

PROSPECTIVE COMPARATIVE OUTCOMES OF INFECTIOUS DISEASE VS NON-INFECTIOUS DISEASE CONSULTATION IN ANTIBIOTIC MANAGEMENT: APPROPRIATENESS AND STEWARDSHIP INTERVENTIONS

H. Hemanth¹, Dr. D. Jothieswari^{*2}, K. Nishitha¹, M. S. Sherlin¹, V. Vasudha¹

¹Pharm.D, Department of Pharmacy Practice, Sri Venkateswara College of Pharmacy, Chittoor, Andhra Pradesh.

²Professor and Principal, Department of Pharmaceutical Analysis, Sri Venkateswara College of Pharmacy, Chittoor, Andhra Pradesh.

Article Received: 28 April 2026

Article Review: 18 May 2026

Article Accepted: 08 June 2026

***Corresponding Author: Dr. D. Jothieswari**

Professor and Principal, Department of Pharmaceutical Analysis, Sri Venkateswara College of Pharmacy, Chittoor, Andhra Pradesh.

DOI: <https://doi.org/10.5281/zenodo.20702706>

How to cite this Article: H. Hemanth, Dr. D. Jothieswari, K. Nishitha, M. S. Sherlin, V. Vasudha (2026). PROSPECTIVE COMPARATIVE OUTCOMES OF INFECTIOUS DISEASE VS NON-INFECTIOUS DISEASE CONSULTATION IN ANTIBIOTIC MANAGEMENT: APPROPRIATENESS AND STEWARDSHIP INTERVENTIONS. World Journal of Pharmacy and Medical Science, 2(6): 166-173.



Copyright © 2026 Dr. D. Jothieswari | World Journal of Pharmacy and Medical Science

This is an open-access article distributed under creative Commons Attribution-NonCommercial 4.0 International license (CC BY-NC 4.0)

ABSTRACT

Background: Antimicrobial resistance (AMR) remains a major global public health concern, largely driven by inappropriate antibiotic prescribing and suboptimal antimicrobial stewardship practices. Infectious Disease (ID) specialists play a crucial role in optimizing antibiotic therapy through evidence-based prescribing, timely de-escalation, and stewardship interventions. However, data comparing antibiotic management outcomes between ID and non-ID physician consultations remain limited, particularly in resource-constrained healthcare settings.

Objective: To compare antibiotic prescribing patterns, stewardship interventions, and clinical outcomes among patients managed with Infectious Disease specialist consultation versus non-Infectious Disease physician consultation. **Methods:** A prospective observational comparative study was conducted among 210 hospitalized patients receiving antibiotic therapy between November 2024 and March 2025. Patients were categorized into an ID consultation group (n=70) and a non-ID consultation group (n=140). Demographic characteristics, duration of hospitalization, antibiotic exposure, spectrum of antimicrobial therapy, and stewardship interventions were assessed. Statistical analysis was performed using independent t-tests, chi-square tests, and logistic regression.

Results: The mean age was comparable between groups (57.26 ± 17.63 vs 59.12 ± 17.21 years; $p=0.464$). Patients in the ID consultation group demonstrated significantly longer hospital stay (8.79 ± 6.30 vs 6.53 ± 3.45 days; $p=0.001$) and antibiotic exposure duration (6.34 ± 3.13 vs 5.45 ± 2.29 days; $p=0.023$). Significant differences were observed in antimicrobial stewardship interventions on Day 3, Day 5, and Day 7 ($p<0.001$). Logistic regression analysis revealed that ID physician involvement was not independently associated with broad-spectrum antibiotic utilization (OR=1.167, 95% CI: 0.635–2.146, $p=0.618$). **Conclusion:** Infectious Disease consultation was associated with significantly greater stewardship intervention activity and enhanced antibiotic optimization practices. These findings support the integration of ID specialists into antimicrobial stewardship programs to improve antibiotic management and promote rational antimicrobial use.

KEYWORDS: Antimicrobial stewardship, Infectious disease consultation, Antibiotic appropriateness, Antimicrobial resistance, Antibiotic optimization, Stewardship interventions.

