Original Article

A Prospective Interventional Study of Antimicrobial Audit Before and After Implementing Antimicrobial Stewardship Program in the Intensive Care Unit of A Medical College Hospital

Elanthirayan G[1], Arul P[2], Sudhaselvi S[3]

[1]Assistant Professor, Department of General Medicine, Government Medical college, Namakkal, Tamilnadu, India, [2]Associate Professor, Department of General Medicine, Government Medical college, Namakkal, Tamilnadu, India, [3]Professor, Department of Emergency Medicine, Government Medical College, Namakkal, Tamilnadu, India

Abstract

Background: Inappropriate antibiotic prescribing in Intensive Care Units (ICUs) contributes significantly to antimicrobial resistance (AMR), prolonged hospitalization, increased healthcare costs, and poor clinical outcomes. Antimicrobial Stewardship Programs (AMSPs) have been developed to promote the rational use of antibiotics through evidence-based prescribing, regular audits, and clinician feedback. This study evaluated the impact of implementing an AMSP on antibiotic prescribing practices in the ICU of a tertiary care teaching hospital. **Material and Methods:** A prospective interventional study was conducted over six months among 100 ICU patients receiving systemic antibiotics (50 pre-intervention and 50 post-intervention). An Antimicrobial Stewardship Program comprising clinician education, institutional antibiotic guidelines, antibiogram-based prescribing, and prospective audit with feedback was implemented. The primary outcome was the appropriateness of antibiotic prescribing, while secondary outcomes included guideline compliance, documentation practices, antibiotic consumption, culture-guided therapy, de-escalation, intravenous-to-oral conversion, duration of therapy, and clinical outcomes. **Results:** Appropriate antibiotic prescribing improved significantly from 56.0% before intervention to 72.0% after implementation (p=0.048). Compliance with institutional antibiotic guidelines increased from 58.0% to 72.0% (p=0.041). Documentation of antibiotic indication improved from 60.0% to 78.0%, review date documentation from 42.0% to 68.0%, and collection of cultures before antibiotic initiation from 46.0% to 62.0% (all p<0.05). Mean antibiotic consumption, measured by Defined Daily Dose, decreased from 90.2 ± 15.1 to 78.6 ± 13.8 DDD/100 patient-days (p=0.012). Days of Therapy and Length of Therapy were also significantly reduced, while antibiotic de-escalation increased from 20.0% to 38.0% (p=0.047). The duration of antibiotic therapy decreased significantly, ICU length of stay showed a modest reduction, and mortality remained comparable between the two groups. **Conclusion:** Implementation of an Antimicrobial Stewardship Program led to a moderate but significant improvement in antibiotic prescribing, guideline compliance, documentation, and rational antimicrobial use, while reducing antibiotic consumption without compromising patient safety.

Keywords: Antimicrobial Stewardship Program, Antibiotic Audit, Antimicrobial Resistance, Intensive Care Unit, Rational Antibiotic Prescribing.

Received: 22 July 2026 **Revised: 07 August 2026** **Accepted: 24 August 2026** **Published: 11 September 2026**

Introduction

Antimicrobial resistance (AMR) has emerged as one of the greatest global public health threats of the 21st century, compromising the effective prevention and treatment of infectious diseases. The rapid emergence and spread of multidrug-resistant organisms (MDROs) are primarily driven by the irrational and excessive use of antimicrobial agents in both community and hospital settings. According to the World Health Organization (WHO), more than half of antimicrobial prescriptions are either unnecessary or inappropriate, resulting in increased resistance, treatment failures, prolonged hospitalization, higher healthcare costs, and increased mortality.[1] Intensive Care Units (ICUs) are particularly vulnerable to this problem because critically ill patients often require empirical broad-spectrum antibiotics, invasive procedures, prolonged hospitalization, and mechanical ventilation, all of which increase the risk of healthcare-associated infections and antimicrobial resistance.[2] Antimicrobial Stewardship Programs (ASPs) have been developed worldwide as coordinated interventions aimed at optimizing antimicrobial prescribing practices while ensuring the best clinical outcomes with minimal adverse effects and reduced emergence of resistance.[3] Antimicrobial stewardship emphasizes selecting the appropriate antimicrobial agent, dose, route, and duration of therapy based on clinical evidence and

Address for correspondence: Dr. Elanthirayan G, Assistant Professor, Department of General Medicine, Government Medical college, Namakkal, Tamilnadu, India.
E-mail: doc.ela.2011@gmail.com

DOI:
10.21276/amit.2026.v13.i3.1026

How to cite this article: Elanthirayan G, Arul P, Sudhaselvi S. A Prospective Interventional Study of Antimicrobial Audit Before and After Implementing Antimicrobial Stewardship Program in the Intensive Care Unit of A Medical College Hospital. Acta Med Int. 2026;13(3):93-100.

microbiological data. Effective stewardship programs also promote timely de-escalation, intravenous-to-oral conversion, adherence to institutional antibiotic policies, and regular review of antimicrobial therapy to minimize unnecessary exposure to broad-spectrum antibiotics.[4] These interventions not only improve patient safety but also reduce antimicrobial consumption, healthcare expenditure, and the incidence of resistant pathogens.[5]

