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Original Research Article

A prospective study to evaluate the utility of blood culture in hospitalized children with community acquired pneumonia (age three months to eighteen years)

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ABSTRACT

Background: Community-acquired pneumonia (CAP) remains a leading cause of morbidity and mortality among children worldwide. Although blood culture is the diagnostic gold standard for bacteremia, its routine use in paediatric CAP is debated due to low yield and contamination risk. To evaluate the diagnostic and prognostic utility of blood culture in hospitalized children with CAP.
Methods: A prospective analytical study was conducted among 100 children aged 3 months-18 years admitted with CAP at GBH General Hospital, AIIMS Udaipur (January 2023-July 2025). Demographic, clinical, laboratory and radiological data were recorded. Blood cultures were obtained before antibiotic therapy and processed using standard microbiological methods. Associations between culture results and outcomes were analysed using SPSS v25 ($p<0.05$).
Results: Blood culture was positive in 22% of cases, with *Streptococcus pneumoniae* as the predominant isolate (45.5%). Positive cultures were significantly associated with ICU admission (81.8%), complications (31.8%), antibiotic escalation (81.8%) and mortality (36.4%) ($p<0.001$). Kaplan–Meier survival analysis showed markedly lower survival among culture-positive patients (63.6%) compared to culture-negative (98.7%, $p<0.001$).
Conclusions: Blood culture positivity in pediatric CAP signifies severe disease and adverse outcomes. Selective use in moderate-to-severe cases can guide rational antibiotic therapy and improve prognostic assessment.

Keywords: Community-acquired pneumonia, Blood culture, Bacteremia, Paediatric infection, Streptococcus pneumoniae, Survival analysis

INTRODUCTION

Pediatric community-acquired pneumonia (CAP) remains a leading cause of preventable childhood morbidity and mortality worldwide, despite major gains in immunization, nutrition and access to care.[1] The burden is disproportionately concentrated in low- and middle-income countries, where undernutrition, household air pollution, crowding and incomplete vaccination amplify both incidence and severity.[2] Respiratory syncytial virus (RSV) is a dominant cause of acute lower respiratory infection in young children, frequently presenting as pneumonia and driving seasonal surges in hospital admissions.[3] Even among hospitalized children with radiographically confirmed CAP, modern multicenter studies show that viral pathogens are detected more often than bacteria, while mixed infections are also common.[4]

Because clinical signs, routine laboratory markers and chest radiography have limited ability to reliably distinguish viral from bacterial disease at presentation, antibiotics are frequently initiated empirically.[5]

In settings with high antibiotic exposure and evolving antimicrobial resistance, improving diagnostic precision is essential to avoid unnecessary broad-spectrum therapy and to preserve antibiotic effectiveness.[6] Blood culture is the traditional reference test for confirming bacteremia and identifying causative bacteria and international guidelines recommend obtaining it mainly in children hospitalized with presumed moderate-to-severe bacterial CAP or complicated pneumonia.[5]

However, systematic reviews demonstrate that true-positive blood culture yield in pediatric CAP is generally low and may be offset by contamination, which can trigger repeat testing, additional antibiotics and higher costs.[7] Large cohort analyses further suggest that routine blood culture obtainment rarely changes definitive therapy for most children and may be associated with longer hospital length of stay while clinicians await negative results.[8]

Therefore, the present study evaluates the utility of blood culture among hospitalized children with CAP in a tertiary-care Indian setting to inform a targeted testing approach and support rational antimicrobial use.

METHODS

This prospective analytical observational study was conducted in the Department of Paediatrics, GBH General Hospital, AIIMS Udaipur, Rajasthan, from 1 January 2023 to 31 July 2025. Hospitalized children aged 3 months to 18 years diagnosed with community-acquired pneumonia (WHO clinical criteria) were enrolled by convenience sampling (n=100).

Children with recent hospitalization, immunodeficiency, chronic lung disorders (e.g., cystic fibrosis/Kartagener), congenital airway malformations, prior parenteral antibiotics before admission or suspected aspiration/foreign body were excluded.

After informed consent, demographic and clinical data were recorded and all participants underwent clinical examination, CBC with differential/ANC, CRP and chest radiography. Blood culture was collected aseptically at admission before in-hospital antibiotics and processed using standard laboratory methods for organism identification and antibiotic susceptibility.

Patients received routine treatment as per hospital protocol; outcomes included blood culture yield and isolates, need for antibiotic change, ICU admission, complications and mortality. Data were analyzed using SPSS v25; continuous variables were summarized as mean±SD and categorical variables as frequencies/percentages. Group comparisons used independent t-test and chi-square/Fisher's exact test; $p<0.05$ was considered significant.

RESULTS

Table 1 shows that the study population was predominantly young, with 85% of children below five years of age (48% infants and 37% aged 1-5 years) and a male preponderance (68%), while nearly half (48%) had incomplete or no immunization.

Cough (98%), fever (92%), cold (92%), tachypnea (89%) and chest retractions (84%) were the most frequent presenting clinical features.

