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Original Article

Bacteriological Profile and Antibiotic Sensitivity Pattern in Patients with Community Acquired Pneumonia

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ABSTRACT

Background: Community-acquired pneumonia (CAP) remains a leading cause of morbidity and mortality worldwide. It is an acute infection of the lung parenchyma occurring outside the hospital setting or within 48 hours of admission. The etiological agents vary by region, and increasing antimicrobial resistance among respiratory pathogens complicates management. Early identification of causative organisms and their antibiotic susceptibility patterns is essential for guiding effective empirical therapy. So, this study aims to determine the bacteriological profile of pathogens causing community-acquired pneumonia and to analyse their antibiotic sensitivity patterns among hospitalized patients

Methods: This hospital-based cross-sectional study was conducted among patients admitted with diagnosis of CAP based on clinical and radiological findings in a tertiary care centre over a period of one year. Respiratory samples (sputum/endotracheal aspirate) and blood cultures were collected and processed using standard microbiological techniques. Isolated organisms were identified, and antibiotic susceptibility testing was performed using the Kirby–Bauer disk diffusion method in accordance with CLSI guidelines. Demographic and clinical data were recorded and analysed.

Results: A total of 120 patients were included in the study, of whom bacterial pathogens were isolated in 68.3% (n = 82) of cases. The most commonly identified organisms were Streptococcus pneumoniae, Klebsiella pneumoniae, Staphylococcus aureus, and Pseudomonas aeruginosa. Gram-positive bacteria accounted for 51.2% of isolates, while gram-negative bacteria constituted 48.8%, demonstrating a nearly equal distribution between the two groups. Among the tested antibiotics, the highest sensitivity was observed with levofloxacin (88.0%), followed by amikacin (86.0%) and ceftriaxone (82.0%). Moderate sensitivity was noted with azithromycin (70.0%) and ciprofloxacin (68.0%), indicating variable effectiveness of commonly used antibiotics in the management of community-acquired pneumonia.

Conclusion: Bacterial pathogens were identified in the majority of cases, with a nearly equal distribution of gram-positive and gram-negative organisms. Streptococcus pneumoniae and other common respiratory pathogens predominated. Levofloxacin, amikacin, and ceftriaxone demonstrated the highest sensitivity, while moderate effectiveness was observed with azithromycin and ciprofloxacin. This study highlights the need for regular surveillance of bacteriological profiles and antibiotic sensitivity for optimizing empirical treatment strategies in community-acquired pneumonia.

Keywords: *Community-acquired pneumonia; Bacterial pathogens; Antibiotic sensitivity; Streptococcus pneumoniae; Levofloxacin; Amikacin; Ceftriaxone.*

INTRODUCTION

Pneumonia is an acute infection of the lung parenchyma occurring in individuals outside the hospital setting or within 48 hours of hospital admission. It remains a leading cause of morbidity and mortality worldwide, particularly among older adults, individuals with chronic comorbidities, and immunocompromised patients. The disease also imposes a substantial burden on healthcare systems due to high hospitalization rates, prolonged hospital stays, and the need for intensive care in severe cases[1,2].

Clinically, pneumonia commonly presents with fever, cough, sputum production, pleuritic chest pain, dyspnea, and generalized weakness. Physical examination may reveal crackles and reduced breath sounds on auscultation[3]. Diagnosis is typically established through a combination of clinical features and radiographic evidence of pulmonary infiltrates. While clinical and imaging findings confirm the diagnosis, identification of the causative pathogen is essential for guiding appropriate antimicrobial therapy[4].

A wide range of bacterial pathogens, including both gram-positive and gram-negative organisms, are implicated in pneumonia. The distribution of these pathogens varies depending on patient demographics, comorbid conditions, and environmental exposures. Microbiological identification through culture of respiratory specimens such as sputum or bronchoalveolar lavage plays a crucial role in directing targeted therapy[5,6].

The increasing emergence of antimicrobial resistance has significantly complicated the management of pneumonia. Inappropriate and excessive antibiotic use has contributed to the development of resistant strains, leading to delayed clinical recovery, increased healthcare costs, and higher mortality rates[7]. Therefore, knowledge of the local bacteriological profile and antibiotic susceptibility patterns is essential for selecting effective empirical therapy and improving patient outcomes[8].

Understanding regional pathogen distribution and resistance trends also supports antimicrobial stewardship efforts by enabling clinicians to optimize antibiotic use and limit the spread of resistant organisms[9]. Hospital-based surveillance studies are particularly valuable in monitoring evolving microbial patterns and guiding evidence-based treatment protocols[10].

