RESEARCH PAPER

Effectiveness of a Nurses' Empowerment Program on Antibiotic Stewardship on Patient Outcomes in Selected Hospitals, Chennai

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Abstract

Background: Antibiotic resistance is a major global public health concern that threatens the effective treatment of infectious diseases and increases morbidity, mortality and healthcare costs. Antibiotic stewardship promotes the appropriate use of antibiotics, improves patient safety and helps prevent the development of antimicrobial resistance. Nurses play a vital role in antibiotic stewardship through appropriate administration, monitoring, documentation, patient education and early identification of adverse effects. Empowering nurses with knowledge and skills related to antibiotic stewardship may therefore improve their practice and contribute to better patient outcomes.

Objective: To assess the effectiveness of a Nurses' Empowerment Program on antibiotic stewardship on patient outcomes.

Methods: A quasi-experimental, non-randomized controlled design with pre-intervention and post-intervention assessments was adopted among adult inpatients receiving antibiotic therapy in selected hospitals in Chennai. A total of 148 patients were assessed: 66 in the control group (32 before and 34 after the intervention period) and 82 in the study group (40 before and 42 after). Patient outcomes were assessed using a structured 13-item checklist covering clinical response to antibiotic therapy, antibiotic safety and short-term healthcare outcomes. Data were analysed using descriptive statistics, the chi-square test, the independent t-test and multiple linear regression.

Results: In the control group, the mean patient outcome score was 8.44 ± 1.74 in Assessment 1 and 8.03 ± 2.50 in Assessment 2; the difference of 0.41 points was not statistically significant ($p = 0.448$). In the study group, the mean score increased from 8.10 ± 1.91 in Assessment 1 to 9.29 ± 1.83 in Assessment 2, a difference of 1.19 points that was statistically significant ($p = 0.005$). The proportion of patients with good outcomes in the study group rose from 25.0% to 52.4%.

Conclusion: The Nurses' Empowerment Program on antibiotic stewardship was effective in improving patient outcomes. Strengthening nurse-led antibiotic stewardship in hospital settings may promote appropriate antibiotic use, improve patient safety and contribute to better clinical outcomes.

Keywords: Antibiotic stewardship; Antimicrobial resistance; Nurses; Empowerment program; Patient outcomes

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Introduction

Antibiotics are among the most important therapeutic agents in modern medicine for the prevention and treatment of bacterial infections. Since their discovery, they have substantially reduced the morbidity and mortality associated with infectious diseases and have made many medical and surgical procedures safer. However, inappropriate and excessive use of antibiotics has led to the emergence and spread of antimicrobial resistance (AMR), now one of the major global public health challenges.

Antimicrobial resistance occurs when microorganisms such as bacteria, viruses, fungi and parasites change over time and no longer respond to antimicrobial medicines. Antibiotic resistance is particularly important in hospitals, because resistant bacterial infections can delay recovery, prolong hospitalization, increase healthcare expenditure and raise the risk of treatment failure, complications and death. Appropriate antibiotic use requires coordinated action among physicians, nurses, pharmacists, microbiologists, infection-control personnel and other healthcare professionals. Antibiotic stewardship is therefore increasingly recognized as a multidisciplinary

approach to optimizing antibiotic therapy, achieving the best possible clinical outcomes while minimizing adverse effects and the development of resistance.

Antibiotic stewardship refers to coordinated interventions designed to improve and measure the appropriate use of antibiotics by promoting the optimal regimen, including the appropriate drug, dose, route and duration of therapy. Effective stewardship aims to ensure that patients receive antibiotics only when clinically indicated, and that treatment is initiated, monitored, modified, de-escalated or discontinued according to the patient's clinical condition and microbiological findings. A successful stewardship program can reduce inappropriate antibiotic use and resistance, and can also improve patient safety, clinical recovery and healthcare outcomes.

Nurses constitute one of the largest groups of healthcare professionals and have continuous contact with patients throughout their hospitalization, which gives them a crucial role in the safe and effective use of antibiotics. Although prescribing is primarily the responsibility of authorized prescribers, nurses are directly involved in many stages of antibiotic therapy.

Need for the study

Inappropriate and unnecessary antibiotic use has accelerated the emergence of antibiotic-resistant organisms, which can result in treatment failure, prolonged illness, higher healthcare costs, longer hospitalization and a greater risk of complications and death. Optimizing antibiotic use has therefore become an essential component of quality and patient-safety initiatives in healthcare institutions.

Antibiotic stewardship provides a systematic approach to ensuring that antibiotics are used appropriately with respect to indication, selection, dose, route and duration. Successful stewardship requires the active involvement of a multidisciplinary team, and nurses have a particularly important role because they are continuously involved in administering and monitoring antibiotic therapy.

At the bedside, nurses are responsible for several activities that influence the safe and effective use of antibiotics: verifying patient identity, checking allergy and contraindication status, administering antibiotics on time, following hand hygiene and aseptic practices, monitoring therapeutic response, recognizing adverse reactions, documenting administration and communicating clinically significant findings to the healthcare team. Nurses can also reinforce patient education and infection-prevention practices. Their knowledge and practices are therefore essential to the successful implementation of antibiotic stewardship.

Despite this important role, nurses may have inadequate or inconsistent knowledge of stewardship principles and may not be sufficiently empowered to participate in stewardship activities. Educational interventions that combine structured information, practical demonstrations, clinical scenarios, discussion and reinforcement may improve nurses' understanding of and engagement in antibiotic stewardship. Although improvement in nurses' knowledge or compliance is valuable, the ultimate objective of stewardship is to improve the quality and safety of patient care. Appropriate antibiotic administration and monitoring may lead to a better clinical response, fewer adverse effects, prevention of complications and timely recovery. Evaluating patient outcomes therefore provides a more meaningful assessment of the impact of a nurse-focused stewardship intervention, and may generate evidence to support the integration of nurse-focused stewardship education into hospital practice.

Aim of the study

To assess the effectiveness of a Nurses' Empowerment Program on antibiotic stewardship on patient outcomes.

Specific objectives

1. To assess patient outcomes in the control and study groups.
2. To determine the effectiveness of the Nurses' Empowerment Program on antibiotic stewardship on patient outcomes.
3. To determine the association between selected demographic and clinical variables of patients and their outcomes.

Research hypotheses

- **H1:** There will be a significant difference in patient outcomes between the control and study groups.
- **H2:** There will be a significant association between selected demographic and clinical variables of patients and their outcomes.

Materials and Methods

Research approach and design

A quantitative approach was used. The study adopted a non-randomized controlled trial with a quasi-experimental pre-test–post-test control group design.