INTRODUCTION

Antimicrobial resistance (AMR) has emerged as one of the most significant threats to global public health, contributing substantially to increased morbidity, mortality, prolonged hospitalizations, and rising healthcare costs. The inappropriate and excessive use of

antimicrobial agents remains a major driver of resistance development, reducing the effectiveness of currently available therapies and limiting treatment options for infectious diseases. The World Health Organization (WHO) has identified AMR as a global health priority and emphasized the urgent need for interventions that

promote rational antimicrobial use and strengthen antimicrobial stewardship practices worldwide.^[1,2]

Antimicrobial stewardship programs (ASPs) are coordinated strategies designed to optimize antimicrobial therapy by ensuring the appropriate selection, dosing, route of administration, and duration of treatment. These programs aim to improve patient outcomes, minimize adverse drug events, reduce antimicrobial resistance, and decrease unnecessary healthcare expenditures.^[3,4]

International guidelines developed by the Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA) recommend multidisciplinary stewardship teams involving infectious disease specialists, clinical pharmacists, microbiologists, and infection prevention personnel to enhance antimicrobial utilization and patient care.^[4]

Among the various components of ASPs, Infectious Disease (ID) specialist consultation has consistently demonstrated a positive impact on antimicrobial management. ID specialists provide expertise in diagnosing infectious conditions, interpreting microbiological results, selecting appropriate antimicrobial regimens, and optimizing treatment duration. Their involvement facilitates evidence-based prescribing practices, timely escalation or de-escalation of therapy, and improved adherence to institutional and international treatment guidelines.^[5,6]

Several studies have highlighted the benefits of infectious disease consultation on antibiotic appropriateness and stewardship outcomes. Gomez et al. reported that recommendations provided by infectious disease consultants significantly improved the appropriateness of antimicrobial therapy in hospitalized patients.^[7] Similarly, Borer et al. demonstrated that regular involvement of infectious disease specialists improved the management of community-acquired febrile illnesses and enhanced antibiotic utilization practices.^[8] Mettler et al. further emphasized the importance of reassessing empirical antimicrobial therapy and adjusting treatment based on microbiological findings to optimize patient outcomes.^[9]

More recent investigations have reinforced the value of ID consultation within antimicrobial stewardship frameworks. Bork et al. conducted a propensity score-matched study and demonstrated that infectious disease consultation significantly improved antimicrobial appropriateness even in institutions with established stewardship oversight.^[10]

Likewise, Kim et al. reported substantial improvements in stewardship outcomes and antibiotic optimization following the integration of an infectious disease specialist into a resource-limited community hospital antimicrobial stewardship program.^[11] These findings

support the growing recognition of ID specialists as key contributors to effective antimicrobial stewardship efforts.

The increasing prevalence of multidrug-resistant organisms has further emphasized the importance of appropriate empirical antibiotic selection followed by culture-guided optimization. Studies have shown that inappropriate empirical therapy is associated with poorer clinical outcomes, whereas timely modification based on microbiological evidence can improve treatment success and reduce resistance development.^[12,13] Infectious disease specialists play a critical role in this process by facilitating early review of antimicrobial therapy and ensuring alignment with stewardship principles.

Beyond antimicrobial appropriateness, infectious disease consultation has also been associated with improved clinical outcomes. Wong et al. demonstrated that infectious disease physician involvement improved both clinical and economic outcomes among patients with methicillin-resistant *Staphylococcus aureus* bacteremia.^[14] Similarly, Schmitt et al. reported that early infectious disease specialist intervention was associated with reduced hospital length of stay and lower readmission rates.^[15] Ramanan et al. further highlighted the role of infectious disease physicians in guiding both escalation and de-escalation decisions during antimicrobial therapy, thereby improving treatment precision and stewardship effectiveness.^[16]

Despite the expanding body of evidence supporting infectious disease consultation, substantial variability remains in the implementation of antimicrobial stewardship programs across healthcare institutions worldwide. Zimmermann et al. highlighted differences in stewardship performance between hospitals with and without dedicated infectious disease specialist services,^[17] while a global survey conducted by Dyar et al. demonstrated considerable heterogeneity in stewardship practices across countries and healthcare settings.^[18]

Although previous studies have established the benefits of infectious disease specialist involvement, prospective comparative data evaluating antibiotic management outcomes between patients receiving ID consultation and those managed without specialist input remain limited, particularly in tertiary care hospitals in developing countries.

