Original Article

IAHS Medical Journal
Volume 08 Issue 01 June 2025; 44-51

Pattern of Blood Stream Infections and their Antibiotic Susceptibility Profile in a Neonatal Intensive Care Unit of a Tertiary Care Hospital: A Current Perspective

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ABSTRACT

Background: *Bloodstream Infections (BSIs) are a significant cause of illness and mortality in Neonatal Intensive Care Units (NICUs) particularly among low birth weight and premature infants. The rise of multidrug-resistant organisms complicates treatment, making prompt identification and appropriate antibiotic selection essential. This study overviews BSI trends and antibiotic resistance in a tertiary care NICU. This study investigated bacterial pathogens' prevalence and antibiotic susceptibility patterns causing neonatal BSIs in a tertiary hospital in Chattogram, Bangladesh.*

Materials and methods: *This retrospective study included data retrieved from Laboratory Information Systems (LIS) of Apollo Imperial Hospitals Ltd, Chattogram from January 2020 to January 2025.It included 312 blood samples from NICU patients (Aged 0–28 days) with suspected neonatal sepsis. Samples were cultured using a BACT/Alert system, followed by bacterial identification and antimicrobial susceptibility testing and data were analyzed using Microsoft Excel 2016. Results, shown as means and percentages, focused on the distribution of Gram-positive and Gram-negative organisms and their resistance patterns.*

Results: *Of the 312 NICU blood cultures, 55% were from female and 45% from male patients (Ratio 1:1.23). Acinetobacter baumannii (31.65%) was the most common pathogen, followed by Pseudomonas aeruginosa (25.32%), Klebsiella pneumoniae, CoNS and Staphylococcus aureus. Multidrug-resistant Gram-negative bacteria predominated. Colistin was 100% effective against A. baumannii and K. pneumoniae, while tigecycline and ceftazidime-avibactam showed moderate activity. Resistance to cephalosporins, carbapenems and aminoglycosides was widespread. Chryseobacterium indologenes were highly resistant. Among Gram-positives, penicillin and ampicillin resistance were high, though vancomycin, teicoplanin and linezolid remained effective.*

Conclusion: *Major causative agents of neonatal bloodstream infection were Acinetobacter spp. Multidrug resistance among these bacteria was observed in the study, which necessitate the implementation of antibiotic stewardship program to improve neonatal outcomes.*

Key words: Acinetobacter species; Antimicrobial-resistant organisms; BSI (Blood Stream Infection); Coagulase-negative staphylococci; Neonatal Intensive Care Unit (NICU).

Introduction

Healthcare-associated infections are frequent and critical complications associated with hospitalization of neonates, especially very low birth weight neonates, in Neonatal Intensive Care Units (NICU).[1] Neonatal infections currently cause about 1.6 million deaths per year in developing countries. Sepsis and meningitis are responsible for most of these deaths.[2] Neonatal infections annually claim the lives of 1.4 million neonates worldwide. Early-onset neonatal sepsis occurs within 72h of birth, while late-onset neonatal sepsis occurs after the first 72h of life and both are major causes of infant mortality.[3] Sepsis is responsible for 30-50% of total neonatal deaths, highlighting its severity.[4] The incidence of LOS is notably higher in hospitalized neonates, with a predominance of cases linked to environmental sources.[5] Blood Stream Infections (BSIs) in Neonatal Intensive Care Units (NICUs) represent a significant clinical challenge, contributing to high morbidity and mortality rates among vulnerable neonates. The prevalence of BSIs is exacerbated by the emergence of multidrug-resistant pathogens, necessitating continuous surveillance and effective antibiotic stewardship. Recent studies have highlighted

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Date of Submission : 15th March 2025
Date of Acceptance : 1st June 2025

IAHS Medical Journal
Volume 08 Issue 01 June 2025; 44-51

the diverse etiological agents responsible for BSIs, with a notable predominance of Gram-negative bacteria, particularly Klebsiella pneumoniae and Escherichia coli, alongside Gram-positive organisms such as Staphylococcus aureus. This introduction aims to synthesize current findings on the patterns of BSIs and their antibiotic susceptibility profiles in NICUs. A study in Vadodara reported a BSI rate of 22% among neonates, with Staphylococcus aureus being the most common pathogen (36.35%).[6,7] In a larger cohort from a tertiary hospital, 23.8% of blood cultures were positive, predominantly for Gram-negative bacteria like Klebsiella pneumoniae (45.5%).[8]

