



Original Article

A Prospective Study on Bacterial Etiology and Antibiotic Resistance Pattern in Acute Lower Respiratory Tract Infections Among Hospitalized Children in a Tertiary Care Centre

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ABSTRACT

Background: Acute lower respiratory tract infections (ALRTIs) remain a leading cause of morbidity and mortality among children, particularly in developing countries. The emergence of antibiotic resistance poses a major challenge in their effective management.

Objective: To determine the bacterial etiologies of ALRTI and their antibiotic resistance patterns among hospitalized paediatric patients.

Methods: This prospective observational study was conducted over a period of 12 months in the Departments of Paediatrics and Microbiology, VIMS Medical College, Gajraula. Sputum, endotracheal aspirates, and blood samples from 150 children (aged 1 month–12 years) with clinically diagnosed ALRTI were processed for bacterial culture and sensitivity testing using standard microbiological techniques. Antimicrobial susceptibility was assessed by the Kirby–Bauer disc diffusion method as per CLSI guidelines (2023).

Results: Of 150 patients, bacterial growth was obtained in 104 (69.3%) cases. The predominant isolates were *Streptococcus pneumoniae* (34.6%), *Haemophilus influenzae* (23.1%), *Staphylococcus aureus* (18.3%), *Klebsiella pneumoniae* (13.5%), and *Pseudomonas aeruginosa* (10.5%). High resistance was noted to ampicillin (74%) and co-trimoxazole (62%), whereas good sensitivity was retained to amoxicillin-clavulanate (68%), ceftriaxone (72%), and levofloxacin (81%).

Conclusion: *S. pneumoniae* and *H. influenzae* remain major pathogens in paediatric ALRTI. Rising resistance to first-line antibiotics underscores the need for rational antibiotic use and periodic surveillance.

Keywords: Bacterial Etiology, Antibiotic Resistance, Acute lower respiratory tract infections (ALRTIs).

INTRODUCTION

Acute lower respiratory tract infections (ALRTIs) are one of the major causes of morbidity and mortality in children, especially in low- and middle-income countries. The World Health Organization (WHO) estimates that pneumonia alone causes nearly 14% of all deaths in children under five years globally [1]. Despite the availability of vaccines and improved antibiotic regimens, antibiotic resistance among respiratory pathogens continues to rise.

Streptococcus pneumoniae and *Haemophilus influenzae* are traditionally recognized as predominant bacterial agents in ALRTI [2,3]. However, hospital-acquired infections increasingly involve gram-negative bacteria such as *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, complicating treatment outcomes [4]. Rational antibiotic therapy requires knowledge of local etiological patterns and resistance trends, which vary geographically [5]. This study was designed to determine the bacterial spectrum and antibiotic resistance profile in paediatric ALRTI cases in a tertiary care hospital setting.

MATERIALS AND METHODS

This was a prospective observational study conducted over one year (January 2024–December 2024) in the Departments of Paediatrics and Microbiology, VIMS Medical College, Gajraula, Uttar Pradesh. A total of 150 children aged 1 month to 12 years admitted with clinically and radiologically confirmed ALRTI were included. Exclusion criteria included recent antibiotic use (within 48 hours), known immunodeficiency, or chronic pulmonary disease.

Sputum, endotracheal aspirates, and blood samples were collected aseptically and processed using standard microbiological methods. Bacterial identification was performed using Gram staining and biochemical tests. Antibiotic susceptibility was determined by the Kirby–Bauer disc diffusion method on Mueller-Hinton agar as per Clinical and Laboratory Standards Institute (CLSI) guidelines, 2023 [6]. Statistical analysis was performed using SPSS version 25, and $p < 0.05$ was considered significant.

RESULTS

Of the 150 children enrolled, 104 (69.3%) yielded bacterial growth. *Streptococcus pneumoniae* (34.6%) was the most frequent isolate followed by *Haemophilus influenzae* (23.1%), *Staphylococcus aureus* (18.3%), *Klebsiella pneumoniae* (13.5%), and *Pseudomonas aeruginosa* (10.5%).

