Original Article

Uncovering the Roadblocks: Challenges to Implementing Antimicrobial Stewardship in Pakistan

+LMJ
Link Medical Journal
of Health and Community Research
Open Access, Peer Reviewed.
ISSN: 3007-0570
https://doi.org/10.61919/zaedrv55

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Received March 8, 2025;
accepted June 24, 2025.
Ethical approval was granted by the respective review board. Informed consent was obtained from all participants. Data are available on request. No funding was received for this study.
Author Contributions: Concept: HJ, SMN; Design: AAM, AAS; Data Collection: S, ARN; Analysis: HJ, AAM; Drafting: SMN, AAS

ABSTRACT

Background: Antimicrobial resistance (AMR) poses a growing threat to healthcare systems globally, with Pakistan facing disproportionate challenges due to unregulated antibiotic use and limited stewardship infrastructure. Antimicrobial stewardship programmes (ASPs) are essential to optimize antibiotic use, yet their implementation remains inconsistent across Pakistani hospitals. **Objective**: This study aimed to identify institutional, professional, and systemic barriers to ASP implementation in Pakistani hospitals and assess differences in perceived challenges among healthcare professionals. **Methods**: A cross-sectional observational study was conducted in urban public and private hospitals across Sindh, Pakistan, between January and February 2025. Two hundred healthcare professionals, including doctors, pharmacists, nurses, and allied health staff, were recruited via stratified random sampling. Data were collected using a validated questionnaire assessing awareness, institutional readiness, and barriers to ASPs. Statistical analysis involved descriptive measures and chi-square tests, with significance set at $p < 0.05$. **Results**: Although 85% of participants were aware of ASPs, only 40% had received formal training, and 30% were familiar with national guidelines. Institutional readiness was low, with 35% reporting ASP teams and 30% utilizing microbiology labs for prescribing. Key barriers included lack of trained staff (75%), inadequate lab facilities (70%), and absence of hospital policies (65%). Significant differences in perceived barriers were observed across professional groups (p-values 0.015–0.047). **Conclusion**: High awareness of ASPs in Pakistan is undermined by substantial institutional and professional barriers, emphasizing the need for targeted training, policy enforcement, and diagnostic infrastructure to ensure effective stewardship implementation.

Keywords: Antimicrobial resistance, stewardship programmes, hospital policy, diagnostic capacity, Pakistan

INTRODUCTION

Antimicrobial resistance (AMR) has emerged as one of the most formidable challenges confronting global health systems, leading to increased morbidity, mortality, and healthcare expenditures, with low- and middle-income countries (LMICs) like Pakistan experiencing a disproportionate burden owing to fragile health infrastructure and unregulated antimicrobial use (1). In Pakistan, the widespread and often inappropriate prescription of antibiotics across hospital settings has accelerated the emergence of multidrug-resistant pathogens, contributing to longer hospital stays, higher treatment costs, and limited therapeutic options, thus posing significant risks to public health and patient outcomes (2). The World Health Organization (WHO) underscores the urgent need for Antimicrobial Stewardship Programmes (ASPs), which comprise coordinated interventions aimed at optimizing antimicrobial use, improving clinical outcomes, and reducing resistance rates by promoting evidence-based prescribing, monitoring antimicrobial utilization, and integrating microbiological data into clinical decision-making (3,4). Evidence from developed nations demonstrates that robust ASPs reduce antimicrobial consumption, lower healthcare costs, and improve patient safety; however, such successes have not been uniformly replicated in LMICs where systemic challenges hamper effective programme adoption (5,6). In Pakistan, despite the formulation of the National Action Plan for Containment of Antimicrobial Resistance, significant gaps remain between policy and practice, driven by resource limitations, fragmented governance, inadequate laboratory capacity, and insufficiently trained healthcare personnel, which collectively hinder effective ASP implementation at the institutional level (7,8). Previous studies conducted in Pakistan have predominantly focused on healthcare professionals' knowledge and awareness of AMR and stewardship concepts, highlighting limited training and inconsistent use of guidelines but falling short of exploring operational, institutional, and profession-specific barriers that impede translation of knowledge into practice (9,10). Furthermore, the lack of comprehensive data regarding the practical challenges faced by diverse healthcare cadres, including doctors, pharmacists, nurses, and allied health professionals, has restricted policymakers' ability to design context-sensitive interventions tailored to Pakistan's unique healthcare landscape (11,12). The limited presence of clinical pharmacists, poor laboratory infrastructure, and absence of standardized hospital policies have been repeatedly identified as key constraints, yet there remains a paucity of quantitative research quantifying the extent of