Neonates are very susceptible to infection because of their compromised immune systems. Neonatal sepsis has significant morbidity and mortality and is difficult to diagnose on presentation. For this reason, those with suspected sepsis commenced on empiric antibiotic therapy until sepsis can be ruled out. Overuse of antibiotics results in the development of Antimicrobial-Resistant Organisms (ARO). Infection with ARO results in delay in starting effective antibiotic therapy, fewer possible treatment options and increased morbidity and mortality, with prolonged hospital stay and greater costs of hospitalization.[9] Multidrug resistance is prevalent, with significant resistance observed against commonly used antibiotics. For instance, 98% of Acinetobacter spp. were resistant to ampicillin.[10] Extended-Spectrum Beta-Lactamase (ESBL) production was noted in 58% of Klebsiella pneumoniae isolates.[7] The high rates of multidrug-resistant organisms necessitate urgent infection control measures and the formulation of hospital antibiotic policies to mitigate resistance.[10] Continuous monitoring and tailored antibiotic therapy are essential to improve outcomes in neonates with BSIs.[11] Empiric antibiotic therapies rely on monitoring antimicrobial sensitivity patterns in culture isolates. To accelerate the progress of preventing neonatal morbidity and mortality, specific strategies tailored to specific countries are required for the prevention and treatment of neonatal sepsis. Antibiotic stewardship, including appropriate choice and administration of antibiotics, de-escalation of therapy and a multidisciplinary team approach to managing neonatal sepsis, is recommended to limit inappropriate antibiotic use and prevent the development of resistant microorganisms. Moreover, Identification of risk factors and early diagnosis and the institution of therapy according to local epidemiology and antimicrobial resistance patterns can improve neonatal survival. In this study, it is aimed to identify the most prevalent bacterial pathogens involved in neonatal BSI in the tertiary health care hospitals in Chattogram with NICU facilities. It was attempted to determine the antibiotic susceptibility patterns of the pathogens to see the changing trend of antimicrobial susceptibility in this region.

Materials and methods

This retrospective study included data retrieved from Laboratory Information Systems (LIS) of Apollo Imperial Hospitals Ltd, Chattogram from January 2020 to January 2025.

Total 312 blood samples from infants aged 0 to 28 days admitted to the Neonatal Intensive Care Unit (NICU) with symptoms of neonatal sepsis were examined.

Blood samples were cultured using the BACT/Alert system and manual methods. Pathogens were identified, and antimicrobial susceptibility was tested using the Kirby-Bauer disk diffusion method. Data included patient and maternal details. Only bloodstream infections were analyzed, with early-onset sepsis defined as occurring within 72 hours and late-onset after 3 days.

Isolation and Identification of Bacterial Isolates: Blood samples were inoculated into pediatric FAN culture bottles and incubated in the BACT/Alert system for up to 5 days. Positive cultures were subcultured on MacConkey and 5% sheep blood agar, then incubated at 37°C aerobically. Bacterial identification was performed using standard microbiological and biochemical tests following WHO guidelines.[12] Antimicrobial susceptibility testing was done using the Kirby-Bauer disc diffusion method on Mueller-Hinton agar, following CLSI 2019 guidelines.[13]

The antibiotic discs of ampicillin (Amp) cotrimoxazole (Cot) ciprofloxacin (Cip) levofloxacin (Lev) ceftriaxone (CTR) chloramphenicol (Clo) amoxyclav (AMC) cefixime (CXM) cefotaxime (CTX) gentamicin (Gen) amikacin (AK) azithromycin (Az) ceftazidime (CAZ) meropenem (Mero) piperacillin-tazobactam (TZP) colistin (Col) were used for Gram negative bacteria and ampicillin (Amp), cephradine (Ceph) cotrimoxazole (Cot) ciprofloxacin (Cip) levofloxacin (Lev) cefotaxime (CTX) ceftriaxone (CTR) amoxyclav (AMC) gentamicin (Gen) amikacin (AK) imepenem (Ime) cefixime (CXM) erythromycin (Ery) Tetracycline (TC) vancomycin (Van) cefoxitin (CFX) linezolid (Lz) were used for Gram positive bacteria. All antibiotic discs were obtained from Oxoid Ltd, Bashingstore, Hampire, UK.

The study was approved by the Institutional Review Board of Apollo Imperial Hospitals. Data were analyzed in Excel 2016 and presented as means, frequencies, and percentages, focusing on bacterial distribution and resistance profiles.