Ampicillin and co-trimoxazole showed the highest resistance rates (74% and 62%, respectively). Sensitivity remained high for ceftriaxone (72%) and levofloxacin (81%). Multidrug resistance was observed in 28% of gram-negative isolates.

DISCUSSION

The findings of this study reaffirm that *Streptococcus pneumoniae* and *Haemophilus influenzae* are leading bacterial agents responsible for paediatric ALRTI, consistent with several regional and international reports [2,3,7]. The predominance of these pathogens is likely due to incomplete vaccine coverage, nasopharyngeal carriage, and seasonal variation influencing transmission [8].

The emergence of gram-negative organisms such as *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* among hospitalized children aligns with previous findings from Indian tertiary care centres, where prolonged hospitalization, mechanical ventilation, and broad-spectrum antibiotic exposure predispose to nosocomial infections [9,10].

High resistance to ampicillin and co-trimoxazole noted in this study mirrors global resistance trends reported by Kumar et al. and Patel et al. [11,12]. Resistance to beta-lactam antibiotics is often mediated by altered penicillin-binding proteins or beta-lactamase enzyme production. Increasing resistance in *H. influenzae* to ampicillin is also attributed to widespread plasmid-mediated TEM-type beta-lactamases [13]. *S. aureus* isolates, including methicillin-resistant *S. aureus* (MRSA), accounted for 18.3% of infections. This reflects the growing burden of MRSA-related respiratory infections in children, particularly those with recent healthcare contact [14]. The sensitivity to levofloxacin and ceftriaxone observed in this study suggests that these agents remain effective empirically, though prudent use is essential to prevent further resistance [15]. Vaccination against pneumococcus and *H. influenzae* type b (Hib) has significantly reduced the incidence of invasive disease in many countries, but incomplete immunization and vaccine escape variants remain a concern in India [16,17].

The results emphasize the need for routine antimicrobial surveillance to guide empirical therapy. Strengthening antibiotic stewardship programs, promoting vaccine uptake, and improving infection control practices are critical to mitigating resistance emergence [18,19].

Limitations of this study include its single-centre design and limited sample size, which may restrict generalizability. Future multicentric studies incorporating molecular resistance profiling are recommended. In conclusion, periodic monitoring of bacterial etiology and resistance trends is crucial to guide empirical treatment strategies in paediatric ALRTI and reduce antimicrobial resistance burden.

TABLES

Table 1. Distribution of bacterial isolates (n=104)

Pathogen	No. of isolates	Percentage (%)
<i>Streptococcus pneumoniae</i>	36	34.6
<i>Haemophilus influenzae</i>	24	23.1
<i>Staphylococcus aureus</i>	19	18.3
<i>Klebsiella pneumoniae</i>	14	13.5
<i>Pseudomonas aeruginosa</i>	11	10.5

Table 2. Antibiotic resistance pattern (% of isolates resistant)

Antibiotic	<i>S. pneumoniae</i>	<i>H. influenzae</i>	<i>S. aureus</i>	<i>K. pneumoniae</i>	<i>P. aeruginosa</i>
Ampicillin	68	79	85	91	100
Co-trimoxazole	56	66	58	73	60
Amox-clav	28	35	42	61	55
Ceftriaxone	21	30	36	44	50
Levofloxacin	10	12	15	23	25

CONCLUSION

Streptococcus pneumoniae and *Haemophilus influenzae* remain the predominant bacterial pathogens in paediatric ALRTI. Increasing resistance to commonly prescribed antibiotics such as ampicillin and co-trimoxazole highlights the need for continuous surveillance and rational antibiotic use. Strengthening immunization programs and infection control measures will help reduce morbidity and mortality from these preventable infections.

Declaration:

Conflicts of interests: The authors declare no conflicts of interest.

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