Setting and population

The study was conducted in selected hospitals in Chennai. The target population was inpatients admitted to the selected hospitals, and the accessible population was all adult patients admitted to the selected study wards during the pre-intervention and post-intervention data collection periods. The sample comprised adult patients receiving antibiotic therapy, selected by purposive sampling. A total of 148 patients were assessed: 66 in the control group (32 at Assessment 1 and 34 at Assessment 2) and 82 in the study group (40 at Assessment 1 and 42 at Assessment 2).

Sampling criteria

Inclusion criteria:

- Patients aged 20 years and above.
- Inpatients receiving therapeutic antibiotic therapy.

Exclusion criteria:

- Patients receiving antibiotics in the outpatient department or casualty.
- Patients receiving surgical prophylaxis (culture not indicated).
- Patients transferred from other facilities who were already receiving antibiotics.
- Patients receiving palliative or end-of-life care with comfort-measures-only orders.

- Severely immunocompromised patients, such as those with HIV or cancer, or receiving immunosuppressive drugs.
- Patients with an expected hospital stay of less than 24 hours, or short-stay day cases.

Variables

Independent variable: the Nurses' Empowerment Program, i.e. the process of empowering nurses in antibiotic stewardship. **Dependent variable:** patient outcomes.

Study instruments

The data collection instruments were developed through an extensive review of the literature and in consultation with experts. They comprised three sections.

Section A – Demographic variables proforma: age, gender, educational status, occupation, monthly income, religion, marital status and dietary pattern.

Section B – Clinical variables proforma: area of admission, reason for admission, indication for antibiotic treatment, antibiotic used and duration, duration of illness, comorbid conditions, personal habits, body mass index (BMI), nature of activity, presence of catheters or drainage devices, healthcare-associated infections, length of stay, hospital readmission and infection-related mortality.

Section C – Patient outcome checklist: This tool was developed based on the Centers for Disease Control and Prevention (CDC) Core Elements of Hospital Antibiotic Stewardship Programs. The checklist consists of 13 items in three domains: clinical response to antibiotic therapy (4 items), antibiotic safety outcomes (3 items) and short-term healthcare outcomes (6 items). It was administered through direct patient observation and review of medical records. Patient outcomes were assessed from 48 hours after initiation of antibiotic therapy until discharge. Each item was scored Yes (1) or No (0), giving a maximum possible score of 13, with higher scores indicating better outcomes. Scores were interpreted as good (10–13), moderate (5–9) or poor (0–4) patient outcomes.

Data collection procedure

Data were collected after obtaining permission from the concerned hospital authorities and informed consent from the participants.

Phase I – Pre-intervention assessment: Patients who fulfilled the inclusion criteria were selected by purposive sampling over a period of one month. Baseline patient outcomes were assessed in both the control and study groups using the structured Patient Outcome Assessment Checklist, covering clinical response to antibiotic therapy, antibiotic safety and short-term healthcare outcomes. Information was collected through patient assessment and review of medical records.

Phase II – Intervention: After the pre-intervention assessment, an Empowerment Program on Antibiotic Stewardship was conducted for the nurses in the study group. The program was developed based on the relevant literature and recommendations from the Indian Council of Medical Research (ICMR), the CDC and the World Health Organization (WHO). It was conducted on three days per week and delivered in batches using PowerPoint presentations, self-learning modules, group discussions and case scenarios. Each session lasted approximately one hour (12:00 noon to 1:00 pm).

Phase III – Post-intervention assessment: One month after completion of the program, patient outcomes were assessed over a period of one month among eligible inpatients admitted to both the control and study wards, using the same checklist. Outcome scores from the pre-intervention and post-intervention assessments were compared within and between groups to determine the effectiveness of the program.

Statistical analysis

Frequencies and percentages were used to describe the demographic and clinical variables and to categorize patient outcomes, and means and standard deviations were used to summarize outcome scores. The chi-square test was used to examine the homogeneity of the groups and the association between categorical variables and patient outcomes. The independent t-test was used to compare mean outcome scores between Assessment 1 and Assessment 2 within each group. Multiple linear regression was used to examine the association between selected baseline variables and patient outcome scores. A p-value below 0.05 was considered statistically significant.

Results

Control group

Table 1 shows the demographic variables of the control group. Most patients were aged 41–70 years (62.5% in Assessment 1 and 47.1% in Assessment 2) (Figure 1). Males and females each accounted for about half of the sample. Higher secondary education was most common (40.6% vs 32.4%), followed by secondary (15.6% vs 26.5%) and primary education (18.8% vs 20.6%). Private employment (28.1% vs 35.3%) and retirement (25.0% vs 35.3%) were the commonest occupational categories. Most patients earned between ₹30,001 and ₹50,000 per month (65.7% vs 79.4%), and very few earned more than ₹50,000 (about 9%). Most were married (65.6% vs 58.8%), with slightly more widowed patients in Assessment 2 (20.6%). Patients were mainly Hindu (40.6% vs 47.1%), followed by Christian (21.9% vs 32.4%) and Muslim (25.0% vs 20.6%). The dietary pattern was predominantly mixed (87.5% vs 82.4%). None of the demographic variables differed significantly between assessments ($p > 0.05$), confirming the comparability of the two samples.

Table 1: Demographic variables of patients in the control group (N = 66)

Variable	Assessment 1 (n = 32) f (%)	Assessment 2 (n = 34) f (%)	χ^2	df	p
Age (years)					
≤40	9 (28.1)	12 (35.3)	2.173	4	0.704
41–50	5 (15.6)	4 (11.8)			
51–60	8 (25.0)	5 (14.7)			
61–70	7 (21.9)	7 (20.6)			
>70	3 (9.4)	6 (17.6)			
Gender					
Male	16 (50.0)	16 (47.1)	0.057	1	0.811
Female	16 (50.0)	18 (52.9)			
Educational qualification					

