

Prevalence and Antibiotic Sensitivity of Nosocomial Bloodstream Infections: An Analysis of Medical Wards in a Tertiary Care Hospital

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Abstract: Nosocomial bloodstream infections (BSIs) are a significant cause of morbidity and mortality in tertiary care hospitals, especially with the rising burden of multidrug-resistant (MDR) organisms. Understanding local epidemiology and antibiotic susceptibility patterns is essential for guiding empirical therapy and strengthening infection-control practices. **Objective:** To determine the prevalence, microbial distribution, and antibiotic sensitivity patterns of nosocomial bloodstream infections among hospitalized patients in a tertiary care hospital. **Methods:** A descriptive cross-sectional study was conducted among 420 hospitalized patients. Nosocomial BSIs were identified in patients who developed clinical symptoms after 48 hours of admission. Blood samples were collected under aseptic conditions and processed using automated blood culture systems. Microorganisms were identified using standard biochemical and morphological methods. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method according to CLSI guidelines. Data were analyzed using descriptive statistics. **Results:** Of the 420 patients screened, 71 (16.9 percent) had confirmed nosocomial BSIs. Most infected patients were urban residents (77.46 percent), and UTIs were the leading primary source of bacteremia (45.05 percent). Gender-wise differences were notable: *Salmonella typhi* was more common in males (80 percent), and *Klebsiella pneumoniae* was more prevalent in females (71.42 percent). ICU patients showed higher isolation rates of MDR organisms, particularly *Acinetobacter baumannii* and *K. pneumoniae*. Antibiotic susceptibility profiles revealed high resistance rates among Gram-negative isolates: *E. coli* showed 90 percent resistance to Ampicillin, *K. pneumoniae* exhibited complete resistance to Ampicillin and Augmentin, and *A. baumannii* demonstrated 85.7 percent resistance to Ampicillin. Glycopeptides such as Vancomycin and Teicoplanin retained 100 percent sensitivity against *Enterococcus spp.* and *Streptococcus pneumoniae*. **Conclusion:** Nosocomial BSIs remain a significant concern, with a high prevalence of MDR Gram-negative pathogens and substantial variability in susceptibility patterns. The preserved efficacy of glycopeptides underscores their continued role in treating resistant Gram-positive infections. Strengthening antimicrobial stewardship, improving infection-control measures, and adopting evidence-based prescribing practices are essential to mitigate the burden of BSIs in tertiary care hospitals.

Keywords: Nosocomial bloodstream infections, antimicrobial resistance, ICU pathogens, *E. coli*, *Klebsiella pneumoniae*, antibiotic susceptibility.

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Introduction

Nosocomial bloodstream infections (BSIs) remain a significant challenge for healthcare systems worldwide, particularly in tertiary care hospitals where critically ill and immunocompromised patients are at greater risk. These infections occur when pathogenic microorganisms enter the bloodstream during hospitalization, leading to significant morbidity, prolonged hospital stays, increased healthcare costs, and elevated mortality rates. Globally, BSIs account for approximately 20 to 40 percent of all healthcare-associated infections (HAIs), reflecting their substantial clinical and public health burden (1,2).

The growing emergence of multidrug-resistant (MDR) organisms has further complicated the management of BSIs. Pathogens such as *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus* have been frequently implicated, with resistance patterns varying across regions and hospital settings (3,4). A systematic review by Alemu and colleagues highlighted the high prevalence of MDR isolates, attributing this trend to inappropriate antibiotic use, suboptimal antimicrobial stewardship, and gaps in infection-control practices (5). In several tertiary care settings, more than 60 percent of isolated pathogens associated with BSIs have demonstrated multidrug resistance, posing substantial diagnostic and therapeutic challenges (6).

The COVID-19 pandemic has further influenced infection dynamics in healthcare facilities. Studies have reported increased rates of BSIs caused by carbapenem-resistant organisms during and after the pandemic, driven by overwhelmed healthcare systems, excessive antibiotic use, and disruptions in standard infection-prevention measures (7,8,9). These developments highlight the need for continuous surveillance and timely updates to treatment protocols.