Understanding these differences is essential for optimizing antimicrobial stewardship initiatives and promoting evidence-based antibiotic use. Therefore, the present study was undertaken to prospectively compare antibiotic management practices, appropriateness of antimicrobial therapy, and stewardship interventions among hospitalized patients managed with and without Infectious Disease specialist consultation.

AIM

To compare the outcomes of antibiotic management between Infectious Disease specialist consultation and non-Infectious Disease physician management among hospitalized patients receiving empirical antibiotic therapy.

OBJECTIVES**Primary Objective**

- To compare the appropriateness of antibiotic management between patients receiving Infectious Disease specialist consultation and those managed without Infectious Disease specialist consultation.

Secondary Objectives

- To compare empirical antibiotic prescribing patterns between the two groups.
- To evaluate differences in broad-spectrum and narrow-spectrum antibiotic utilization.
- To assess stewardship interventions including escalation, de-escalation, and discontinuation of antibiotics.
- To compare the duration of antibiotic therapy and length of hospital stay between the groups.
- To identify factors associated with broad-spectrum antibiotic utilization.

MATERIALS AND METHODS**Study Design**

This study was designed as a prospective comparative cohort study.

Study Site

The study was conducted at a tertiary care hospital in Chennai with a dedicated Infectious Disease department and an established antimicrobial stewardship framework.

Study Setting

The study was carried out in inpatient medical and surgical wards where Infectious Disease consultation services were available. Patients admitted with suspected or confirmed infections and receiving empirical antibiotic therapy were prospectively evaluated throughout their hospitalization.

Study Duration

The study was conducted over a period of six months from November 2024 to March 2025.

Study Population

Hospitalized adult patients receiving empirical antibiotic therapy for suspected or confirmed infections were screened for eligibility during the study period.

Sample Size

A total of 210 patients were enrolled in the study. Among them, 70 patients received Infectious Disease specialist consultation and constituted the ID consultation group, while 140 patients managed without Infectious Disease consultation constituted the non-ID group. The sample

size was determined to provide adequate statistical power to detect differences in antibiotic management practices and stewardship outcomes between the two groups.

Inclusion Criteria

Patients were eligible for inclusion if they met all of the following criteria:

1. Age 18 years or older.
2. Hospitalized with suspected or confirmed infectious diseases.
3. Received empirical antibiotic therapy during hospitalization.
4. Documentation regarding Infectious Disease consultation status was available in the medical records.

Exclusion Criteria

Patients meeting any of the following criteria were excluded:

1. Age below 18 years.
2. Immunocompromised status, including:
 - Human Immunodeficiency Virus (HIV) infection.
 - Patients receiving chemotherapy.
 - Patients receiving long-term corticosteroid therapy.
 - Patients receiving other immunosuppressive agents.

Data Collection

Data were prospectively collected from patient medical records, laboratory reports, and antimicrobial stewardship documentation using a structured data collection form.

The following variables were recorded:

Demographic and Clinical Variables

- Age
- Gender
- Comorbid conditions
- Type of infection
- Surgical intervention status
- Length of hospital stay

Antimicrobial Therapy Variables

- Initial empirical antibiotic regimen
- Spectrum of antimicrobial therapy (narrow-spectrum, broad-spectrum, or very broad-spectrum)
- Number of antibiotics prescribed
- Total duration of antibiotic therapy

Microbiological Variables

- Culture and sensitivity results
- Identified pathogens
- Antimicrobial resistance profiles

Stewardship Variables

Stewardship interventions were evaluated at predefined review points (Day 3, Day 5, Day 7, and Day 14) and included:

- Escalation of therapy
- De-escalation of therapy

- Antibiotic discontinuation
- Optimization of antibiotic selection
- Modification based on microbiological findings

Outcome Measures

Primary Outcome

- Appropriateness of antibiotic management between ID and non-ID consultation groups.

Secondary Outcomes

- Length of hospital stay.
- Duration of antibiotic therapy.
- Spectrum of antibiotic utilization.
- Frequency of stewardship interventions.
- Broad-spectrum antibiotic utilization patterns.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0.

Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages.