Table 1: Baseline demographic and clinical characteristics (n=100).

Variables	Category	Frequency (N)	Percentage (%)
Age	3 months-1 years	48	48
	1-5 years	37	37
	5-10 years	10	10
	10-18 years	5	5
Gender	Male	68	68
	Female	32	32
Immunization status	Complete	52	52
	Partial	19	19
	Unimmunized	29	29
Common symptoms	Cough	98	98
	Cold	92	92
	Fever	92	92
	Vomiting	7	7
	Poor feeding	35	35
Respiratory signs	Tachypnea	89	89
	Retractions	84	84
	Nasal flaring	40	40
	Abnormal breath sounds	15	15

Table 2 shows that children had mild anaemia (mean Hb 10.29±1.82 g/dl) with leukocytosis (TLC 12,089±3,814/mm³), while bronchopneumonia (57%) and consolidation (51%) were the predominant radiological findings.

Blood culture was positive in 22% of cases, confirming bacteremia in nearly one in five hospitalized children with CAP. Table 3 shows that among the 22 culture-positive cases, Streptococcus pneumoniae (45.5%) was the predominant isolate, followed by S. aureus, E. coli, Klebsiella, Pseudomonas and H. influenzae (9.1-13.6% each). Culture-positive children also had a significantly higher mean ANC (1955.63±382.86 vs 1790.77±328.88 cells/mm³), suggesting a stronger inflammatory response in bacteremic cases.

Table 2: Laboratory, radiological and blood culture findings (n=100).

Parameters	Normal range	Mean±SD/frequency	Percentage (%)
Hemoglobin (g/dl)	11-14	10.29±1.82	-
Total leukocyte count (/mm³)	4,000-11,000	12,089±3,814	-
Neutrophils (%)	40-60	54.75±7.13	-
Lymphocytes (%)	20-40	30.57±6.85	-
CRP (mg/l)	<10	7.33±3.19	-
ANC (cells/mm³)	>1500	1827.04±346.30	-
X-ray findings	Lobar pneumonia	31	31
	Bronchopneumonia	57	57
	Consolidation	51	51
	Pleural effusion	6	6
	Normal	7	7
Blood culture	Positive	22	22
	Negative	78	78

Table 3: Bacterial isolates and association with laboratory parameters.

Bacterial isolate (n=22)	Frequency (N)	% among positives
Streptococcus pneumoniae	10	45.5
Staphylococcus aureus	3	13.6
Escherichia coli	3	13.6
Klebsiella pneumoniae	2	9.1
Pseudomonas aeruginosa	2	9.1
Haemophilus influenzae	2	9.1
Significant comparison (culture +vs−)		
ANC (cells/mm³)	Positive: 1955.63±382.86	Negative: 1790.77±328.88

Table 4 shows that blood culture positivity was strongly associated with adverse clinical outcomes including ICU admission (22%), antibiotic escalation (22%), complications (12%) and mortality (9%) all reaching statistical significance (p≤0.001).

Survival was markedly lower among culture-positive children (63.6%) compared with culture-negative children (98.7%, p<0.001), underscoring the prognostic value of blood culture in pediatric CAP.

Figure 1 (Kaplan–Meier Survival Curve): The survival probability was consistently higher in the blood culture–negative group (blue) compared to the blood culture–positive group (green), which showed an early and steeper decline.

Each step-down indicates an event and "+" marks indicate the censored observations. Overall, blood culture positivity was associated with poorer survival over the follow-up period.

Table 4: Treatment outcomes and association with blood culture.

Outcomes	Total (N)	%	Association (p value)
Improved on initial antibiotic	78	78	<0.001
Required antibiotic change	22	22	<0.001
ICU admission required	22	22	<0.001
Developed complications	12	12	0.001
Mortality	9	9	<0.001
Survival (by culture)	Negative: 77 (98.7)	Positive: 14 (63.6)	<0.001

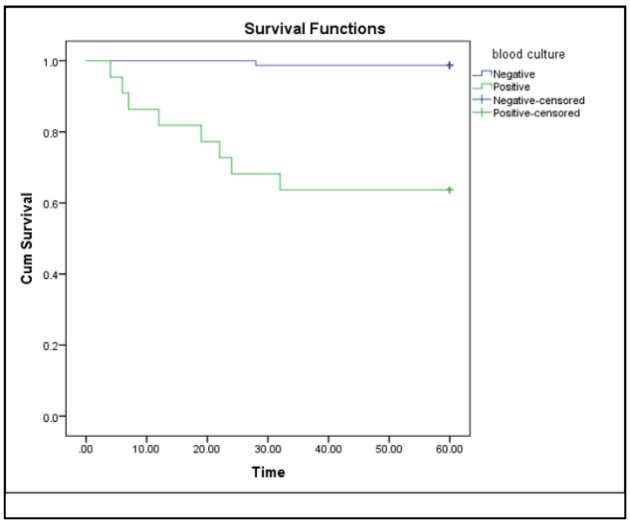


Figure 1: Kaplan-Meier analysis of overall survival according to mortality and blood culture positive vs negative.

