

**Original article**

## **Bacteriological And Fungal Profile of Blood Stream Infections in a Tertiary Care Hospital in North India: A Retrospective Study**

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### **Abstract**

*Background-* Bloodstream infections (BSIs) are an important cause of morbidity and mortality, particularly with the rising burden of antimicrobial resistance. Knowledge of prevalent pathogens and their resistance profiles is essential for appropriate empirical therapy and infection control.

*Aim-* To determine the prevalence of bloodstream infections and analyze the antimicrobial resistance patterns of bacterial and fungal isolates obtained from blood cultures in a tertiary care hospital.

*Materials and Methods-* A retrospective observational study was conducted in the Department of Microbiology of a tertiary care hospital from July 2024 to December 2024. Blood samples received for culture and sensitivity testing were processed using standard microbiological techniques. Identification of isolates and antimicrobial susceptibility testing were performed according to standard laboratory protocols.

*Results-* Among 478 blood samples processed, 142 showed positive growth, yielding a positivity rate of 29.7%. The predominant isolates were *Pseudomonas aeruginosa* (21.1%), followed by *Staphylococcus aureus* (20.4%), *Klebsiella pneumoniae* (17.6%), *Escherichia coli* (15.5%), and *Acinetobacter baumannii* (13.4%). Less frequently isolated organisms included *Salmonella Typhi* (3.5%), *Streptococcus pneumoniae* (2.8%), *Enterococcus* species (2.1%), and *Candida* species (2.1%). ESBL production was observed in 31.8% of *E. coli* isolates and 16% of *Klebsiella pneumoniae* isolates. Carbapenem resistance was noted in 72% of *Klebsiella pneumoniae* isolates and 78.9% of *Acinetobacter baumannii* isolates. Among *Staphylococcus aureus* isolates, MRSA constituted 93.5%, while MSSA accounted for 6.5%. All *Enterococcus* isolates were sensitive to vancomycin, and no VRE isolate was detected. Among *Candida* isolates, 33.3% were *Candida albicans* and 66.7% were non-*albicans* *Candida* species.

*Conclusion-* The study demonstrates a high prevalence of multidrug-resistant organisms in bloodstream infections, particularly among Gram-negative bacilli. Continuous antimicrobial surveillance, rational antibiotic use, and strict infection control measures are essential to reduce the burden of resistant pathogens and improve patient outcomes.

**Keywords-** Bloodstream infection; Antimicrobial resistance; ESBL; MRSA; Carbapenem resistance; Blood culture.

### **Introduction**

Bloodstream infections (BSIs) are among the most serious infectious diseases encountered in clinical practice and are caused by the presence of viable microorganisms in the bloodstream, either continuously or intermittently<sup>(1)</sup>. BSIs are associated with significant morbidity and mortality, prolonged hospitalization, increased healthcare expenditure, and poor patient outcomes<sup>(2,3)</sup>. The reported mortality rate ranges from 20% to 50%, particularly in critically ill and immunocompromised patients<sup>(4)</sup>.

The increasing incidence of multidrug-resistant (MDR) organisms has become a major global health concern. Factors such as inappropriate hand hygiene practices, irrational and excessive use of antibiotics, inadequate infection control measures, and failure to adhere to barrier nursing protocols contribute significantly to the emergence and spread of resistant pathogens. The rapid evolution of antimicrobial resistance has complicated the management of bloodstream infections and limited the effectiveness of empirical antimicrobial therapy<sup>(5)</sup>.

Blood culture remains the gold standard for the diagnosis of bloodstream infections and plays a crucial role in identifying the causative organisms and determining their antimicrobial susceptibility patterns. Knowledge regarding the prevalence of bacterial pathogens and their resistance profiles is essential for guiding empirical therapy, formulating hospital antibiotic policies, and implementing effective infection prevention and control strategies<sup>(6,7)</sup>.

In tertiary care hospitals, continuous surveillance of bloodstream pathogens and antimicrobial resistance patterns is necessary to monitor changing trends and support antimicrobial stewardship programs. Such data assist clinicians in selecting appropriate antibiotics, reducing treatment failure, and preventing the further emergence of resistant strains.

Therefore, the present study was undertaken to evaluate the spectrum of pathogens isolated from blood cultures and to analyze their antimicrobial resistance patterns in a tertiary care hospital.