IAHS Medical Journal
Volume 08 Issue 01 June 2025; 44-51

Results

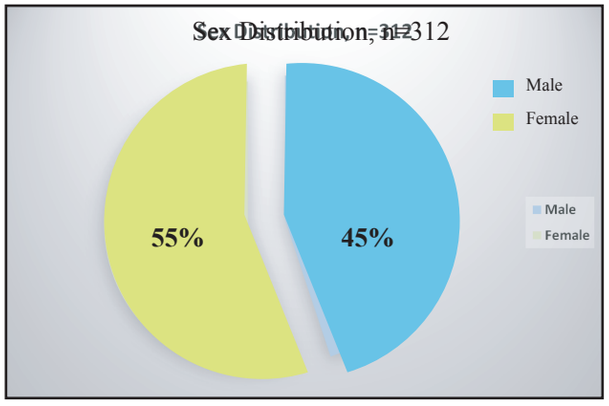

Figure 1 Distribution of the received sample according to sex group

312 blood culture samples were taken from patients admitted in the neonatal intensive care unit, of which the majority were female,172 (55%)and 140(45%) Male. with male male-to-female ratio M: F=1: 1.23.

Table I Frequency of neonatal bloodstream infection from samples of suspected cases (n=312)

Gram-Reactive Organism	Frequency	Percent (%)	p value
Growth Positive	79	25.32	0.932
Growth Negative	233	74.68	
Total	312	100	

p- value = 0.932. p > 0.05, statistically not significant.

The frequency of neonatal bloodstream infection from the samples received illustrated in Table I. The Bloodstream Infection rate was 25.32% (79/312).

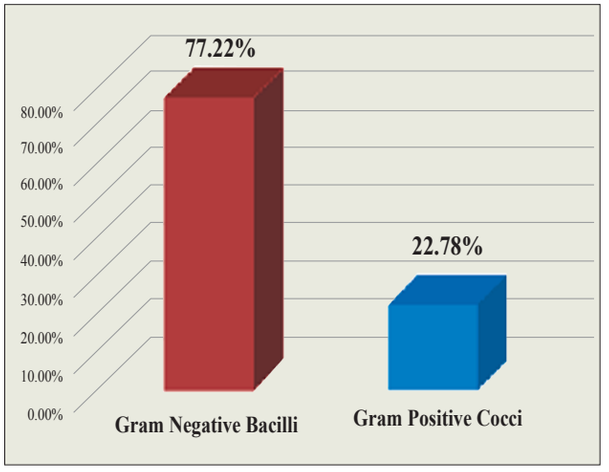

Figure 2 Frequency Distribution of Gram-Reactive Organisms (n=79)

Among the growth-positive cases, 77.22 % (61/79) were infected by Gram-negative bacilli while 22.78%(18/79) cases were infected by Gram-positive cocci.

Table II Distribution of Bacterial Pathogens Causing Neonatal Bloodstream Infection (n=79)

Pathogen	Frequency	Percentage (%)
Acinetobacter Baumannii	25	31.65
Pseudomonas Aeroginosa	20	25.32
Klebsiella Pneumoniae	08	10.13
CoNS	09	11.39
Staphylococcus aureus	05	6.32
Enterococci spp.	04	5.05
Burkholderia capacia complex	03	3.80
Stenotrophomonas	03	3.80
Serratia Marcescens	01	1.27
Chryseobacterium indologenes	01	1.27
Total	79	100.0

Table II shows the distribution of bacterial pathogens isolated from 79 clinical samples, revealing their frequencies and percentages of occurrence. Acinetobacter baumannii was the most frequently isolated pathogen, with 25 isolates (31.65%), followed by Pseudomonas aeruginosa with 20 isolates (25.32%). Other notable pathogens included Klebsiella pneumoniae (8 isolates, 10.13%), coagulase-negative staphylococci (9 isolates, 11.39%) and Staphylococcus aureus (5 isolates, 6.32%). Less common pathogens were Enterococci (4 isolates, 5.05%) Burkholderia cepacia complex and Stenotrophomonas (3 isolates each, 3.80%), Serratia marcescens and Chryseobacterium indologenes (1 isolate each, 1.27%). These data highlight the more occurrence of gram-negative bacteria, particularly multidrug-resistant non-fermenters and underscore the need for effective infection control and targeted antimicrobial application.