DISCUSSION

In our prospective analytical study of 100 hospitalized children (3 months-18 years) with community-acquired pneumonia (CAP), blood culture was positive in 22%, indicating a meaningful burden of bacteremia in admitted (moderate–severe) cases. This yield is higher than most international pediatric CAP cohorts, where true positivity is generally low; Neuman et al and Kwon et al reported very low true bacteremia rates and limited benefit of routine cultures in lower-risk children.[9,10,17]

A systematic review by Tam et al also showed modest overall yield with higher positivity in severe CAP, and McCulloh et al highlighted concerns of contamination and limited impact in low-risk admissions.[11,12] In another study, Youssef et al reported a 1.3% true bacteremia rate, but noted that positive cultures were significantly associated with ICU admission, toxic appearance and elevated CRP, supporting the selective use of blood cultures in more severe clinical presentations.[13]

Streptococcus pneumoniae was the most common isolate in our cohort (10% of total cases), aligning with evidence that pneumococcus remains a leading bacterial cause of pediatric CAP. A recent Brazilian review by Lima et al confirmed the high prevalence of S. pneumoniae in pediatric CAP, alongside Mycoplasma pneumoniae and Staphylococcus aureus, depending on the age group affected.[14]

Similarly, a large multicentre study in Taiwan by Chi et al involving over 1,000 hospitalized children showed that S. pneumoniae was the most commonly detected bacterial agent (31.6%), followed by Mycoplasma pneumoniae (22.6%).[15] A large case-control study by Verma et al, conducted across tertiary hospitals in northern India, reported S. pneumoniae isolation in 8.1% of CAP cases aged 2-59 months.[16]

In our study of hospitalized children with community-acquired pneumonia (CAP), the most commonly observed symptoms were cough (98%), fever (92%), cold or rhinorrhea (92%) and respiratory distress (74%). These findings are consistent with numerous clinical studies emphasizing that cough and fever are hallmark symptoms of pediatric CAP.

For example, a comprehensive study by Ugleva and Ushakova (2023) found cough in 100% of children and fever in 45.3%, alongside frequent signs such as tachycardia (66.8%) and tachypnea (18%) particularly associated with hypoxemia in children under six.[17] Similarly, Dahy et al reported fever in 91.7% and cough in 75% of PICU-admitted children with CAP, along with respiratory distress features such as hypoxia, retractions and tachypnea.[18]

Davies also emphasized cough and tachypnea as the most common presenting features in children older than 2 years, with viral pathogens dominating in infants but bacterial infections more common in older children.[19]

Our study demonstrated that positive blood cultures in children hospitalized with CAP were significantly associated with more severe outcomes, including higher ICU admissions (81.8%), increased complication rates (31.8%), frequent need for antibiotic change (81.8%) and elevated mortality (36.4%).

This highlights the critical role of blood culture not only in identifying etiology but also in prognosticating disease severity. Multiple studies corroborate these findings. Fritz et al found that blood culture-positive children with CAP had a fivefold increased risk of ICU admission and mechanical ventilation, underscoring the link between bacteremia and disease escalation.[19,20] Similarly, Youssef et al identified significant associations between bacteremia and toxic appearance, ICU care and markedly elevated CRP (>300 mg/l).[13]

Williams similarly concluded that all true bacteremia cases in their cohort required ICU admission, highlighting that blood culture positivity reliably identifies critical illness.[21] Iqbal et al found that adherence to severity-based blood culture guidelines was poor, often leading to unnecessary testing without clinical benefit in mild CAP.[22] In addition, Heine et al reported that all patients with positive cultures showed signs of systemic illness and effusions, further confirming the clinical alignment between bacteremia and CAP severity.[23]

Shah et al found that bacteremic cases altered antibiotic therapy in most instances, illustrating the therapeutic implications of culture-guided treatment.[24] Collectively, these findings support our conclusion that blood culture positivity in hospitalized pediatric CAP is a strong indicator of critical illness, guiding intensive care decisions and therapy adjustments and should therefore be reserved for children with moderate to severe disease or poor clinical response.

Limitations

This was a single-centre study with n=100, limiting generalizability, and prior antibiotic exposure may have reduced culture yield. Absence of viral/molecular diagnostics (e.g., PCR) likely underestimated non-bacterial etiologies.

CONCLUSION

Blood culture positivity (22%) in our hospitalized pediatric CAP cohort indicates meaningful bacteremia among moderate–severe admissions and supports selective culture use in higher-risk children. *Streptococcus pneumoniae* remained the predominant isolate and blood culture positivity was strongly linked

with ICU care, complications, antibiotic escalation and mortality, highlighting its prognostic value.

Recommendations

Blood cultures should be obtained before antibiotics in hospitalized children with moderate–severe CAP or poor clinical response to guide targeted therapy and stewardship. Future multicenter studies should add molecular/viral testing and resistance surveillance to improve etiological accuracy and regional treatment guidance.

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