### Materials and Methods

#### Study Design

A retrospective observational study was conducted to analyze blood culture isolates and their antimicrobial susceptibility patterns.

Study Setting: The study was carried out in the Department of Microbiology of a tertiary care teaching hospital.

Study Duration: The study was conducted over a period of six months from July 2024 to December 2024.

Study Population: All blood samples received in the microbiology laboratory for culture and antimicrobial susceptibility testing during the study period were included.

#### Inclusion Criteria

All blood samples received for culture and sensitivity testing during the study period.

#### Exclusion Criteria

- Repeated blood culture samples from the same patient yielding identical isolates.
- Samples with incomplete patient details or inadequate volume.

#### Sample Collection and Processing

Blood samples were collected under strict aseptic precautions by trained healthcare personnel before initiation of antimicrobial therapy whenever possible. Samples were inoculated into blood culture bottles and processed according to standard microbiological procedures.

Positive cultures were identified based on colony morphology, Gram staining characteristics, and standard biochemical tests. Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar, and results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

#### Data Collection

Relevant demographic and laboratory details including age, sex, ward/ICU distribution, isolated organisms, and antimicrobial susceptibility patterns were collected from laboratory records and entered into a structured proforma.

#### Statistical Analysis

Data were entered into Microsoft Excel and analyzed using descriptive statistics. Results were expressed as frequencies, percentages, tables, and charts wherever appropriate.

#### Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee (IEC). Patient confidentiality and anonymity were maintained throughout the study in accordance with National Medical Commission (NMC) ethical guidelines and the Declaration of Helsinki.

### Results

A total of 478 blood samples were processed during the study period. Out of these, 142 samples showed positive growth, yielding a positivity rate of 29.7% (Table 1).

The most common isolate was *Staphylococcus aureus* (21.8%), followed by *Pseudomonas aeruginosa* (21%), *Klebsiella pneumoniae* (17.6%), *Escherichia coli* (15.5%), and *Acinetobacter baumannii* (13.4%) (Figure 1).

ESBL production and carbapenem resistance were common among Gram-negative isolates (Figure 2).

Among 31 *Staphylococcus aureus* isolates, MRSA accounted for 29 isolates while MSSA accounted for 2 isolates. All *Enterococcus* isolates were vancomycin-sensitive (Figure 3). No vancomycin-resistant *Enterococcus* (VRE) isolate was identified. Among *Candida* isolates, non-albicans *Candida* predominated (Figure 4).