IAHS Medical Journal
Volume 08 Issue 01 June 2025; 44-51

Table III Drug Susceptibility Pattern of Gram-Negative Isolates (n=61)

Antibiotics	Acinetobacter Baumannii n=25 (%)		Pseudomonas Aeroginosa n=20 (%)		Klebsiella Pneumoniae n=08 (%)		Burkholderia capacia complex n=03 (%)		Sternotrophomonas, n=03 (%)		Serratia Marcescens n=01 (%)		Chryseobacterium indologenes, n=01 (%)	
	S (%)	R	S	R	S	R	S	R	S	R	S	R	S	R
Amikacin	11 (44)	14 (56)	8 (40)	12 (60)	3 (37.5)	5 (62.5)	01 (33.33)	2 (66.67)	01 (33.33)	2 (66.67)	0(00)	1 (100%)	00(00)	1 (100%)
Ceftazidime	6 (24)	19 (76)	6 (30)	14 (70)	3 (37.5)	5 (62.5)	2 (66.67)	01 (33.33)	01 (33.33)	2 (66.67)	0(00)	1 (100%)	00(00)	1 (100%)
Ceftazidime Avibactam	15 (60)	10 (40)	8 (40)	12 (60)	4 (50)	4 (50)	2 (66.67)	01 (33.33)	-	-	-	-	-	-
Amoxiclav	15 (60)	10 (40)	13(65)	7 (35)	-	-	-	-	-	-	0(00)	1 (100%)	-	-
Colistin	25 (100)	00	18 (90)	2 (10)	8 (100)	00	2 (66.67)	01 (33.33)	3 (100)	0	0(00)	1 (100%)	-	-
Cefuroxime	9 (36)	16 (64)	7 (35)	13 (65)	2 (25)	6 (75)	-	-	-	-	0(00)	1 (100%)	-	-
Gentamycin	4 (16)	21 (84)	13 (65)	7 (35)	2 (25)	6 (75)	-	-	-	-	0(00)	1 (100%)	00(00)	1 (100%)
Meropenem	6 (24)	19 (76)	8 (40)	12 (60)	3 (37.5)	5 (62.5)	3 (100)	00	2 (66.67)	01 (33.33)	0(00)	1 (100%)	00(00)	1 (100%)
Tigecycline	18 (72)	7 (28)	-	-	6	2	2 (66.67)	01 (33.33)	2 (66.67)	01 (33.33)	-	-	-	-
Cefixime	8 (32)	17 (68)	7 (35)	13 (65)	3 (37.5)	5 (62.5)	-	-	-	-	0(00)	1 (100%)	00(00)	1 (100%)
Ceftriaxone	20 (80)	5 (20)	-	-	3 (37.5)	5 (62.5)	-	-	-	-	0(00)	1 (100%)	00(00)	1 (100%)
Ciprofloxacin	8 (32)	17 (68)	7 (35)	13 (65)	2 (25)	6 (75)	2 (66.67)	01 (33.33)	-	-	0(00)	1 (100%)	00(00)	1 (100%)
Cotrimoxazole	9 (36)	16 (64)	13 (65)	7 (35)	3 (37.5)	5 (62.5)	3 (100)	00	2 (66.67)	1 (33.33)	0(00)	1 (100%)	00(00)	1 (100%)
Cefepime	00	25 (100)	9 (45)	11 (55)	2 (25)	6 (75)	-	-	-	-	0(00)	1 (100%)	00(00)	1 (100%)
Doripenem	-	-	11 (55)	9 (45)	2 (25)	6 (75)	-	-	-	-	0(00)	1 (100%)	00(00)	1 (100%)
Levofloxacin	11 (44)	14 (56)	10 (50)	10 (50)	4 (50)	4 (50)	3 (100)	00	2 (66.67)	1 (33.33)	0(00)	1 (100%)	00(00)	1 (100%)
Tazobactam-Piperacillin	9(36)	16 (64)	11 (55)	9 (45)	3 (37.5)	5 (62.5)	01 (33.33)	2 (66.67)	2 (66.67)	1 (33.33)	0(00)	1 (100%)	00(00)	1 (100%)
Chloramphenicol		8 (32)	17 (68)	-	-	3 (37.5)	5 (62.5)	01 (33.33)	2 (66.67)	2 (66.67)	1 (33.33)	0(00)	1 (100%)	-
Aztreonam	7 (28)	18 (72)	12 (60)	8 (40)	5 (62.5)	3 (37.5)	-	-	-	-	-	-	00(00)	1 (100%)
Tobramycin	6(24)	19 (76)	12 (60)	8 (40)	5 (62.5)	3 (37.5)	-	-	2 (66.67)	1 (33.33)	0(00)	1 (100%)	00(00)	1 (100%)
Tetracycline	11 (44)	14 (56)	-	-	3 (37.5)	5 (62.5)	-	-	-	-	-	-	00(00)	1 (100%)
Minocycline	-	-	-	-	-	-	2 (66.67)	01 (33.33)	3 (100)	00	0(00)	1 (100%)	00(00)	1 (100%)
Penicillin	-	-	-	-	-	-	-	-	-	-	-	-	00(00)	1 (100%)
Ampicillin-Sulbactam	-	-	-	-	-	-	-	-	-	-	-	-	00(00)	1 (100%)
Cefoxitin	-	-	-	-	-	-	-	-	3 (100)	00	-	-	-	-