Variable	Assessment 1 (n = 32) f (%)	Assessment 2 (n = 34) f (%)	χ^2	df	p
No formal education	3 (9.4)	3 (8.8)	1.438	4	0.838
Primary	6 (18.8)	7 (20.6)			
Secondary	5 (15.6)	9 (26.5)			
Higher secondary	13 (40.6)	11 (32.4)			
Graduate and above	5 (15.6)	4 (11.8)			
Occupation					
Government	5 (15.6)	5 (14.7)	3.949	4	0.413
Private	9 (28.1)	12 (35.3)			
Self-employed	5 (15.6)	1 (2.9)			
Retired	8 (25.0)	12 (35.3)			
Unemployed	5 (15.6)	4 (11.8)			
Monthly income (₹)					
<30,000	8 (25.0)	4 (11.8)	2.561	3	0.464
30,001–40,000	11 (34.4)	17 (50.0)			
40,001–50,000	10 (31.3)	10 (29.4)			
>50,000	3 (9.4)	3 (8.8)			
Marital status					
Single	6 (18.8)	6 (17.6)	0.783	3	0.854
Married	21 (65.6)	20 (58.8)			
Separated/divorced	1 (3.1)	1 (2.9)			
Widowed	4 (12.5)	7 (20.6)			
Religion					
Hindu	13 (40.6)	16 (47.1)	5.210	3	0.157
Christian	7 (21.9)	11 (32.4)			
Muslim	8 (25.0)	7 (20.6)			
Others	4 (12.5)	0 (0.0)			
Dietary pattern					
Vegetarian	1 (3.1)	4 (11.8)	1.941	2	0.379
Non-vegetarian	3 (9.4)	2 (5.9)			
Mixed	28 (87.5)	28 (82.4)			

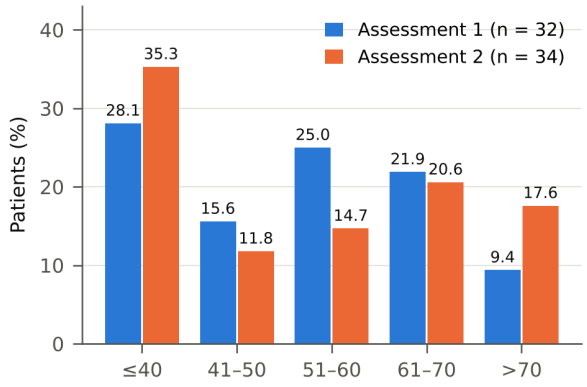


Figure 1: Age distribution of patients in the control group in Assessment 1 and Assessment 2.

Table 2 shows the clinical variables of the control group. Admissions were predominantly to medical wards and for medical conditions (81.3% vs 82.4%). The commonest indications for antibiotic treatment were respiratory (37.5% vs 32.4%) and gastrointestinal infections (21.9% vs 20.6%). Ceftriaxone was the most frequently used antibiotic (50.0% vs 41.2%), followed by piperacillin–tazobactam and amoxicillin–clavulanate (Figure 2). Most patients had an illness duration of less than 6 months (65.6% vs 64.7%). Comorbidities included diabetes (25.0% vs 14.7%), hypertension (9.4% vs 17.6%) and both (18.8% vs 32.4%). Most patients were non-smokers and non-alcoholic (62.5% vs 70.6%). BMI differed significantly between assessments (p = 0.001): 67.6% of patients in Assessment 2 had a normal BMI compared with 21.9% in Assessment 1, whereas overweight (34.4%) and underweight (31.3%) were more frequent in Assessment 1. Activity was mostly sedentary or light, most patients had no catheter or drainage device (87.5% vs 79.4%), readmission within 30 days was rare (6.3% vs 5.9%) and there was no infection-related mortality. Apart from BMI, the clinical variables were comparable (p > 0.05).

Table 2: Clinical variables of patients in the control group (N = 66)

Variable	Assessment 1 (n = 32) f (%)	Assessment 2 (n = 34) f (%)	χ^2	df	p
Area of admission					
Medical ward	26 (81.3)	28 (82.4)	0.013	1	0.908
Surgical ward	6 (18.8)	6 (17.6)			
Reason for admission					
Medical condition	26 (81.3)	28 (82.4)	0.013	1	0.908
Surgical condition	6 (18.8)	6 (17.6)			
Indication for antibiotic treatment					
ENT	0 (0.0)	2 (5.9)	7.414	7	0.387
Genito-urinary	4 (12.5)	8 (23.5)			
Respiratory	12 (37.5)	11 (32.4)			
Gastrointestinal	7 (21.9)	7 (20.6)			
Bloodstream	1 (3.1)	0 (0.0)			
CNS	2 (6.3)	0 (0.0)			
Skin	1 (3.1)	0 (0.0)			
Other	5 (15.6)	6 (17.6)			
Antibiotic used					
Ceftriaxone	16 (50.0)	14 (41.2)	8.166	5	0.147
Cefotaxime	1 (3.1)	7 (20.6)			
Piperacillin–tazobactam	6 (18.8)	8 (23.5)			
Amoxicillin–clavulanate	5 (15.6)	3 (8.8)			
Vancomycin	0 (0.0)	1 (2.9)			
Meropenem	4 (12.5)	1 (2.9)			
Duration of illness					
<6 months	21 (65.6)	22 (64.7)	6.158	3	0.104
6–11 months	6 (18.8)	1 (2.9)			
12–24 months	4 (12.5)	7 (20.6)			
>24 months	1 (3.1)	4 (11.8)			
Comorbidity					
Diabetes	8 (25.0)	5 (14.7)	4.260	4	0.372
Hypertension	3 (9.4)	6 (17.6)			
Diabetes + hypertension	6 (18.8)	11 (32.4)			
Other	1 (3.1)	0 (0.0)			
None	14 (43.8)	12 (35.3)			
Personal habits					
Smoking	6 (18.8)	5 (14.7)	1.538	3	0.673

Variable	Assessment 1 (n = 32) f (%)	Assessment 2 (n = 34) f (%)	χ^2	df	p
Alcohol	3 (9.4)	4 (11.8)			
Smoking + alcohol	3 (9.4)	1 (2.9)			
Neither	20 (62.5)	24 (70.6)			
BMI (kg/m²)					
<18.5 (underweight)	10 (31.3)	5 (14.7)	15.624	3	0.001*
18.5–24.9 (normal)	7 (21.9)	23 (67.6)			
25–30 (overweight)	11 (34.4)	6 (17.6)			
>30 (obese)	4 (12.5)	0 (0.0)			
Nature of activity					
Sedentary	13 (40.6)	11 (32.4)	1.166	2	0.558
Light	10 (31.3)	15 (44.1)			
Moderate	9 (28.1)	8 (23.5)			
Catheter/drainage devices					
None	28 (87.5)	27 (79.4)	0.776	1	0.378
Present	4 (12.5)	7 (20.6)			
Readmission within 30 days					
Yes	2 (6.3)	2 (5.9)	0.004	1	0.950
No	30 (93.8)	32 (94.1)			
Infection-related mortality					
Yes	0 (0.0)	0 (0.0)	–	–	–
No	32 (100.0)	34 (100.0)			

**Significant at p < 0.05.*

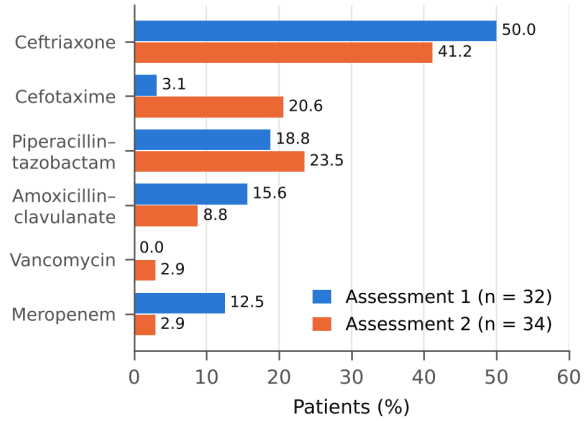


Figure 2: Antibiotics used in the control group in Assessment 1 and Assessment 2.