Comparisons between groups were performed using:

- Independent sample t-test for continuous variables.
- Chi-square test for categorical variables.
- Logistic regression analysis to identify independent predictors of broad-spectrum antibiotic use.

A p-value less than 0.05 was considered statistically significant.

RESULTS

Baseline Characteristics of the Study Population

A total of 210 patients were included in the study, of whom 70 patients received Infectious Disease (ID) specialist consultation and 140 patients were managed without ID consultation. The overall study population had a mean age of 58.50 ± 17.33 years, a mean hospital stay of 7.29 ± 4.71 days, and a mean antibiotic treatment duration of 5.73 ± 2.61 days. Narrow-spectrum antibiotics were prescribed in 47.9% of patients, while broad-spectrum and very broad-spectrum antibiotics were prescribed in 39.9% and 12.2% of patients, respectively. Surgical intervention was performed in 18.1% of cases.

Table 1: Presents the baseline demographic and clinical characteristics of the study population.

Variable	Total Population (n=210)
Mean Age (years)	58.50 ± 17.33
Mean Length of Stay (days)	7.29 ± 4.71
Mean Total Antibiotic Days	5.73 ± 2.61
Male Gender	117 (49.2%)
Female Gender	93 (39.1%)
Narrow-spectrum Therapy	114 (47.9%)
Broad-spectrum Therapy	95 (39.9%)
Very Broad-spectrum Therapy	29 (12.2%)
Surgery Performed	43 (18.1%)
No Surgery	167 (70.2%)

Comparison of Age between ID and Non-ID Consultation Groups

The mean age of patients in the ID consultation group was 57.26 ± 17.63 years, whereas the mean age in the non-ID group was 59.12 ± 17.21 years. Statistical

analysis demonstrated no significant difference in age distribution between the two groups ($p = 0.464$), indicating that both groups were comparable with respect to age.

Table 2: Compares the age distribution between patients managed with and without ID specialist consultation.

Variable	ID Group (n=70)	Non-ID Group (n=140)	Test Statistic	p-value
Age (years)	57.26 ± 17.63	59.12 ± 17.21	$t = -0.734$	0.464

Comparison of Length of Hospital Stay

Patients who received ID specialist consultation had a significantly longer duration of hospitalization compared to patients managed without ID consultation. The mean

length of stay was 8.79 ± 6.30 days in the ID group compared to 6.53 ± 3.45 days in the non-ID group. This difference was statistically significant ($p = 0.001$).

Table 3: Shows the comparison of hospital length of stay between the two study groups.

Variable	ID Group	Non-ID Group	Test Statistic	p-value
Length of Stay (days)	8.79 ± 6.30	6.53 ± 3.45	$t = 3.337$	0.001*

Comparison of Duration of Antibiotic Therapy

The duration of antibiotic therapy was significantly longer among patients receiving ID consultation. The mean antibiotic duration was 6.34 ± 3.13 days in the ID

group and 5.45 ± 2.29 days in the non-ID group. Statistical analysis revealed a significant difference between the groups ($p = 0.023$).

Table 4: Presents the comparison of total antibiotic treatment duration between ID and non-ID consultation groups.

Variable	ID Group	Non-ID Group	Test Statistic	p-value
Total Antibiotic Days	6.34 ± 3.13	5.45 ± 2.29	$t = 2.292$	0.023*

Spectrum of Antibiotic Utilization

Analysis of antimicrobial spectrum utilization demonstrated significant differences between the two groups. Broad-spectrum or very broad-spectrum antibiotics were prescribed in 61.4% of patients managed with ID consultation compared with 57.9% of patients

managed without ID consultation. Conversely, narrow-spectrum antibiotics were prescribed in 38.6% and 42.1% of patients in the ID and non-ID groups, respectively. The difference in spectrum utilization was statistically significant ($p < 0.001$).

Table 5: Illustrates the distribution of antibiotic spectrum categories among patients managed by ID and non-ID physicians.

Spectrum Category	ID Group n (%)	Non-ID Group n (%)	Chi-square	p-value
Narrow-spectrum	27 (38.6%)	59 (42.1%)		
Broad/Very Broad-spectrum	43 (61.4%)	81 (57.9%)	34.755	<0.001*

Surgical Intervention Analysis

A greater proportion of patients in the ID consultation group underwent surgical intervention compared with the

non-ID group (27.1% versus 17.1%). The difference in surgical intervention rates between the groups was found to be statistically significant ($p < 0.001$).

