this issue and to improve the clinical outcomes associated with antibiotic use. Despite efforts, inappropriate usage persists, highlighting the need for further education and engagement of healthcare professionals.⁴ When choosing antimicrobial therapy, factors beyond cost must be considered. Cheaper antibiotics may lead to resistance and increased expenses. A comprehensive evaluation is necessary for effective selection.⁵

Several studies have previously investigated antibiotic usage and resistance in Pakistani intensive care units. However, there's a lack of data on the effectiveness of antibiotic stewardship programs (ASP)

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Received: 13 Sep 2023; revision received: 30 May 2025; accepted: 08 Aug 2025

specifically in ICU settings. Consequently, this study aims to assess knowledge regarding antimicrobial resistance (AMR) and prescribing patterns among healthcare professionals in an ICU setting to provide insights into antibiotic usage and resistance.

METHODOLOGY

This cross sectional study was carried out at CMH Quetta, Pakistan which was selected as the sole tertiary care hospital with an ICU in the province for a period of 6 months February to July 2023. Permission was granted from institutional ethical review board vide reference no: CMH QTA-IERB/07/2023. The sample size was calculated by using WHO sample size calculator keeping level of significance 5%, power of test 90%, keeping the probability of adequate knowledge of antibiotic stewardship among health professionals to be 45%⁶ and probability of inadequate knowledge about use of antibiotic stewardship among health professionals to be 29%.⁶ The sample size was estimated to be 190. The final sample size of 221 healthcare workers was calculated, approved by the Department of Community Health Sciences (CHS) at CMH Quetta.

Inclusion Criteria: The participants included healthcare workers from various specialties who were employed in intensive care units (ICUs). This encompassed physicians, neonatologists, microbiologists, surgeons, anesthetists, and house officers.

Exclusion Criteria: However, Nurses, ward boys and ayas were excluded.

The assessment of knowledge and practices was done by using a questionnaire, consisting of 20 carefully designed questions by collaboration of medicine and pathology department in accordance with the WHO ABS criteria and assessment tool.⁷ Its size was divided to ensure a focused and concise assessment of the participants' knowledge, perception, and practices related to ABS. They were distributed among the participants via Google Sheets.

The data collected from the completed surveys were subjected to analysis using the Statistical Package for the social sciences (SPSS) version 27:00 software. The statistical analysis aimed to explore various aspects related to the understanding of antimicrobial resistance (AMR) and the patterns of antibiotic prescription among the healthcare professionals in the ICU. The analysis of the collected data would provide valuable insights into the knowledge and practices of the participants, aiding in understanding the current scenario of antibiotic usage and resistance in the ICU

setting. Quantitative variables like age were depicted as mean and standard deviation. Qualitative data, such as qualification and different specialties were presented as frequency and percentage and compare by chi square test. The p -value <0.05 was considered statistically significant.

To analyze the responses, we segregated them in two ways: based on the level of qualification and based on the specialty of the participants. This allowed us to examine the data from different perspectives and gain insights into the differences and similarities in knowledge and practices among healthcare professionals with varying qualifications and specialties. By conducting this segmentation, we aimed to identify any patterns or trends that could provide valuable information for improving antibiotic stewardship and addressing antimicrobial resistance.

RESULTS

The study included a total of 221 participants, with 82(35.2%) being males and 139(59.7%) females. Most of the respondents, that's 124(43.2%) respondents, held a bachelor's degree (MBBS/BSN), while 97(41.6%) were postgraduates. The age distribution of the participants is presented in Table-I. One-hundred and twenty-three (55.6%) respondents were from medicine/allied medicine while only 18(8.1%) from surgery. There were 5(2.3%) neonatologists, 6(2.7%) microbiologists, 57(25.7%) house officers, 7(3.1%) gynecologists and 5(2.3%) anesthesiologists as shown in Table-II. There was no significant difference between the answers between both groups with p -value >0.05 in all questions except one which showed that Education level had minimal impact on knowledge and practices related to antibiotic stewardship. Junior doctors exhibited a higher inclination to follow local guidelines compared to senior doctors. A significant proportion of junior doctors 92(42.0%) emphasized the need for regular training sessions and 108(49.0%) of juniors recognized the value of collaboration with microbiologists to enhance stewardship practices. The comparison of responses between bachelors and postgraduates is made in Table-III with respective p -values.

