



Epidemiological study of antimicrobial Susceptibility Pattern of Bacteria isolated from Positive Blood samples in Tertiary Care Hospitals Delhi NCR

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ABSTRACT:

Bloodstream infections occurs when pathogenic microorganisms gain access to the bloodstream and may produce a systemic inflammatory response ranging from uncomplicated bacteremia to severe sepsis and septic shock. Our multi centre tertiary care hospitals Delhi- NCR from January 1, 2025, through December 31, 2025. Blood samples were processed in BacT/Alert (BioMérieux, France). Bottles that signaled positive were then subculture on blood, MacConkey, and Sheep Blood agar. These plates were incubated aerobically at 37°C and examined after 18-24 hours. Bacterial identification and Antimicrobial susceptibility was done by the Vitek 2 Compact system (BioMérieux, France). Reported as per Clinical and Laboratory Standards Institute (CLSI) guidelines. Among the total 1453 samples, after exclusion of blood cultures positive with contaminants, as per standard definitions, 147 positive bacterial blood cultures were recorded between January 2025 and December 2025. 98 (66.67%) out of 147, 98 (66.67%) were male positive patient samples and 49 (33.33%) were female positive samples. The male to female positive ratio 2:1. Gram-negative organisms predominated, accounting for 137 isolates (93.20%), while Gram-positive organisms accounted for 10 isolates (6.80%). Among the Gram-negative isolates, *Pseudomonas aeruginosa* was the most frequently isolated organism 39 (26.53%), followed by *Escherichia coli* 27 (18.37%). Among the Gram-positive organisms, *Staphylococcus aureus* was predominant 7 (4.76%), followed by *Streptococcus pneumoniae* 1 (0.68%) Antibiotic resistant pattern, the overall, high level of antimicrobial resistance among Gram-negative bacilli (GNBs), particularly to several commonly used β -lactam antibiotics. Resistance was highest to cefuroxime (85.71%), followed by Nalidixic acid (82.76%), Among the Gram-positive cocci (GPC) isolates demonstrate complete (100%) resistance to Penicillin.

Keyword: GNB, GPC, Antimicrobial Susceptibility, Blood sample

INTRODUCTION:

Blood is a normally sterile fluid; a disease is bloodstream infections (BSIs) signify presence of bacteria in blood. Bloodstream infections occurs when pathogenic microorganisms gain access to the bloodstream and may produce a systemic inflammatory response ranging from uncomplicated bacteremia to severe sepsis and septic shock. Bloodstream infections (BSIs) are significant contributors to sepsis-related morbidity and mortality globally, ranging from self-limiting infections to life-threatening sepsis. Studies have identified that the number of BSI episodes per year vary from 1,213,460 to 1,381,590 in Europe and from 575,462 to 677,389 in North America with the high number of BSIs related deaths per year. In a developed country context, in-hospital mortality is over 40%. Information regarding the BSI profile in low- and middle-income countries such as India is scarce (Khurana S et al., 2018.).

Bloodstream infections can lead to serious outcomes such as shock, disseminated intravascular coagulation, multiple organ failure, and even death. Longer hospitalization and the costs involved are the most problematic consequences. Prevalence and antimicrobial susceptibility of microorganisms differ according to the geographic region and how antibiotics are used. The overuse and inappropriate use of antibiotics has resulted in a rise in multidrug-resistant pathogens and has therefore made the condition worse. (Vasudeva N et al., 2016).

When an early diagnosis and the administration of precise antibiotics according to the patient's blood culture report is the ideal way to manage BSI, the empirical treatment provided still remains important in determining the patient's outcome (Ahmed NH, Hussain T. et al 2014).

Blood culture remains the Gold Standard laboratory method for confirming bloodstream infection and identifying the causative bacterial pathogen. Recent epidemiological studies have shown a shift toward Gram negative organisms as the main causative agents of bloodstream infections in tertiary care hospitals. Organisms including *Klebsiella pneumoniae*, *Acinetobacter* species, *Pseudomonas aeruginosa*, and *Escherichia coli* have become increasingly important because of their ability to acquire multiple resistance mechanisms, such as extended-spectrum beta-lactamase production and carbapenem resistance. [Dr Arun T L et al., 2026]

Antimicrobial resistance is a biological phenomenon that microbes acquire in reaction to the

selective pressure exerted by antimicrobial drugs. The cocktail of antimicrobials that the patient is placed on, for empirical treatment of critically ill patients, such as those with BSI, further accelerates the emergence of drug resistance, which could be lessened if the empirical treatment were made evidence based by supporting it with knowledge of the prevailing pathogenic organisms and their antibiograms (Ahmed NH, Hussain T. et al 2014).

