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Bacteriological Profile and Antibiogram of Blood Culture Isolates In Pediatric Population From A Tertiary Care Hospital: A Hospital-Based Observational Study

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A B S T R A C T

Background: One of the main causes of illness and mortality in pediatric populations, especially in developing nations, is blood stream infections (BSIs). To enhance treatment results, it is essential to promptly identify the pathogenic organisms and the patterns of antibiotic resistance they exhibit.
Objective: To assess the antibiogram and bacteriological profile of blood culture isolates in children at a north Indian tertiary care facility.
Methods: 200 children with suspected BSIs, ages 0 to 18, participated in this 18-month hospital-based observational study. Antimicrobial susceptibility testing was carried out in accordance with CLSI guidelines, and blood cultures were processed using normal microbiological procedures.
Results: Pseudomonas aeruginosa, E.coli, and Klebsiella were the most common gram-negative bacteria among the isolates. Among gram positive Staphylococcus aures and Coagulase negative staphylococci (CoNS) were isolated. A significant prevalence of antimicrobial resistance was observed, particularly among Gram-negative isolates, with high resistance to cephalosporins and carbapenems. MRSA strains showed resistance to multiple agents but remained susceptible to vancomycin and linezolid. MRSA strains showed resistance to multiple agents but remained susceptible to vancomycin and linezolid.
Conclusion: The result shows the urgent need for local surveillance of antimicrobial resistance patterns in pediatric BSIs. To enhance clinical results and prevent the emergence of resistance, empirical antibiotic regimens need to be modified often to reflect local resistance trends.

Keywords: Pediatric bloodstream infections, antibiogram, antimicrobial resistance, Klebsiella pneumoniae, MRSA, empirical therapy.

INTRODUCTION

Bloodstream infections are defined as the presence of viable infectious microorganism in the bloodstream causing clinical illness. [1] Bloodstream infections are critical health threats among pediatric patients, particularly neonates and immunocompromised children and are associated with significant morbidity and mortality in the population. [2] Sepsis in neonates is influenced by the quality of intrauterine life, host and environmental factors. [3] Over the years, there has been a dramatic shift in the etiology of bloodstream infections, with gram-negative bacterial dominance increasingly complicating treatment protocols due to the emergence of multidrug-resistant organisms (MDROs), particularly in resource-limited settings. [4] Blood culture is a vital tool and remains the gold standard for bacteremia detection. [5] The profile of causative agents of neonatal septicemia varies in different geographical areas and from time to time. In India, Klebsiella pneumoniae is the most frequently isolated pathogen followed by Staphylococcus aureus. [5] The growing issue of antibiotic resistance makes it more difficult to manage these infections successfully. Inadequate data on the

bacteriological profile and the resistance patterns of pathogens in the pediatric age group can lead to inappropriate and ineffective antibiotic therapies, resulting in prolonged illness, increased healthcare costs, and higher mortality rates.
In order to help clinicians choose the best antibiotics, enhance patient outcomes, and support infection control measures, t his study aims to identify the common bacteria that cause bloodstream infections in children and assess their resistance trends.

METHODS

This is an observational study conducted with 200 pediatric cases (0–18 years) with suspected bloodstream infections and approved by the Institutional Ethical Committee. Blood samples were collected under aseptic conditions and then processed for culture and sensitivity (BACTEC). In adolescents, 10–20 ml of blood was drawn under aseptic precautions using standard venipuncture techniques. In neonates, 1 ml of blood sample was collected via peripheral cannula with age-appropriate analgesia and sterile technique. Samples were labeled, transported at room temperature, and processed per standard protocols for pathogen identification and antimicrobial sensitivity testing. **Inclusion criteria**: Patients in the age group ≤ 18 years with signs and symptoms of Blood Stream Infections like **fever, chills, rigors, irritability, confusion, drowsiness** (altered mental status), **poor feeding or vomiting (infants), tachycardia, tachypnoea, hypotension (late sign), cold extremities, poor capillary refill** time, etc. **Exclusion criteria**: Cultures which yielded contaminants and mixed bacterial growth, patients in the age group > 18yrs, patients who denied consent for participation in study, history of antibiotic intake in past.

Statistical analysis The data was entered in Microsoft excel 2019 using SPSS version 25.0, and a p-value of ≤0.05 was considered statistically significant for determining relevant associations.

RESULTS

The study analyzed 200 cases with suspected bloodstream infections over 18-months period at Department of Pediatrics, Muzaffarnagar Medical College. Cases from neonates to adolescents (0–18 years) age group were taken into account, with the highest burden of cases in the NICU group (n=120), predominantly among neonates aged 1–10 days (37%). The PICU group (n=80) mostly included children aged 1–5 years i.e. 24.5% (Table-1) . Overall, males outnumbered females (57.5% vs. 42.5%), although gender distribution was not statistically significant.