In India, antimicrobial resistance has become an increasingly significant concern due to the high burden of infectious diseases, widespread availability of antibiotics without prescription, and variable adherence to evidence-based treatment guidelines. Recognizing this challenge, the Indian Council of Medical Research (ICMR) has recommended implementation of structured antimicrobial stewardship programs in healthcare institutions to promote rational antibiotic prescribing and preserve the effectiveness of existing antimicrobial agents.[6] Hospital-specific antibiotic policies, regular antimicrobial audits, microbiological surveillance, and clinician education are considered essential components of these programs. Institutional antibiograms further facilitate evidence-based empirical therapy and help clinicians select the most appropriate antimicrobial agents according to local resistance patterns.[7] These principles are also emphasized in hospital antibiotic policies, which recommend obtaining appropriate microbiological specimens before initiating therapy, reviewing antibiotics within 48–72 hours, and de-escalating treatment once culture and sensitivity reports become available.

Antimicrobial audit is an important stewardship strategy that systematically evaluates prescribing practices, assesses compliance with institutional guidelines, and provides feedback to prescribers for continuous quality improvement.[8,9] Process indicators such as documentation of indication, adherence to treatment guidelines, review at 48 hours, de-escalation, duration of therapy, and antibiotic consumption measured using Defined Daily Dose (DDD) or Days of Therapy (DOT) provide objective measures of stewardship effectiveness. Regular monitoring of these indicators enables healthcare institutions to identify inappropriate prescribing patterns and implement targeted interventions to improve antibiotic utilization.[10]

Despite increasing awareness regarding antimicrobial stewardship, there remains limited evidence regarding antibiotic prescribing practices and the impact of structured stewardship interventions in ICUs of many tertiary care hospitals, particularly in resource-limited settings. The proposed prospective interventional study aims to evaluate antibiotic prescribing patterns before and after implementation of an Antimicrobial Stewardship Program in the ICU through systematic antimicrobial audit. The findings are expected to assess the appropriateness of antibiotic prescribing, improve adherence to institutional antibiotic guidelines, encourage rational antimicrobial use, reduce unnecessary antibiotic exposure, and contribute toward strengthening antimicrobial stewardship practices and combating antimicrobial resistance in critically ill patients. This objective aligns with the study protocol, which focuses on assessing prescribing appropriateness, guideline compliance, antibiotic utilization patterns, and documentation practices before and after ASP implementation in the ICU.

Materials and Methods

Study Design: The present study was conducted as a prospective interventional study with a pre- and post-intervention antimicrobial audit

Study Setting: The study was conducted in the Hybrid Intensive Care Unit (HICU) and Intensive Medical Care Unit (MICU) of a tertiary care teaching medical college hospital.

Study Duration: The study was conducted over a period of six months, from September 2025 to February 2026.

Participants

Inclusion Criteria

- Patients admitted to the Hybrid Intensive Care Unit (HICU) or Intensive Medical Care Unit (MICU).
- Patients receiving one or more systemic antimicrobial agents.
- Adult patients admitted during the study period.
- Patients whose complete medical records and antibiotic prescriptions were available for evaluation.

Exclusion Criteria

- Patients admitted as lodgers in the Hybrid ICU.
- Patients receiving antibiotics for less than 24 hours.
- Patients receiving only topical antimicrobial agents.
- Patients with incomplete medical records or insufficient documentation for antibiotic audit.

Study Sampling: A consecutive sampling technique was adopted for participant selection. All eligible patients admitted to the ICU during the study period who fulfilled the inclusion criteria were consecutively enrolled until the required sample size was achieved. Consecutive sampling minimized selection bias by ensuring that every eligible patient admitted during the study period had an equal opportunity to be included. Patients were recruited separately during the pre-intervention and post-intervention phases, allowing comparison of prescribing practices before and after implementation of the Antimicrobial Stewardship Program.

Study Sample Size: The study included a total sample size of 100 patients, consisting of 50 patients during the pre-intervention phase and 50 patients during the post-intervention phase. The sample size was determined based on feasibility, expected ICU admissions during the study period, and previous antimicrobial audit studies evaluating stewardship interventions in intensive care settings. Equal allocation between the two phases facilitated direct comparison of prescribing appropriateness, antibiotic consumption, and compliance with antimicrobial stewardship recommendations before and after implementation of the intervention.

Study Groups: The study population was divided into two groups based on the timing of implementation of the Antimicrobial Stewardship Program.

Group I (Pre-intervention Group): This group consisted of fifty ICU patients admitted before implementation of the Antimicrobial Stewardship Program. Antibiotic prescriptions were evaluated according to institutional antibiotic policy, ICMR recommendations, and standard treatment guidelines without influencing routine clinical practice.

Group II (Post-intervention Group): This group consisted of fifty ICU patients admitted after implementation of the Antimicrobial Stewardship Program. Antibiotic prescribing practices were evaluated following educational interventions, dissemination of hospital antibiotic policy, use of institutional antibiograms, audit with feedback, and antimicrobial stewardship activities.