Table 3 compares patient outcomes between the two assessments in the control group. Improvement in primary signs and symptoms within 72 hours was observed in 4 (12.5%) patients in Assessment 1 and 13 (38.2%) in Assessment 2 (χ^2 = 5.709, p = 0.017) (Figure 3), and improvement in laboratory parameters in 6 (18.8%) and 12 (35.3%) patients, respectively (p = 0.131) (Figure 4). No allergic reaction was observed in 28 (87.5%) patients in Assessment 1 and 34 (100.0%) in Assessment 2 (χ^2 = 4.524, p = 0.033). The proportion of patients with no unnecessary prolongation of therapy fell from 20 (62.5%) to 10 (29.4%) (χ^2 = 7.279, p = 0.007), and the proportion with no escalation to higher antibiotics fell from 25 (78.1%) to 11 (32.4%) (χ^2 = 13.930, p < 0.001). A hospital stay of ≤5 days was recorded in 21 (65.6%) and 25 (73.5%) patients, respectively (p = 0.485). No infection-related readmission within 30 days was reported in 30 (93.8%) and 32 (94.1%) patients (p = 0.950), and infection had resolved or was improving at discharge in 27 (84.4%) and 25 (73.5%) patients (p = 0.281). There was no infection-related mortality.

Table 3: Comparison of patient outcomes between Assessment 1 and Assessment 2 in the control group (N = 66)

Variable	Assessment 1 (n = 32) f (%)	Assessment 2 (n = 34) f (%)	χ^2	df	p
Domain I: Clinical response					
Improvement in primary signs and symptoms within 72 hours					
Yes	4 (12.5)	13 (38.2)	5.709	1	0.017*
No	28 (87.5)	21 (61.8)			
Improvement in laboratory parameters (WBC, CRP, lactate)					
Yes	6 (18.8)	12 (35.3)	2.275	1	0.131
No	26 (81.3)	22 (64.7)			
No progression of infection					
Yes	15 (46.9)	16 (47.1)	0.000	1	0.988
No	17 (53.1)	18 (52.9)			
Vital signs stabilized within 72 hours					
Yes	19 (59.4)	21 (61.8)	0.039	1	0.843
No	13 (40.6)	13 (38.2)			
Domain II: Antibiotic safety					
No antibiotic-related adverse drug reaction					
Yes	19 (59.4)	21 (61.8)	0.039	1	0.843
No	13 (40.6)	13 (38.2)			
No antibiotic-associated diarrhoea					
Yes	24 (75.0)	19 (55.9)	2.654	1	0.103
No	8 (25.0)	15 (44.1)			
No allergic reaction to antibiotic					
Yes	28 (87.5)	34 (100.0)	4.524	1	0.033*
No	4 (12.5)	0 (0.0)			
Domain III: Short-term healthcare outcomes					
No unnecessary prolongation of therapy					
Yes	20 (62.5)	10 (29.4)	7.279	1	0.007*
No	12 (37.5)	24 (70.6)			
No escalation to higher antibiotics					
Yes	25 (78.1)	11 (32.4)	13.930	1	<0.001*
No	7 (21.9)	23 (67.6)			
Length of hospital stay not prolonged					
≤5 days	21 (65.6)	25 (73.5)	0.488	1	0.485
>5 days	11 (34.4)	9 (26.5)			
No infection-related readmission within 30 days					
Yes	30 (93.8)	32 (94.1)	0.004	1	0.950
No	2 (6.3)	2 (5.9)			
Infection resolved or improving at discharge					
Yes	27 (84.4)	25 (73.5)	1.160	1	0.281
No	5 (15.6)	9 (26.5)			
Infection-related mortality					
Yes	0 (0.0)	0 (0.0)	–	–	–
No	32 (100.0)	34 (100.0)			

**Significant at p < 0.05.*

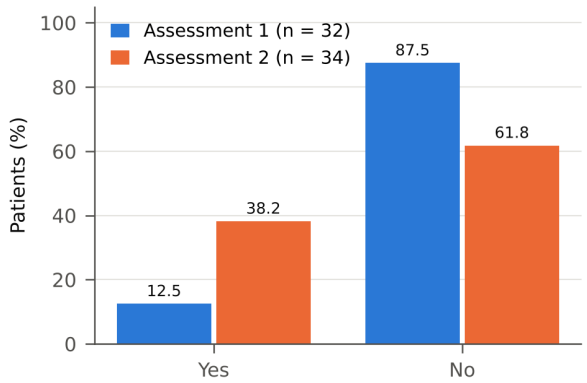


Figure 3: Improvement in primary signs and symptoms within 72 hours in the control group.

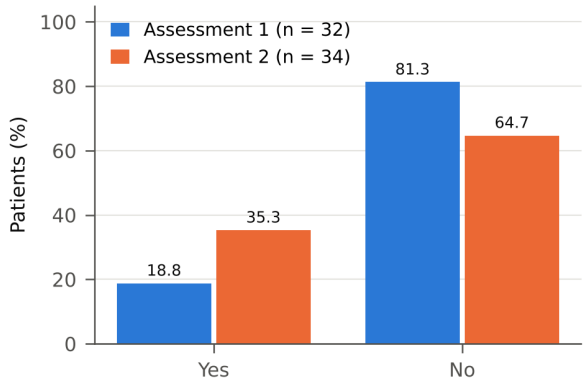


Figure 4: Improvement in laboratory parameters (WBC, CRP, lactate) in the control group.

In the control group, most patients had moderate outcomes in both assessments (71.9% and 61.8%), followed by good outcomes (25.0% and 32.4%), while poor outcomes were minimal (3.1% and 5.9%) (Table 4, Figure 5).

