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Spectrum Of Bacterial Isolates And Their Antimicrobial Susceptibility Pattern In A Pediatric Intensive Care Unit: A Prospective Observational Study

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Abstract

Objective: To assess the distribution of bacterial pathogens and their antimicrobial susceptibility patterns among children admitted to a pediatric intensive care unit. ***Methods:*** This prospective observational study was conducted over one year (June 2024–June 2025) in a tertiary care PICU. Children aged 1 month to 18 years with suspected bacterial infections were included. Various clinical samples were processed using standard microbiological techniques. Antibiotic susceptibility testing was performed using CLSI guidelines.[9] ***Results:*** Out of 254 admissions, 124 (48.8%) yielded culture-positive results. Gram-negative organisms predominated (82.1%). The most common isolates were Klebsiella pneumoniae, Acinetobacter baumannii, Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus aureus. High resistance to cephalosporins and fluoroquinolones was observed. Carbapenems showed moderate sensitivity, whereas colistin remained highly effective.[3,7] ***Conclusions:*** Gram-negative organisms dominate PICU infections with significant multidrug resistance. Regular antibiogram monitoring is essential for appropriate empirical therapy.[8]

Keywords: Gram-Negative Bacteria, Antimicrobial Resistance ,Pediatric Intensive Care Unit , Multidrug-Resistant Organisms ,Antibiotic Stewardship

INTRODUCTION

Healthcare-associated infections remain a major challenge in pediatric intensive care units, contributing significantly to morbidity and mortality.[1,2] Children admitted to PICUs are particularly vulnerable due to invasive procedures, prolonged hospitalization, and frequent exposure to broad-spectrum antibiotics.

Antimicrobial resistance has emerged as a critical global health concern, limiting therapeutic options and increasing healthcare burden.[3] Empirical antibiotic therapy is often initiated in critically ill children; however, inappropriate use may promote resistance.[4]

Studies from developing countries have consistently demonstrated that Gram-negative organisms are the predominant pathogens in intensive care settings.[5,6] Organisms such as Klebsiella, Acinetobacter, and Pseudomonas are known for their ability to acquire multiple resistance mechanisms, including extended-spectrum beta-lactamase and carbapenemase production.[7]

Regular monitoring of bacterial isolates and their antimicrobial susceptibility patterns is essential for guiding empirical therapy and strengthening antibiotic stewardship programs.[8] This study was conducted to evaluate the bacterial spectrum and antibiogram pattern in a tertiary care PICU.

METHODS

This prospective observational study was conducted in the pediatric intensive care unit of NRI Institute of Medical Sciences, Visakhapatnam, from June 2024 to June 2025.

Children aged 1 month to 18 years with suspected bacterial infections were included. Patients with contaminated samples and duplicate isolates were excluded.

Clinical specimens including blood, urine, cerebrospinal fluid, endotracheal aspirate, pus, and pleural fluid were collected aseptically and processed using standard microbiological methods. Identification of organisms was performed by conventional techniques.

Antimicrobial susceptibility testing was carried out using the Kirby–Bauer disk diffusion method and interpreted according to CLSI guidelines.[9]

Multidrug resistance was defined as resistance to at least one agent in three or more antimicrobial classes.[10]

Statistical Analysis

Data were analyzed using descriptive statistics. Categorical variables were expressed as percentages, while continuous variables were presented as mean ± standard deviation.

RESULTS

A total of 254 children were admitted during the study period, of whom 124 (48.8%) had culture-positive infections. The mean age was 4.2 ± 3.6 years, with a male predominance (58.5%). Mechanical ventilation was required in 52% of cases.

Gram-negative organisms constituted 82.1% of isolates. The most frequently identified pathogens were Klebsiella pneumoniae, followed by Acinetobacter baumannii, Escherichia coli, and Pseudomonas aeruginosa. Among Gram-positive organisms, Staphylococcus aureus was the most common.

Endotracheal aspirates showed the highest positivity rate, suggesting a significant burden of ventilator-associated infections.[2]

A high level of resistance was observed to third-generation cephalosporins and fluoroquinolones. Carbapenems demonstrated moderate sensitivity, while colistin retained high activity against multidrug-resistant organisms.[7,11]

Gram-positive organisms showed preserved susceptibility to vancomycin and linezolid.[12]

DISCUSSION

The present study highlights the predominance of Gram-negative bacterial infections in the PICU, which is consistent with previous reports from similar healthcare settings.[5,6]

Klebsiella pneumoniae and Acinetobacter baumannii were the leading pathogens identified. These organisms are commonly associated with hospital-acquired infections, particularly in ventilated patients, and have the ability to survive in hospital environments.[2,7]

The high resistance to cephalosporins observed in this study suggests the presence of extended-spectrum beta-lactamase-producing organisms, a trend also reported in national surveillance data.[3]

Although carbapenems remain an important treatment option, emerging resistance among Gram-negative organisms is concerning and limits therapeutic choices. Rational use of these agents is essential to prevent further resistance.

Colistin demonstrated high effectiveness against multidrug-resistant organisms, consistent with earlier studies.[11] However, its potential toxicity necessitates cautious use.

Gram-positive isolates retained good sensitivity to vancomycin and linezolid, which aligns with previous findings.[12]

Continuous monitoring of antimicrobial resistance patterns, along with strict infection control measures and antibiotic stewardship programs, is crucial in reducing the burden of resistant infections.[8]

CONCLUSION

Gram-negative organisms are the predominant pathogens in PICU infections and exhibit significant resistance to commonly used antibiotics. Regular surveillance and appropriate antibiotic policies are essential to improve patient outcomes and combat antimicrobial resistance.

TABLES

Table 1: Distribution of Culture Positivity

Specimen	Total	Positive	%
Blood	110	48	43.6

Endotracheal aspirate	52	34	65.3
Urine	46	20	43.4
Pus	22	12	54.5
CSF	14	4	28.6
Pleural fluid	10	6	60
Total	**254**	**124**	**48.8**

Table 2: Clinical Characteristics

Variable	**Value**
Total admissions	254
Culture positive	124 (48.8%)
Male	72 (58.5%)
Female	52 (41.5%)
Mean age	4.2 ± 3.6
Mean stay	7.8 ± 3.4
Mechanical ventilation	64 (52%)

Table 3: Bacterial Isolates

Organism	**n**	**%**
Klebsiella pneumoniae	33	26.6
Acinetobacter baumannii	26	21.0
Escherichia coli	21	16.9
Pseudomonas aeruginosa	15	12.1
Staphylococcus aureus	18	14.5
Enterococcus spp.	6	4.8
CONS	5	4.0
Total	**124**	**100**

Table 4 Antibiotic susceptibility pattern (% sensitive)
Gram-negative organisms

Antibiotic	**Klebsiella**	**E coli**	**Acinetobacter**	**Pseudomonas**

Ceftriaxone	24	38	18	28
Piperacillin-tazobactam	58	64	42	61
Amikacin	62	71	48	67
Gentamicin	55	66	44	60
Ciprofloxacin	41	52	33	49
Meropenem	79	83	61	76
Imipenem	76	81	58	72
Colistin	100	100	96	100

Gram-positive organisms

Antibiotic	**Staphylococcus aureus**	**Enterococcus**
Penicillin	22	35
Amoxicillin-clavulanate	48	51
Clindamycin	72	NA
Gentamicin	69	61
Ciprofloxacin	55	58
Vancomycin	100	100
Linezolid	100	100

WHAT THIS STUDY ADDS

- Provides updated PICU antibiogram data from an Indian tertiary care center
- Highlights the growing burden of multidrug-resistant Gram-negative infections

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