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Bloodstream Infection Surveillance in a Tertiary Care Centre in Krishnagiri District, Tamil Nadu, January–June 2025

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ABSTRACT

Background: Bloodstream infections (BSIs) are a major cause of morbidity and mortality in hospitalized patients. Continuous surveillance of blood culture isolates and their susceptibility patterns is essential to guide empirical therapy and support antimicrobial stewardship in tertiary care settings.
Objectives: To analyze the spectrum of blood culture isolates and their antimicrobial susceptibility patterns, with special emphasis on multidrug-resistant organisms (MDROs) in a tertiary care centre in the Krishnagiri district.
Methods: A laboratory record–based descriptive observational study was conducted over six months (January–June 2025). Blood culture samples were processed using standard microbiological techniques. Organisms were identified, and antimicrobial susceptibility testing was performed according to Clinical and Laboratory Standards Institute (CLSI) M100 guidelines, 35th edition, 2025. Data were analyzed descriptively.
Results: Out of 177 blood culture–positive samples, 82 (46.3%) were true pathogens and 95 (53.7%) were commensals. Gram-negative bacilli predominated among pathogenic isolates, with Enterobacterales forming the largest group. Among the Gram-negative bacilli, Escherichia coli was the predominant isolate, followed by Klebsiella pneumoniae. Gram-positive pathogens included methicillin-resistant Staphylococcus aureus (MRSA, n=14), Streptococcus pneumoniae (n=3), and Enterococcus spp. (n=3), including one vancomycin-resistant isolate. Among Gram-positive coccus, Staphylococcus aureus was the most common isolate. Gram-negative isolates demonstrated a high burden of multidrug resistance, including carbapenem-resistant Enterobacterales and resistant non-fermenting Gram-negative bacilli.
Conclusion: A high burden of drug-resistant organisms was observed among bloodstream isolates, particularly among Gram-negative bacilli. Regular surveillance and strengthened antimicrobial stewardship are imperative to optimize empirical therapy and limit the spread of resistance.

Keywords: *Bloodstream infection, antibiogram, MRSA, CRE, MDRO, NFGNB.*

INTRODUCTION

Bloodstream infections (BSIs) are significant clinical conditions that contribute to prolonged hospital stay, increased healthcare costs, and high mortality rates, particularly among critically ill and immunocompromised individuals [1,2]. Prompt detection of the causative organism and early initiation of appropriate antimicrobial therapy are crucial for improving patient outcomes [1,3].

The management of BSIs has become more challenging in recent years due to the rapid emergence and spread of antimicrobial resistance worldwide [2,6]. Healthcare facilities are increasingly encountering resistant pathogens such as

methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), carbapenem-resistant Enterobacterales (CRE), and multidrug-resistant non-fermenting Gram-negative bacilli. These resistant organisms considerably restrict available treatment options and are often associated with poor clinical outcomes and therapeutic failure [3,7,10].

The distribution of bloodstream pathogens and their antimicrobial resistance profiles can vary depending on geographic location, healthcare settings, and patient demographics [2,4]. Therefore, continuous surveillance and institution-specific data are essential for guiding empirical antibiotic therapy, developing local antimicrobial stewardship policies, and improving infection prevention and control measures [4,6].

Although bloodstream infections are a major concern in clinical practice, data from secondary and tertiary healthcare centres in semi-urban regions of Tamil Nadu are relatively scarce. Hence, the present study was conducted to analyse the spectrum of bacterial isolates obtained from blood cultures and to evaluate their antimicrobial susceptibility patterns in a tertiary care hospital in Krishnagiri district, Tamil Nadu. The findings of this study aim to provide region-specific information that may assist in strengthening antimicrobial stewardship efforts.

MATERIALS AND METHODS

Study Design and Setting

This laboratory record–based descriptive observational study (blood culture surveillance) was carried out in the Department of Microbiology of a tertiary care teaching hospital located in Krishnagiri district, Tamil Nadu. The study was conducted over six months, from January to June 2025. All blood culture samples received during this period were included for analysis.