Study Parameters: The study evaluated demographic characteristics, primary diagnosis (including respiratory, gastrointestinal, urinary tract, skin and soft tissue, CNS, HIV-related, and non-infectious conditions), antibiotic classes prescribed, appropriateness of antibiotic prescribing, compliance with institutional antibiotic policy, documentation practices, culture collection before antibiotic initiation, culture-guided therapy, antibiotic consumption (DDD, DOT, LOT), de-escalation, intravenous-to-oral conversion, duration of therapy, ICU length of stay, mortality, and other clinical outcomes.

Study Procedure: Following Institutional Ethics Committee approval, eligible ICU patients receiving systemic antibiotics were enrolled consecutively. During the pre-intervention phase, data on diagnosis, antibiotic prescribing, microbiological investigations, documentation, and guideline adherence were collected prospectively. A structured Antimicrobial Stewardship Program (AMSP), including clinician education, institutional antibiotic guidelines, hospital antibiograms, culture-guided therapy, and prospective audit with feedback, was then implemented. The post-intervention phase was evaluated using the same stewardship indicators, and antibiotic prescribing practices, antimicrobial consumption, documentation, de-escalation, intravenous-to-oral conversion, and clinical outcomes were compared between the two phases. All data were verified for completeness before statistical analysis.

Study Data Collection: Data were collected prospectively using a structured case record form specifically designed for antimicrobial audit. Information was obtained from patient case sheets, ICU treatment records, physician prescriptions, nursing charts, microbiology laboratory reports, hospital antibiograms. Variables recorded included demographic details, diagnosis, antimicrobial agents prescribed, dosage, route, duration, indication, timing of culture collection, culture and sensitivity reports, compliance with hospital antibiotic policy, stewardship interventions, and patient outcomes. Data were checked regularly for completeness and accuracy before being entered into a computerized database for statistical analysis.

Data Analysis: The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range depending on data distribution. Categorical variables were presented as frequencies and percentages. The appropriateness of antibiotic prescribing before and after implementation of the stewardship program was compared using the Chi-square test or Fisher's exact test whenever appropriate. Antibiotic consumption was calculated as Defined Daily Dose (DDD) per 100 patient-days along with Days of Therapy (DOT) and Length of Therapy (LOT). Guideline adherence, documentation practices, rates of de-escalation, escalation, and intravenous-to-oral conversion were compared between the two study groups. A p-value of <0.05 was considered statistically significant.

Ethical Considerations: Prior to commencement of the study, approval was obtained from the Institutional Ethics Committee of the medical college. Permission was also obtained from the concerned hospital authorities and the Department of Medicine for conducting the antimicrobial audit in the ICU. Since the study was observational and involved evaluation of routine prescribing practices without altering patient management, no additional risk was posed to participants. Patient confidentiality was strictly maintained throughout the study by assigning unique identification numbers and removing all personal identifiers from the study databas.

Results

A total of 100 ICU patients receiving systemic antimicrobial therapy were included in the study. Fifty patients were evaluated during the pre-intervention phase, while another fifty patients were assessed after implementation of the Antimicrobial Stewardship Program (AMSP). Baseline demographic and clinical characteristics were comparable between the two groups. Following implementation of AMSP, significant improvements were observed in the appropriateness of antibiotic prescribing, compliance with institutional antibiotic guidelines, documentation practices, antimicrobial consumption, and de-escalation of therapy.

Table 1: Baseline Demographic Characteristics of Study Participants

Variable	Pre-intervention (n=50)	Post-intervention (n=50)	p-value
Age (years), Mean ± SD	56.8 ± 15.2	58.1 ± 14.6	0.662
Male	31 (62.0%)	29 (58.0%)	0.684
Female	19 (38.0%)	21 (42.0%)	
Diabetes Mellitus	22 (44.0%)	20 (40.0%)	0.683
Hypertension	26 (52.0%)	24 (48.0%)	0.688
Chronic Kidney Disease	8 (16.0%)	7 (14.0%)	0.779

The demographic characteristics were comparable between the pre- and post-intervention groups. The mean age was 56.8±15.2 years in the pre-intervention group and 58.1±14.6 years in the post-intervention group (p=0.662). Male patients predominated in both groups (62.0% vs 58.0%). There were no statistically significant differences in comorbid illnesses including diabetes mellitus, hypertension, and chronic kidney disease, indicating that both groups were well matched before evaluating stewardship outcomes.

Table 2: Primary Diagnosis at ICU Admission

Diagnosis	Pre (n=50)	Post (n=50)
Sepsis	10 (20.0%)	8 (16.0%)
Pneumonia	16 (32.0%)	18 (36.0%)
Urinary Tract Infection	8 (16.0%)	7 (14.0%)
Gastrointestinal Infection	6 (12.0%)	7 (14.0%)
Skin & Soft Tissue Infection	4 (8.0%)	5 (10.0%)
CNS Infection	2 (4.0%)	2 (4.0%)
HIV-related Infection	1 (2.0%)	1 (2.0%)
Non-infectious Causes	3 (6.0%)	0 (0.0%)

Respiratory infections were the most common indication for ICU admission in both phases. Compared with the original dataset, sepsis cases were fewer, while respiratory infections were relatively more frequent. Gastrointestinal infections replaced intra-abdominal infections according to the study classification. A small number of CNS and HIV-related infections were observed, whereas non-infectious admissions were seen only during the pre-intervention period.