Table 1: Distribution of cases according to Age (N=200)

Group	Age	Frequency	Percentage	P value
NICU (N=120)	1-10 days	74	37.0 %	<0.001
	11-20 days	28	14.0 %	
	21-28 days	18	9.0 %	
PICU (N=80)	< 1 year	2	1.0 %	
	1-5 years	49	24.5 %	
	6-10 years	13	6.5 %	
	11-15 years	14	7.0 %	
	≤18 years	2	1.0 %	

As shown in table 2, out of 120 NICU cases, 71(59.2%) were outborn (Figure-1), and 64(53.3%) were delivered via LSCS. A majority (76.7%) of NICU cases had at least one maternal risk factor (Table-3), with preterm labor, intrapartum fever, and PROM being most common. Respiratory distress was the leading comorbidity (28.3%). As shown in table 4, among PICU patients, URTI (18.8%), enteric fever (13.8%), and bronchopneumonia (8.8%) were most prevalent, with respiratory (33.8%) and gastrointestinal (30%) systems being most affected.

Table 2: Distribution of cases according to Inborn/ Out-born (N=120)

Inborn/ Out-born	Frequency	Percentage
Inborn	49	40.8 %
Out-born	71	59.2 %
Total	120	100.0%

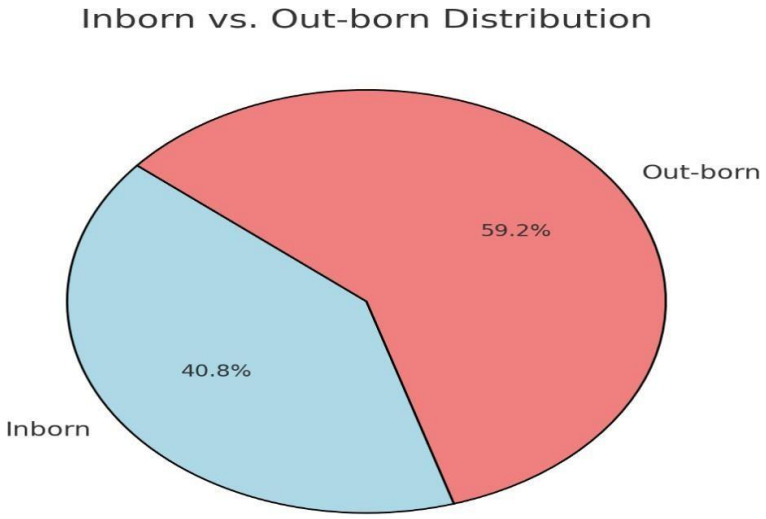

Figure 1: Distribution of cases according to Inborn/ Out-born

Table 3: Distribution of cases according to maternal risk factors (N=120)

Maternal Risk Factors	**Frequency**	**Percentage**
None	28	23.3%
Preterm Labor	28	23.3%
Intrapartum Fever	21	17.5%
Chorioamnionitis	17	14.2%
Premature Rupture of Membranes (PROM)	17	14.2%
Gestational Diabetes Mellitus (GDM)	5	4.2%
Preeclampsia	2	1.7%
Intrauterine Growth Restriction (IUGR)	2	1.7%
Total	**120**	**100.0%**

Table 4: Distribution of cases according to Diagnosis (N=80)

Diagnosis	**Frequency**	**Percentage**
URTI	15	18.8%
Enteric Fever	11	13.8%
Acute Diarrhoea	7	8.8%
Bronchopneumonia	7	8.8%
Nephrotic Syndrome	7	8.8%
DKA	5	6.3%
Acute Viral Hepatitis	4	5.0%
AFI	4	5.0%
Bronchiolitis	2	2.5%
Gastroenteritis	2	2.5%
Seizure Disorder	2	2.5%
Shock	2	2.5%
Skin Abscess	2	2.5%
Anemia	1	1.3%
Septic Arthritis	1	1.3%
Cellulitis	1	1.3%
Dengue Fever	1	1.3%
DMD	1	1.3%
Epiglottitis	1	1.3%
Febrile Seizure	1	1.3%
Pneumonia	1	1.3%

Skin Infection	1	1.3%
UTI	1	1.3%
Total	**80**	**100.0%**

Blood cultures were positive in 142 cases (71%). Gram-negative bacteria (56%) were more prevalent than Gram-positive organisms (41.5%), *Klebsiella pneumoniae* (13.5%), *Group B Streptococcus* (13%), *Pseudomonas aeruginosa* (6.5%), and *Salmonella typhi* (5.5%) were the most common isolates. MRSA (3.5%) and *Enterococcus* spp. (4%) were exclusive to NICU, indicating potential nosocomial infections. Fungal isolates, particularly *Candida albicans*, were identified in 2.5% of cultures. (Table-5; Figure-2)