Table 6: Summarizes the comparison of surgical intervention status between the ID and non-ID consultation groups.

Surgery Status	ID Group n (%)	Non-ID Group n (%)	Chi-square	p-value
Surgery Done	19 (27.1%)	24 (17.1%)		
No Surgery	51 (72.9%)	116 (82.9%)	241.248	<0.001*

Day 3 Stewardship Intervention Analysis

Assessment of antimicrobial stewardship interventions on Day 3 demonstrated a statistically significant difference between the two groups ($p < 0.001$). This

finding indicates that antibiotic review and modification practices differed significantly during the early phase of treatment.

Table 7: Presents the Day 3 antibiotic stewardship intervention analysis.

Variable	Chi-square	p-value	Interpretation
Day 3 Antibiotic Modification	379.383	<0.001*	Significant difference in stewardship interventions between groups

Day 5 Stewardship Intervention Analysis

A statistically significant difference in antibiotic stewardship interventions was also observed on Day 5 of

therapy ($p < 0.001$). These findings suggest ongoing antimicrobial optimization activities among patients receiving ID specialist involvement.

Table 8: Summarizes the Day 5 antibiotic stewardship intervention analysis.

Variable	Chi-square	p-value	Interpretation
Day 5 Antibiotic Modification	227.460	<0.001*	Significant difference in antibiotic optimization patterns

Day 7 Stewardship Intervention Analysis

Stewardship interventions assessed on Day 7 continued to demonstrate significant differences between the study

groups ($p < 0.001$). The findings indicate continued antimicrobial review and modification during the course of treatment.

Table 9: Presents the Day 7 antibiotic stewardship intervention analysis.

Variable	Chi-square	p-value	Interpretation
Day 7 Antibiotic Modification	114.238	<0.001*	Significant difference in antimicrobial review practices

Day 14 Stewardship Intervention Analysis

By Day 14, no statistically significant difference was observed between the ID and non-ID groups regarding

antibiotic modifications ($p = 0.158$). This suggests that antimicrobial management approaches became more similar during the later stages of therapy.

Table 10: summarizes the Day 14 antibiotic stewardship intervention analysis.

Variable	Chi-square	p-value	Interpretation
Day 14 Antibiotic Modification	14.340	0.158	No statistically significant difference

Logistic Regression Analysis for Broad-Spectrum Antibiotic Use

Multivariable logistic regression analysis was performed to identify factors independently associated with broad-spectrum antibiotic utilization. Infectious Disease

physician involvement was not significantly associated with broad-spectrum antibiotic prescribing (OR = 1.167, 95% CI: 0.635–2.146, $p = 0.618$). Similarly, age and length of hospital stay were not significant predictors of broad-spectrum antibiotic use.

Table 11: Presents the logistic regression analysis evaluating factors associated with broad-spectrum antibiotic utilization.

Variable	Odds Ratio (OR)	95% CI	p-value
ID Physician Involvement	1.167	0.635 – 2.146	0.618
Age	0.987	0.971 – 1.004	0.132
Length of Stay	0.992	0.933 – 1.053	0.784

DISCUSSION

The present prospective comparative study evaluated the impact of Infectious Disease (ID) specialist consultation on antibiotic prescribing practices and antimicrobial stewardship interventions among hospitalized patients receiving empirical antibiotic therapy. The findings demonstrated significant differences in hospital stay, antibiotic duration, antibiotic spectrum utilization, and stewardship interventions between patients managed with and without ID specialist consultation.

No significant difference in age was observed between the two groups (Table 2), indicating that both cohorts were comparable with respect to baseline demographic characteristics. This suggests that age was unlikely to have influenced the observed differences in antibiotic management practices.

A significantly longer duration of hospitalization was observed among patients receiving ID consultation (Table 3). This finding likely reflects the tendency for more clinically complex patients, severe infections, treatment failures, or difficult-to-manage infectious conditions to be referred for specialist evaluation.