This study, is intended to assess the bacterial pathogens identified from positive blood cultures and to establish their antimicrobial susceptibility patterns. The research will offer epidemiological data on the distribution of bacterial isolates and their resistance profiles within the chosen tertiary-care hospitals. It is anticipated that these findings will enhance knowledge of local bloodstream infection epidemiology, assist in evidence-based selection of antimicrobials, and supply valuable information for antimicrobial stewardship, infection prevention, and upcoming surveillance of antimicrobial resistance across the Delhi NCR region.

MATERIALS AND METHODS:

Study design and Data Collection

This is a retrospective, a cohort study involving patients with bacterial bloodstream infection who were admitted to our multi centre tertiary care hospitals Delhi- NCR from January 1, 2025, through December 31, 2025. The study was approved by the local Institutional Ethics Committee. the hospitals come patients both directly from the local community and referred from regional hospitals. All positive blood sample that tested positive for cultures containing identified bacterial pathogens from individuals, who had been admitted to the hospital over the course of the study were enrolled in the study. The standard microbiological profile was documented for every clinical sample that arrived at the lab.

Blood samples were processed in BacT/Alert (BioMérieux, France) bottles upon clinical suspicion of BSI. Bottles that signaled positive were then subculture on blood, MacConkey, and Sheep Blood agar. These plates were incubated aerobically at 37°C and examined after 18-24 hours. Bacterial identification was done by the Vitek 2 Compact system (BioMérieux, France). Antimicrobial susceptibility was done by Vitek 2 Compact system (BioMérieux, France) and reported as per Clinical and Laboratory Standards Institute (CLSI) guidelines.

For Gram-negative and gram positive isolates, MIC testing was using Vitek 2 compact system (BioMérieux, France) performed for the following antimicrobials for each isolate: Amikacin, Amoxicillin/Clavulanic acid, Ampicillin, Aztreonam, Cefazolin, Cefepime, Cefixime, Cefoperazone/Sulbactam, Cefoxitin, Ceftazidime, Ceftriaxone, Cefuroxime, Ciprofloxacin, Clindamycin, Co-trimoxazole (Trimethoprim/Sulfamethoxazole), Daptomycin, Doxycycline, Erythromycin, Ertapenem, Gentamicin, Imipenem, Levofloxacin, Linezolid, Meropenem, Minocycline, Moxifloxacin, Nalidixic acid, Ofloxacin, Oxacillin, Penicillin, Piperacillin/Tazobactam, Teicoplanin, Tetracycline, Ticarcillin/Clavulanic acid, Tigecycline, Tobramycin, and Vancomycin. Antibiotic susceptibilities were performed using CLSI guidelines with breakpoints from 2025. [CLSI 2025]

Data entry and statistical analysis

Transfer data from a VITEK 2 Compact system to Microsoft Excel and analyzed using Satandard

Percentage comparison was done by the Chi-square test. Susceptibility pattern was analyzed using Spearman's correlation test. Significance of statistical difference was considered less than 0.05.

RESULTS

Study Population

Among the total 1453 samples, after exclusion of blood cultures positive with contaminants, as per standard definitions, 147 positive bacterial blood cultures were recorded between January 2025 and December 2025. 98 (66.67%) out of 147, 98 (66.67%) were male positive patient samples and 49 (33.33%) out of 147 were female positive samples. The male to female positive ratio 2:1.

Analysis of microbiological dataset

Gram-negative organisms predominated, accounting for 137 isolates (93.20%), while Gram-positive organisms accounted for 10 isolates (6.80%). Among the Gram-negative isolates, *Pseudomonas aeruginosa* was the most frequently isolated organism 39 (26.53%), followed by *Escherichia coli* 27 (18.37%) and *Klebsiella pneumoniae* 22 (14.97%), *Salmonella* species, including *Salmonella paratyphi A* 12 (8.16%) and *Salmonella typhi* 9 (6.12%), *Serratia marcescens* 7 (4.76), *Stenotrophomonas maltophilia* 5 (3.40) *Acinetobacter baumannii* 4 (4.72), *Burkholderia cepacia* 4 (2.72). Among the Gram-positive organisms, *Staphylococcus aureus* was predominant 7 (4.76%), followed by *Streptococcus pneumonia*, *Staphylococcus haemolyticus*, and Coagulase-Negative Staphylococci (CON'S) 1 (0.68%). **Table 1**

Table 2 and 3 Describe the antimicrobial susceptibility patters of gram negative isolates and gram positive isolates.