Table 5: Distribution of cases according to Trends of bacterial isolates associated with bloodstream infections (N=142)

Organism	**NICU**	**PICU**	**Total**
Staphylococcus aureus	8 (6.7%)	6 (7.5%)	14 (7.0%)
Staphylococcus haemolyticus	0 (0.0%)	2 (2.5%)	2 (1.0%)
Streptococcus pneumoniae	0 (0.0%)	4 (5.0%)	4 (2.0%)
Streptococcus pyogenes	0 (0.0%)	8(10.0%)	8 (4.0%)
MRSA	7 (5.8%)	0(0.0%)	7 (3.5%)
Enterococcus spp.	8 (6.7%)	0(0.0%)	8 (4.0%)
Group B Streptococcus (GBS)	24(20.0%)	2(2.5%)	26(13.0%)
Candida sp.	2 (1.7%)	3 (3.8%)	5 (2.5%)
Escherichia coli	6 (5.0%)	6 (7.5%)	12 (6.0%)
Haemophilus influenzae	0 (0.0%)	4 (5.0%)	4 (2.0%)
Klebsiella pneumoniae	25 (20.8%)	2 (2.5%)	27 (13.5%)
Pseudomonas aeruginosa	13 (10.8%)	0 (0.0%)	13 (6.5%)
Salmonella typhi	0 (0.0%)	11 (13.8%)	11 (5.5%)
Shigella	0 (0.0%)	1 (1.2%)	1 (0.5%)
Total	93 (65.5%)	49 (34.5%)	142 (100.0%)

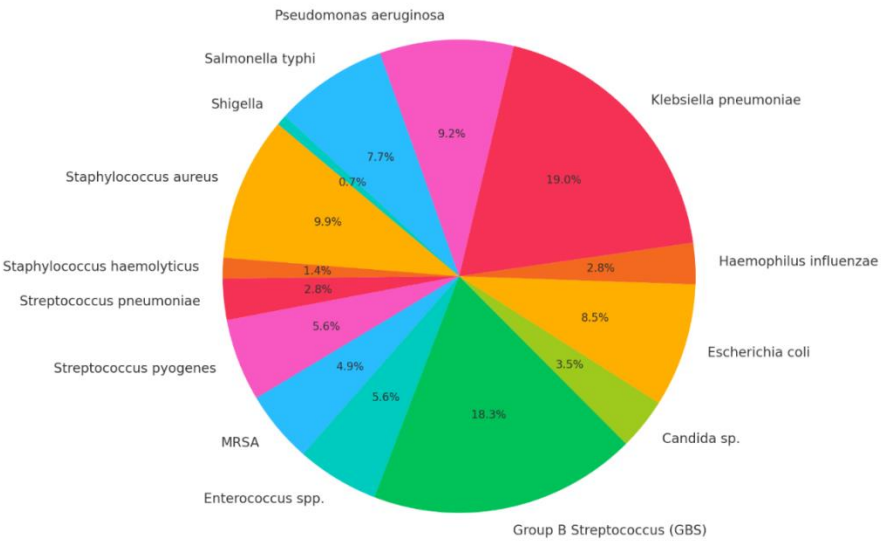

Figure 2 : Percentage of organisms isolated in NICU and PICU

Antibiotic resistance patterns revealed high resistance to beta-lactams, notably ampicillin, cefotaxime, and cefepime. However, drugs like vancomycin, linezolid, daptomycin, and meropenem retained high efficacy across most isolates. NICU pathogens showed broader resistance profiles than those in PICU.

Statistically, as shown in table 6, NICU patients had significantly higher CRP, TLC, and ESR values ($p < 0.001$), indicating greater inflammatory response. The overall recovery rate was 95%, with no significant difference in mortality or outcome between NICU and PICU groups ($p = 0.51$). (Figure-3)

Table 6: Distribution of cases according to clinical outcome (N=200)

Clinical outcome	NICU	PICU	Total	χ^2 and p value
Mortality	7 (5.8%)	3 (3.8%)	10 (5.0%)	
Recovered	113 (94.2%)	77 (96.2%)	190 (95.0%)	
Total	120 (60.0%)	80 (40.0%)	200 (100.0%)	χ^2=0.44, p=0.51