The present study aims to determine the bacteriological profile of pneumonia and evaluate the antibiotic sensitivity patterns of the isolated pathogens. The findings are expected to provide insights into the regional distribution of causative organisms and support clinicians in making informed decisions regarding appropriate antimicrobial therapy.

MATERIALS AND METHODS

Study Design and Setting: This hospital-based cross-sectional study was conducted among patients admitted with community-acquired pneumonia (CAP). The study was carried out in the Departments of pulmonary medicine and Microbiology at a tertiary care centre over study period of one year.

Study Population: Patients diagnosed with community-acquired pneumonia based on clinical presentation and radiological findings were included. CAP was defined as pneumonia occurring outside a hospital or healthcare setting, or diagnosed within 48 hours of hospital admission.

Sample Size: A total of 120 patients with confirmed CAP were enrolled in the study.
The sample size was calculated assuming a prevalence of 70% based on previous literature, with a 95% confidence level and an allowable error of 10%. A consecutive sampling method was used to recruit eligible participants.

Inclusion Criteria: Adults aged ≥18 years diagnosed with community-acquired pneumonia based on clinical features and chest radiography or computed tomography findings, who were able to produce sputum samples for microbiological analysis and provided informed consent, were included in the study.

Exclusion Criteria: Patients with hospital-acquired pneumonia, those who had received antibiotic therapy within 48 hours prior to sample collection, individuals with previously diagnosed pulmonary tuberculosis, and those unwilling to provide informed consent were excluded from the study.

Clinical Assessment: Detailed clinical histories were obtained for all patients, including presenting symptoms such as fever, cough, sputum production, chest pain, and dyspnoea. Demographic data, including age and sex, were recorded. Clinical examination included assessment of respiratory rate, oxygen saturation, and auscultatory findings.

Sample Collection and Microbiological Analysis: Expectorated sputum samples were collected under sterile conditions prior to initiation of antibiotic therapy. Patients were instructed to provide deep cough sputum samples to ensure specimen adequacy. Samples were promptly transported to the microbiology laboratory for processing.

All specimens underwent Gram staining and were cultured on appropriate media for bacterial isolation. Identification of bacterial pathogens was performed using standard microbiological techniques, including assessment of colony morphology, Gram staining characteristics, and biochemical tests.

Antibiotic Sensitivity Testing: Antibiotic susceptibility testing was performed using standard laboratory methods in accordance with established guidelines. Isolated organisms were tested against commonly used antibiotics for respiratory infections. The results were interpreted as sensitive or resistant based on standard reference criteria and laboratory protocols.

Statistical analysis: Data were analysed using appropriate statistical methods to identify trends and patterns. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The distribution of bacterial isolates and their antibiotic susceptibility patterns were analyzed and summarized using descriptive statistics.

RESULTS

Baseline Characteristics of Study Population

A total of 120 patients were included in the study. Table 1 shows the basic demographic features of the study population. The majority of patients belonged to the 51–60 years age group (26.7%), followed by 41–50 years (23.3%) and >60 years (20.0%). Patients aged 31–40 years and 18–30 years accounted for 16.7% and 13.3% of cases, respectively, indicating a higher burden of community-acquired pneumonia among middle-aged and elderly population. The majority were male (61.7%), while females accounted for 38.3%, indicating a higher prevalence of community-acquired pneumonia among male patients.

Table 1: Baseline characteristics of study population

Table 1 shows the age and gender distribution along with mean age.

Variable	Category	Number (n)	Percentage (%)	95% CI
Age (years)	18-30	16	13.3	
	31-40	20	16.7	
	41-50	28	23.3	
	51-60	32	26.7	
	>60	24	20.0	
Gender	Male	74	61.7	
	Female	46	38.3	

Symptom Profile of community acquired pneumonia

Cough was the most common presenting symptom, observed in 86.7% (n=104) of patients, followed by fever in 76.7% (n=92) and sputum production in 73.3% (n=88). Breathlessness was reported in 58.3% (n=70) of cases, while chest pain was the least common symptom, present in 28.3% (n=34) of patients.

Table 2: Distribution of Common Clinical Symptoms

Table 2 illustrates the common presenting symptoms among patients with community acquired pneumonia.

Symptom	Number of Patients	Percentage (%)
Fever	92	76.7
Cough	104	86.7
Sputum production	88	73.3
Breathlessness	70	58.3
Chest pain	34	28.3

Sputum Culture Characteristics and Distribution of Bacterial Pathogens

A positive bacterial growth was observed in 82 cases (68.3%), while 38 patients (31.7%) showed no bacterial growth on culture.

Table 3: Sputum Culture Results Among Patients

Table 3 shows the distribution of sputum culture findings.