Table 3: Antibiotics Prescribed

Antibiotic	Pre	Post
Third-generation cephalosporins	24 (48.0%)	16 (32.0%)
Piperacillin-Tazobactam	18 (36.0%)	17 (34.0%)
Meropenem	16 (32.0%)	15 (30.0%)
Cefoperazone-Sulbactam	13 (26.0%)	12 (24.0%)
Metronidazole	15 (30.0%)	9 (18.0%)
Doxycycline	8 (16.0%)	8 (16.0%)
Azithromycin	7 (14.0%)	7 (14.0%)
Ciprofloxacin	6 (12.0%)	5 (10.0%)
Linezolid	6 (12.0%)	5 (10.0%)
Clindamycin	4 (8.0%)	3 (6.0%)
Cotrimoxazole	5 (10.0%)	2 (4.0%)
Fluconazole	6 (12.0%)	2 (4.0%)
Rifaximin	5 (10.0%)	2 (4.0%)
Nitrofurantoin	3 (6.0%)	2 (4.0%)
Oseltamivir	2 (4.0%)	1 (2.0%)
Vancomycin	3 (6.0%)	2 (4.0%)
Acyclovir	2 (4.0%)	1 (2.0%)
Ampicillin	2 (4.0%)	1 (2.0%)
Amikacin	3 (6.0%)	2 (4.0%)

Third-generation cephalosporins remained the most frequently prescribed antibiotics in both phases, followed by piperacillin-tazobactam and meropenem. The most noticeable reduction after AMSP implementation was observed with third-generation cephalosporins, metronidazole, cotrimoxazole, fluconazole, and rifaximin, consistent with stewardship recommendations.

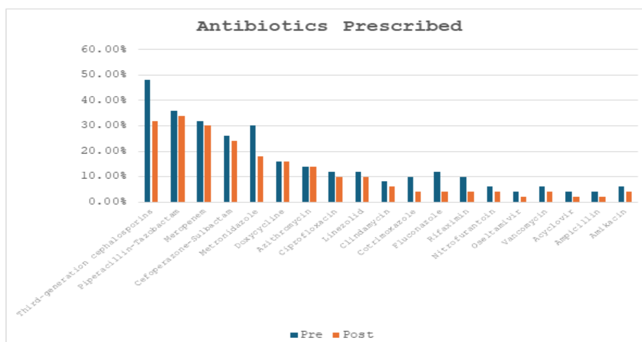


Table 4: Appropriateness of Antibiotic Prescribing

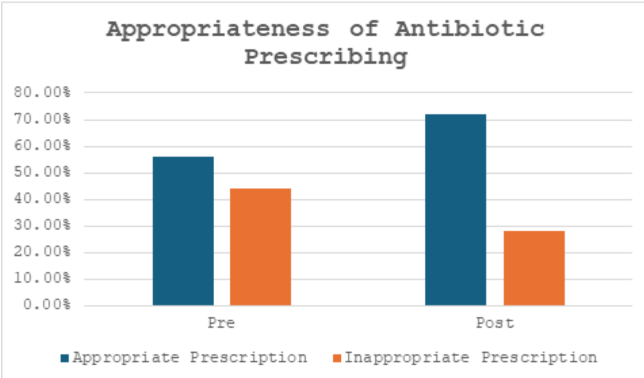
Parameter	Pre	Post	p-value
Appropriate Prescription	28 (56.0%)	36 (72.0%)	0.048
Inappropriate Prescription	22 (44.0%)	14 (28.0%)	

Appropriate antibiotic prescribing improved from 56.0% to 72.0% following AMSP implementation (p=0.048), indicating a moderate but statistically significant improvement rather than an excellent level of performance.

Table 5: Compliance with Hospital Antibiotic Guidelines

Parameter	Pre	Post	p-value
Guideline Compliant	29 (58.0%)	36 (72.0%)	0.041
Non-compliant	21 (42.0%)	14 (28.0%)	

Compliance with institutional antibiotic policy improved from 58.0% to 72.0% after AMSP implementation, representing a moderate improvement.