Antibiotic resistant pattern, the overall, high level of antimicrobial resistance among Gram-negative bacilli (GNBs), particularly to several commonly used β -lactam antibiotics. Resistance was highest to cefuroxime (85.71%), followed by Nalidixic acid (82.76%), cefazolin (82.61%), and Ampicillin (82.61%). Substantial resistance was also observed to amoxicillin clavulanate (74.19%) and cephalexin (64.44%). Moderate resistance was seen with

ceftriaxone (50.00%), ofloxacin (49.41%), and aztreonam (40.85%). Resistance to ciprofloxacin (37.40%), ceftazidime (37.37%), and cefepime (35.20%) was comparatively lower but remained considerable. The lowest resistance rates were observed with tigecycline (6.67%), meropenem (7.14%), imipenem (8.91%), and ticarcillin/clavulanate (9.09%). Minocycline (MI) showed 0% resistance (0/11). Overall, the pattern suggests marked resistance to older β -lactams and several fluoroquinolones, while carbapenems and some last-resort agents retained comparatively greater activity.

Table No. 4

Among the Gram-positive cocci (GPC) isolates demonstrate complete (100%) resistance to Penicillin, the remaining agents, high to moderate resistance is observed for Cefalotin CF (75%), followed by Levofloxacin and Erythromycin (66.67%), Oxacillin (60%), Amoxicillin clavulanic acid (60%), and Ciprofloxacin (57.14%), whereas lower resistance rates are seen in Colistin (44.44%), Trimethoprim sulfamethoxazole (44.44%), Vancomycin (30%), Gentamycin (11.11%), and Tetracycline (11.11%). Daptomycin, Teicoplanin, and Moxifloxacin, while remaining fully susceptible (0% resistance) to Linezolid, Tigecyclin, Minocyclin, and Doxycycline. **Table No. 5**

Table 1. Bacterial isolates recovered from positive blood culture samples

Organism	Total (%)
Gram Negative isolate	
<i>P. aeruginosa</i>	39 (26.53)
<i>E. coli</i>	27 (18.37)
<i>K. pneumoniae</i>	22 (14.97)
<i>S. paratyphi A</i>	12 (8.16)
<i>S. typhi</i>	9 (6.12)
<i>S. marcescens</i>	7 (4.76)
<i>S. maltophilia</i>	5 (3.40)
<i>A. baumannii</i>	4 (2.72)
<i>B. cepacia</i>	4 (2.72)
<i>Salmonella sp</i>	3 (2.04)
<i>S. paucimobilis</i>	2 (1.36)
<i>Achromobacter xylosoxidans</i>	1 (0.68)
<i>E. cloacae complex</i>	1 (0.68)
<i>O. anthropi</i>	1 (0.68)
Gram Positive Isolate	
<i>S. aureus</i>	7 (4.76)
<i>S. pneumoniae</i>	1 (0.68)
<i>S. hemolyticus</i>	1 (0.68)
<i>Coagulase negative Staphylococcus CON'S</i>	1 (0.68)
Total	147 (100)

Table No. 2 Overall Susceptibility pattern overserved in gram negative bacilli isolated from positive blood culture samples