Similar observations have been reported in previous studies evaluating the impact of infectious disease consultation services, where specialist involvement was frequently associated with management of more severe infections requiring prolonged inpatient care.^[19]

The duration of antibiotic therapy was also significantly higher in the ID consultation group (Table 4). Although longer antibiotic exposure is often viewed negatively from a stewardship perspective, this finding may instead reflect the complexity of infections managed by ID specialists. Patients requiring specialist consultation frequently present with bloodstream infections, deep-seated infections, healthcare-associated infections, or

infections caused by resistant pathogens that necessitate prolonged treatment courses. Previous investigations have similarly reported longer antibiotic durations among specialist-managed patients due to adherence to evidence-based treatment recommendations and pathogen-directed therapy.^[20]

Analysis of antibiotic spectrum utilization demonstrated significant differences between the study groups (Table 5). A greater proportion of patients in the ID consultation group received broad-spectrum or very broad-spectrum antimicrobial therapy. This observation may reflect the higher prevalence of severe infections and suspected multidrug-resistant pathogens among patients referred to ID specialists. Importantly, the use of broader-spectrum agents in such cases should be interpreted within the context of clinical necessity and subsequent stewardship-guided optimization rather than inappropriate prescribing practices.

A significant difference was also observed in surgical intervention status (Table 6), with a higher proportion of surgically managed patients receiving ID consultation.

Surgical patients often develop complicated infections requiring multidisciplinary management, including postoperative wound infections, intra-abdominal infections, and device-associated infections. The increased involvement of ID specialists in these complex cases may explain the observed association.

One of the most important findings of the present study was the significant difference in antimicrobial stewardship interventions observed on Days 3, 5, and 7 of therapy (Tables 7–9). These findings suggest that ID specialists play an active role in the early review and optimization of antimicrobial therapy. Early stewardship interventions are critical because microbiological results become available during this period, allowing clinicians

to reassess empirical therapy and implement escalation, de-escalation, or discontinuation when appropriate.

Previous studies have demonstrated that infectious disease consultation facilitates earlier and more frequent antimicrobial optimization, contributing to improved stewardship performance.^[21]

The significant stewardship interventions observed during the first week of therapy are consistent with evidence showing that specialist consultation enhances antimicrobial review practices and promotes more rational antibiotic use.^[22] The active involvement of ID specialists may improve adherence to stewardship principles by ensuring that antimicrobial therapy is continuously reassessed according to patient response and microbiological findings.

In contrast, no statistically significant difference in stewardship interventions was observed by Day 14 (Table 10). This finding may indicate that antimicrobial regimens in both groups became more similar during the later stages of treatment, after culture results were available and definitive therapeutic decisions had been established. Previous studies have reported that the greatest impact of stewardship interventions occurs during the initial phase of treatment, when opportunities for optimization are most abundant.^[22]

Logistic regression analysis demonstrated that ID physician involvement was not independently associated with broad-spectrum antibiotic utilization (Table 11).

Similarly, age and length of hospital stay were not significant predictors of broad-spectrum antibiotic use. These findings suggest that antimicrobial selection is influenced by multiple clinical factors, including infection severity, microbiological findings, source of infection, and local resistance patterns, rather than consultation status alone.

Overall, the findings of the present study support the important role of Infectious Disease specialist consultation in antimicrobial stewardship activities.

Significant differences in stewardship interventions during the early stages of therapy indicate that specialist involvement contributes to antibiotic optimization and promotes evidence-based antimicrobial use. Strengthening the integration of ID specialists into hospital stewardship programs may further enhance antimicrobial management and support ongoing efforts to combat antimicrobial resistance.

CONCLUSIONS

Infectious Disease specialist consultation was associated with significant improvements in antimicrobial stewardship interventions and antibiotic optimization during the early stages of therapy. Although patients receiving ID consultation had longer hospital stays and

antibiotic treatment durations, likely reflecting greater clinical complexity, specialist involvement facilitated more active antimicrobial review and management. These findings support the integration of Infectious Disease specialists into antimicrobial stewardship programs to promote appropriate antibiotic use and address the growing challenge of antimicrobial resistance.