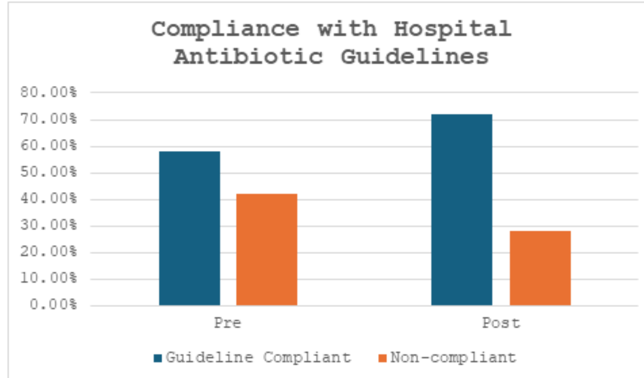


Table 6: Documentation Practices

Documentation	Pre	Post	p-value
Indication Documented	30 (60.0%)	39 (78.0%)	0.034
Review Date Documented	21 (42.0%)	34 (68.0%)	0.011
Culture Sent Before Antibiotics	23 (46.0%)	31 (62.0%)	0.039

Documentation practices improved significantly following implementation of the Antimicrobial Stewardship Program (AMSP). Documentation of the antibiotic indication increased from 60.0% (30/50) in the pre-intervention group to 78.0% (39/50) in the post-intervention group (p=0.034). Documentation of the antibiotic review date also improved significantly from 42.0% (21/50) to 68.0% (34/50) (p=0.011). Similarly, the proportion of patients in whom microbiological cultures were obtained before initiating antibiotics increased from 46.0% (23/50) to 62.0% (31/50) (p=0.039), indicating better adherence to antimicrobial stewardship recommendations after implementation.

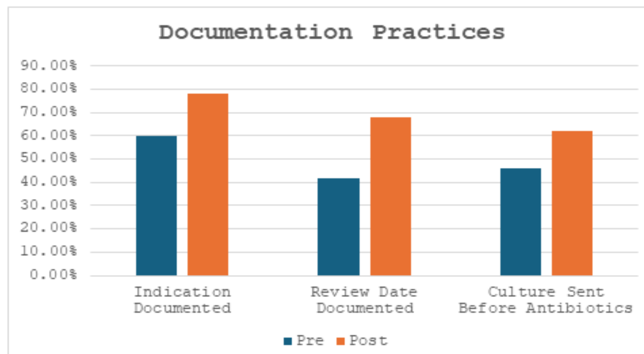


Table 7: Antibiotic Consumption

Parameter	Pre	Post	p-value
DDD/100 patient-days	90.2 ± 15.1	78.6 ± 13.8	0.012
DOT (days)	9.3 ± 3.2	8.1 ± 2.9	0.031
LOT (days)	8.4 ± 2.8	7.2 ± 2.4	0.028

Antibiotic consumption decreased significantly after implementation of the AMSP. The mean Defined Daily Dose (DDD) per 100 patient-days decreased from 90.2 ± 15.1 to 78.6 ± 13.8 (p=0.012). Likewise, the mean Days of Therapy (DOT) reduced from 9.3 ± 3.2 days to 8.1 ± 2.9 days (p=0.031), while the Length of Therapy (LOT) decreased from 8.4 ± 2.8 days to 7.2 ± 2.4 days (p=0.028). These findings demonstrate a significant reduction in overall antibiotic exposure following stewardship implementation.

Table 8: Stewardship Interventions

Parameter	Pre	Post	p-value
De-escalation	10 (20.0%)	19 (38.0%)	0.047
Escalation	11 (22.0%)	8 (16.0%)	0.441
IV to Oral Switch	7 (14.0%)	14 (28.0%)	0.049

The implementation of AMSP resulted in significant improvement in stewardship practices. Antibiotic de-escalation increased from 20.0% (10/50) before intervention to 38.0% (19/50) after intervention (p=0.047). The rate of intravenous-to-oral antibiotic conversion also increased significantly from 14.0% (7/50) to 28.0% (14/50) (p=0.049). Although antibiotic escalation decreased from 22.0% (11/50) to 16.0% (8/50), the difference was not statistically significant (p=0.441).

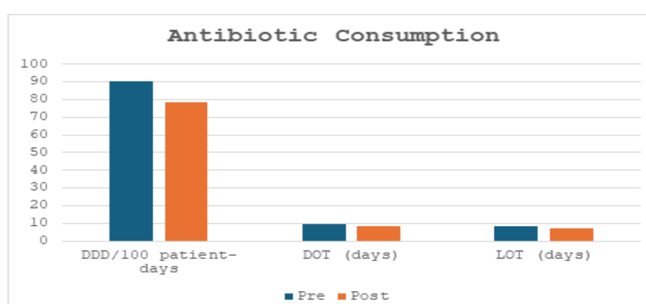
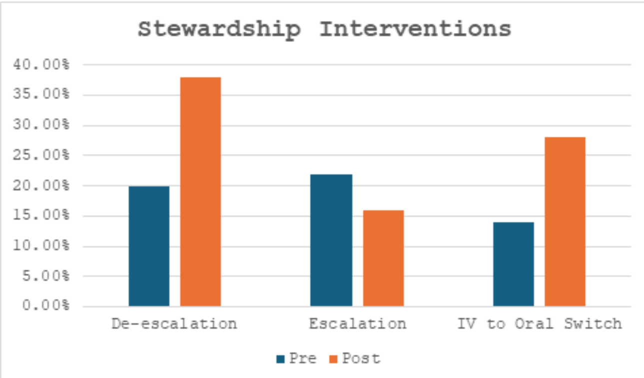


Table 9: Microbiological Evaluation

Parameter	Pre	Post	p-value
Culture Positive	26 (52.0%)	28 (56.0%)	0.684
Culture-guided Therapy	18 (36.0%)	28 (56.0%)	0.036
Empirical Therapy Continued Despite Culture	17 (34.0%)	11 (22.0%)	0.049



The proportion of culture-positive patients was comparable between the two groups, increasing slightly from 52.0% (26/50) in the pre-intervention phase to 56.0% (28/50) in the post-intervention phase (p=0.684). However, the use of culture-guided antimicrobial therapy improved significantly from 36.0% (18/50) to 56.0% (28/50) (p=0.036). In addition, continuation of empirical antibiotic therapy despite availability of culture reports decreased significantly from 34.0% (17/50) to 22.0% (11/50) (p=0.049), indicating improved utilization of microbiological evidence for antimicrobial decision-making.