TABLE 1

SAMPLE	TOTAL SAMPLES	POSITIVE	PERCENTAGE POSITIVITY
BLOOD	478	142	29.7%

FIGURE 1

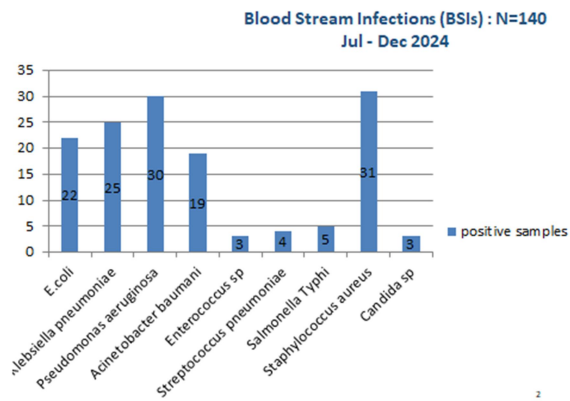


FIGURE 2

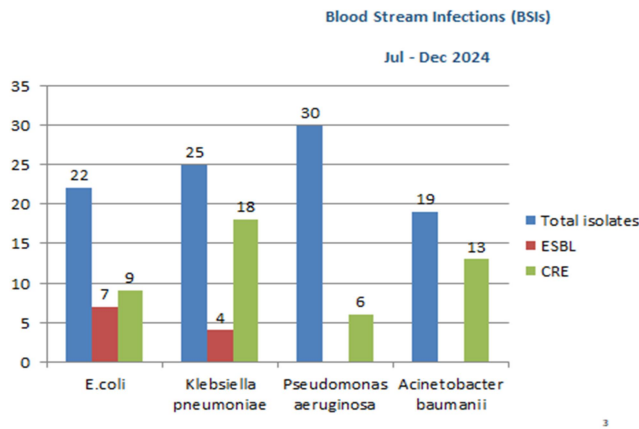


FIGURE 3

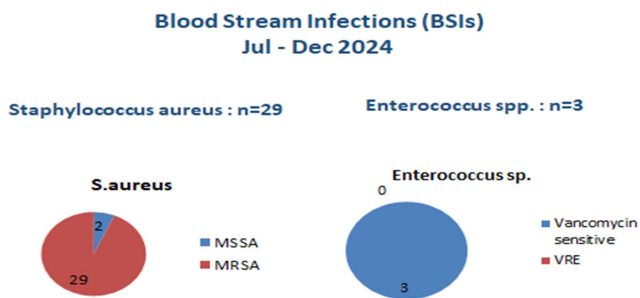
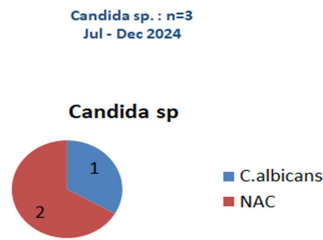


FIGURE 4



### Discussion

Bloodstream infections (BSIs) remain a major cause of morbidity and mortality worldwide, particularly among hospitalized and critically ill patients. Early identification of causative organisms and their antimicrobial susceptibility patterns is essential for prompt treatment and improved clinical outcomes. In the present study, the blood culture positivity rate was 29.7%, which is comparable with findings reported from similar tertiary care hospital-based studies in India and other developing countries<sup>(8,9)</sup>. Variations in positivity rates across studies may be attributed to differences in patient population, infection control practices, prior antibiotic exposure, and blood culture techniques<sup>(10)</sup>.

In the current study, Gram-negative bacilli predominated among the isolates, with *Pseudomonas aeruginosa* being the most frequently isolated Gram negative organism. This finding is consistent with several hospital-based studies where Gram-negative pathogens were predominant causes of nosocomial bloodstream infections. The higher prevalence of these organisms may be related to prolonged hospital stay, invasive procedures, intensive care unit admissions, use of indwelling medical devices, and widespread empirical antibiotic therapy<sup>(11-13)</sup>.

A significant level of antimicrobial resistance was observed among Gram-negative isolates, particularly *Klebsiella pneumoniae* and *Acinetobacter baumannii*. High rates of carbapenem resistance among these pathogens are alarming because carbapenems are often considered last-resort antibiotics for multidrug-resistant infections. The emergence of Extended Spectrum Beta-Lactamase (ESBL)-producing Enterobacterales in the present study further highlights the growing burden of antimicrobial resistance and emphasizes the need for rational and judicious antibiotic use<sup>(14,15)</sup>.

Among Gram-positive organisms, a considerable proportion of *Staphylococcus aureus* isolates were identified as Methicillin-Resistant *Staphylococcus aureus* (MRSA), indicating the continued importance of MRSA as a major healthcare-associated pathogen. However, all *Enterococcus* isolates remained sensitive to vancomycin, and no Vancomycin-Resistant Enterococci (VRE) isolates were detected during the study period. This finding may reflect effective antimicrobial stewardship and infection control measures within the institution<sup>(16)</sup>.

Fungal bloodstream infections were also identified, with non-albicans *Candida* species being more common than *Candida albicans*. Similar epidemiological trends have been increasingly reported worldwide. The rising prevalence of non-albicans *Candida* species is clinically significant because many of these species exhibit reduced susceptibility to commonly used antifungal agents, thereby complicating treatment strategies<sup>(17)</sup>.

The findings of the present study underscore the importance of continuous microbiological surveillance and periodic monitoring of antimicrobial susceptibility patterns. Such surveillance data are essential for guiding empirical therapy, developing institutional antibiotic policies, strengthening antimicrobial stewardship programs, and implementing effective infection prevention and control practices.

#### Limitations of the Study

The study was retrospective in nature and dependent on available laboratory records. Clinical correlation and patient outcome analysis could not be performed. Molecular characterization of resistant isolates was not carried out due to resource limitations. Being a single-center study, the findings may not be generalizable to all healthcare settings.

## **Conclusion**

The present study demonstrates that Gram-negative bacilli are the predominant causes of bloodstream infections, with an alarming rise in multidrug-resistant organisms including carbapenem-resistant isolates and MRSA. Continuous surveillance, strict infection control practices, and rational antibiotic use are crucial to reduce the burden of antimicrobial resistance and improve patient outcomes.

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