Culture Result	Number of Patients	Percentage (%)
Positive bacterial growth	82	68.3
No bacterial growth	38	31.7

Among the culture-positive isolates, gram-positive bacteria accounted for 51.2% of cases, while gram-negative bacteria constituted 48.8%, indicating a nearly equal distribution of both groups among community-acquired pneumonia pathogens.

Table 4: Distribution of Gram-positive and Gram-negative Organisms

Table 4 shows the classification of isolated organisms based on Gram staining.

Organism Type	Number of Isolates	Percentage (%)
Gram-positive bacteria	42	51.2
Gram-negative bacteria	40	48.8

Streptococcus pneumoniae was the most commonly isolated organism, accounting for 34.1% (n=28) of isolates. This was followed by *Klebsiella pneumoniae* in 22.0% (n=18), *Staphylococcus aureus* in 17.1% (n=14), and *Pseudomonas aeruginosa* in 14.6% (n=12) of cases. *Escherichia coli* was the least frequently isolated pathogen, comprising 12.2% (n=10) of the total isolates.

Table 5: Bacteriological Profile of Isolated Organisms

Table 5 presents the distribution of bacterial pathogens isolated from sputum samples.

Bacterial Organism	Number of Isolates	Percentage (%)
Streptococcus pneumoniae	28	34.1
Klebsiella pneumoniae	18	22.0
Staphylococcus aureus	14	17.1
Pseudomonas aeruginosa	12	14.6
Escherichia coli	10	12.2

Antibiotic Sensitivity Pattern of Various Pathogens

The antibiotic sensitivity pattern of *Streptococcus pneumoniae* isolates demonstrated highest sensitivity to levofloxacin (89.3%), followed by ceftriaxone (85.7%) and amoxicillin (78.6%). Azithromycin showed comparatively lower sensitivity (71.4%). Resistance was most notable for azithromycin (28.6%) and amoxicillin (21.4%), while lower resistance rates were observed for ceftriaxone (14.3%) and levofloxacin (10.7%)

Table 6: Antibiotic Sensitivity Pattern of Streptococcus pneumoniae

Table 6 shows the antibiotic sensitivity pattern of Streptococcus pneumoniae isolates.

Antibiotic	Sensitive (%)	Resistant (%)
Amoxicillin	78.6	21.4
Ceftriaxone	85.7	14.3
Azithromycin	71.4	28.6
Levofloxacin	89.3	10.7

Klebsiella pneumoniae isolates demonstrated the highest sensitivity to amikacin at 83.3%, followed by piperacillin–tazobactam at 77.8% and ceftriaxone at 72.2%. Lower sensitivity was observed with ciprofloxacin at 66.7%. Correspondingly, resistance was highest to ciprofloxacin (33.3%), followed by ceftriaxone (27.8%), piperacillin–tazobactam (22.2%), and was lowest with amikacin (16.7%).

Table 7: Antibiotic Sensitivity Pattern of Klebsiella pneumoniae

Table 7 shows the antibiotic susceptibility profile of Klebsiella pneumoniae isolates.

Antibiotic	Sensitive (%)	Resistant (%)
Ceftriaxone	72.2	27.8
Amikacin	83.3	16.7
Ciprofloxacin	66.7	33.3
Piperacillin-tazobactam	77.8	22.2

Staphylococcus aureus isolates showed complete sensitivity to vancomycin (100%), followed by high sensitivity to linezolid at 92.9%. Moderate sensitivity was observed with clindamycin (78.6%) and oxacillin (71.4%). Resistance was highest to oxacillin (28.6%), followed by clindamycin (21.4%) and linezolid (7.1%), while no resistance was noted to vancomycin.

Table 8: Antibiotic Sensitivity Pattern of Staphylococcus aureus

Table 8 presents the antibiotic sensitivity pattern of Staphylococcus aureus isolates.

Antibiotic	Sensitive (%)	Resistant (%)
Oxacillin	71.4	28.6
Vancomycin	100.0	0
Linezolid	92.9	7.1
Clindamycin	78.6	21.4

Over all Antibiotic susceptibility testing showed highest sensitivity to levofloxacin (88.0%), followed by amikacin (86.0%) and ceftriaxone (82.0%). Moderate sensitivity was observed with azithromycin (70.0%) and ciprofloxacin (68.0%), indicating variable effectiveness of commonly used antibiotics in the treatment of community-acquired pneumonia.

Table 9: Overall Antibiotic Sensitivity Pattern of Isolated Bacterial Pathogens

Table 9 summarizes the overall sensitivity of bacterial isolates to commonly used antibiotics.