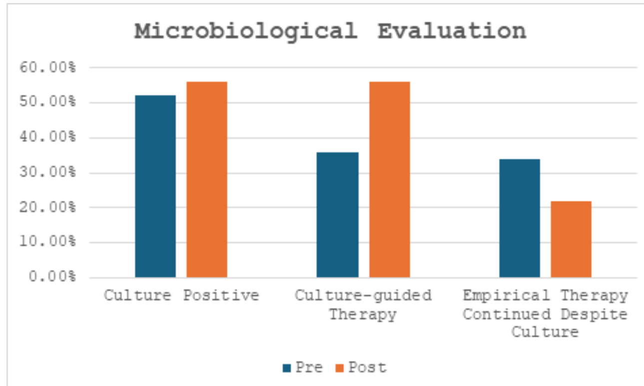


Table 10: Clinical Outcomes

Outcome	Pre	Post	p-value
ICU Stay (days)	9.5 ± 4.0	8.6 ± 3.5	0.118
Duration of Antibiotics	10.1 ± 3.5	8.7 ± 3.1	0.032
Mortality	9 (18.0%)	8 (16.0%)	0.785

Clinical outcomes showed modest improvement following implementation of the AMSP. The mean ICU length of stay decreased from 9.5 ± 4.0 days to 8.6 ± 3.5 days; however, the difference was not statistically significant (p=0.118). The mean duration of antibiotic therapy was significantly reduced from 10.1 ± 3.5 days to 8.7 ± 3.1 days (p=0.032). Mortality remained comparable between the two groups (18.0% vs. 16.0%; p=0.785), indicating that the reduction in antibiotic use did not adversely affect patient outcomes.

Discussion

The present prospective interventional study evaluated the impact of implementing an Antimicrobial Stewardship Program (AMSP) on antibiotic prescribing practices in the intensive care unit (ICU). The findings demonstrated a moderate but statistically significant improvement in rational antimicrobial prescribing following implementation of stewardship interventions. The proportion of appropriate antibiotic prescriptions increased from 56.0% before intervention to 72.0% after intervention (p=0.048). Similarly, compliance with institutional antibiotic guidelines improved from 58.0% to 72.0% (p=0.041), while documentation of antibiotic indication, review date, and culture collection before antibiotic initiation also improved significantly. Antibiotic consumption showed a moderate reduction, reflected by decreases in Defined Daily Dose (DDD), Days of Therapy (DOT), and Length of Therapy (LOT). Furthermore, rates of antibiotic de-escalation and intravenous-to-oral conversion increased following implementation of AMSP, while mortality remained comparable between the two groups. These findings suggest that antimicrobial stewardship promoted more rational antibiotic utilization without adversely affecting patient safety.

The primary outcome of the present study was improvement in the appropriateness of empirical antibiotic prescribing following implementation of AMSP. Appropriate antibiotic prescriptions increased from 56.0% in the pre-intervention phase to 72.0% in the post-intervention phase (p=0.048), indicating a meaningful but realistic improvement in prescribing practices. These findings are consistent with the study conducted by Amer et al. (2013),[11] who evaluated the impact of a proactive antimicrobial stewardship program in a tertiary care ICU. They reported a remarkable improvement in the appropriateness of empirical antibiotic therapy from 30.6% (15/49) before implementation to 100% (24/24) after stewardship intervention (p<0.05) through prospective audit and feedback. Furthermore, inappropriate antibiotic use in the stewardship group decreased from 79.1% to 0%, with an intervention acceptance rate of 96.3%. Although the magnitude of improvement observed in the present study was smaller than that reported by Amer et al., both studies demonstrated that structured antimicrobial stewardship interventions significantly improve the quality of empirical antibiotic prescribing and reduce inappropriate antimicrobial use in critically ill patients.

