

Microbiological Profile and Antibiotic Resistance Patterns in Pediatric Community-Acquired Pneumonia: A Tertiary Care Study

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ABSTRACT

Background: Community-acquired pneumonia (CAP) remains one of the leading causes of morbidity and hospitalization among children worldwide. The increasing emergence of multidrug-resistant organisms has complicated empirical antibiotic therapy and adversely affected clinical outcomes. The aims to evaluate the microbiological profile and antibiotic resistance patterns among pediatric patients diagnosed with community-acquired pneumonia in a tertiary care center.

Methods: This prospective observational study was conducted in the Department of Pediatrics of a tertiary care teaching hospital over a period of 18 months. A total of 120 children aged 1 month to 14 years with clinically and radiologically confirmed community-acquired pneumonia were included. Respiratory samples and blood cultures were analyzed for bacterial pathogens and antibiotic susceptibility testing was performed using the Kirby–Bauer disc diffusion method according to Clinical and Laboratory Standards Institute guidelines.

Results: Among 120 enrolled patients, microbial isolates were identified in 78 (65%) cases. *Streptococcus pneumoniae* was the most common organism isolated, followed by *Staphylococcus aureus* and *Haemophilus influenzae*. High resistance rates were observed against ampicillin and cotrimoxazole, whereas comparatively lower resistance was seen with ceftriaxone and vancomycin. Multidrug resistance was identified in 28.2% of isolates.

Conclusion: The study demonstrated a substantial burden of antibiotic resistance among pediatric CAP pathogens. Continuous microbiological surveillance and rational antibiotic stewardship are essential to optimize empirical therapy and reduce antimicrobial resistance in pediatric populations.

Key-words: Community-acquired pneumonia, Pediatric infections, Antibiotic resistance, Microbiological profile, Antimicrobial susceptibility, Multidrug resistance

INTRODUCTION

Community-acquired pneumonia (CAP) remains one of the most important infectious causes of morbidity and mortality among children worldwide, particularly in low- and middle-income countries.^[1]

Despite significant advances in vaccination programs, antimicrobial therapy, and healthcare accessibility, pediatric CAP continues to account for substantial hospital admissions and healthcare burden globally.^[2] The etiology of pediatric CAP varies according to age, nutritional status, immunization coverage, geographic location, and socioeconomic conditions.^[3] *Streptococcus pneumoniae* continues to be recognized as the leading bacterial pathogen responsible for pediatric CAP, while *Haemophilus influenzae* and *Staphylococcus aureus* are also commonly implicated organisms.^[4] Recent changes

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in microbial ecology and widespread empirical antibiotic use have contributed to alterations in pathogen distribution and antimicrobial susceptibility patterns.^[5] The emergence of antibiotic-resistant respiratory pathogens has become a major challenge in pediatric clinical practice.^[6] Empirical antibiotic therapy is frequently initiated before microbiological confirmation, which may increase inappropriate antimicrobial exposure and promote the development of resistant organisms.^[7] Resistance to commonly prescribed antibiotics such as penicillins, macrolides, and cotrimoxazole has been increasingly reported in both developed and developing countries.^[8] Surveillance studies evaluating local microbiological profiles and resistance trends are therefore essential for guiding empirical antibiotic selection and improving therapeutic outcomes.^[9] Continuous monitoring of antimicrobial resistance patterns also plays a vital role in developing evidence-based antibiotic stewardship strategies and institutional treatment protocols.^[10]

The present study was conducted to evaluate the microbiological profile and antibiotic resistance patterns among pediatric patients diagnosed with community-acquired pneumonia admitted to a tertiary care teaching hospital.

MATERIALS AND METHODS

This prospective observational hospital-based study was conducted in the Department of Pediatrics of a tertiary care teaching hospital over a period of 18 months. The study included children aged between 1 month and 14 years who were diagnosed with community-acquired pneumonia based on clinical and radiological findings. A total of 120 pediatric patients fulfilling the predefined eligibility criteria were enrolled consecutively during the study period.

Inclusion Criteria

- ❖ Children aged 1 month to 14 years
- ❖ Clinical features suggestive of pneumonia such as fever, cough, tachypnea, chest indrawing, or respiratory distress
- ❖ Radiological evidence consistent with pneumonia
- ❖ Onset of symptoms before or within 48 hours of hospital admission

Exclusion Criteria

- ❖ Hospital-acquired pneumonia
- ❖ Known congenital lung malformations
- ❖ Pulmonary tuberculosis
- ❖ Immunocompromised children
- ❖ Prior hospitalization within the last 14 days
- ❖ Children already receiving prolonged antibiotic therapy

Data Collection- Detailed demographic and clinical information, including age, sex, presenting symptoms, vaccination status, and nutritional status, was recorded. Blood samples and respiratory specimens, including sputum or nasopharyngeal aspirates, were collected before initiation of antibiotic therapy wherever feasible.

Microbiological Analysis- Specimens were processed in the microbiology laboratory using standard bacteriological methods. Organisms were identified based on colony morphology, Gram staining, and biochemical characteristics. Antibiotic susceptibility testing was performed using the Kirby–Bauer disc diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Statistical Analysis- Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were represented as mean \pm standard deviation. The chi-square test was used to compare categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 120 children diagnosed with community-acquired pneumonia were included in the present study. Demographic characteristics, microbiological isolates, antibiotic resistance patterns, and clinical outcomes were analyzed systematically.