Table III summarizes the in vitro susceptibility profiles of several Gram-negative bacterial species: Acinetobacter baumannii (n = 25), Pseudomonas aeruginosa (n = 20), Klebsiella pneumoniae (n = 8), Burkholderia cepacia complex (n = 3) Stenotrophomonas maltophilia (n = 3) Serratia marcescens (n = 1) and Chryseobacterium indologenes (n = 1). The data included the percentage of Susceptible (S) and resistant (R) isolates against commonly used antibiotics.Acinetobacter baumannii showed 100% susceptibility to colistin, confirming its last-resort status. Tigecycline (72%), ceftazidime-avibactam (60%) and amoxicillin-clavulanic acid (60%) demonstrated moderate effectiveness, whereas high resistance was noted for gentamicin (84%), meropenem (76%) and cefepime (100%). Pseudomonas aeruginosa had high susceptibility to colistin (90%) but showed significant resistance to cephalosporins and carbapenems, such as ceftazidime (70%) and meropenem (60%). Klebsiella pneumoniae exhibited 100% susceptibility to colistin but high resistance to most other antibiotics; ceftazidime-avibactam and levofloxacin showed 50% susceptibility. For Burkholderia cepacia complex, colistin showed 66.67% susceptibility. Stenotrophomonas maltophilia was fully susceptible to minocycline and colistin but resistant to most beta-lactams.Both Serratia marcescens and Chryseobacterium indologenes displayed 100% resistance to multiple antibiotics, including colistin and meropenem, with Chryseobacterium being resistant to all agents tested.

IAHS Medical Journal
Volume 08 Issue 01 June 2025; 44-51

Table IV Drug Susceptibility Pattern of Gram-positive Isolates (n=18)

Antibiotics	CoNS (n=09) (%)		Staphylococcus aureus (n=05) (%)		Enterococci spp. (n=04) (%)	
	S (%)	R	S	R	S	R
Penicillin	-	-	1 (20)	4 (80)	1 (25)	3 (75)
Ampicillin	5 (55.56)	4 (44.44)	1 (20)	4 (80)	1 (25)	3 (75)
Doxycycline	-	-	-	-	2 (50)	2 (50)
Ciprofloxacin	3 (33.33)	6 (66.67)	3 (60)	2 (40)	1 (25)	3 (75)
Levofloxacin			-	-	1 (25)	3 (75)
Vancomycin	8 (88.89)	1 (11.11)	4 (80)	1 (20)	4 (100)	0 (00)
Teicoplanin	-	-	-	-	4 (100)	0 (00)
Linezolid	7 (77.78)	2 (22.22)	4 (80)	1 (20)	3 (75)	1 (25)
Cefoxitin	6 (66.67)	3 (33.33)	2 (40)	3 (60)	-	-
Chloramphenicol	5 (55.56)	4 (44.44)	2 (40)	3 (60)	-	-
Erythromycin	3 (33.33)	6 (66.67)	-	-	-	-
Azithromycin	8 (88.89)	1 (11.11)	4 (80)	1 (20)	-	-
Tetracycline	8 (88.89)	1 (11.11)	-	-	-	-
Cefuroxime	3 (33.33)	6 (66.67)	1 (20)	4 (80)	-	-
Clindamycin	3 (33.33)	6 (66.67)	1 (20)	4 (80)	-	-
Cotrimoxazole	5 (55.56)	4 (44.44)	1 (20)	4 (80)	-	-
Gentamycin	5 (55.56)	4 (44.44)	1 (20)	4 (80)	-	-
Tigecycline	8 (88.89)	1 (11.11)	5 (100)	0 (00)	-	-
Rifampicin	8 (88.89)	1 (11.11)	5 (100)	0 (00)	-	-