Local epidemiological data are crucial for guiding empirical therapy and shaping hospital infection-control policies. Research by Vandael et al. noted an antimicrobial-use prevalence of 27.1 percent among hospitalized patients, illustrating the strong relationship between antibiotic consumption and resistance (10). Misuse and overuse of broad-spectrum antibiotics have been key drivers of resistance, especially among Gram-negative bacilli (11).

In Pakistan, the burden of nosocomial infections, including BSIs, remains significantly high. Limited healthcare resources, gaps in infection-control infrastructure, and the widespread availability of non-prescription antibiotics contribute substantially to the emergence of resistant pathogens. Data generated through local studies are vital for developing targeted strategies to reduce BSI incidence and enhance antimicrobial stewardship efforts (12,13).

The present study aims to determine the prevalence of nosocomial bloodstream infections in a tertiary care hospital, identify the causative microorganisms, and assess their antibiotic susceptibility patterns. By



providing updated, context-specific evidence, the study seeks to support informed decision-making and improve patient outcomes and infection-control practices within the local healthcare setting.

Methodology

This study was conducted in the medical wards of a tertiary care hospital. It employed a descriptive cross-sectional design to determine the prevalence and antibiotic sensitivity patterns of nosocomial bloodstream infections (NBSIs). A total of 420 hospitalized patients were selected through random sampling. Patients were included if they developed clinical features suggestive of bloodstream infection after 48 hours of hospital stay, indicating a nosocomial origin. Blood cultures were obtained from all enrolled individuals following standard aseptic techniques. Patients with incomplete clinical information or those who had blood samples taken before hospital admission were excluded.

Trained laboratory technologists collected blood samples in accordance with internationally recommended sterile procedures. Before venipuncture, patient identity and verbal consent were confirmed. The selected venipuncture site—typically a peripheral vein—was disinfected with 70 percent isopropyl alcohol and allowed to air-dry. Using a sterile syringe and needle, 5–10 mL of blood was withdrawn from adult patients and immediately inoculated into aerobic and anaerobic blood culture bottles. Samples were promptly transported to the laboratory and loaded into an automated blood culture system, such as BACTEC or BacT/ALERT, which continuously monitored microbial growth. Positive culture bottles were sub-cultured onto blood agar and MacConkey agar. Media preparation followed standard microbiological procedures: nutrient agar was autoclaved at 121°C for 15 minutes, cooled to 45–50°C, and enriched with 5–10 percent sterile defibrinated sheep blood for blood agar plates. MacConkey agar was prepared separately to allow differentiation of lactose-fermenting Gram-negative bacteria.

Isolated organisms were identified using conventional biochemical and morphological methods. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method, following Clinical and Laboratory Standards Institute (CLSI) guidelines. A panel of commonly used antibiotics—including penicillins, cephalosporins, aminoglycosides, fluoroquinolones, carbapenems, glycopeptides, and polymyxins—was tested according to the pathogen type. Zones of inhibition were measured and interpreted as sensitive or resistant based on CLSI breakpoints.

Data on demographics, primary infection sites, ward type, and microbial profiles were collected using a structured questionnaire. All data were reviewed for completeness before analysis. Results were summarized using descriptive statistics, including frequencies and percentages. Antibiotic resistance profiles for each pathogen were presented in tabular format. The study adhered to standard ethical practices, and blood sample handling met biosafety and infection-control guidelines to ensure patient safety, sample integrity, and environmental protection.

Results

A total of 420 patients were enrolled, and 71 (16.9%) were confirmed to have nosocomial bloodstream infections. Among these infected patients, 77.46 percent were from urban areas, 32.39 percent were homemakers, and 26.76 percent were students, reflecting the demographic characteristics of those most affected (Table 1).

Urinary tract infections represented the most common primary source, accounting for 45.05 percent of bloodstream infections, followed by gastrointestinal infections (23.94 percent) and respiratory infections (16.90 percent), indicating that urinary and digestive systems were the major contributors to secondary bacteremia (Table 2).

Gender-wise distribution revealed that *Salmonella typhi* was isolated from 80 percent of males, whereas *Klebsiella pneumoniae* was isolated from 71.42 percent of females. *Escherichia coli* was more common among females (57 percent), while *Staphylococcus aureus* showed 69.23 percent prevalence in males, highlighting organism-specific gender patterns (Table 3).