Blood Culture Processing and Organism Identification

Blood samples collected under strict aseptic precautions from patients with suspected bloodstream infections were inoculated into automated blood culture bottles and processed using the BacT/ALERT blood culture system (bioMérieux), following standard microbiological procedures [1,2]. Bottles flagged positive by the system were subcultured onto appropriate solid media. Organism identification was performed using the VITEK 2 automated identification system (bioMérieux), along with Gram staining and conventional biochemical observations as required [3].

Antimicrobial Susceptibility Testing and Resistance Categorization

Antimicrobial susceptibility testing was carried out using the VITEK 2 automated system (bioMérieux). Interpretation of susceptibility results was done in accordance with the Clinical and Laboratory Standards Institute (CLSI) M100 guidelines, 35th edition, 2025 [5]. Isolates were categorized as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), carbapenem-resistant Enterobacterales (CRE), or multidrug-resistant non-fermenting Gram-negative bacilli based on phenotypic resistance patterns [7,10]. Multidrug resistance was defined as non-susceptibility to at least one agent in three or more antimicrobial categories [11].

Figure 1. Workflow of bloodstream infection surveillance showing sterile aseptic blood collection, automated blood culture processing, organism identification, antimicrobial susceptibility testing using VITEK 2, resistance categorization, and data analysis.

Data Compilation and Analysis

Microbiological and susceptibility data were entered into a structured database and analyzed using simple descriptive statistics. Results were expressed as counts and percentages to describe the distribution of pathogens and their antimicrobial resistance patterns.

RESULTS

Blood Culture Yield

Table 1: Blood culture yield during the study period

Category	Number (n=177)	Percentage (%)
Pathogenic isolates	82	46.3
Commensals	95	53.7

Out of 730 blood culture specimens processed during the study period, 177 (24.2%) showed microbial growth. Of these, 82 (46.3%) yielded true pathogens, while 95 (53.7%) were commensals.

Distribution of Pathogens

Table 2: Distribution of bloodstream isolates (n = 82)

Organism group	Isolate	Number
Enterobacterales	*Escherichia coli* (CRE = 3)	22
	Klebsiella pneumoniae (MDRO = 4)	14
	Enterobacter cloacae complex	4
	Proteus mirabilis	2
	Salmonella spp.	1
NFGNB	*Acinetobacter baumannii* complex (MDRO = 4)	5
	Burkholderia cepacia complex	5
	Pseudomonas aeruginosa (MDRO = 1)	3
	Alcaligenes faecalis	2
	Stenotrophomonas maltophilia	2
	Sphingomonas paucimobilis	2
Gram-positive cocci	*Staphylococcus aureus* (MRSA=14)	14
	Streptococcus pneumoniae	3
	Enterococcus spp. (VRE = 1)	3

The majority of isolates were Gram-negative organisms, with Enterobacterales constituting the predominant group. Among the Gram-negative bacilli, *Escherichia coli* was the predominant isolate, followed by *Klebsiella pneumoniae*, while *Staphylococcus aureus* was the most common Gram-positive coccus.

Antimicrobial Susceptibility Pattern of Gram-Positive Isolates

Table 3: Antimicrobial susceptibility pattern of major Gram-positive isolates (%)

Antibiotic	MRSA (n=14)	*Enterococcus* spp. (n=3)	*S. pneumoniae* (n=3)
Linezolid	93%	67%	100%
Vancomycin	93%	67%	100%
Teicoplanin	93%	67%	–
Tigecycline	–	100%	–
Tetracycline	–	–	67%

MRSA isolates showed high susceptibility to glycopeptides and oxazolidinones, while one *Enterococcus* isolate was vancomycin resistant.

Antimicrobial Susceptibility Pattern of Enterobacterales

Table 4: Key antimicrobial susceptibility of Enterobacterales (%)

Antibiotic	*E. coli* (n=22)	*K. pneumoniae* (n=14)
Tigecycline	100%	100%
Fosfomycin	100%	71%
Imipenem	82%	64%
Meropenem	86%	64%
Aminoglycosides	68%	57%

Escherichia coli demonstrated excellent susceptibility to fosfomycin and tigecycline, while *Klebsiella pneumoniae* showed notable multidrug resistance.