Table 4: Levels of patient outcomes in Assessment 1 and Assessment 2 in the control group (N = 66)

Outcome level	Assessment 1 (n = 32) f (%)	Assessment 2 (n = 34) f (%)
Good (10–13)	8 (25.0)	11 (32.4)
Moderate (5–9)	23 (71.9)	21 (61.8)
Poor (0–4)	1 (3.1)	2 (5.9)

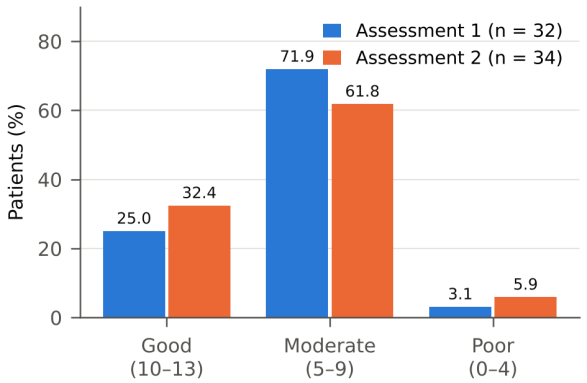


Figure 5: Levels of patient outcomes in the control group in Assessment 1 and Assessment 2.

The mean outcome score in the control group was 8.44 ± 1.74 in Assessment 1 and 8.03 ± 2.50 in Assessment 2. The mean difference of 0.41 points was not statistically significant (t = 0.764, p = 0.448) (Table 5).

Table 5: Comparison of mean patient outcome scores between Assessment 1 and Assessment 2 in the control group (N = 66)

Group	Max score	Assessment 1 mean ± SD	Assessment 2 mean ± SD	Mean diff.	t	p
Control	13	8.44 ± 1.740 (n = 32)	8.03 ± 2.504 (n = 34)	0.408	0.764	0.448

Independent t-test.

Study group

Table 6 shows the demographic variables of the study group. Most patients were aged 41–70 years (50.0% in Assessment 1 and 59.5% in Assessment 2), with fewer aged ≤40 years (30.0% vs 21.4%) or >70 years (20.0% vs 19.0%). Males predominated in Assessment 1 (62.5%), whereas the distribution was balanced in Assessment 2 (50.0% each). Education differed significantly (p = 0.010): higher secondary education was most common in Assessment 2 (50.0%), whereas secondary (30.0%) and graduate-level education (22.5%) were more frequent in Assessment 1. Retired (30.0% vs 38.1%) and privately employed (22.5% vs 19.0%) patients were the commonest occupational groups (Figure 6). Monthly income was mostly ₹30,001–40,000 (62.5% vs 57.1%). Most patients were married (72.5% vs 54.8%). Religion differed significantly (p = 0.010), with Christians predominating in Assessment 1 (42.5%) and "others" in Assessment 2 (38.1%). The dietary pattern was mostly mixed (72.5% vs 69.0%), although vegetarian diet was more common in Assessment 2 (23.8% vs 7.5%; p = 0.050). The other demographic variables were comparable (p > 0.05).

Table 6: Demographic variables of patients in the study group (N = 82)

Variable	Assessment 1 (n = 40) f (%)	Assessment 2 (n = 42) f (%)	χ^2	df	p
Age (years)					
≤40	12 (30.0)	9 (21.4)	2.214	4	0.696
41–50	5 (12.5)	7 (16.7)			
51–60	5 (12.5)	3 (7.1)			
61–70	10 (25.0)	15 (35.7)			
>70	8 (20.0)	8 (19.0)			
Gender					
Male	25 (62.5)	21 (50.0)	1.300	1	0.254
Female	15 (37.5)	21 (50.0)			
Educational status					
No formal education	6 (15.0)	3 (7.1)	13.344	4	0.010*
Primary	2 (5.0)	9 (21.4)			
Secondary	12 (30.0)	5 (11.9)			
Higher secondary	11 (27.5)	21 (50.0)			
Graduate and above	9 (22.5)	4 (9.5)			

Variable	Assessment 1 (n = 40) f (%)	Assessment 2 (n = 42) f (%)	χ^2	df	p
Occupation					
Government	5 (12.5)	5 (11.9)	2.669	4	0.615
Private	9 (22.5)	8 (19.0)			
Self-employed	2 (5.0)	5 (11.9)			
Retired	12 (30.0)	16 (38.1)			
Unemployed	12 (30.0)	8 (19.0)			
Monthly income (₹)					
≤30,000	6 (15.0)	9 (21.4)	0.972	3	0.808
30,001–40,000	25 (62.5)	24 (57.1)			
40,001–50,000	8 (20.0)	7 (16.7)			
>50,000	1 (2.5)	2 (4.8)			
Marital status					
Single	6 (15.0)	8 (19.0)	4.615	3	0.202
Married	29 (72.5)	23 (54.8)			
Separated/divorced	4 (10.0)	5 (11.9)			
Widowed	1 (2.5)	6 (14.3)			
Religion					
Hindu	11 (27.5)	10 (23.8)	11.329	3	0.010*
Christian	17 (42.5)	11 (26.2)			
Muslim	9 (22.5)	5 (11.9)			
Others	3 (7.5)	16 (38.1)			
Dietary pattern					
Vegetarian	3 (7.5)	10 (23.8)	5.997	2	0.050
Non-vegetarian	8 (20.0)	3 (7.1)			
Mixed	29 (72.5)	29 (69.0)			

**Significant at p < 0.05.*



Figure 6: Occupation of patients in the study group in Assessment 1 and Assessment 2.

Table 7 shows the clinical variables of the study group. Most patients were admitted to medical wards (65.0% vs 64.3%) for medical conditions (67.5% vs 64.3%). The commonest indications for antibiotic treatment were respiratory (32.5% vs 45.2%) and gastrointestinal infections (32.5% vs 26.2%). Ceftriaxone was the most frequently used antibiotic (47.5% vs 42.9%), followed by cefotaxime (12.5% vs 28.6%) and piperacillin–tazobactam (17.5% vs 11.9%). Illness duration was mostly less than 6 months (62.5% vs 52.4%). Diabetes with hypertension was more frequent in Assessment 1 (35.0% vs 19.0%). Most patients were non-smokers and non-alcoholic (70.0% vs 81.0%). Overweight was most common in Assessment 1 (40.0%) and obesity in Assessment 2 (33.3%). Nature of activity differed significantly (p = 0.013), with sedentary activity more common in Assessment 2 (57.1% vs 25.0%). Most patients had no catheter or drainage device (80.0% vs 85.7%), readmission within 30 days was rare (5.0% vs 7.1%) and there was no infection-related mortality. Apart from nature of activity, the clinical variables were comparable (p > 0.05).