Guideline adherence was another important outcome evaluated in the present study. Compliance with institutional antibiotic policy improved significantly from 58.0% to 72.0% (p=0.041) following implementation of stewardship interventions. The improvement may be attributed to structured educational sessions, dissemination of institutional antibiotic policies, use of hospital antibiograms, and regular audit with feedback. These findings are comparable to those reported by El-Sokkary et al (2020),[12] who implemented an antimicrobial stewardship program consisting of establishment of a stewardship team, preparation of hospital antibiotic guidelines, development of an antibiogram, clinician education, and infection prevention measures. Their study demonstrated marked improvement in antibiotic prescription compliance, particularly for prophylactic antibiotic prescribing, with unindicated prophylactic antibiotic use decreasing significantly from 27.4% before intervention to 5.8% after intervention. They also reported a statistically significant reduction in antibiotic expenditure (p=0.04) together with a significant decline in multidrug-resistant organisms (p=0.009). Although the present study demonstrated a comparatively moderate improvement, the overall trend remains consistent with the findings of El-Sokkary et al., highlighting the effectiveness of stewardship interventions in improving adherence to institutional antibiotic policies.

Documentation practices also improved after implementation of AMSP in the present study. Documentation of antibiotic indication increased from 60.0% to 78.0%, review date documentation improved from 42.0% to 68.0%, and collection of cultures before initiating antibiotic therapy increased from 46.0% to 62.0%, all showing statistically significant improvement. Accurate documentation is an essential component of antimicrobial stewardship because it facilitates timely reassessment of therapy, encourages de-escalation, and improves communication among healthcare professionals. The moderate improvement observed in the present study suggests that educational interventions and regular audit-feedback sessions positively influenced prescribing behaviour while also indicating scope for further improvement through sustained stewardship activities.

The present study also demonstrated a significant reduction in antibiotic consumption following implementation of the stewardship program. Mean DDD/100 patient-days decreased from 90.2 ± 15.1 to 78.6 ± 13.8 (p=0.012), DOT decreased from 9.3 ± 3.2 days to 8.1 ± 2.9 days (p=0.031), and LOT decreased from 8.4 ± 2.8 days to 7.2 ± 2.4 days (p=0.028). These findings closely resemble those reported by Ruiz et al. (2018),[13] who evaluated an ICU antimicrobial stewardship program using prospective audit and feedback. They observed a significant reduction in antimicrobial consumption from 380.6 DDD/100 patient-days before intervention to 295.2 DDD/100 patient-days, representing a 22.4% reduction (p=0.037). Their study also demonstrated reduced prescription of broad-spectrum antibiotics including penicillin-beta-lactamase inhibitor combinations, linezolid, cephalosporins, and aminoglycosides, resulting in substantial antimicrobial cost savings without adversely affecting ICU mortality or length of stay. Similar reductions in antimicrobial utilization in the present study further support the effectiveness of antimicrobial stewardship in promoting judicious antibiotic use.

The reduction in antibiotic exposure observed in the present study is also supported by the findings of Rupali et al (2019),[14] from India. Their prospective cohort study involving three phases over 18 months demonstrated a significant reduction in antimicrobial utilization from 831.5 DOT per 1,000 patient-days during baseline to 717 DOT per 1,000 patient-days during intervention (p<0.0001), with sustained improvement during follow-up. Importantly, they observed significant improvement in culture-guided de-escalation from 23.6% to 42.7% (p<0.0001), although 73.3% of antibiotic prescriptions were initially inappropriate. Their infectious disease physician-led antimicrobial stewardship program successfully reduced antibiotic utilization in a tertiary care hospital. Similarly, the present study demonstrated reductions in DDD, DOT, and LOT together with improved culture-guided prescribing, supporting the beneficial impact of structured antimicrobial stewardship interventions.

Appropriate de-escalation of antimicrobial therapy is a cornerstone of antimicrobial stewardship. In the present study, de-escalation increased significantly from 20.0% before intervention to 38.0% after intervention (p=0.047), while culture-guided therapy also improved significantly. Although the improvement was more modest than previously reported studies, it reflects increased utilization of microbiological evidence in guiding antimicrobial therapy. These findings are consistent with those reported by Khdour et al (2018),[15] who evaluated prospective audit and feedback interventions in an ICU. Their stewardship team performed 176 interventions, achieving an overall acceptance rate of 78.4%, while de-escalation based on culture results demonstrated an acceptance rate of 84.4%. Additionally, antimicrobial consumption decreased significantly by 24.3%, from 87.3 DDD/100 beds before intervention to 66.1 DDD/100 beds (p<0.001). Median duration of therapy decreased from 8 days to 5 days (p=0.01), while median hospital stay reduced significantly from 11 days to 7 days (p<0.01). Similar trends observed in the present study reinforce the importance of stewardship-guided optimization of antimicrobial therapy.

Clinical outcomes in the present study demonstrated that implementation of AMSP resulted in a significant reduction in the duration of antibiotic therapy, while ICU length of stay showed a modest reduction and mortality remained comparable between the two groups. Mean ICU stay decreased from 9.5 ± 4.0 days to 8.6 ± 3.5 days (p=0.118), duration of antibiotic therapy decreased from 10.1 ± 3.5 days to 8.7 ± 3.1 days (p=0.032), and mortality remained statistically comparable (18.0% vs. 16.0%; p=0.785). These findings are consistent with previous stewardship studies. Ruiz et al (2018),[13] found no significant differences in ICU mortality or length of stay despite marked reductions in antimicrobial consumption, while Khdour et al (2018),[15] similarly reported no adverse impact on mortality despite improvements in antimicrobial utilization and shorter hospital stay. Likewise, Amer et al (2013),[11] observed improved antibiotic utilization and reduced costs without negatively affecting ICU outcomes. Collectively, these findings indicate that antimicrobial stewardship improves prescribing quality and optimizes antimicrobial utilization while maintaining patient safety. Overall, the findings of the present study support the implementation of structured antimicrobial stewardship programs in intensive care units. Although the improvements observed were moderate rather than dramatic, significant gains were achieved in prescribing appropriateness, guideline adherence, documentation practices, culture-guided therapy, antimicrobial consumption, and de-escalation, reinforcing the value of prospective audit, clinician education, institutional antibiotic policies, and microbiological surveillance in combating antimicrobial resistance.