Ward-based analysis showed that ICU patients had a higher frequency of multidrug-resistant organisms. *Acinetobacter baumannii* and *Klebsiella pneumoniae* were notably more common in ICU settings, whereas *Salmonella typhi* appeared predominantly in patients from general wards (Table 4).

Antibiotic susceptibility testing demonstrated substantial resistance across several key pathogens. *E. coli* showed 90 percent resistance to Ampicillin, *K. pneumoniae* exhibited 100 percent resistance to Ampicillin and Augmentin, and *A. baumannii* showed 85.7 percent resistance to Ampicillin. On the other hand, *Enterococcus spp.* and *Streptococcus pneumoniae* remained 100 percent sensitive to Vancomycin, Teicoplanin, and Linezolid, indicating preserved activity of glycopeptides and oxazolidinones (Table 5).

Table 1. Demographic Profile of NBSI-Positive Patients

Variable	Category	n (%)
Total patients	—	420 (100)
NBSI-positive	—	71 (16.9)
Residence	Urban	77.46
	Rural	22.54
Occupation	Housewife	32.39
	Student	26.76
	Laborer	9.85
	Retired	9.85
	Healthcare worker	8.45
	Office worker	8.45
	Government officer	5.60

Table 2. Primary Infection Sources

Source of Infection	Percentage (%)
Urinary tract infection	45.05
Gastrointestinal infection	23.94
Respiratory infection	16.90
Other infections	14.11

Table 3. Gender-Wise Distribution of Isolated Pathogens

Pathogen	Male (%)	Female (%)
Salmonella typhi	80	20
Klebsiella pneumoniae	28.58	71.42
Escherichia coli	43	57
Staphylococcus aureus	69.23	30.77

Table 4. Distribution of Microorganisms in ICU vs General Wards

Pathogen	ICU	General Wards
Acinetobacter baumannii	High	Low
Klebsiella pneumoniae	High	Moderate
Pseudomonas aeruginosa	Present	Present
Escherichia coli	Present	Present
Staphylococcus aureus	Present	Present
Salmonella typhi	Rare	Present

Table 5. Antibiotic Susceptibility Patterns of Bacterial Isolates

Antibiotic	E. coli (R/S %)	S. aureus (R/S %)	S. typhi (R/S %)	A. baumannii (R/S %)	K. pneumoniae (R/S %)	P. aeruginosa (R/S %)	Enterococcus spp. (R/S %)	S. pneumoniae (R/S %)
Ampicillin	90 / 10	30.76 / 69.24	60 / 40	85.7 / 14.28	100 / 0	28.57 / 71.43	100 / 0	0 / 100
Augmentin	90 / 10	82.31 / 17.69	40 / 60	85.7 / 14.28	100 / 0	28.57 / 71.43	100 / 0	0 / 100
Piperacillin/Tazobactam	88 / 12	87.69 / 12.31	60 / 40	71.42 / 28.57	100 / 0	85.72 / 14.28	—	—
Ceftriaxone	76.6 / 23.4	70.76 / 29.24	80 / 20	85.7 / 14.28	85.71 / 14.29	14.28 / 85.72	100 / 0	0 / 100
Doxycycline	76.6 / 23.4	53.88 / 46.15	—*	42.85 / 57.14	100 / 0	—	—	—
Cefepime	46.11 / 53.89	—	—	100 / 0	—	44.28 / 54.28	—	—
Colistin	—	—	20 / 80	44.28 / 54.28	85.78 / 14.28	—	—	—
Aztreonam	54.28 / 44.28	—	—	28.57 / 71.43	—	—	—	—
Teicoplanin	—	—	—	—	—	—	0 / 100	0 / 100
Linezolid	—	—	—	—	—	—	0 / 100	0 / 100
Vancomycin	—	46.16 / 53.84	—	—	—	—	0 / 100	0 / 100

(R = Resistant, S = Sensitive)

Discussion

The findings of this study provide important insight into the burden and microbiological profile of nosocomial bloodstream infections in a tertiary care hospital. Among 420 enrolled patients, 16.9 percent were confirmed to have BSIs, a proportion comparable to international reports of 15 to 25 percent in similar healthcare settings (14). Most affected patients were from urban areas (77.46 percent), which supports earlier evidence indicating higher infection rates in urban populations due to greater healthcare access and patient density (14).