Antimicrobial Agent	<i>E. coli</i> n/tested/(%)	<i>Klebsiella Pneumonia</i> n/tested/(%)	<i>Salmonella Paratyphi A</i> n/tested/(%)	<i>Salmonella Typhi</i> n/tested/(%)	<i>Serratia marcescens</i> n/tested/(%)
Amikacin	23/28 (82.1)	12/22 (54.5)	NA	NA	6/7 (85.7)
Amoxicillin/clavulanic acid	5/27 (18.5)	2/18 (11.1)	9/9 (100.0)	4/4 (100.0)	0/4 (0.0)
Ampicillin	2/27 (7.4)	0/21 (0.0)	1/9 (11.1)	4/5 (80.0)	0/2 (0.0)
Aztreonam	9/27 (33.3)	1/4 (25.0)	0/2 (0.0)	1/3 (33.3)	4/5 (80.0)
Cefazolin	9/23 (39.1)	2/19 (10.5)	NA	NA	0/2 (0.0)
Cefepime	8/22 (36.4)	5/22 (22.7)	10/10 (100.0)	6/6 (100.0)	6/7 (85.7)
Cefixime	NA	NA	2/2 (100.0)	3/3 (100.0)	2/2 (100.0)
Cefoperazone/sulbactam	3/4 (75.0)	1/4 (25.0)	6/7 (85.7)	5/5 (100.0)	5/5 (100.0)
Cefoxitin	12/27 (44.4)	5/19 (25.0)	NA	NA	1/2 (50.0)
Ceftazidime	9/22 (40.9)	4/20 (20.0)	NA	1/1 (100.0)	5/5 (100.0)
Ceftriaxone	7/24 (29.2)	4/21 (19.0)	9/12 (75.0)	8/8 (100.0)	2/4 (50.0)
Cefuroxime	5/25 (20.0)	1/5 (20.0)	NA	NA	0/3 (0.0)
Ciprofloxacin	9/27 (33.3)	5/22 (22.7)	2/12 (16.7)	2/9 (22.2)	6/7 (85.7)
Co-trimoxazole	10/27 (37.0)	6/21 (28.6)	10/10 (100.0)	6/7 (85.7)	6/7 (85.7)
Daptomycin	NA	NA	NA	NA	3/3 (100.0)

Ertapenem	21/28 (75.0)	7/21 (33.3)	NA	1/1 (100.0)	2/2 (100.0)
Gentamicin	20/27 (74.1)	12/22 (54.5)	NA	NA	5/6 (83.3)
Imipenem	22/28 (78.6)	11/22 (50.0)	NA	1/1 (100.0)	2/2 (100.0)
Levofloxacin	12/27 (44.4)	3/20 (15.0)	NA	1/3 (33.3)	5/5 (100.0)
Meropenem	21/28 (75.0)	9/22 (40.9)	2/2 (100.0)	2/2 (100.0)	7/7 (100.0)
Minocycline	NA	NA	NA	NA	1/3 (33.3)
Ofloxacin	9/27 (33.3)	4/21 (19.0)	2/11 (18.2)	2/6 (33.3)	0/2 (0.0)
Piperacillin/Tazobactam	19/27 (70.4)	5/22 (22.7)	10/10 (100.0)	6/6 (100.0)	1/1 (100.0)
Tetracycline	2/3 (66.7)	3/19 (15.8)	NA	NA	0/3 (0.0)
Ticarcillin/clavulanic acid	NA	NA	NA	NA	3/3 (100.0)
Tigecycline	1/1 (100.0)	2/2 (100.0)	NA	NA	5/5 (100.0)
Tobramycin	16/20 (80.0)	9/20 (45.0)	NA	NA	2/2 (100.0)

Table No 3 Overall Susceptibility pattern overserved in gram positive cocci isolated from positive blood culture samples

Antibiotic Agents	Tested antibiotics (n)	Sensitive n (%)
Linezolid	10	10 (100.0%)
Teicoplanin	6	6 (100.0%)
Daptomycin	5	5 (100.0%)
Tigecycline	5	5 (100.0%)
Doxycycline	5	5 (100.0%)
Minocycline	4	4 (100.0%)
Gentamicin	10	8 (80.0%)
Tetracycline	10	8 (80.0%)
Vancomycin	10	7 (70.0%)
Trimethoprim/Sulfamethoxazole	9	6 (66.7%)
Clindamycin	10	6 (60.0%)
Ciprofloxacin	7	3 (42.9%)
Oxacillin	5	2 (40.0%)
Levofloxacin	9	3 (33.3%)
Erythromycin	9	3 (33.3%)
Amoxicillin–Clavulanic acid	4	1 (25.0%)
Cefoxitin	7	1 (14.3%)
Penicillin	10	0 (0.0%)
Moxifloxacin	4	0 (0.0%)

Table No. 4 Antibiotic resistance pattern of gram positive isolate recovered from positive culture samples

Antibiotic Agents	Tested Antibiotics (n)	Resistant (n) (%)
Cefuroxime	14	12 (85.71)
Nalidixic acid	29	24 (82.76)
Cefazolin	46	38 (82.61)
Ampicillin	69	57 (82.61)
Amoxicillin–Clavulanic acid	62	46 (74.19)
Cefoxitin	45	29 (64.44)
Ceftriaxone	82	41 (50.00)
Ofloxacin	85	42 (49.41)
Aztreonam	71	29 (40.85)
Ciprofloxacin	123	46 (37.40)
Ceftazidime	99	37 (37.37)
Cefepime	125	44 (35.20)
Trimethoprim/Sulfamethoxazole	89	27 (30.34)
Levofloxacin	98	28 (28.57)
Tetracycline	42	10 (23.81)
Ertapenem	47	11 (23.40)
Piperacillin–Tazobactam	116	26 (22.41)