Antimicrobial Susceptibility Pattern of Non-Fermenting Gram-Negative Bacilli

Table 5: Antimicrobial susceptibility of major NFGNB (%)

Organism	Key susceptible antibiotics
Acinetobacter baumannii complex	Overall susceptibility was ~20%
Burkholderia cepacia complex	Ciprofloxacin, Levofloxacin, Meropenem, Minocycline, TMP-SMX (100%)
Pseudomonas aeruginosa	Aminoglycosides, Carbapenems (67%)
Alcaligenes faecalis	Amikacin, Cefepime, Imipenem (100%)
Stenotrophomonas maltophilia	Levofloxacin, Minocycline (100%)
Sphingomonas paucimobilis	Levofloxacin, Minocycline, Cefoperazone- Sulbactam, Trimethoprim-Sulfamethoxazole (100%)

Non-fermenters, particularly *Acinetobacter baumannii* complex, showed extensive resistance, emphasizing the need for stringent infection control measures.

DISCUSSION

The present study provides institution-specific data on bloodstream infections and antimicrobial resistance patterns from a tertiary care centre in Krishnagiri district, Tamil Nadu. Bloodstream infections are associated with significant morbidity and mortality, and their management has become increasingly challenging due to the global and national rise in antimicrobial resistance [1,2].

In the current study, Gram-negative bacilli predominated among pathogenic bloodstream isolates, with Enterobacterales constituting the largest proportion. This finding is consistent with data from the ICMR Antimicrobial Resistance Surveillance Network and other Indian tertiary care studies, which report *Escherichia coli* and *Klebsiella pneumoniae* as the most common causes of BSIs [4,7]. The observed predominance of Gram-negative organisms reflects changing epidemiological trends in Indian hospitals, particularly in healthcare-associated infections.

The detection of carbapenem-resistant Enterobacterales (CRE) in this study is concerning and parallels findings from multicentric Indian studies that report increasing carbapenem resistance among *E. coli* and *K. pneumoniae* bloodstream isolates [7,8]. Although susceptibility to agents such as tigecycline and fosfomycin remained relatively preserved, dependence on these last-line drugs underscores the narrowing therapeutic options and the need for judicious antimicrobial use.

Among Gram-positive pathogens, methicillin-resistant *Staphylococcus aureus* (MRSA) constituted a significant proportion of isolates. The MRSA rate observed is comparable to that reported in Indian hospital-based surveillance studies [7,10]. Most MRSA isolates retained susceptibility to vancomycin, teicoplanin, and linezolid, consistent with previous Indian and international reports [3,10]. The identification of a vancomycin-resistant *Enterococcus* (VRE) isolate, though limited in number, is clinically important, as VRE bloodstream infections are associated with limited treatment options and poorer outcomes [10].

Non-fermenting Gram-negative bacilli, particularly Acinetobacter baumannii complex, demonstrated extensive resistance, a pattern widely reported in Indian ICU-based studies [12,13]. These findings highlight the critical role of strict infection prevention measures and antimicrobial stewardship programs in controlling the spread of multidrug-resistant organisms [14,15].

The relatively high proportion of commensals observed in this study (53.7%) highlights the need for continued training and strict adherence to aseptic blood culture collection techniques, particularly during sample collection in busy clinical settings.

CONCLUSION

Regular surveillance of blood culture isolates and their susceptibility patterns is essential to guide empirical therapy and control the spread of multidrug-resistant organisms. The findings underscore the need for continuous monitoring and robust infection control measures. Institution-specific antibiograms generated through regular surveillance are crucial for optimizing empirical therapy and strengthening antimicrobial stewardship.

Limitations

The study was limited by its relatively short duration of six months and reliance on phenotypic resistance data without molecular characterization.

Conflict of Interest

None declared.

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