Table 7: Clinical variables of patients in the study group (N = 82)

Variable	Assessment 1 (n = 40) f (%)	Assessment 2 (n = 42) f (%)	χ^2	df	p
Area of admission					
Medical ward	26 (65.0)	27 (64.3)	0.005	1	0.946
Surgical ward	14 (35.0)	15 (35.7)			
Reason for admission					
Medical condition	27 (67.5)	27 (64.3)	0.094	1	0.759
Surgical condition	13 (32.5)	15 (35.7)			
Indication for antibiotic treatment					
Genito-urinary	6 (15.0)	6 (14.3)	3.578	5	0.612
Respiratory	13 (32.5)	19 (45.2)			
Gastrointestinal	13 (32.5)	11 (26.2)			
Bloodstream	0 (0.0)	1 (2.4)			
CNS	1 (2.5)	0 (0.0)			
Other	7 (17.5)	5 (11.9)			
Antibiotic used					
Ceftriaxone	19 (47.5)	18 (42.9)	5.597	6	0.470
Cefotaxime	5 (12.5)	12 (28.6)			
Piperacillin–tazobactam	7 (17.5)	5 (11.9)			
Amoxicillin–clavulanate	6 (15.0)	4 (9.5)			
Vancomycin	1 (2.5)	0 (0.0)			
Meropenem	2 (5.0)	2 (4.8)			
Others	0 (0.0)	1 (2.4)			
Duration of illness					
<6 months	25 (62.5)	22 (52.4)	1.073	3	0.784
6–11 months	7 (17.5)	8 (19.0)			
12–24 months	7 (17.5)	10 (23.8)			
>24 months	1 (2.5)	2 (4.8)			
Comorbidity					
Diabetes	8 (20.0)	11 (26.2)	5.192	5	0.393
Hypertension	5 (12.5)	6 (14.3)			
Diabetes + hypertension	14 (35.0)	8 (19.0)			
Other	0 (0.0)	3 (7.2)			
None	13 (32.5)	14 (33.3)			
Personal habits					
Smoking	7 (17.5)	7 (16.7)	3.200	2	0.202
Alcohol	5 (12.5)	1 (2.4)			
Neither	28 (70.0)	34 (81.0)			
BMI (kg/m²)					
<18.5 (underweight)	5 (12.5)	7 (16.7)	4.048	3	0.256
18.5–24.9 (normal)	12 (30.0)	11 (26.2)			

Variable	Assessment 1 (n = 40) f (%)	Assessment 2 (n = 42) f (%)	χ^2	df	p
25–30 (overweight)	16 (40.0)	10 (23.8)			
>30 (obese)	7 (17.5)	14 (33.3)			
Nature of activity					
Sedentary	10 (25.0)	24 (57.1)	8.727	2	0.013*
Light	18 (45.0)	11 (26.2)			
Moderate	12 (30.0)	7 (16.7)			
Catheter/drainage devices					
None	32 (80.0)	36 (85.7)	0.473	1	0.492
Present	8 (20.0)	6 (14.3)			
Readmission within 30 days					
Yes	2 (5.0)	3 (7.1)	0.164	1	0.685
No	38 (95.0)	39 (92.9)			
Infection-related mortality					
Yes	0 (0.0)	0 (0.0)	–	–	–
No	40 (100.0)	42 (100.0)			

**Significant at p < 0.05.*

Table 8 compares patient outcomes between the two assessments in the study group. In clinical response, improvement in primary signs and symptoms increased from 32.5% to 50.0% (p = 0.108), and no progression of infection increased from 40.0% to 64.3% (p = 0.028), whereas stabilization of vital signs within 72 hours declined from 57.5% to 35.7% (p = 0.048). In antibiotic safety, the proportions of patients with no adverse drug reaction (70.0% vs 52.4%; Figure 7), no antibiotic-associated diarrhoea (72.5% vs 81.0%; Figure 8) and no allergic reaction (97.5% vs 100%) did not differ significantly (p > 0.05). Short-term healthcare outcomes improved significantly: the proportion with no unnecessary prolongation of therapy rose from 25.0% to 69.0% (p < 0.001), no escalation to higher antibiotics rose from 35.0% to 73.8% (p < 0.001), and a hospital stay of ≤5 days rose from 57.5% to 81.0% (p = 0.021). Infection had resolved or was improving at discharge in 95.0% and 100% of patients (p = 0.142), no infection-related readmission was reported in 95.0% and 90.5% (p = 0.432), and there was no infection-related mortality.

Table 8: Comparison of patient outcomes between Assessment 1 and Assessment 2 in the study group (N = 82)

Variable	Assessment 1 (n = 40) f (%)	Assessment 2 (n = 42) f (%)	χ^2	df	p
Domain I: Clinical response (4 items)					
Improvement in primary signs and symptoms of infection (pain, swelling, redness) within 72 hours of antibiotic initiation					
Yes	13 (32.5)	21 (50.0)	2.585	1	0.108
No	27 (67.5)	21 (50.0)			
Improvement in laboratory parameters (WBC, CRP, serum lactate)					
Yes	13 (32.5)	13 (31.0)	0.023	1	0.880
No	27 (67.5)	29 (69.0)			
No progression of infection (no new symptoms or spread)					
Yes	16 (40.0)	27 (64.3)	4.845	1	0.028*
No	24 (60.0)	15 (35.7)			
Vital signs stabilized within 72 hours					
Yes	23 (57.5)	15 (35.7)	3.910	1	0.048*
No	17 (42.5)	27 (64.3)			
Domain II: Antibiotic safety (3 items)					
No antibiotic-related adverse drug reaction (nausea, vomiting, skin rash, headache, dizziness)					
Yes	28 (70.0)	22 (52.4)	2.673	1	0.102
No	12 (30.0)	20 (47.6)			
No antibiotic-associated diarrhoea					
Yes	29 (72.5)	34 (81.0)	0.822	1	0.365
No	11 (27.5)	8 (19.0)			
No allergic reaction to antibiotic (rash, itching, swelling, anaphylaxis)					
Yes	39 (97.5)	42 (100.0)	1.063	1	0.303
No	1 (2.5)	0 (0.0)			
Domain III: Short-term healthcare outcomes (6 items)					
No unnecessary prolongation of antibiotic therapy					
Yes	10 (25.0)	29 (69.0)	15.93	1	<0.001*
No	30 (75.0)	13 (31.0)			
No escalation to higher antibiotics without indication					
Yes	14 (35.0)	31 (73.8)	12.46	1	<0.001*
No	26 (65.0)	11 (26.2)			
Length of hospital stay not prolonged due to infection					
≤5 days	23 (57.5)	34 (81.0)	5.317	1	0.021*
>5 days	17 (42.5)	8 (19.0)			
No infection-related readmission within 30 days					
Yes	38 (95.0)	38 (90.5)	0.618	1	0.432
No	2 (5.0)	4 (9.5)			
Infection resolved or improving at discharge					
Yes	38 (95.0)	42 (100.0)	2.153	1	0.142
No	2 (5.0)	0 (0.0)			
Infection-related mortality					
Yes	0 (0.0)	0 (0.0)	–	–	–
No	40 (100.0)	42 (100.0)			