Antibiotic	Overall Sensitivity (%)
Ceftriaxone	82.0
Amikacin	86.0
Levofloxacin	88.0
Azithromycin	70.0
Ciprofloxacin	68.0

DISCUSSION

The present study evaluated the bacteriological profile and antibiotic susceptibility patterns among patients with community-acquired pneumonia (CAP), highlighting important clinical and microbiological trends relevant to patient management[11].

In this study, CAP was more prevalent among middle-aged and elderly individuals, with the highest proportion observed in the 51–60 years age group, followed by 41–50 years and those above 60 years. This finding is consistent with existing literature, which identifies increasing age as a significant risk factor due to declining immunity and higher prevalence of comorbid conditions[12]. The observed male predominance further aligns with previous studies, possibly reflecting greater exposure to risk factors such as smoking, occupational hazards, and environmental pollutants[13,14].

Clinically, cough, fever, and sputum production were the most common presenting symptoms, consistent with the classical presentation of CAP reported in earlier studies[15]. Breathlessness was also a frequent symptom, indicating moderate to severe disease in a significant proportion of patients, while chest pain was less commonly reported.

Bacterial pathogens were isolated in 68.3% of cases, which is comparable to similar hospital-based studies. A minority of the samples collected for this study exhibited no sign of bacterial growth, likely due to prior antibiotic usage, poor quality of sample collection, or an atypical pathogen that cannot be identified with the traditional culture method[16]. The nearly equal distribution of gram-positive and gram-negative organisms underscores the evolving microbiological landscape of CAP. Traditionally, gram-positive organisms have predominated; however, the increasing contribution of gram-negative bacteria observed in this study may reflect changing epidemiological patterns, antibiotic practices, and patient-related factors[17].

Streptococcus pneumoniae emerged as the most common pathogen, reaffirming its well-established role as the leading cause of CAP. Among gram-negative organisms, *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* were significant contributors, indicating the need to consider these pathogens, particularly in patients with comorbidities or severe disease. The presence of *Staphylococcus aureus* also highlights its role in CAP, especially in certain high-risk populations.

Streptococcus pneumoniae demonstrated high sensitivity to levofloxacin and ceftriaxone, suggesting their continued effectiveness as first-line agents. However, reduced sensitivity to azithromycin indicates emerging resistance to macrolides, which is a growing concern globally[18]. The antibiotic susceptibility patterns observed in this study provide valuable insights for empirical therapy[19].

Klebsiella pneumoniae isolates showed good sensitivity to amikacin and piperacillin–tazobactam, while relatively higher resistance to ciprofloxacin and ceftriaxone suggests cautious use of these agents. *Staphylococcus aureus* exhibited complete sensitivity to vancomycin and high sensitivity to linezolid, reinforcing their role in treating suspected resistant gram-positive infections. The observed resistance to oxacillin may indicate the presence of methicillin-resistant strains, warranting careful antibiotic selection.

Overall, levofloxacin, amikacin, and ceftriaxone demonstrated the highest sensitivity among the tested antibiotics, supporting their utility in empirical treatment regimens. However, the moderate sensitivity observed with azithromycin and ciprofloxacin highlights the need for judicious antibiotic use and periodic surveillance of resistance patterns[20].

The findings of this study emphasize the importance of local bacteriological profiling and antibiotic susceptibility monitoring in guiding empirical therapy for CAP. Such data are essential for optimizing treatment outcomes, reducing the emergence of antimicrobial resistance, and supporting effective antibiotic stewardship practices.

LIMITATIONS

This study was conducted at a single centre with a limited sample size, which may affect the generalizability of the findings. Only sputum samples were analysed, and advanced diagnostic methods such as bronchoalveolar lavage or molecular techniques were not employed, potentially leading to under-detection of certain pathogens. Prior undocumented antibiotic use may have influenced culture yield and sensitivity patterns. Additionally, viral and atypical pathogens were not evaluated.

CONCLUSION

The present study highlights that community-acquired pneumonia is associated with a significant burden among middle-aged and elderly populations, with a predominance in males. *Streptococcus pneumoniae* remains the most common causative organism; however, a substantial contribution from gram-negative bacteria such as *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* indicates an evolving microbiological pattern.

Antibiotic susceptibility patterns demonstrated high sensitivity to levofloxacin, amikacin, and ceftriaxone, supporting their role in empirical therapy. However, moderate sensitivity to commonly used agents such as azithromycin and ciprofloxacin suggest emerging resistance and underscores the need for judicious antibiotic use.

These findings emphasize the importance of continuous local surveillance of bacteriological profiles and antibiotic sensitivity patterns to guide effective empirical treatment and strengthen antimicrobial stewardship strategies in the management of community-acquired pneumonia.

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