Table IV presents the antimicrobial susceptibility profiles of three Gram-positive bacterial groups-Coagulase-Negative Staphylococci (CoNS) (n = 9), Staphylococcus aureus (n = 5) and Enterococci spp. (n = 4)-against a panel of commonly used antibiotics. The data were expressed in terms of the number of isolates Susceptible (S) or Resistant (R) to each antibiotic, along with corresponding percentages in parentheses. Here, Penicillin resistance was prevalent across all three bacterial groups. Among S. aureus isolates, 80% (4/5) were resistant, while Enterococci spp. showed 75% resistance. CoNS also demonstrated substantial resistance to ampicillin (44.44%) although a slightly higher proportion (55.56%) remained susceptible. The overall high resistance rates to β-lactam antibiotics such as penicillin and ampicillin are consistent with known resistance mechanisms, including β-lactamase production. Doxycycline susceptibility was reported only for Enterococci spp., with a 50% susceptibility rate. Ciprofloxacin showed moderate activity, with 33.33% of CoNS, 60% of S. aureus and 25% of Enterococci spp. isolates were susceptible. This indicates a variable but generally reduced efficacy of fluoroquinolones across these species. From the Glycopeptides and Oxazolidinones group, it was observcd that Vancomycin retained high efficacy against all tested organisms, particularly Enterococci spp. (100% susceptibility). CoNS (88.89%) and S. aureus (80%) also exhibited high susceptibility to vancomycin. Similarly, teicoplanin and linezolid demonstrated excellent activity, especially against Enterococci spp., where susceptibility was 100% and 75%, respectively. This supports the continued use of glycopeptides and oxazolidinones as effective treatments against resistant Gram-positive infections.Cefoxitin, a surrogate marker for methicillin resistance, showed 66.67% susceptibility in CoNS and only 40% in S. aureus, indicating a considerable presence of methicillin-resistant strains. Chloramphenicol exhibited moderate efficacy, with susceptibility rates ranging from 40–55% among CoNS and S. aureus. Erythromycin 66.67% and azithromycin (11.11%) resistance was notably high among CoNS. While azithromycin showed higher susceptibility (88.89% in CoNS and 80% in S. aureus), erythromycin susceptibility was considerably lower (33.33% in CoNS). Macrolide data were not reported for Enterococci spp.

IAHS Medical Journal
Volume 08 Issue 01 June 2025; 44-51

Discussion

Neonatal Blood Stream Infections (BSIs) remain a major global concern, compounded by rising antimicrobial resistance. In this study, the overall BSI rate was 25.32%, with no anaerobic cultures performed. ICU-admitted neonates are at higher risk and vertical transmission from mothers contributes to vulnerability. Similar studies report lower BSI rates: 17.2% in Dhaka, 10.56% at Dhaka Shishu Hospital and 16.9% in Nepal.[14-16] This study showed a slight female predominance (55% vs. 45%). While some Bangladeshi studies support this trend prevalence of female infants (53%) over males (47%).[17] Conversely, an Indian study reported higher BSI rates in male infants (57.95%), suggesting regional gender-based variations.[18]

The current study found that 77.22% of cases were infected by Gram-negative bacilli, while 22.78% were infected by Gram-positive cocci. In a related study with 593 blood cultures, 63.88% were Gram-negative, mainly Klebsiella pneumoniae at 25%. Another study reported 75% Gram-positive infections, with Staphylococcus aureus as the leading isolate at 54.5%. These findings highlight variability in infection patterns across Neonatal Intensive Care Units (NICUs) and emphasize the need for ongoing monitoring of bacterial profiles and resistance patterns.[19]