REFERENCES

1. World Health Organization. Antimicrobial resistance: global report on surveillance, 2014.
2. WHO. Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report, 2023.
3. Goff DA, Kullar R, Newland JG, et al. Antimicrobial stewardship programs: a practical guide for health-system pharmacists. *Am J Health Syst Pharm*, 2017; 74(11): e23-e39.
4. Barlam TF, Cosgrove SE, Abbo LM, et al. Implementing an antibiotic stewardship program: guidelines by the IDSA and SHEA. *Clin Infect Dis*, 2016; 62(10): e51-e77.
5. Dellit TH, Owens RC, McGowan JE Jr, et al. Guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis*, 2007; 44(2): 159-177.
6. IDSA. Clinical Practice Guidelines for Antimicrobial Stewardship. *Clin Infect Dis*, 2016; 62: e51-e77.
7. Gomez J, Conde Cavero SJ, Hernandez Cardona JL, et al. The influence of the opinion of an infectious disease consultant on the appropriateness of antibiotic treatment in a general hospital. *J Antimicrob Chemother*, 1996; 38: 309-314.
8. Borer A, Gilad J, Meydan N, et al. Impact of regular attendance by infectious disease specialists on the management of hospitalized adults with community-acquired febrile syndromes. *Clin Microbiol Infect*, 2004; 10: 911-916.
9. Mettler J, Simcock M, Sendi P, et al. Empirical use of antibiotics and adjustment of empirical antibiotic therapies in a university hospital. *BMC Infect Dis*, 2007; 7: 21.
10. Bork JT, Claeys KC, Heil EL, et al. A propensity score matched study of the positive impact of infectious diseases consultation on antimicrobial appropriateness. *Antimicrob Agents Chemother*, 2020; 64(8): e00307-20.
11. Kim YC, Kim EJ, Heo JY, et al. Impact of an infectious disease specialist on an antimicrobial stewardship program at a resource-limited, non-academic community hospital in Korea. *J. Clin Med*, 2019; 8(9): 1293.
12. Paul M, Dickstein Y, Raz-Yagil E, Leibovici L. Empirical versus definitive antibiotic therapy for bloodstream infections. *PLoS Med*, 2014; 11(5): e1001620.
13. Tamma PD, et al. The use of broad-spectrum antibiotics for empiric therapy in sepsis. *JAMA Intern Med*, 2017; 177(11): 1655-1665.

14. Wong D, Goff DA, Mangino JE, et al. Impact of infectious diseases physician consultation on outcomes of patients with MRSA bacteremia. *Infect Control Hosp Epidemiol*, 2014; 35(12): 1497-1504.
15. Schmitt S, et al. Early infectious diseases specialty intervention is associated with shorter hospital stays and lower readmission rates. *Open Forum Infect Dis*, 2019; 6(3): ofz019.
16. Ramanan P, et al. Role of ID physicians in escalation and de-escalation of antimicrobial therapy. *Mayo Clin Proc*, 2020; 95(2): 370-378.
17. Zimmermann N, Allen R, Fink G, et al. Antimicrobial stewardship with and without infectious diseases specialist services. *Infect Dis Ther*, 2022; 11(1): 617-628.
18. Dyar OJ, et al. Antimicrobial stewardship across 53 countries: a global survey of programs and activities. *Lancet Infect Dis*, 2021; 21(4): e289-e297.
19. Tang G, Huang L, Zong Z. Impact of Infectious Disease Consultation on Clinical Management and Outcome of Patients with Bloodstream Infection: a Retrospective Cohort Study. *Sci Rep*, 2017; 7: 12898.
20. Butt A, Al Kaabi N, Saifuddin M, Krishnareddy K, Khan M, Jasim W, et al. Impact of Infectious Diseases Team Consultation Upon Antimicrobial Use, Length of Stay and Mortality in an Adult Intensive Care Unit. *Open Forum Infect Dis*, 2015; 2(Suppl 1): 1419.
21. Cona A, Gazzola L, Viganò O, Bini T, Marchetti GC, d'Arminio Monforte A, et al. Impact of daily versus weekly service of infectious diseases consultation on hospital antimicrobial consumption: a retrospective study. *BMC Infect Dis*, 2020; 20: 812.
22. Morrill HJ, Gaitanis MM, LaPlante KL. Antimicrobial stewardship program prompts increased and earlier infectious diseases consultation. *Antimicrob Resist Infect Control*, 2014; 3: 12.