

Prevalence and Antimicrobial Susceptibility Pattern of Multidrug-Resistant Bacteria Isolated From Bloodstream Infections

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ABSTRACT

Bloodstream infections (BSIs) are among the leading causes of morbidity and mortality worldwide and are increasingly complicated by the emergence of multidrug-resistant (MDR) bacteria. The present study was conducted to detect MDR bacteria isolated from blood samples and evaluate their antimicrobial susceptibility patterns. A total of 100 blood samples collected from patients clinically suspected of bloodstream infections were processed using standard microbiological methods. Bacterial isolates were identified through culture characteristics, Gram staining, and biochemical tests. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines. Out of 100 blood samples, 38 (38%) showed positive bacterial growth.

Gram-negative bacteria predominated, accounting for 76.3% of isolates, while Gram-positive bacteria constituted 23.7%. *Escherichia coli* (31.6%) and *Klebsiella pneumoniae* (23.7%) were the most frequently isolated pathogens. Antimicrobial susceptibility testing revealed high resistance to ampicillin (79.3%), cefotaxime (69.0%), and ciprofloxacin (62.1%). Carbapenems and aminoglycosides demonstrated comparatively higher effectiveness. Among the isolates, 24 (63.2%) were identified as multidrug-resistant. MDR *Klebsiella pneumoniae* and MDR *Escherichia coli* were the predominant resistant organisms. The findings highlight the increasing burden of antimicrobial resistance among bloodstream pathogens and emphasize the need for continuous surveillance, infection control measures, and antimicrobial stewardship programs.

Keywords: Bloodstream Infections, Multidrug Resistance, Antimicrobial Resistance, *Escherichia coli*, *Klebsiella pneumoniae*, Antibiotic Susceptibility

INTRODUCTION

Bloodstream infections (BSIs) represent one of the most severe forms of bacterial infection and remain a major cause of morbidity and mortality globally. These infections occur when pathogenic microorganisms enter the bloodstream and trigger systemic inflammatory responses that may progress to sepsis, septic shock, multiple organ dysfunction syndrome, and death if not managed appropriately. The burden of bloodstream infections has increased considerably due to prolonged hospitalization, invasive medical procedures, immunosuppressive conditions, and the widespread use of antimicrobial agents.

The emergence of multidrug-resistant (MDR) bacteria has become a major challenge in the management of bloodstream infections. MDR organisms are defined as bacteria resistant to at least one antimicrobial agent in three or more antibiotic classes. Such pathogens significantly reduce available therapeutic options and contribute to treatment failure, prolonged hospitalization, increased healthcare costs, and elevated mortality rates. The rapid spread of antimicrobial resistance has transformed bloodstream infections into a major public health concern worldwide.

Gram-negative bacteria such as *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* are increasingly associated with bloodstream infections and frequently exhibit multidrug resistance. These organisms possess several resistance mechanisms, including beta-lactamase production, efflux pumps, target site modification, and biofilm formation. Gram-positive organisms, particularly methicillin-resistant *Staphylococcus aureus* (MRSA), also contribute significantly to antimicrobial resistance in healthcare settings.

The increasing prevalence of MDR bloodstream pathogens highlights the need for continuous surveillance and antimicrobial susceptibility testing to guide appropriate therapeutic interventions. Early detection of resistant organisms enables clinicians to initiate effective treatment and implement infection control strategies. Therefore, the present study was undertaken to detect multidrug-resistant bacteria isolated from blood samples and evaluate their antimicrobial susceptibility patterns among patients with suspected bloodstream infections.

MATERIALS AND METHODS

The present study was conducted as a hospital-based cross-sectional observational study in the Department of Microbiology of a tertiary care healthcare facility. The study was carried out from January 2026 to May 2026 and included blood samples collected from patients clinically suspected of bloodstream infections or septicemia. A total of 100 blood samples were included in the study.

Blood samples were collected aseptically using sterile disposable syringes following proper skin disinfection procedures. Approximately 5–10 mL of blood was collected from adult patients, whereas 1–3 mL was collected from pediatric patients. Samples were inoculated into blood culture bottles and transported immediately to the microbiology laboratory for processing.

Blood culture bottles were incubated aerobically at 37°C and monitored for microbial growth. Positive cultures were subcultured onto Blood Agar and MacConkey Agar plates. Colony morphology, pigmentation, hemolytic characteristics, and lactose fermentation patterns were observed. Gram staining was performed for preliminary identification, followed by biochemical characterization using catalase, coagulase, oxidase, indole, citrate utilization, urease, Triple Sugar Iron (TSI), and motility tests.

Antimicrobial susceptibility testing was carried out using the Kirby–Bauer disk diffusion method on Mueller–Hinton Agar according to CLSI guidelines. Antibiotics tested against Gram-negative bacteria included ampicillin, cefotaxime, ceftazidime, ceftriaxone, ciprofloxacin, gentamicin, amikacin, piperacillin–tazobactam, imipenem, and meropenem. Gram-positive isolates were tested against penicillin, ceftioxin, erythromycin, clindamycin, vancomycin, and linezolid. Isolates resistant to at least one antimicrobial agent in three or more antibiotic classes were classified as multidrug-resistant.

Data were entered into Microsoft Excel and analyzed using descriptive statistical methods. Results were expressed as frequencies and percentages.