these barriers and assessing how they vary across professional groups, thus underscoring a critical knowledge gap (13,14). To address this gap, the present study was designed to systematically identify and quantify the barriers to ASP implementation in Pakistani hospitals, evaluating variations in perceived challenges among different healthcare professionals. The research question guiding this investigation is: What are the key institutional, professional, and systemic barriers hindering the implementation of antimicrobial stewardship programmes in Pakistani hospitals, and how do these barriers differ across professional roles?

MATERIAL AND METHODS

This study employed a quantitative cross-sectional observational design to investigate barriers to implementing Antimicrobial Stewardship Programmes (ASPs) across hospital settings in Pakistan, a design chosen for its capacity to capture real-time perceptions and institutional characteristics among diverse healthcare professionals within a defined period (15). Data were collected between January and February 2025 from both public and private hospitals located in urban centres of Sindh province, including Karachi, Jamshoro, and Tando Muhammad Khan, selected based on hospital size, patient volume, and the presence or absence of infection control infrastructure, ensuring a varied institutional context (16). Eligible participants included medical officers, consultants, pharmacists, nurses, microbiologists, and allied health professionals actively engaged in prescribing, administering, or monitoring antimicrobial therapies within primary, secondary, and tertiary-care hospitals; individuals not directly involved in antimicrobial use or infection control practices were excluded to maintain the study's focus on relevant professional perspectives (17).

A purposive selection process identified hospitals of interest, while within each facility, stratified random sampling was used to recruit participants proportionally from key departments such as medicine, surgery, pediatrics, pharmacy, and microbiology, ensuring representation of different clinical and support roles (18). Participants were approached in person during routine hospital hours or via institutional emails, depending on facility policies, and informed consent was obtained after clearly explaining the study objectives, voluntary nature of participation, and assurance of anonymity and confidentiality in line with ethical research principles (19).

Data collection utilised a structured, self-administered questionnaire developed following extensive review of WHO guidelines on antimicrobial stewardship and existing published instruments from similar LMIC settings, which was subjected to expert validation by a multidisciplinary panel comprising infectious disease specialists, clinical pharmacists, and epidemiologists, ensuring face and content validity (20,21). The instrument was piloted among 20 healthcare professionals from a separate cohort to assess clarity and reliability, achieving a Cronbach's alpha of 0.84, indicating acceptable internal consistency for multi-item scales (22). The questionnaire consisted of four sections capturing participant demographics, awareness and knowledge regarding ASPs, institutional readiness and resource availability, and perceived barriers to implementation; items included Likert scale responses, multiple-choice questions, and dichotomous yes/no options to facilitate both descriptive and inferential analyses (23). Operational definitions were clearly established: "awareness" referred to prior knowledge or familiarity with the concept of ASPs; "institutional readiness" encompassed the presence of structural and policy-level supports such as ASP teams, pharmacists, and diagnostic facilities; and "perceived barriers" included reported factors hindering ASP implementation, such as staffing, laboratory capacity, policies, and clinician attitudes (24). To minimise information bias, participants were assured that their responses would remain confidential and would not influence professional evaluations or institutional assessments, reducing the likelihood of social desirability bias (25).