**Significant at p < 0.05.*

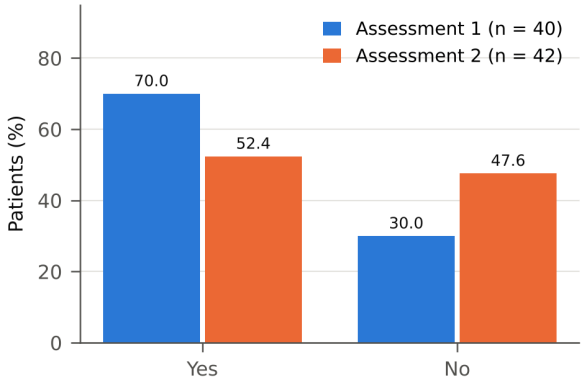


Figure 7: Patients with no antibiotic-related adverse drug reaction in the study group.

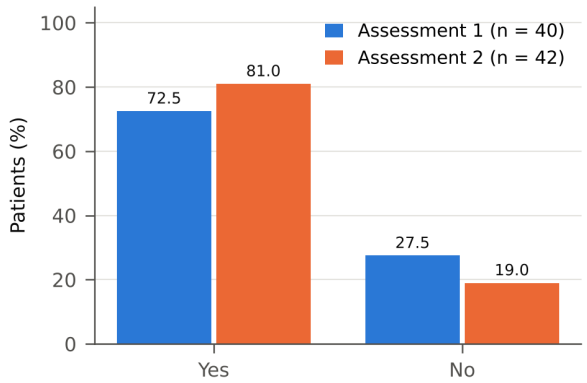


Figure 8: Patients with no antibiotic-associated diarrhoea in the study group.

In the study group, the proportion of patients with good outcomes increased from 25.0% in Assessment 1 (before the intervention) to 52.4% in Assessment 2 (after the intervention), while moderate outcomes declined from 72.5% to 47.6%. Only one patient (2.5%) had a poor outcome in Assessment 1, and none in Assessment 2 (Table 9).

Table 9: Levels of patient outcomes in Assessment 1 and Assessment 2 in the study group (N = 82)

Outcome level	Assessment 1 (n = 40) f (%)	Assessment 2 (n = 42) f (%)
Good (10–13)	10 (25.0)	22 (52.4)
Moderate (5–9)	29 (72.5)	20 (47.6)
Poor (0–4)	1 (2.5)	0 (0.0)

The mean outcome score in the study group increased from 8.10 ± 1.91 in Assessment 1 to 9.29 ± 1.83 in Assessment 2. The mean difference of 1.19 points was statistically significant (t = −2.878, p = 0.005) (Table 10, Figure 9).

Table 10: Comparison of mean patient outcome scores between Assessment 1 and Assessment 2 in the study group (N = 82)

Group	Max score	Assessment 1 mean ± SD	Assessment 2 mean ± SD	Mean diff.	t	p
Study	13	8.10 ± 1.905 (n = 40)	9.29 ± 1.825 (n = 42)	−1.186	−2.878	0.005*

*Independent t-test. *Significant at p < 0.01.*

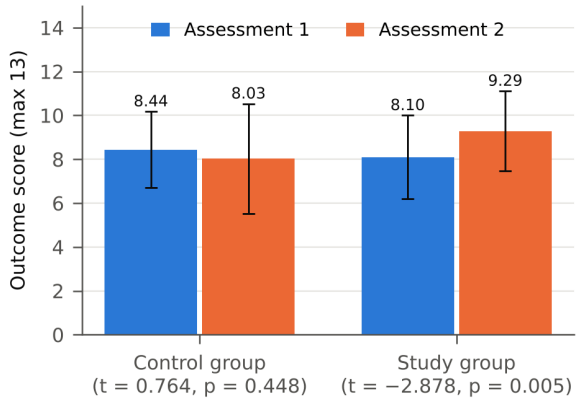


Figure 9: Mean (± SD) patient outcome scores in Assessment 1 and Assessment 2 in the control and study groups.

Association of baseline variables with patient outcomes

In the control group, only age was significantly associated with outcome scores in Assessment 1 (B = −0.838, p = 0.038), with younger patients having better scores (Table 11). In Assessment 2, both age (B = −0.814, p = 0.002) and gender (B = −1.125, p = 0.037) were significantly associated with outcome scores (Table 12). Other variables, including indication for antibiotic use, comorbidity, BMI and activity, were not significant (p > 0.05).

Table 11: Multiple linear regression of baseline variables on patient outcome scores: control group, Assessment 1 (n = 32)

Variable	B	SE	β	t	p	95% CI for B
(Constant)	13.760	3.283		4.191	<0.001	6.912 to 20.609
Age	−0.838	0.378	−0.652	−2.219	0.038*	−1.626 to −0.050
Gender	−0.953	0.808	−0.278	−1.180	0.252	−2.638 to 0.732
Area of admission	−0.442	0.946	−0.101	−0.467	0.646	−2.416 to 1.532
Reason for admission	−0.442	0.946	−0.101	−0.467	0.646	−2.416 to 1.532
Indication for antibiotic use	−0.037	0.274	−0.043	−0.136	0.893	−0.608 to 0.533
Antibiotic used	−0.105	0.276	−0.107	−0.379	0.709	−0.681 to 0.471
Duration of illness	−0.138	0.492	−0.067	−0.282	0.781	−1.164 to 0.887
Comorbid illness	0.025	0.156	0.038	0.162	0.873	−0.299 to 0.350
Personal habits	−0.202	0.336	−0.142	−0.602	0.554	−0.903 to 0.499
BMI	0.097	0.347	0.059	0.280	0.782	−0.626 to 0.820
Nature of activity	−0.104	0.423	−0.050	−0.246	0.808	−0.986 to 0.778
Catheter/drainage device	0.018	1.276	0.003	0.014	0.989	−2.645 to 2.680

*B, unstandardized coefficient; SE, standard error; β, standardized coefficient; CI, confidence interval. *Significant at p < 0.05.*

