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IMPACT OF AN ANTIBIOTIC STEWARDSHIP INTERVENTION ON ANTIBIOTIC USE AND HEALTH-CARE-ASSOCIATED INFECTION RATES

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ABSTRACT

Background: Antimicrobial resistance is a global health threat, driven in large part by irrational antibiotic prescribing in hospitals. Antibiotic stewardship programs (ASPs) are evidence-based strategies to optimize antibiotic use, reduce resistance, and improve patient outcomes. This study evaluated the impact of an antibiotic stewardship intervention on antibiotic consumption and health-care-associated infection (HAI) rates at Ch. Pervaiz Elahi Institute of Cardiology, Multan.

Methods: A prospective interventional study was conducted on 300 patients admitted between January and June 2025. Patients were divided into two groups: pre-intervention (n=150) and post-intervention (n=150). The stewardship program included prescriber education, guideline dissemination, and audit-feedback mechanisms. Outcomes assessed included antibiotic consumption, appropriateness of prescribing, and incidence of HAIs. Data were analyzed using chi-square and t-tests, with $p<0.05$ considered significant.

Results: The average number of antibiotic prescriptions per patient declined from 2.4 in the pre-intervention phase to 1.7 in the post-intervention phase ($p<0.01$). Use of carbapenems decreased significantly from 30.0% to 14.0%, while third-generation cephalosporin use declined from 36.0% to 26.0%. Inappropriate prescriptions were reduced from 44.7% to 20.0% ($p<0.001$). HAI incidence decreased from 8.0% (12/150) in the pre-intervention group to 3.3% (5/150) in the post-intervention group ($p=0.04$). No significant differences were observed in mortality (4.0% vs. 3.3%) or mean hospital stay (6.8 vs. 6.5 days).

Conclusion: The stewardship intervention led to substantial improvements in antibiotic prescribing and a reduction in HAIs without adverse effects on patient safety. Sustained ASP implementation is recommended to combat antimicrobial resistance and enhance patient outcomes in resource-limited hospital settings.

INTRODUCTION

Antimicrobial resistance (AMR) is an escalating global public health threat that undermines the effectiveness of modern medicine and complicates routine clinical care. The World Health Organization (WHO) highlights that AMR increases the risk of treatment failure, prolonged hospital stay, and death, and calls for urgent multisectoral action to preserve the utility of existing antimicrobials [1]. Recent analyses have documented a continuing rise in global antibiotic consumption driven by expanding access in some regions and persistent inappropriate use in others which increases selective pressure for resistant organisms and further aggravates the AMR burden [2].

Hospitals are key settings where antibiotic exposure and AMR interact: complex patients, frequent device use, invasive procedures, and high antibiotic prescribing rates create an environment conducive to the selection and transmission of resistant organisms and to health-care-associated infections (HAIs). Reducing unnecessary and inappropriate antibiotic use in hospitals is therefore a cornerstone of national AMR strategies and patient-safety initiatives. Antimicrobial stewardship programs (ASPs) defined as coordinated interventions that promote the appropriate use of antimicrobials, optimize clinical outcomes, and limit unintended consequences such as resistance and *Clostridioides difficile* infection have been implemented across many health systems with demonstrated benefits in antibiotic consumption and process measures [3,4].

A growing body of evidence, including recent systematic reviews and meta-analyses, indicates that ASPs consistently reduce total antibiotic use and improve prescribing appropriateness. Several pooled analyses have also reported reductions in adverse outcomes such as *C. difficile* infections and infections caused by resistant organisms [3,5]. Importantly, these benefits appear reproducible across diverse stewardship strategies from pre-authorization and prospective audit with feedback to guideline implementation and pharmacist-led interventions although the magnitude of effect varies with the intensity of the intervention, local epidemiology, and concurrent infection-prevention practices [4,6].

Despite strong international evidence, substantial gaps remain in stewardship implementation and reporting from low- and middle-income countries (LMICs), where resource constraints, limited microbiology capacity, and different prescribing cultures pose unique challenges. Recent reviews focused on LMIC settings show that stewardship interventions can be effective in improving guideline adherence and reducing antibiotic use, but emphasize heterogeneity between studies and the need for contextually adapted, sustainable models that integrate microbiology, pharmacy, and infection prevention [7,8]. Moreover, national policy momentum is variable: while global frameworks and technical guidance from WHO encourage adoption of ASPs, many countries including Pakistan are still in the early stages of operationalizing national action plans and scaling hospital-level stewardship programs. Evaluations of Pakistan's national AMR response have identified gaps in routine surveillance, antibiotic-use monitoring, and structured stewardship implementation across tertiary hospitals [9,10].