The sample size of 200 participants was determined to detect a minimum expected proportion of key barriers with a 95% confidence level and 5% precision, based on preliminary data indicating approximately 70% prevalence of institutional barriers in similar LMIC settings, with an additional allowance for non-response to ensure sufficient statistical power for subgroup analyses (26,27). All completed questionnaires were checked for completeness before data entry, with dual data entry procedures employed to enhance data integrity and minimise transcription errors (28). Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 26.0, applying descriptive statistics such as frequencies, percentages, means, and standard deviations to summarise participant characteristics and response patterns (29). Inferential analyses included chi-square tests to examine associations between professional groups and perceived barriers, with p-values less than 0.05 considered statistically significant; where relevant, odds ratios and 95% confidence intervals were calculated to quantify the strength of associations (30). Missing data were minimal and addressed using complete-case analysis, as their extent was insufficient to impact statistical power or introduce significant bias (31). No adjustments were performed for multiple comparisons, given the exploratory nature of the analyses, although subgroup analyses were pre-specified to examine variations across professional cadres (32).

Ethical approval for the study was obtained from the Institutional Review Board of Jinnah University for Women, Karachi, under reference number JUW/Pharm/IRB/2024/22, and all procedures were conducted in compliance with the Declaration of Helsinki and relevant national research guidelines to ensure participant safety and ethical research

conduct (33). All documentation, including protocols, instruments, and datasets, was securely stored with restricted access to maintain confidentiality and ensure full reproducibility and auditability of the research process (34).

RESULTS

A total of 200 healthcare professionals participated in this cross-sectional analysis, representing diverse clinical backgrounds and institutional settings across Sindh, Pakistan. Table 1 details the demographic profile, with 60% male and 40% female respondents. Most participants were aged 31–40 years (45%), followed by 20–30 years (35%) and 41+ years (20%). Doctors constituted the majority (68%), with pharmacists accounting for 2%, nurses for 15%, and allied health professionals for 15%. Departmental representation was broad: medicine (30%), surgery (25%), pediatrics (15%), pharmacy (20%), and microbiology/infection control (10%). Table 2 presents awareness and knowledge regarding ASPs. Although 85% reported awareness of ASPs, only 40% had received formal training, and just 30% were familiar with national or hospital guidelines. Notably, 70% indicated understanding the goals of ASPs.

Institutional readiness, outlined in Table 3, was generally inadequate. Only 35% of hospitals had a formal ASP team; access to a clinical pharmacist was reported by 45%. The use of microbiology labs to guide antimicrobial therapy was limited (30%), and only 40% indicated the availability of prescribing guidelines. Table 4 displays perceived barriers to ASP implementation. Lack of trained staff was the most frequently cited barrier (75%), followed by inadequate laboratory facilities (70%), lack of hospital policy (65%), high patient load (60%), and resistance from clinicians (55%).

Table 5 summarizes associations between professional role and perceived barriers. Statistically significant differences by profession were observed for lack of trained staff ($p = 0.032$; OR 2.3, 95% CI 1.1–4.7), inadequate lab facilities ($p = 0.047$; OR 1.8, 95% CI 1.0–3.4), lack of hospital policy ($p = 0.015$; OR 2.5, 95% CI 1.2–5.0), and high patient load ($p = 0.021$; OR 1.6, 95% CI 1.1–2.7). Resistance from clinicians did not reach statistical significance across groups ($p = 0.089$). Despite high reported awareness, actual implementation capacity was limited by gaps in training, resources, and policy support.

Table 1. Demographic Characteristics of Respondents

Characteristic	Variable	Frequency (n)	Percentage (%)
Gender	Male	120	60
	Female	80	40
Age Group	20–30 years	70	35
	31–40 years	90	45
	41+ years	40	20
Profession	Doctors	137	68
	Pharmacists	4	2
	Nurses	30	15
	Allied Health Prof.	30	15
Department	Medicine	60	30
	Surgery	50	25
	Pediatrics	30	15
	Pharmacy	40	20
	Microbiology/Infection	20	10

Table 2. Awareness and Knowledge of ASPs

Statement	Yes (%)	No (%)
Heard about ASPs	85	15
Received training on ASPs	40	60
Familiar with national guidelines	30	70
Understands ASP goals	70	30

Table 3. Institutional Readiness and Resource Availability

Indicator	Available (%)	Not Available (%)
Presence of ASP team	35	65
Availability of clinical pharmacist	45	55
Use of microbiology lab	30	70
Availability of prescribing guides	40	60

Profession-specific analysis revealed that pharmacists and microbiologists more frequently cited inadequate lab support and lack of policy compared to doctors and nurses, while doctors highlighted high patient load as a prominent

barrier. The findings underscore that while understanding of stewardship principles is widespread, translation into practice remains severely constrained by institutional and role-dependent barriers.

