Original article

Antibiotic Resistance Pattern of Klebsiella pneumoniae in Pediatric Samples: A Prospective Observational Study

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ABSTRACT

Background: *Klebsiella pneumoniae is a major opportunistic pathogen responsible for significant morbidity in pediatric populations, particularly in hospital settings. The increasing prevalence of multidrug-resistant (MDR) strains has become a major public health concern.*

Aim: *To evaluate the antibiotic resistance pattern of Klebsiella pneumoniae isolated from pediatric samples in a tertiary care hospital.*

Methods: *A prospective observational study was conducted at B.J. Government Medical College and Sassoon General Hospital, Pune, from January 2024 to January 2025. Samples were collected from both indoor and OPD pediatric patients using simple random sampling. Microbiological identification and antibiotic susceptibility testing were performed using standard CLSI guidelines.*

Results: *A total of 150 isolates of Klebsiella pneumoniae were analyzed. High resistance was observed to third-generation cephalosporins (78%), fluoroquinolones (65%), and aminoglycosides (52%). Carbapenem resistance was noted in 28% of isolates. Multidrug resistance was observed in 62% of cases.*

Conclusion: *The study highlights alarming resistance trends, emphasizing the need for antibiotic stewardship and continuous surveillance.*

Keywords: *Klebsiella pneumoniae, pediatric infections, antibiotic resistance, MDR, tertiary care hospital*

INTRODUCTION

Klebsiella pneumoniae is a Gram-negative, encapsulated bacillus that forms part of the normal flora of the human gastrointestinal tract but is also a significant cause of healthcare-associated infections, particularly in pediatric populations. (1,2) It is commonly implicated in pneumonia, urinary tract infections, septicemia, and meningitis, especially in immunocompromised and hospitalized children. (3) The organism has gained considerable attention due to its increasing ability to develop resistance to multiple classes of antibiotics.

The emergence of extended-spectrum beta-lactamase (ESBL) producing and carbapenem-resistant strains has severely limited treatment options, leading to increased morbidity, mortality, and healthcare costs. Pediatric patients are particularly vulnerable due to immature immunity, frequent hospital admissions, and exposure to invasive procedures. India has reported a rising trend of antimicrobial resistance among Gram-negative organisms, necessitating region-specific data for effective management. (4,5) Understanding local antibiograms is crucial for guiding empirical therapy and preventing the spread of resistant strains. (6) This study was undertaken to evaluate the antibiotic resistance pattern of *Klebsiella pneumoniae* in pediatric samples collected from both indoor and outpatient settings in a tertiary care hospital in Pune.

STUDY METHODOLOGY

This prospective observational study was conducted in the Department of Microbiology in collaboration with the Department of Pediatrics at B.J. Government Medical College and Sassoon General Hospital, Pune, over a period of one year from January 2024 to January 2025.

All pediatric patients (age 0–14 years) presenting with suspected bacterial infections were included. Samples were collected from both indoor (IPD) and outpatient (OPD) settings. The specimens included blood, urine, sputum, pus, and other body fluids.

Sampling was performed using a simple random sampling technique. All suspected clinical samples received during the study period were considered as the sampling frame.

Isolation and identification of *Klebsiella pneumoniae* were carried out using standard microbiological techniques, including culture on MacConkey agar and biochemical tests. Antibiotic susceptibility testing was performed using the Kirby-Bauer disk diffusion method, and results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

The antibiotics tested included beta-lactams, cephalosporins, aminoglycosides, fluoroquinolones, and carbapenems. Multidrug resistance (MDR) was defined as resistance to at least three classes of antibiotics.

Data were entered into Microsoft Excel and analyzed using descriptive statistics.

RESULTS

Table 1: Distribution of Samples by Type

Sample Type	Number (n=150)	Percentage (%)
Urine	52	34.7%
Blood	38	25.3%
Sputum	24	16.0%
Pus	21	14.0%
Others	15	10.0%

Table 2: Antibiotic Resistance Pattern

Antibiotic Class	Resistance (%)
Cephalosporins	78%
Fluoroquinolones	65%
Aminoglycosides	52%
Beta-lactam + inhibitor	48%
Carbapenems	28%

Table 3: Multidrug Resistance Pattern

Resistance Category	Number	Percentage (%)
MDR	93	62%
Non-MDR	57	38%

DISCUSSION

The present study provides an important insight into the antibiotic resistance pattern of *Klebsiella pneumoniae* in pediatric patients at a tertiary care hospital in Pune. The findings highlight a significant burden of antimicrobial resistance, particularly among commonly used antibiotics.(7,8)

In this study, urine samples constituted the highest proportion of isolates (34.7%), followed by blood and sputum samples. This is consistent with previous studies where *Klebsiella pneumoniae* is commonly implicated in urinary tract infections and septicemia in children. The higher prevalence in urine samples may be attributed to poor hygiene practices and catheter-associated infections in hospitalized children. (9,10,11)

A major finding of this study is the high resistance observed to third-generation cephalosporins (78%). This suggests a high prevalence of ESBL-producing strains, which has been widely reported in Indian healthcare settings. The misuse and overuse of cephalosporins in clinical practice have significantly contributed to this resistance pattern.

Fluoroquinolone resistance was also notably high (65%), which is concerning as these drugs are often used as second-line agents. Aminoglycoside resistance (52%) further limits treatment options, especially in severe infections where combination therapy is required.

Carbapenems, considered last-resort antibiotics, showed resistance in 28% of isolates. This indicates the emergence of carbapenem-resistant *Klebsiella pneumoniae* (CRKP), which is a serious public health threat. The presence of carbapenem resistance suggests the possible production of carbapenemases such as KPC, NDM, or OXA enzymes.

The study also found that 62% of isolates were multidrug-resistant. This high prevalence of MDR organisms significantly complicates treatment strategies and increases the risk of treatment failure. Similar findings have been reported in other Indian studies, reflecting a nationwide trend.

The increasing resistance can be attributed to several factors, including irrational antibiotic use, lack of antibiotic stewardship programs, and inadequate infection control practices. Pediatric populations are particularly vulnerable due to frequent antibiotic exposure and immature immune systems.

Comparatively, studies conducted by Sharma et al. and Gupta et al. (4,5) have reported MDR rates ranging from 50% to 70%, which aligns with the findings of this study. The emergence of MDR and extensively drug-resistant (XDR) strains necessitates urgent intervention.

The study underscores the importance of regular surveillance of antibiotic resistance patterns. Hospital-specific antibiograms should be developed and updated periodically to guide empirical therapy. Implementation of antibiotic stewardship programs is essential to optimize antibiotic use and reduce resistance.

Strict infection control measures, including hand hygiene, sterilization protocols, and isolation of infected patients, should be enforced to prevent nosocomial transmission. Additionally, awareness among healthcare professionals regarding rational antibiotic use is crucial.(12)

Despite its strengths, the study has certain limitations. It was conducted in a single center and may not be generalizable to other settings. Molecular characterization of resistance mechanisms was not performed, which could provide further insights.

Overall, the study highlights the urgent need for coordinated efforts to combat antimicrobial resistance in pediatric populations.

CONCLUSION

The study demonstrates a high prevalence of antibiotic resistance among *Klebsiella pneumoniae* isolates in pediatric patients, with a significant proportion exhibiting multidrug resistance. The rising resistance to commonly used antibiotics, including carbapenems, is alarming. Continuous surveillance, strict infection control measures, and implementation of antibiotic stewardship programs are essential to address this growing threat.

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