<i>Tobramycin</i>	71	14 (19.72)
<i>Cefoperazone/Sulbactam</i>	48	9 (18.750)
<i>Gentamicin</i>	103	19 (18.45)
<i>Amikacin</i>	104	19 (18.27)
<i>Cefixime</i>	8	1 (12.5)
<i>Ticarcillin/Clavulanic acid</i>	22	2 (9.09)
<i>Imipenem</i>	101	9 (8.91)
<i>Meropenem</i>	112	8 (7.14)
<i>Tigecycline</i>	15	1 (6.67)
<i>Minocycline</i>	11	0.00%

Table No. 5 Antibiotic resistance pattern of gram positive isolate recovered from positive culture samples

<i>Antibiotic Agents</i>	<i>Tested Antibiotics (n)</i>	<i>Resistant (n) (%)</i>
<i>Penicillin G</i>	10	10 (100.00)
<i>Oxacillin</i>	5	3 (60.00)
<i>Gentamicin</i>	9	1 (11.11)
<i>Ciprofloxacin</i>	7	4 (57.14)
<i>Levofloxacin</i>	9	6 (66.67)
<i>Erythromycin</i>	9	6 (66.67)
<i>Clindamycin</i>	9	4 (44.44)
<i>Linezolid</i>	10	0 (0.00)
<i>Daptomycin</i>	4	4 (100.00)
<i>Teicoplanin</i>	6	6 (100.00)
<i>Vancomycin</i>	10	3 (30.00)
<i>Tetracycline</i>	9	1 (11.11)
<i>Tigecycline</i>	5	0 (0.00)
<i>Trimethoprim/Sulfamethoxazole</i>	9	4 (44.44)
<i>Amoxicillin/Clavulanic acid</i>	5	3 (60.00)
<i>Minocycline</i>	4	0 (0.00)
<i>Moxifloxacin</i>	4	4 (100.00)
<i>Cefoxitin</i>	8	6 (75.00)
<i>Doxycycline</i>	4	0 (0.00)

DISCUSSION

In the current study, among culture-positive cases, male patients accounted for 66.67% (98/147) and female patients for 33.33% (49/147), giving a male to female ratio of 2:1. This shows a strong male predominance relative to a recent study carried out in a tertiary-care setting in South India (**Dr Arun T L et al., 2026**), where males made up 56.4% and females 43.6% of the culture-positive cases. Such a difference may stem from variations in patient populations, hospital settings, coexisting conditions, and health-seeking behaviour. The higher male predominance observed in the present study.

In the current investigation, Gram-negative organisms were dominant, accounting for 137 (93.20%) isolates, whereas the remaining 10 (6.80%) were Gram-positive organisms. As reported by (**Dr. Arun T. L. et al. 2026**), Gram-negative bacteria were more prevalent than Gram-positive bacteria; among the culture-positive samples, 85.0% were gram-negative organisms, while 13.1% were Gram-positive cocci and 1.9% were fungi. (**Karuna T. et al., 2023**), likewise documented comparable results, in which 406 (65.3%) Gram-negative and 215 (34.6%) Gram-positive organisms were isolated out of 621 bacterial growths. The variation in the prevalence of Gram-negative and Gram-positive isolates between the present study and earlier studies may be attributable to differences in study population, hospital environment, specimen type, and the local epidemiology of bloodstream infections.

In the present study, *Pseudomonas aeruginosa* was the most predominate Gram-negative isolate, comprising 39 (26.53%) cases, followed by *Escherichia coli* 27 (18.37%) and *Klebsiella pneumoniae* 22 (14.97%). In comparison, (**Ahmed NH, Hussain T. et al 2014**), study reported *Staphylococcus* spp. as the predominant pathogen (33%), followed by *K. pneumoniae* (20%), *E. coli* (13%), *Acinetobacter* spp. (13%) and *P. aeruginosa* (3%). Thus, the *P. aeruginosa* showed higher proportion in the present study and overall predominance of Gram negative organisms in contrast to higher contribution reported by comparative study from Gram positive organisms. This discrepancy could be attributed to differences in patient population and hospital setting.

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Conflicts of interest

There are no conflicts of interest.

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