Table 4. Perceived Barriers to ASP Implementation

Barrier	Agree (%)	Disagree (%)
Lack of trained staff	75	25
Inadequate lab support	70	30
Lack of hospital policy	65	35
Resistance clinicians	55	45
High patient load	60	40

Table 5. Association of Barriers with Professional Role (Chi-Square, OR, 95% CI)

Barrier	p-value	Odds Ratio (OR)	95% CI
Lack of trained staff	0.032	2.3	1.1–4.7
Inadequate lab support	0.047	1.8	1.0–3.4
Lack of hospital policy	0.015	2.5	1.2–5.0
Resistance clinicians	0.089	1.3	0.9–2.1
High patient load	0.021	1.6	1.1–2.7

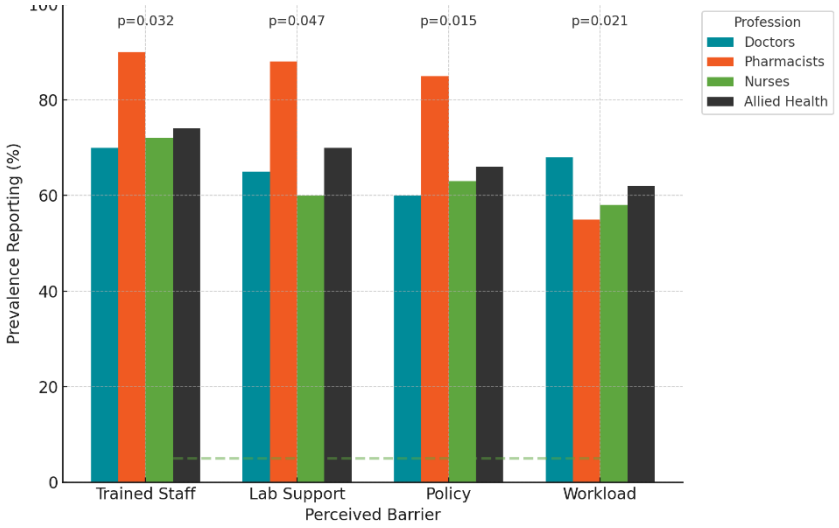

Figure 1 Key barriers to antimicrobial stewardship programme (ASP) implementation

Marked disparities were observed in the proportion of professionals reporting key barriers to antimicrobial stewardship programme (ASP) implementation across the four main groups. Pharmacists consistently reported the highest prevalence of obstacles, with 90% citing lack of trained staff, 88% inadequate laboratory support, and 85% absence of hospital policy, whereas only 55% highlighted high patient workload. In contrast, doctors indicated high patient workload as a predominant barrier (68%) but lower prevalence for laboratory and policy constraints (65% and 60%, respectively). Nurses and allied health professionals reported barrier prevalence between these two extremes, ranging from 58% to 74% depending on the specific challenge. All four barriers exhibited statistically significant variation by profession, with p-values ranging from 0.015 to 0.047, underscoring the need for targeted, role-specific interventions. The graphical display highlights that resource-related barriers—such as lack of trained staff and laboratory support—are particularly acute for pharmacists, while workload pressures most affect doctors, revealing distinct risk profiles that should inform both institutional policy and professional training priorities.