RESULTS AND DISCUSSION

3.1 Blood Culture Positivity Rate

A total of 100 blood samples were processed during the study period. Among these, 38 samples demonstrated positive bacterial growth, resulting in a blood culture positivity rate of 38%, while 62 samples showed no growth.

Table 1. Distribution of Blood Culture Results

Blood Culture Result	Number	Percentage (%)
Positive Culture	38	38.0
Negative Culture	62	62.0
Total	100	100

The positivity rate observed in the present study indicates a considerable burden of bloodstream infections among clinically suspected patients.

3.2 Distribution of Gram-Positive and Gram-Negative Isolates

Among the culture-positive isolates, Gram-negative bacteria predominated and accounted for 76.3% of isolates, whereas Gram-positive bacteria represented 23.7%.

Table 2. Distribution of Gram-Positive and Gram-Negative Isolates

Type of Isolate	Number	Percentage (%)
Gram-Positive	9	23.7
Gram-Negative	29	76.3
Total	38	100

The predominance of Gram-negative organisms reflects their increasing importance as bloodstream pathogens and their association with antimicrobial resistance.

3.3 Distribution of Bacterial Isolates

Escherichia coli emerged as the most common bloodstream pathogen, followed by Klebsiella pneumoniae and Staphylococcus aureus.

Table 3. Distribution of Bacterial Isolates

Bacterial Isolate	Number	Percentage (%)
Escherichia coli	12	31.6
Klebsiella pneumoniae	9	23.7
Staphylococcus aureus	7	18.4
Pseudomonas aeruginosa	5	13.2
Acinetobacter baumannii	3	7.9
Others	2	5.2
Total	38	100

The predominance of Gram-negative bacteria, particularly Escherichia coli and Klebsiella pneumoniae, is consistent with reports from healthcare institutions worldwide.

3.4 Antimicrobial Susceptibility Pattern of Gram-Negative Isolates

Antimicrobial susceptibility testing revealed substantial resistance among Gram-negative isolates.

Table 4. Antibiotic Susceptibility Pattern of Gram-Negative Isolates

Antibiotic	Sensitive (%)	Resistant (%)
Ampicillin	20.7	79.3
Cefotaxime	31.0	69.0
Ciprofloxacin	37.9	62.1
Gentamicin	55.2	44.8
Amikacin	72.4	27.6
Imipenem	82.8	17.2
Meropenem	79.3	20.7

High resistance to ampicillin, cefotaxime, and ciprofloxacin was observed. In contrast, carbapenems and aminoglycosides demonstrated comparatively better activity against the recovered isolates.

3.5 Prevalence of Multidrug-Resistant Isolates

The prevalence of multidrug-resistant bacteria was remarkably high among bloodstream pathogens.

Table 5. Prevalence of MDR Isolates

Category	Number	Percentage (%)
MDR Isolates	24	63.2
Non-MDR Isolates	14	36.8
Total	38	100

More than half of the bacterial isolates recovered from bloodstream infections were classified as multidrug resistant, indicating a serious antimicrobial resistance burden.

3.6 Distribution of MDR Organisms

MDR *Klebsiella pneumoniae* and MDR *Escherichia coli* were the predominant multidrug-resistant organisms identified in the present study.

Table 6. Distribution of MDR Organisms

MDR Organism	Number	Percentage (%)
MDR <i>Klebsiella pneumoniae</i>	8	33.3
MDR <i>Escherichia coli</i>	7	29.2
MDR <i>Pseudomonas aeruginosa</i>	4	16.7
MDR <i>Acinetobacter baumannii</i>	3	12.5
MRSA	2	8.3
Total	24	100

The predominance of MDR Gram-negative bacteria observed in this study reflects the growing challenge of antimicrobial resistance in healthcare settings. The emergence of resistant bloodstream pathogens significantly limits therapeutic options and increases the risk of treatment failure, prolonged hospitalization, and adverse clinical outcomes. The findings are consistent with recent reports describing increasing multidrug resistance among bloodstream pathogens worldwide. Continuous surveillance, infection control measures, antimicrobial stewardship programs, and evidence-based antibiotic therapy are essential for controlling the spread of resistant organisms and improving patient outcomes.

CONCLUSION

The present study demonstrated a significant prevalence of multidrug-resistant bacteria among bloodstream infection isolates. Out of 100 blood samples analyzed, 38% yielded positive cultures, with Gram-negative bacteria accounting for the majority of isolates. *Escherichia coli* and *Klebsiella pneumoniae* emerged as the predominant bloodstream pathogens. Antimicrobial susceptibility testing revealed high resistance to ampicillin, cefotaxime, and ciprofloxacin, while carbapenems and amikacin retained comparatively better activity.

The prevalence of MDR bacteria was 63.2%, indicating a substantial burden of antimicrobial resistance. MDR *Klebsiella pneumoniae* and MDR *Escherichia coli* were the most frequently encountered resistant organisms. These findings underscore the urgent need for routine antimicrobial resistance surveillance, strict infection control measures, rational antibiotic prescribing, and implementation of antimicrobial stewardship programs. Early detection of MDR pathogens and evidence-based antimicrobial therapy are essential for improving patient outcomes and reducing the spread of resistant bacteria in healthcare settings.

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