Table 12: Multiple linear regression of baseline variables on patient outcome scores: control group, Assessment 2 (n = 34)

Variable	B	SE	β	t	p	95% CI for B
(Constant)	14.193	2.138		6.639	<0.001	9.907 to 18.479
Age	−0.814	0.249	−0.548	−3.273	0.002*	−1.312 to −0.315
Gender	−1.125	0.526	−0.262	−2.139	0.037*	−2.180 to −0.070
Area of admission	–	–	–	–	–	Excluded
Reason for admission	0.398	0.621	0.072	0.641	0.524	−0.847 to 1.643
Indication for antibiotic use	−0.279	0.140	−0.269	−1.984	0.052	−0.560 to 0.003
Antibiotic used	0.138	0.181	0.099	0.759	0.451	−0.226 to 0.502
Duration of illness	−0.312	0.240	−0.146	−1.299	0.199	−0.792 to 0.169
Comorbid illness	0.026	0.123	0.030	0.211	0.833	−0.221 to 0.274
Personal habits	−0.004	0.225	−0.002	−0.016	0.987	−0.455 to 0.448
BMI	0.341	0.278	0.134	1.226	0.225	−0.217 to 0.899
Nature of activity	−0.429	0.313	−0.156	−1.371	0.176	−1.056 to 0.198
Catheter/drainage device	−1.059	0.752	−0.184	−1.408	0.165	−2.566 to 0.449

*Area of admission was excluded from the model (no estimate reported). *Significant at p < 0.05.*

In the study group, most variables showed no significant association with outcome scores in Assessment 1, except for the presence of comorbid illness (B = 0.426, p = 0.029) (Table 13). In Assessment 2, after the empowerment program, none of the baseline variables was significantly associated with outcome scores (p > 0.05) (Table 14, Figure 10).

Table 13: Multiple linear regression of baseline variables on patient outcome scores: study group, Assessment 1 (n = 40)

Variable	B	SE	β	t	p	95% CI for B
(Constant)	6.153	2.584		2.381	0.025	0.850 to 11.456
Age	0.153	0.357	0.125	0.429	0.671	−0.580 to 0.886
Gender	−0.658	0.543	−0.169	−1.210	0.237	−1.773 to 0.457
Area of admission	1.447	1.734	0.367	0.834	0.411	−2.111 to 5.005
Reason for admission	−0.908	1.669	−0.226	−0.544	0.591	−4.332 to 2.516
Indication for antibiotic use	0.060	0.142	0.062	0.423	0.676	−0.231 to 0.351
Antibiotic used	−0.154	0.204	−0.121	−0.753	0.458	−0.572 to 0.265
Duration of illness	0.139	0.355	0.063	0.390	0.700	−0.590 to 0.867
Comorbid illness	0.426	0.185	0.532	2.305	0.029*	0.047 to 0.805
Personal habits	0.315	0.282	0.203	1.116	0.274	−0.264 to 0.895
BMI	0.063	0.279	0.031	0.227	0.822	−0.510 to 0.637
Nature of activity	0.331	0.376	0.130	0.880	0.387	−0.441 to 1.102
Catheter/drainage device	−1.613	0.912	−0.343	−1.769	0.088	−3.483 to 0.258

**Significant at p < 0.05.*

Table 14: Multiple linear regression of baseline variables on patient outcome scores: study group, Assessment 2 (n = 42)

Variable	B	SE	β	t	p	95% CI for B
(Constant)	10.043	2.234		4.495	<0.001	5.481 to 14.606
Age	−0.346	0.232	−0.280	−1.494	0.146	−0.819 to 0.127
Gender	−0.599	0.671	−0.166	−0.893	0.379	−1.969 to 0.771
Area of admission	0.459	0.686	0.122	0.669	0.508	−0.942 to 1.860
Reason for admission	0.459	0.686	0.122	0.669	0.508	−0.942 to 1.860
Indication for antibiotic use	0.020	0.208	0.019	0.096	0.924	−0.404 to 0.444
Antibiotic used	−0.139	0.211	−0.116	−0.662	0.513	−0.570 to 0.291
Duration of illness	0.464	0.367	0.246	1.264	0.216	−0.285 to 1.213
Comorbid illness	0.247	0.128	0.338	1.933	0.063	−0.014 to 0.509
Personal habits	−0.426	0.330	−0.269	−1.292	0.206	−1.099 to 0.247
BMI	−0.174	0.304	−0.105	−0.572	0.572	−0.794 to 0.446
Nature of activity	0.688	0.439	0.289	1.568	0.127	−0.208 to 1.583
Catheter/drainage device	−0.074	1.070	−0.014	−0.069	0.945	−2.259 to 2.110

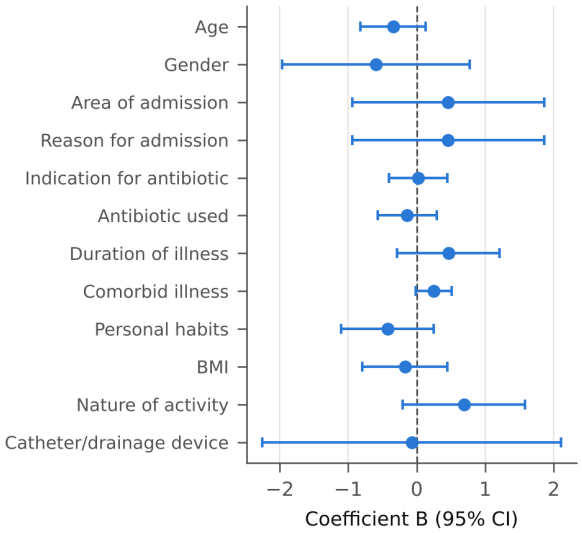


Figure 10: Regression coefficients (B with 95% confidence intervals) of baseline variables on patient outcome scores in the study group, Assessment 2. Intervals crossing zero indicate no significant association.

Conclusion

The Nurses' Empowerment Program on antibiotic stewardship significantly improved patient outcomes compared with the control group. Although the demographic and clinical variables were largely comparable at baseline, the control group showed no meaningful change in outcome scores ($p = 0.448$), whereas the study group showed a statistically significant increase in mean outcome scores, from 8.10 ± 1.91 to 9.29 ± 1.83 ($p = 0.005$). Key improvements were seen in the progression of infection, unnecessary prolongation of antibiotic therapy, escalation to higher antibiotics and length of hospital stay ($p < 0.05$). Overall, the program was effective in improving clinical response and short-term healthcare outcomes, supporting its value in strengthening nursing practice and patient care.

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