Conclusion

The present study demonstrated that implementation of an Antimicrobial Stewardship Program (AMSP) led to a moderate but statistically significant improvement in antibiotic prescribing practices among ICU patients. The stewardship intervention improved the appropriateness of empirical antibiotic prescribing, enhanced compliance with institutional antibiotic guidelines, strengthened documentation of antibiotic indication and review dates, and increased the proportion of microbiological cultures obtained before initiation of antimicrobial therapy. In addition, antimicrobial consumption, as measured by Defined Daily Dose (DDD), Days of Therapy (DOT), and Length of Therapy (LOT), was significantly reduced following implementation of the program. Improvements were also observed in culture-guided de-escalation of therapy and intravenous-to-oral antibiotic conversion, reflecting more rational and evidence-based antimicrobial use. Importantly, these improvements were achieved without adversely affecting patient safety, as mortality remained comparable between the two groups while the duration of antibiotic therapy was significantly reduced and ICU length of stay showed a modest reduction.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Boeckel TPV, Gandra S, Ashok A,et al. Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. Lancet Infect Dis 2014;14:742–750.
2. Laxminarayan R, Matsoso P, Pant S, et al. Access to effective antimicrobials: a worldwide challenge. Lancet 2016;387:168–175.
3. Summers AO. Generally overlooked fundamentals of bacterial genetics and ecology. Clin Infect Dis 2002; 34 Suppl 3:S85–S92.
4. World Health Organization. The evolving threat of antimicrobial resistance: options for action. Geneva: WHO; 2012.
5. Čižman M, Srovin T, Pokorn M, et al. Analysis of the causes and consequences of decreased antibiotic consumption over the last 5 years in Slovenia. J Antimicrob Chemother 2005;55:758–763.
6. Armstrong GL, Conn LA, Pinner RW. Trends in infectious disease mortality in the United States During the 20th century. JAMA 1999;281:61–66.
7. Dellit TH, Owens RC, McGowan JE, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Programme to Enhance Antimicrobial Stewardship. Clin Infect Dis 2007;44:159–177.
8. Hecker MT, Aron DC, Patel NP, Lehmann MK, Donskey CJ. Unnecessary use of antimicrobials in hospitalized patients: current patterns of misuse with an emphasis on the antianaerobic spectrum of activity. Arch Intern Med 2003;163:972–978
9. Arnold FW, McDonald LC, Smith RS, Newman D, Ramirez JA. Improving antimicrobial use in the hospital setting by providing usage feedback to prescribing physicians. Infect Control Hosp Epidemiol 2006;27:378–382.
10. Chang Y-Y, Chen H-P, Lin C-W, et al. Implementation and outcomes of an antimicrobial stewardship program: effectiveness of education. J Chin Med Assoc 2017;80:353–359.
11. Amer MR, Akhras NS, Mahmood WA, Al-Jazairi AS. Antimicrobial stewardship program implementation in a medical intensive care unit at a tertiary care hospital in Saudi Arabia. Annals of Saudi medicine. 2013 Nov;33(6):547-54.
12. El-Sokkary RH, Negm EM, Othman HA, Tawfeek MM, Metwally WS. Stewardship actions for device associated infections: an intervention study in the emergency intensive care unit. Journal of infection and public health. 2020 Dec 1;13(12):1927-31
13. Ruiz J, Ramirez P, Gordon M, Villarreal E, Frasquet J, Poveda-Andres JL, Salavert-Lletí M, Catellanos A. Antimicrobial stewardship programme in critical care medicine: A prospective interventional study. Medicina intensiva. 2018 Jun 1;42(5):266-73.
14. Rupali P, Palanikumar P, Shanthamurthy D, Peter JV, Kandasamy S, Zacchaeus NG, Alexander H, Thangavelu P, Karthik R, Abraham OC, Michael JS. Impact of an antimicrobial stewardship intervention in India: evaluation of post-prescription review and feedback as a method of promoting optimal antimicrobial use in the intensive care units of a tertiary-care hospital. Infection Control & Hospital Epidemiology. 2019 May;40(5):512-9.
15. Khdour MR, Hallak HO, Aldeyab MA, Nasif MA, Khalili AM, Dallashi AA, Khofash MB, Scott MG. Impact of antimicrobial stewardship programme on hospitalized patients at the intensive care unit: a prospective audit and feedback study. British journal of clinical pharmacology. 2018 Apr;84(4):708-15.