Cardiac tertiary centres represent a particularly important but understudied environment for stewardship research. Patients undergoing cardiac surgery and interventional cardiology procedures are frequently exposed to prophylactic and empirical antibiotic therapy, and device-related infections can carry high morbidity. In such centres, stewardship strategies must balance the imperative to prevent surgical-site and device-related infections against the goal

of minimizing unnecessary broad-spectrum exposure demanding locally tailored guidelines, timely microbiology support, and close collaboration between stewardship teams and surgical/cardiac services. Evidence from other specialized hospital units suggests that targeted stewardship bundles (e.g., standardized prophylaxis protocols, prospective review of empirical therapy, and mandatory stop/review dates) can achieve meaningful reductions in broad-spectrum antibiotic use without compromising clinical outcomes [6,11].

Given the burden of inappropriate antibiotic use in many Pakistani hospitals and the relative paucity of published stewardship interventions from tertiary cardiac centres in the region, rigorous evaluation of a locally adapted ASP at Ch. Pervaiz Elahi Institute of Cardiology is both timely and necessary. Such work can demonstrate feasible stewardship models that integrate local antibiogram data, pre-authorization policies for key agents, prospective audit with feedback, and close linkage with infection-prevention programs and can provide empirical evidence on whether reductions in antibiotic consumption translate into lower HAI incidence in this high-risk setting [7,9].

METHODS

This prospective interventional study was conducted at Ch. Pervaiz Elahi Institute of Cardiology, Multan, from January to June 2025. A total of 300 patients admitted to different wards were included, with 150 patients assessed in the pre-intervention phase and 150 in the post-intervention phase. Patients were selected using consecutive sampling, and those with less than 48 hours of hospital stay or incomplete records were excluded. The stewardship intervention consisted of prescriber education, dissemination of antibiotic guidelines, and audit-feedback sessions aimed at promoting rational use of antimicrobials. Data were collected on antibiotic prescriptions, their appropriateness based on institutional guidelines, and incidence of health-care-associated infections (HAIs). Appropriateness was assessed by two independent microbiologists according to drug choice, dose, duration, and de-escalation practices. The primary outcomes were antibiotic consumption per patient, rate of inappropriate prescriptions, and HAI incidence. Secondary outcomes included length of hospital stay and in-hospital mortality. Data were analyzed using SPSS version 26. Categorical variables were compared using chi-square test, while continuous variables were analyzed with independent t-test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 300 patients were included in the study, with 150 in the pre-intervention phase and 150 in the post-intervention phase. The baseline demographic and clinical characteristics, including age, sex, and type of cardiac procedures, were comparable between the two groups, ensuring that differences in outcomes were attributable to the stewardship intervention rather than patient heterogeneity.

Antibiotic consumption showed a notable reduction after the implementation of the stewardship program. The average number of antibiotic prescriptions per patient decreased from 2.4 in the pre-intervention phase to 1.7 in the post-intervention phase, representing a 29% relative reduction. Use of broad-spectrum antibiotics, particularly carbapenems and third-generation cephalosporins, also declined significantly. These changes are detailed in Table 1.

In terms of prescribing quality, inappropriate antibiotic prescriptions were markedly reduced. Before the intervention, 67 out of 150 patients (44.7%) received at least one inappropriate antibiotic prescription, most commonly due to prolonged duration or lack of de-escalation. After the intervention, only 30 patients (20.0%) had inappropriate prescriptions, reflecting a statistically

significant improvement in adherence to stewardship guidelines (Table 2).

The incidence of health-care-associated infections (HAIs) also declined. In the pre-intervention group, 12 patients (8.0%) developed HAIs, compared with 5 patients (3.3%) in the post-intervention group, corresponding to a relative reduction of 58%. The majority of infections were device-associated, with central line–associated bloodstream infections and catheter-associated urinary tract infections being the most frequent. Details are presented in Table 3.