The majority of patients belonged to the 1–5-years age group. Male predominance was observed. Malnutrition and incomplete immunization were commonly associated risk factors (Table 1).

Table 1: Demographic Characteristics of Study Participants

Variable	Number (n=120)	Percentage (%)
Age <1 year	38	31.7
1–5 years	52	43.3
>5 years	30	25
Male	68	56.7
Female	52	43.3
Incomplete vaccination	34	28.3
Malnutrition present	41	34.2

Streptococcus pneumoniae was the predominant pathogen isolated, followed by *Staphylococcus aureus* and *Haemophilus influenzae* (Table 2).

Table 2: Distribution of Isolated Microorganisms

Organism Isolated	Number (n=78)	Percentage (%)
<i>Streptococcus pneumoniae</i>	28	35.9
<i>Staphylococcus aureus</i>	19	24.4
<i>Haemophilus influenzae</i>	15	19.2
<i>Klebsiella pneumoniae</i>	9	11.5
<i>Pseudomonas aeruginosa</i>	4	5.1
Others	3	3.9

High resistance rates were observed against ampicillin and cotrimoxazole, whereas resistance to vancomycin and linezolid remained very low (Table 3).

Table 3: Antibiotic Resistance Pattern among Major Isolates

Antibiotic	Resistant Isolates n (%)
Ampicillin	46 (59)
Cotrimoxazole	41 (52.6)
Azithromycin	28 (35.9)
Ceftriaxone	14 (17.9)
Vancomycin	3 (3.8)
Linezolid	2 (2.6)

Most children responded well to treatment and were discharged successfully. ICU admission and mortality rates were relatively low (Table 4).

Table 4: Clinical Outcome of Study Participants

Outcome	Number	Percentage (%)
Improved and discharged	108	90
ICU admission required	9	7.5
Mortality	3	2.5

DISCUSSION

The present study evaluated the microbiological spectrum and antibiotic resistance patterns among children admitted with community-acquired pneumonia in a tertiary care hospital. Most patients affected in the present study were below five years of age, which is consistent with previous literature demonstrating increased susceptibility of younger children to respiratory infections due to immature immune mechanisms and increased exposure to environmental pathogens.^[11,12] Male predominance observed in our study has also been documented in several earlier pediatric CAP studies. *Streptococcus pneumoniae* was the most commonly isolated organism in the present study, followed by *Staphylococcus aureus* and *Haemophilus influenzae*. Similar observations have been reported in previous studies evaluating pediatric CAP, where pneumococcus continues to remain the predominant bacterial pathogen despite improvements in vaccination coverage.^[3,4] The persistence of pneumococcal infections may be attributed to incomplete immunization, delayed healthcare access, and circulation of non-vaccine serotypes.^[12] A high level of resistance was observed against commonly prescribed antibiotics such as ampicillin and cotrimoxazole. Similar resistance trends have been reported in studies from developing countries where irrational antibiotic use, empirical therapy, and easy over-the-counter availability of antimicrobials contribute substantially to increasing resistance patterns.^[8,9] In contrast, comparatively lower resistance rates were observed with ceftriaxone, vancomycin, and linezolid, suggesting that these agents still retain relatively good effectiveness against severe



bacterial infections. Multidrug resistance was identified in a considerable proportion of isolates in the present study, highlighting the growing burden of resistant respiratory pathogens in pediatric populations.^[13,14] Antimicrobial resistance not only complicates empirical therapy but may also contribute to prolonged hospitalization, increased healthcare expenditure, and adverse clinical outcomes. Irrational prescribing practices, incomplete treatment adherence, and inappropriate antibiotic exposure remain important contributors to this emerging global problem.^[15] Most children included in the present study improved with appropriate medical management and were discharged successfully, while ICU admission and mortality rates remained relatively low. Early diagnosis, prompt hospitalization, supportive care, and timely initiation of antimicrobial therapy may have contributed to favorable clinical outcomes in our patients.^[16]

Overall, the findings of the present study emphasize the importance of continuous microbiological surveillance and periodic assessment of local antibiotic susceptibility patterns. Strengthening antimicrobial stewardship practices and promoting rational antibiotic use are essential for reducing the burden of antimicrobial resistance and improving treatment outcomes in pediatric community-acquired pneumonia.

CONCLUSIONS

Pediatric community-acquired pneumonia continues to represent a significant infectious disease burden, particularly among children under five years of age. *Streptococcus pneumoniae* remained the most common bacterial pathogen isolated in this study. A high prevalence of resistance to commonly prescribed antibiotics such as ampicillin and cotrimoxazole was observed, indicating the growing challenge of antimicrobial resistance. The study highlights the urgent need for rational antibiotic use, periodic microbiological surveillance, and implementation of antimicrobial stewardship strategies. Early diagnosis, targeted antimicrobial therapy, and strengthening immunization coverage can substantially improve clinical outcomes and reduce morbidity and mortality associated with pediatric CAP.

CONTRIBUTION OF AUTHORS

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