Urinary tract infections were the leading primary source of BSIs (45.05 percent), followed by gastrointestinal and respiratory infections. This distribution aligns with global research showing that UTIs are a major contributor to secondary bacteremia, particularly among hospitalized adult patients (15). The link between urinary tract colonization and bacteremia has been well established, emphasizing the need for improved urinary catheter care and infection-control practices in hospitals (14).

Gender-specific trends were also observed: 80 percent of Salmonella typhi isolates were obtained from male patients, and 71.42 percent of Klebsiella pneumoniae isolates were obtained from females. Such patterns have been previously reported, with gender-related biological

and behavioral factors influencing infection risk and pathogen distribution (16). The higher proportion of Escherichia coli infections among females in our study (57 percent) mirrors existing evidence highlighting the predominance of UTIs in women, which may progress to BSIs (16).

A greater concentration of multidrug-resistant organisms—particularly Acinetobacter baumannii and Klebsiella pneumoniae—was detected in ICU patients. This observation is consistent with prior studies showing that ICU environments facilitate rapid transmission of resistant organisms due to invasive procedures and high antibiotic exposure (14). Resistance levels exceeding 80 percent for specific ICU pathogens have been documented, underscoring the need for rigorous infection-control interventions (17).

Antibiotic susceptibility testing revealed extremely high resistance rates among key Gram-negative organisms. E. coli demonstrated 90 percent resistance to Ampicillin, K. pneumoniae exhibited complete resistance to Ampicillin and Augmentin, and A. baumannii showed 85.7 percent resistance to Ampicillin. These alarming trends reflect a global rise in antimicrobial resistance and are consistent with studies reporting significant therapeutic challenges posed by such pathogens (18,19). In contrast, retained sensitivity of Enterococcus spp. and Streptococcus

pneumoniae to Vancomycin and Linezolid suggests that glycopeptides and oxazolidinones remain effective therapeutic options (20).

In the context of Pakistan, these findings are particularly relevant. Limited resources, gaps in antimicrobial stewardship, and inconsistent infection-control policies contribute to the growing burden of nosocomial BSIs. The predominance of infections in urban populations and the high prevalence of multidrug-resistant organisms highlight the need for targeted interventions and stronger surveillance. Strengthening hospital infection-prevention programs, optimizing antibiotic prescribing practices, and improving public awareness about antibiotic misuse are critical steps toward reducing the incidence of BSIs and improving patient outcomes in under-resourced healthcare settings (21,22).

The epidemiology and clinical implications of nosocomial bloodstream infections detailed in our findings provide critical insights for healthcare providers. Given the elevated resistance profiles observed and the specific demographic trends, this study serves as a foundation for developing targeted interventions and strengthening antibiotic stewardship programs in Pakistan's healthcare system.

Conclusion

This study highlights a significant burden of nosocomial bloodstream infections, with 16.9 percent of hospitalized patients affected and a predominance of multidrug-resistant Gram-negative pathogens. The high resistance rates observed in *E. coli*, *Klebsiella pneumoniae*, and *Acinetobacter baumannii* demonstrate the urgent need for stricter antimicrobial stewardship and reinforced infection-control policies. Despite widespread resistance, glycopeptides remained fully effective against *Enterococcus* spp. and *Streptococcus pneumoniae*, indicating their continued therapeutic importance. Strengthening surveillance systems, optimizing antibiotic use, and implementing targeted interventions are crucial steps to reduce the impact of BSIs and improve patient outcomes in tertiary care hospitals.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-MMUNC-92/24)

Consent for publication

Approved

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Conflict of interest

The authors declared no conflicts of interest.

Author Contribution

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Manuscript drafting, Study Design,

MF (BS In Medical Lab Technology)

Review of Literature, Data entry, Data analysis, and drafting articles.

UFG (Assistant Professor)

Conception of Study, Development of Research Methodology Design

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Study Design, manuscript review, and critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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