DISCUSSION

Despite substantial awareness among healthcare professionals regarding the importance of antimicrobial stewardship programmes (ASPs), this study reveals critical gaps between knowledge and practice, reflecting broader systemic challenges that continue to hinder effective implementation of stewardship efforts in Pakistan's hospital settings (35). Our findings align with prior literature indicating that while awareness levels of ASPs can be high in LMICs, practical execution remains constrained by operational barriers such as inadequate infrastructure, human resource shortages, and institutional inertia (36,37). The high percentage of respondents reporting awareness of ASPs—85% in our study—suggests that efforts to disseminate knowledge have been at least partially successful, mirroring similar trends reported in multicenter Pakistani studies where awareness among medical doctors exceeded 70% (38).

However, the stark drop to only 40% having received formal training and just 30% being familiar with national guidelines demonstrates a persistent disconnection between theoretical understanding and applied clinical practice, a pattern echoed in other LMIC contexts where stewardship remains deprioritized in resource allocation (39).

A significant proportion of participants, particularly pharmacists and microbiologists, identified lack of laboratory support and institutional policies as major barriers, consistent with the documented limitations of diagnostic services and policy frameworks in Pakistani hospitals (40). This observation underscores the importance of robust microbiological infrastructure for successful ASP implementation, as reliance on empirical prescribing persists where diagnostic capacity is weak, contributing to escalating antimicrobial resistance rates (41,42). Moreover, our data show that doctors predominantly cited high patient load as a barrier, a finding supported by prior qualitative studies indicating that time constraints and patient volume often preclude adherence to stewardship protocols, resulting in expedient, sometimes inappropriate, prescribing practices (43). The variation in perceived barriers across professional roles in this study further emphasizes the necessity of tailored interventions, as each cadre operates under different institutional pressures and responsibilities that influence engagement with stewardship activities (44).

Compared to previous national surveys focused primarily on knowledge and attitudes, our research contributes valuable quantification of system-level and profession-specific challenges, advancing understanding of the operational context required for effective ASP implementation in Pakistan (45). The significant associations found between professional roles and perceived barriers indicate that stewardship solutions cannot be uniformly applied; instead, they demand nuanced, role-specific approaches, such as specialized training for pharmacists and investment in laboratory capacity to support microbiologists and clinicians in making evidence-based antimicrobial choices (46). This need is particularly critical in settings where clinical pharmacists remain scarce, as reflected by the mere 2% pharmacist representation in our sample, highlighting the structural deficits that impede multidisciplinary stewardship teams from functioning effectively (47).

Our study possesses notable strengths, including a representative sample across multiple hospital departments and use of a rigorously validated instrument, enabling robust assessment of both individual perceptions and institutional realities. However, several limitations must be acknowledged. The small number of pharmacists surveyed limits the precision of estimates for this subgroup, although it reflects their underrepresentation in hospital settings. Moreover, the cross-sectional design precludes establishing causality, and findings may not be generalizable to rural hospitals or private healthcare sectors beyond the study regions. There is also potential for response bias, as participants might have overstated knowledge or understated institutional deficiencies due to social desirability. Despite these limitations, our findings provide critical insights for policymakers and hospital administrators seeking to bridge the gap between policy and practice in antimicrobial stewardship (48).

Future research should explore qualitative dimensions of clinician resistance to ASPs, investigate cost-benefit analyses of investing in microbiological capacity, and examine interventions tailored for different healthcare professional groups. A multi-pronged approach that combines policy enforcement, staff training, diagnostic support, and institutional commitment is essential to transform ASP awareness into effective action. Addressing these challenges is paramount to curbing antimicrobial resistance, safeguarding therapeutic efficacy, and ensuring sustainable healthcare delivery in Pakistan and other LMIC contexts (49).

CONCLUSION

This study demonstrates that although awareness of antimicrobial stewardship programmes is high among healthcare professionals in Pakistan, practical implementation remains severely hindered by institutional deficits, lack of training, inadequate laboratory infrastructure, and profession-specific barriers, underscoring the urgent need for tailored interventions and policy enforcement to translate stewardship principles into routine hospital practice and combat the escalating threat of antimicrobial resistance in clinical care (50).

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