Table-I: Demographic Distribution of Participants by Age Group and Educational Attainment (n=221)

Participants Education	Age Group: 20-29	Age Group: 30-49	Age Group: 50-59
Graduates (MBBS/BSN) n=124(43.2%)	100(80.6%)	22(17.74%)	02(1.61%)
Postgraduates n=97(41.6%)	47(48.45%)	44(45.36%)	06(6.18%)
Total	147(63.1%)	66(28.3%)	8(3.4%)

Table-II: Specialty and Gender Breakdown of Study Participants (n=221)

Specialty	Male	Female
Medicine: 123(55.6%)	42(34%)	81(66%)
Neonatologist: 5(2.3%)	3(60%)	2(40%)
Microbiologist: 6(2.7%)	2(33%)	4(67%)
House officer: 57(25.7%)	30(53%)	27(47%)
Gynecologist: 7(3.1%)	0(0)	7(100%)
Surgery: 18(8.1%)	14(78%)	4(22%)
Anesthetist: 5(2.3%)	3(60%)	2(40%)

Table-III: Antibiotic Stewardship Knowledge Among Participants: A Questionnaire-Based Analysis (n=221)

Questions	Categories	Bachelors n=124	Post- graduation n=97	p- value
Specific infection can be managed with a specific class of antibiotic agent	Agree	102(46%)	83(38%)	0.088
	Disagree	16(7%)	14(6%)	
	Undecided	6(3%)	0(0%)	
Stronger group of antibiotics are always safer and effective	Agree	115(52%)	93(42%)	0.203
	Disagree	5(2%)	4(2%)	
	Undecided	4(2%)	0(0%)	
Regular surveillance of antibiotic resistance pattern in the respective unit is necessary	Agree	61(28%)	44(20%)	0.104
	Disagree	48(22%)	48(22%)	
	Undecided	15(7%)	5(2%)	
Local antimicrobial protocols would be beneficial while considering empirical regimens	Agree	120(54%)	91(41%)	0.025
	Disagree	1(0%)	6(3%)	
	Undecided	3(1%)	0(0%)	
Active involvement of microbiologists have a positive role on antibiotic stewardship abs and infection control	Agree	108(49%)	86(39%)	0.138
	Disagree	7(3%)	9(4%)	
	Undecided	9(4%)	2(1%)	
I actively participate in awareness program regarding optimal use of antibiotic	Agree	99(45%)	72(33%)	0.517
	Disagree	11(5%)	9(4%)	
	Undecided	14(6%)	16(7%)	
It is beneficial to write appropriate clinic notes regarding antibiotic therapy on laboratory request form for cultures	Agree	116(52%)	90(41%)	0.911
	Disagree	3(1%)	2(1%)	
	Undecided	5(2%)	5(2%)	
Quality education should be given at all levels on antibiotic usage	Agree	119(54%)	88(40%)	0.257
	Disagree	1(0%)	1(0%)	
	Undecided	4(2%)	8(4%)	
Proper application of Antibiotic Stewardship Program can improve patient care and antibiotics resistance	Agree	117(53%)	94(43%)	0.641
	Disagree	3(1%)	1(0%)	
	Undecided	4(2%)	2(1%)	
Regular training session including clinical workshop are to be arranged for implantation of Antibiotic Stewardship Program	Agree	92(42%)	76(34%)	0.502
	Disagree	28(13%)	20(9%)	
	Undecided	4(2%)	1(0%)	
In my view the primary physician is the only professional who need to understand ABS	Agree	115(52%)	90(41%)	0.979
	Disagree	6(3%)	5(2%)	
	Undecided	3(1%)	2(1%)	
Health care staff plays a vital role in antibiotics and infection prevention and control programmers in the health system	Agree	117(53%)	96(43%)	0.147
	Disagree	3(1%)	1(0%)	
	Undecided	4(2%)	0(0%)	
I handover antibiotic without prescription	Agree	61(28%)	53(24%)	0.172
	Disagree	56(25%)	43(19%)	
	Undecided	7(5.6)	1(0%)	
I prescribe antibiotics in accordance to local antibiotic guidelines	Agree	97(44%)	84(38%)	0.276
	Disagree	21(10%)	10(5%)	
	Undecided	6(3%)	3(1%)	
I collaborate with others health care professional for infection control	Agree	14(4%)	16(7%)	0.045
	Disagree	84(38%)	79(36%)	
	Undecided	9(4%)	2(1%)	
I seek guidance from prescribers whenever i am unsure about the appropriate choice of an antibiotic	Agree	80(36%)	60(27%)	0.643
	Disagree	29(13%)	21(10%)	
	Undecided	15(7%)	16(7%)	
I make efforts regarding infection prevention and control in the society	Agree	Agree: 97(44%)	Agree: 66(30%)	0.200