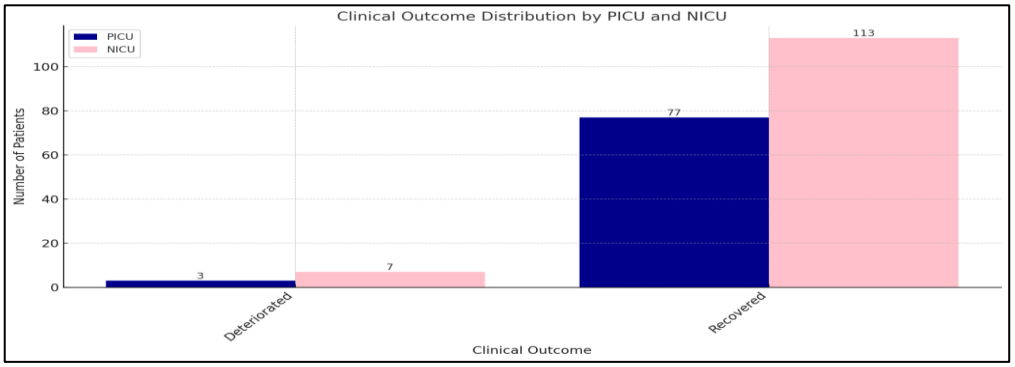

Figure 3: Distribution of cases according to clinical outcome

DISCUSSION

Bloodstream infections (BSIs) continue to pose a significant public health challenge, particularly in pediatric and neonatal intensive care units (NICU and PICU). This study of 200 pediatric blood cultures reaffirms the vulnerability of neonates, especially within the first 10 days of life, to septicemia. Neonates accounted for 37.0% of infections within the first 10 days, consistent with findings from Kumar et al. (2018), **Vaghela et al.** (2019), and **Katyal et al.** (2018), who reported incidences ranging from 36.9% to 42.1% in early neonatal life. While neonatal infections predominate, the 1–5 years age group also showed significant representation (24.5%), aligning with **Gupta et al.** (2016) and **Kante et al.** (2015).

Male predominance in bloodstream infections was noted (57.5%), mirroring the trend observed in earlier studies by **Katyal et al.** (2018), **Kumar et al.** (2018), and **Venkatesh et al.** (2016). Furthermore, a higher incidence of BSI in outborn neonates (59.2%)was noted. This observation parallels findings from Gupta et al. (2016) and **Vaghela et al.** (2019).

The most prevalent neonatal comorbidity in our cohort was respiratory distress (28.3%), aligning with **Sweta et al.** (2016), while jaundice and neonatal seizures were also common. Among PICU diagnoses, upper respiratory tract infections (18.8%) and enteric fever (13.8%) were prominent, consistent with prior data from **Vaghela et al.** (2019) and **Venkatesh et al.** (2016). The respiratory and gastrointestinal systems were the most affected overall.

Gram-negative bacteria predominated (56.0%), particularly *Klebsiella pneumoniae* (13.5%), a pattern observed by **Tariq et al.** (2014) and **Sweta et al.** (2016). Alarmingly, resistance patterns showed high levels of resistance to beta-lactam antibiotics among key pathogens. Notably, *Staphylococcus aureus* showed substantial resistance to Oxacillin and Cefazolin but retained high sensitivity to Vancomycin and Levofloxacin. Similarly, *Enterococcus* spp. and Group B *Streptococcus* demonstrated concerning resistance to Ampicillin and Cephalosporins, while retaining high sensitivity to Linezolid and Vancomycin, consistent with **Katyal et al.** (2018) and **Gupta et al.** (2016). This study underscores the critical need for early detection, targeted empirical therapy, and stringent infection control measures to curb antimicrobial resistance and improve clinical outcomes in pediatric BSIs.

CONCLUSION

This study highlights the high burden of pediatric bloodstream infections, particularly among neonates, with Gram-negative organisms like *Klebsiella pneumoniae* and *Group B Streptococcus* being predominant. Antibiotic resistance is a major concern, emphasizing the need for continuous surveillance, localized antibiograms, and rational antibiotic use. Strengthening infection control, ensuring complete immunization, improving nutrition, and addressing socio-economic disparities are vital to reducing morbidity and mortality. Implementing antimicrobial stewardship and enhancing early diagnosis and treatment can significantly improve outcomes in NICU and PICU settings.

DECLARATION

Author contributions

Kajol Panchal, **Sangita Singhal** and **Sheeba** has designed the study and prepared the initial manuscript. **Manish Agrawal** & **Vima Kush** analyzed data. All the authors have edited and approved the final manuscript.

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Ethics approval

This study was performed in line with the principles of the **National Medical Council, India**. Approval was granted by the **Institutional Ethical Committee** of **Muzaffarnagar Medical College, Uttar Pradesh, India** (Reference number: **MMC/IEC/2023/217**)

Competing interest

The authors declare no competing interests.

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