No significant differences were observed in mean length of hospital stay or mortality between groups. The average length of stay was 6.8 ± 2.1 days in the pre-intervention group and 6.5 ± 1.9 days in the post-intervention group. Mortality rates were 4.0% (6/150) before intervention and 3.3% (5/150) afterward, showing no adverse impact on patient safety.

Table 1. Antibiotic use per patient before and after intervention (n=300)

Antibiotic class	Pre-intervention (n=150)	Post-intervention (n=150)	% Change	p-value
Mean antibiotics per patient	2.4	1.7	–29.0%	<0.01
Carbapenems	45 (30.0%)	21 (14.0%)	–53.3%	<0.01
3rd-generation cephalosporins	54 (36.0%)	39 (26.0%)	–27.8%	0.04
Fluoroquinolones	27 (18.0%)	19 (12.7%)	–29.4%	0.08
Glycopeptides	12 (8.0%)	9 (6.0%)	–25.0%	0.42

Table 2. Appropriateness of antibiotic prescribing (n=300)

Category	Pre-intervention (n=150)	Post-intervention (n=150)	p-value
Appropriate prescriptions	83 (55.3%)	120 (80.0%)	<0.001
Inappropriate prescriptions	67 (44.7%)	30 (20.0%)	<0.001
Most common inappropriate cause	Prolonged duration (26%)	Prolonged duration (12%)	–

Table 3. Health-care-associated infection (HAI) incidence (n=300)

Infection type	Pre-intervention (n=150)	Post-intervention (n=150)	Relative reduction	p-value
Overall HAI	12 (8.0%)	5 (3.3%)	–58%	0.04
CLABSI	4 (2.7%)	2 (1.3%)	–52%	0.38
VAP	5 (3.3%)	2 (1.3%)	–61%	0.24
CAUTI	3 (2.0%)	1 (0.7%)	–67%	0.31

DISCUSSION

This study demonstrated that the implementation of an antibiotic stewardship intervention at Ch. Pervaiz Elahi Institute of Cardiology, Multan, was associated with a significant reduction in antibiotic consumption, improved prescribing appropriateness, and a decline in health-care-

associated infection rates, without adversely affecting patient safety outcomes such as mortality or length of stay. These findings provide compelling evidence for the value of structured stewardship programs in a tertiary care cardiac center in Pakistan.

The reduction in overall antibiotic use, from a mean of 2.4 to 1.7 prescriptions per patient, highlights the effectiveness of targeted interventions such as prescriber education, feedback, and guideline reinforcement. This aligns with findings from recent international studies, where stewardship programs have been shown to reduce broad-spectrum antibiotic use by 20–40% (1,2). In particular, the marked decline in carbapenem and third-generation cephalosporin use reflects a positive shift away from empiric broad-spectrum coverage, which is crucial in minimizing antimicrobial resistance in high-risk hospital settings (3).

Prescribing appropriateness improved significantly in our study, with inappropriate prescriptions decreasing from 44.7% to 20.0%. This improvement is consistent with studies conducted in both high-income and resource-limited settings, where inappropriate use often accounts for up to half of all antibiotic prescriptions (4,5). The most common cause of inappropriate prescribing in our study was prolonged duration of therapy, which is similar to findings reported in regional data from South Asia (6). By enforcing guideline-based duration and de-escalation practices, our intervention directly addressed these shortcomings.

The decline in HAIs, particularly the reduction in overall infection rates from 8.0% to 3.3%, is clinically significant. Although subgroup reductions in CLABSI, VAP, and CAUTI did not reach statistical significance due to smaller numbers, the downward trend mirrors results from stewardship programs in intensive care and surgical units worldwide (7,8). A likely explanation is that reduced unnecessary antibiotic exposure lowers the risk of resistant infections and opportunistic pathogens, thereby contributing to improved infection control.

Importantly, these improvements were not accompanied by adverse clinical outcomes. Mortality and hospital stay remained stable across both groups, reinforcing that stewardship interventions can safely reduce antibiotic use without compromising patient care. This finding is particularly relevant in the Pakistani context, where physicians may be hesitant to restrict antibiotics due to fear of treatment failure. Our results reassure that rationalizing antibiotic use is not only safe but also beneficial in reducing infection-related complications (9).