In this research data reveals that Acinetobacter baumannii (25, 31.65%) and Pseudomonas aeruginosa (20; 25.32%) were the predominant pathogens in the clinical samples, reflecting their known role in hospital-acquired infections. Gram-negative bacteria were more commonly isolated than Gram-positive ones, suggesting a trend of nosocomial infections dominated by multidrug-resistant organisms. This highlights the need for strict infection control and antimicrobial stewardship strategies. A similar study reported a high prevalence of A. baumannii and P. aeruginosa in intensive care units, emphasizing their resistance profiles and association with ventilator-associated pneumonia and bloodstream infections.[20]Another Similar Study from India– observed a similar distribution where A. Baumannii (30.2%) and P. aeruginosa (26.7%) were the leading isolates from samples.[21] A dissimilar Study conducted in a community healthcare setting found Escherichia coli and Staphylococcus aureus as the predominant pathogens, indicating a lower prevalence of multidrug-resistant Acinetobacter and Pseudomonas, likely due to the non-hospital origin of the samples.[22]

The Burkholderia cepacia complex showed a 66.67% susceptibility to colistin, though its effectiveness is variable. Most other agents displayed moderate resistance. For Stenotrophomonas maltophilia, all isolates were 100% susceptible to minocycline and colistin but resistant to most beta-lactams. Moderate susceptibility (66.67%) was observed with Piperacillin, Chloramphenicol and tigecycline.A review of an Indian journal reveals that colistin has a susceptibility rate of 66.67%, indicating variable effectiveness. Other antimicrobial agents show moderate resistance, particularly to beta-lactams and ceftazidime, with susceptibility rates fluctuating over time. Regarding the antimicrobial susceptibility of Stenotrophomonas maltophilia, both minocycline and colistin demonstrate 100% susceptibility, making them reliable treatment options. In contrast, all isolates were resistant to beta-lactams, with moderate susceptibility (66.67%) to tigecycline. While the concerning susceptibility to colistin in Burkholderia cepacia complex (Bcc) is noteworthy, Stenotrophomonas maltophilia's consistent susceptibility to minocycline and colistin offers a potential therapeutic advantage. However, the overall resistance trends underscore the importance of ongoing surveillance and the development of tailored treatment strategies.[23,24]

The study found significant resistance to β-lactam antibiotics, such as penicillin and ampicillin, among three groups of Gram-positive bacteria: Coagulase-Negative Staphylococci (CoNS), Staphylococcus aureus and Enterococcus species. The resistance rates were 80% for S. aureus, 75% for Enterococcus and 44.44% for CoNS. In terms of susceptibility, Enterococcus showed a 50% susceptibility rate to doxycycline, while ciprofloxacin demonstrated moderate effectiveness, with susceptibility rates ranging from 25% to 60%. Glycopeptides, including vancomycin and teicoplanin, along with linezolid, remained highly effective, particularly against Enterococcus, which supports their use in treating resistant infections. Similarly, another study indicated that Gram-positive bacteria identified in blood cultures from the Neonatal Intensive Care Unit (NICU) notably Staphylococcus aureus and Enterococcus species, exhibited high resistance to β-lactam antibiotics (up to 80% for S. aureus and 75% for Enterococcus). Enterococcus showed moderate susceptibility to doxycycline (50%) and variable responses to ciprofloxacin (25–60%). The effectiveness of glycopeptides such as vancomycin and teicoplanin against Enterococcus reinforces their role in treatment. These patterns highlight the necessity for alternative treatment options and ongoing monitoring of antibiotic resistance.[25]

IAHS Medical Journal
Volume 08 Issue 01 June 2025; 44-51

Limitations

This study is limited by its single-centre design, which may not reflect patterns in other institutions or regions. The sample size may be small, reducing the generalizability of findings. Additionally, molecular characterization of resistance mechanisms was not performed, limiting insight into the underlying causes of antibiotic resistance.

Conclusions

In 312 NICU blood cultures, Gram-negative multidrug-resistant pathogens dominated, with Acinetobacter baumannii (31.65%) and Pseudomonas aeruginosa (25.32%) most common. Colistin showed 100% effectiveness against key Gram-negatives, while tigecycline and ceftazidime-avibactam had moderate activity. High resistance was observed to cephalosporins, carbapenems and aminoglycosides. Among Gram-positives, penicillin and ampicillin resistance were prevalent, but vancomycin, teicoplanin and linezolid remained highly effective.

Recommendations

Regular surveillance of bloodstream infection pathogens and their antibiotic susceptibility patterns is essential to guide effective empirical therapy in NICUs. Implementation of strict infection control practices can help reduce the incidence of infections. Periodic review and update of antibiotic policies based on local resistance trends are recommended. Further multicenter studies are needed for broader applicability of findings.

Disclosure

The authors declared no competing interest.

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IAHS Medical Journal
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