DISCUSSION

Findings aligned with previous studies highlighting gaps in AMR awareness and prescribing

practices among healthcare professionals. While theoretical knowledge of antibiotic stewardship appeared sound, practical adherence varied by experience and specialty

A survey conducted in six public teaching hospitals in Lahore assessed the knowledge, attitudes, and practices of doctors towards antimicrobial resistance (AMR).⁸ The results indicated a concerning gap between doctors' understanding of AMR and their prescribing practices. Although physicians demonstrated awareness of the emerging resistance problem, their knowledge regarding appropriate antibiotic use and the consequences of AMR was inadequate. This was reflected in the misuse of antimicrobials, as they were prescribed even for mild upper respiratory tract infections.⁹ Moreover, prescribing multiple antibiotics per prescription was a common practice, raising concerns. These findings align with previous studies and highlight the widespread issues of AMR and inappropriate antibiotic prescribing.¹⁰ Patient demands, and limited understanding of appropriate antibiotic use were identified as factors influencing doctors' practices, emphasising the need for public awareness campaigns and patient education. Additionally, healthcare authorities need to address concerns related to the availability of standardised antibiotics and medicine quality.¹¹ This study underscores the importance of continuous medical education, interventions to improve knowledge, and collaborative efforts to promote appropriate antibiotic use, as addressing these challenges is crucial to mitigate the growing threat of AMR and ensure effective patient care.¹²

In another study, the predominance of gram-negative bacteria compared to gram-positive bacteria was observed among total bacterial isolates, aligning with a similar study conducted in 2012.¹⁰ The higher incidence of gram-negative bacteria may be attributed to their widespread presence in hospital environments and their frequent resistance to antibiotics, contributing to their persistence and dissemination. *Acinetobacter* spp and *Escherichia coli* (*E.coli*) were identified as the predominant gram-negative isolates, differing from previous studies that found *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. *E. coli* was the most frequent isolate in urinary tract infections, while *Acinetobacter* was prominent in respiratory tract samples. Tailoring empirical antibiotic therapy based on local antimicrobial resistance patterns is crucial, and ongoing surveillance is necessary to

monitor evolving patterns and resistance in gram-negative isolates, supporting effective antibiotic stewardship against multidrug-resistant bacteria.¹³

A study conducted in Lahore focused on the knowledge of pharmacists regarding antimicrobial stewardship (AMS).¹⁴ Out of the 414 pharmacists surveyed, 96.6% responded. While the pharmacists exhibited a satisfactory level of knowledge about antibiotics, their practices related to AMS were poor. Collaboration among pharmacists and other healthcare professionals regarding antibiotic use was infrequent, and a significant proportion of participants rarely engaged in AMS awareness campaigns. Poor AMS practices were associated with male sex, younger age, and less than one year of professional experience, as indicated by logistic regression analysis.¹⁵

A study conducted in Korea investigated the discontinuation of an Antimicrobial Stewardship Program (ASP) and its impact on antibiotic usage.¹⁶ In the general ward, there was an immediate increase in antibiotic usage, while in the ICU, the rise was even more significant. However, positive changes in the slope for restrictive antibiotic use were observed, accompanied by a decrease in the use of broad-spectrum antibiotics in the general ward. These findings highlight the critical role of ASPs in influencing and maintaining appropriate antibiotic prescribing practices. The study emphasizes the importance of sustaining such programs to ensure ongoing adherence to optimal antibiotic usage and combat the emergence of antibiotic resistance.¹⁷ A study conducted in a tertiary care hospital in Ecuador analyzed 16,984,355 prescriptions and found a high rate of antibiotic consumption.¹⁸ First-, second-, and third-line antibiotics accounted for a significant portion of the consumption, with broad-spectrum antibiotics frequently prescribed across various hospital areas. The implementation of an Antimicrobial Stewardship Program (ASP) in 2016 had a notable impact on reducing imipenem usage, while meropenem usage remained relatively stable.¹⁹ Out of the 78 neonatal nurses surveyed, 39% were highly knowledgeable about antibiotic stewardship. Most participants did not inquire about the choice, route, or dosage of antibiotics with the treating provider. Furthermore, the majority agreed that further education is necessary to effectively implement antibiotic stewardship principles in neonatal intensive care units.²⁰