The study has several strengths, including its prospective design, clearly defined intervention, and the use of a balanced sample size across both phases. However, certain limitations must be acknowledged. First, the study was conducted at a single cardiac tertiary care hospital, which may limit generalizability to other institutions with different patient populations. Second, we did not assess the long-term impact of the intervention on antimicrobial resistance patterns, which would provide further insight into sustainability. Finally, the relatively small number of HAIs limited statistical power for subgroup analyses.

Despite these limitations, our findings add to the growing body of evidence supporting stewardship programs in low- and middle-income countries. In a setting such as Pakistan, where antimicrobial resistance poses a serious public health challenge, implementing structured stewardship initiatives can serve as a cost-effective strategy to optimize antibiotic use and improve patient outcomes (10,11). Sustained efforts, including continuous education, audit-feedback mechanisms, and integration with infection control policies, are essential to maximize long-term benefits.

CONCLUSION

The antibiotic stewardship intervention implemented at Ch. Pervaiz Elahi Institute of Cardiology, Multan, significantly reduced antibiotic consumption, improved prescribing appropriateness, and lowered health-care-associated infection rates without compromising patient safety. The decline in inappropriate prescriptions and broad-spectrum antibiotic use highlights the effectiveness of structured stewardship practices in optimizing therapy. Importantly, reductions in HAIs were achieved while maintaining stable mortality and hospital stay. These findings underscore the vital role of stewardship programs in combating antimicrobial resistance in resource-limited settings. Sustained implementation and expansion of such initiatives are essential to enhance patient outcomes and preserve antibiotic effectiveness.

REFERENCES

1. World Health Organization. Global action plan on antimicrobial resistance: five years later. *WHO Bulletin*. 2020;98(6):377–377A. doi:10.2471/BLT.20.271072
2. Klein EY, Milkowska-Shibata M, Tseng KK, Sharland M, Gandra S, Pulcini C, et al. Assessment of global trends in antibiotic consumption, 2000 to 2018. *eClinical Medicine*. 2021;41:101152. doi:10.1016/j.eclinm.2021.101152
3. Baur D, Leung V, Baier C, Keller SC, Resman F, Tängdén T. Review of antimicrobial stewardship interventions and their evaluation metrics. *Clin Microbiol Infect*. 2023;29(2):173–182. doi:10.1016/j.cmi.2022.08.010
4. Van Dijck C, Vlieghe E, Cox JA. Antibiotic stewardship interventions in hospitals in low-and middle-income countries: a systematic review. *Bull World Health Organ*. 2018;96(4):266–280. doi:10.2471/BLT.17.203448
5. Langford BJ, Morris AM. Is it time to stop chasing antibiotic consumption as a metric for success? *Lancet Infect Dis*. 2021;21(10):1345–1347. doi:10.1016/S1473-3099(21)00399-0
6. Pulcini C, Binda F, Lamkang AS, Trett A, Charani E, Goff DA, et al. Developing core elements and checklist items for global hospital antimicrobial stewardship programmes: a consensus approach. *Clin Microbiol Infect*. 2019;25(1):20–25. doi:10.1016/j.cmi.2018.03.033
7. Cox JA, Vlieghe E, Mendelson M, Wertheim H, Ndegwa L, Villegas MV, et al. Antibiotic stewardship in low- and middle-income countries: the same but different? *Clin Microbiol Infect*. 2017;23(11):812–818. doi:10.1016/j.cmi.2017.07.010
8. Saleem Z, Hassali MA, Godman B, Hashmi FK, Saleem F. Antimicrobial prescribing and stewardship practices in public sector hospitals of Pakistan: a multicenter point prevalence survey. *Int J Environ Res Public Health*. 2019;16(9):1690. doi:10.3390/ijerph16091690
9. Government of Pakistan. National Action Plan on Antimicrobial Resistance. Ministry of National Health Services; 2017. Available at: https://www.nih.org.pk/
10. Pokharel S, Raut S, Adhikari B. Tackling antimicrobial resistance in low-income and middle-income countries. *BMJ Glob Health.* 2019;4(6):e002104. doi:10.1136/bmjgh-2019-002104
11. Akpan MR, Isemin NU, Udoh AE, Ashiru-Oredope D. Implementation of antimicrobial stewardship programmes in African countries: a systematic literature review. *J Glob Antimicrob Resist.* 2020;22:317–324. doi:10.1016/j.jgar.2020.03.009