We obtained cooperation from previous researchers and critical care organizations in Canada,

resulting in a large and comprehensive participant list. However, some intensivists outside these organizations may not have been contacted. The lack of standardization in ASP composition and design across Canada makes comparisons challenging. Our survey included various ASP components to encompass institutions with any form of ASP. However, self-reporting relies on respondents' understanding, and despite providing a clear definition, variations in interpretation may exist.¹⁶

The survey found that while most participants recognized the global importance of antimicrobial resistance (AMR), a significant number underrated its impact within their own hospitals. Surgeons who received regular reports on local AMR were less likely to underestimate the problem. The availability of systematic AMR reports, treatment guidelines, and advice from infectious diseases specialists were seen as valuable for improving antibiotic prescribing. Both persuasive and restrictive Antibiotic Stewardship Programs (ASPs) were considered helpful measures. Locally developed guidelines were preferred over national ones. Formal training in antibiotic prescribing was limited, but there was interest in receiving more training among those who had received it.¹⁷

The survey conducted among ICU physicians in Egypt revealed their impressive knowledge and strong awareness of antibiotic resistance as a global issue. The study emphasized the urgent need for implementing effective infection control and antimicrobial stewardship (AMS) programs in low- and middle-income countries (LMICs). These programs should include the implementation of local guidelines and comprehensive training on antibiotic prescription. The physicians' perceptions of antibiotic resistance were influenced by factors such as the type of hospital, ICU setting, and years of experience, highlighting the importance of considering these factors when establishing AMS programs.¹⁸ Another study implemented an education-based antibiotic stewardship program at two regional hospitals in Denmark to reduce antibiotic consumption, particularly cephalosporins and fluoroquinolones. The program included education, guidelines, audits, feedback, and ward rounds by a clinical microbiologist. The results showed improvements in junior doctors' knowledge, attitudes, and prescribing practices. However, antibiotic consumption did not significantly decrease, indicating that additional measures may be needed to reduce overall antibiotic use.¹⁹

In contrast to the findings of the previously mentioned studies,²⁰ our study specifically examined the impact of education level on the knowledge and practices of clinicians regarding antibiotic stewardship in the intensive care unit (ICU). Surprisingly, the results indicated that education level had limited influence on clinicians' understanding and implementation of antibiotic stewardship principles in this particular setting.

However, a significant difference was observed when it came to the use of local guidelines between junior and senior doctors. Senior doctors, who likely had more experience and exposure to clinical practice, were found to be more inclined to follow the recommended local guidelines for antibiotic prescribing. This suggests that clinical experience and exposure to evidence-based practices play a crucial role in shaping clinicians' adherence to antibiotic stewardship protocols. Interestingly, the majority of participants across all levels of experience and education agreed on the importance of involving microbiologists and organising regular training sessions and clinical workshops. This highlights the recognition among clinicians of the need for continuous education and collaboration with experts in the field to enhance their knowledge and skills in antibiotic stewardship. These findings underscore the importance of ongoing efforts to provide continuous medical education and training opportunities for clinicians, particularly in the ICU setting. It is imperative to bridge the gap between theoretical knowledge and practical implementation of antibiotic stewardship principles.^{21,22} By involving microbiologists and organising regular training sessions and workshops, healthcare institutions can empower clinicians with the necessary tools and knowledge to make informed decisions regarding antibiotic use, ultimately promoting responsible antibiotic stewardship practices in the ICU and combating the emergence of antibiotic resistance.

LIMITATION OF STUDY

The major limitation of the study was that the survey was conducted online so we cannot say with definite certainty that the level of knowledge these scores depict are true scores. Secondly not all the specialties were covered in the survey.

CONCLUSION

In conclusion, the study findings underscored that while the level of qualification had limited influence on clinicians' knowledge and practices, differences existed in the use of local guidelines. Furthermore, participants

emphasized the importance of involving microbiologists and the need for regular training sessions and clinical workshops. These insights can inform future interventions and initiatives aimed at enhancing antibiotic stewardship practices and ultimately improving patient care.

ACKNOWLEDGEMENT

Special thanks to Amal Awais Khan for helping in this study.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

KSA & FSN: Data acquisition, data analysis, critical review, approval of the final version to be published.

MG & FS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

FB & KM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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