Section: General Medicine

Original Research Article

THE PREVALENCE OF ANTI MICROBIAL RESISTANCE PNEUMONIA AND ITS OUTCOME

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ABSTRACT

Background: Antimicrobial resistant pneumonia (AMRP) represents a growing global health concern due to limited treatment options and poor clinical outcomes. This study aimed to evaluate the demographic, clinical, microbiological, and outcome profiles of patients with AMRP.

Materials and Methods: A total of 100 patients diagnosed with AMRP were included. Data on demographics, clinical presentation, comorbidities, radiological findings, microbiological isolates, antibiotic susceptibility, treatment patterns, and outcomes were analyzed.

Results: Most patients were middle-aged (39–58 years; 51%) with a male predominance (68%). Fever, cough, and dyspnea were the most common presenting symptoms (81%). Gram-negative organisms predominated, with Escherichia coli (33%), Klebsiella species (33%), and Pseudomonas aeruginosa (34%) isolated in nearly equal proportions. Antibiotic susceptibility testing showed that 80% of isolates were sensitive to at least one antimicrobial agent, while 20% were resistant to all tested antibiotics. Broad-spectrum β-lactams and combination therapies were commonly used. Comorbidities were present in 41% of patients, most frequently diabetes mellitus (28%). Radiological evaluation revealed predominant left lung zone consolidation (49%). Hospital stay ranged from 5 to 14 days. Mortality was observed in 35% of patients, mechanical ventilation was required in 41%, and recurrence occurred in 23%.

Conclusion: AMRP is associated with significant morbidity and mortality, driven by multidrug-resistant Gram-negative pathogens. These findings emphasize the need for early diagnosis, antimicrobial stewardship, and targeted treatment strategies to improve patient outcomes.

Keywords: Antimicrobial resistant pneumonia; Multidrug resistance; Gram-negative bacteria; Antibiotic susceptibility; Hospital-acquired pneumonia.

INTRODUCTION

Pneumonia is characterized by the inflammation of the alveoli and adjacent lung tissue. It typically manifests with a sudden high fever, a general feeling of illness, a persistent cough, and difficulty breathing. Since pneumonia is primarily caused by bacterial infections, it is usually treatable with antibiotics. Additionally, there are vaccines available that can help prevent infections from specific pathogens. Generally, individuals in good health can expect to recover within a few weeks; however, pneumonia should not be underestimated, as full recovery may take weeks or even months. It can lead to severe complications, particularly in those with pre-existing health issues, and poses significant risks for infants and the elderly.[1,2]

Since the 1990s, the incidence of community-acquired pneumonia with drug-resistant pathogens (CAP-DRP) has risen, particularly among patients with underlying co- morbidities and frequent exposure to healthcare settings. This pattern was initially observed in patients transferred from nursing homes and other long-term care facilities, where pathogens such as Enterobacteriaceae, Pseudomonas aeruginosa, and methicillin-resistant Staphylococcus aureus (MRSA) were more commonly isolated.

An increasing number of novel microbiological agents, including both familiar and emerging pathogens, have transformed the comprehension of

pneumonia, resulting in the extensive application of contemporary antibiotics. Antimicrobial resistance (AMR) represents one of the most significant global public health threats, as highlighted in the introductory article of this supplement. According to the World Health Organization (WHO),[3] there is an urgent need to change the way antibiotics are prescribed and used. Even with the development of new medications, without a shift in behavior, antibiotic resistance will continue to be a major concern. The first paper in this supplement outlines the various factors contributing to the rise of AMR, as well as the global initiatives aimed at combating this issue. It is essential that each country and region contribute through localized efforts to help address this growing threat.[4]

Antimicrobial resistance (AMR) arises when microorganisms such as bacteria, acquire the ability to withstand the effects of antimicrobial treatments. This resistance complicates the management of infections, increasing the risk of disease transmission, severe illness, and mortality. Streptococcus pneumonia, commonly referred to as pneumococcus, is a gram-positive, lancet-shaped bacterium that is a leading pathogen responsible for pneumococcal infections, including pneumonia, meningitis, and various other severe conditions. Antimicrobial agents can be categorized according to their mechanisms of action. The primary categories include agents that disrupt cell wall synthesis, alter cell membrane potential, inhibit protein synthesis, interfere with nucleic acid synthesis, and obstruct metabolic pathways in bacteria. The mismanagement of antimicrobial agents has significantly contributed to the serious issue of resistance we currently encounter. Several factors have exacerbated the resistance crisis, including the rising use of antimicrobial medications by both humans and animals, as well as inappropriate prescribing practices.[5] Physicians may overprescribe common antimicrobials due to their affordability and low toxicity. Additionally, there are instances of unnecessary prescriptions for broad-spectrum drugs that may ultimately prove ineffective against the pathogens responsible for infections. This excessive use of antibiotics in humans fosters the development of resistant strains. Furthermore, previous exposure to antimicrobial drugs increases a patient's vulnerability to infections caused by resistant organisms, with those having the highest exposure often being the ones infected with resistant bacteria.

MATERIALS AND METHODS

Study Design: Cross- Sectional Observational Study
Sample Size: All Pneumonia Cases During Study Will Be Included With Minimum Number Of 100 Cases.
Study Duration: 2023 – 2025
Study Population: Patients Diagnosed With Pneumonia In Gandhi Hospital.
Inclusion Criteria
Patients with Suspected or Confirmed Pneumonia More Than 18 Years of Age.
Exclusion Criteria
All the Viral and Fungal Pneumonia Cases and Culture Negative Cases.
Data Collection: Data collection will be done using medical records and relevant data to collect include demographics (age, gender), comorbidities, clinical presentations, Antimicrobial therapy, and outcomes such as length Of hospital stay, mortality, and recurrence of Pneumonia.
Laboratory Testing: Sputum culture and sensitivity will be done to determine the susceptibility of bacteria to various antimicrobial agents.

RESULTS

Table 1: Distribution of Patients characteristics

Age Years	Frequency	Percent
19 - 28	14	14.0
29 - 38	9	9.0
39 - 48	26	26.0
49 - 58	25	25.0
59 - 68	14	14.0
.69 - 78	10	10.0
79 - 88	2	2.0
Total	100	100.0
Gender		
Female	32	32.0
Male	68	68.0
Comorbidities		
Diabetes	28	28.0
Hypertension	13	13.0
None	59	59.0

This table presents the distribution of patients across various age groups, ranging from 19 to 88 years. The largest proportion of patients falls within the 39-48 years (26%) and 49-58 years (25%) age groups, indicating a predominance of middle-aged individuals in the study cohort. Younger (19-28 years, 14%) and older patients (69-78 years, 10%) constituted smaller proportions. The gender

distribution shows a male predominance with 68% of the patients being male, while females account for 32%. Comorbid conditions were present in 41% of patients, with diabetes (28%) being the most common, followed by hypertension (13%). The majority (59%) had no recorded comorbidities.

Table 2: Spectrum of Causative Organisms and Antibiotic Response

Organism Isolated	No. of patients	Percent
E. coli	33	33.0
Klebsiella	33	33.0
Pseudomonas	34	34.0
Antibiotics		
Amikacin	1	1.0
Amikacin and Levofloxacin	27	27.0
Cefoparazone Salbactam	29	29.0
Imipenem cilastatin	8	8.0
Levofloxacin	8	8.0
Piperacillin Tazobactam	27	27.0
Total	100	100.0
Sensitive to none		
None	20	20.0
Yes	80	80.0

Three primary bacterial pathogens were identified with near-equal frequency: E. coli (33%), Klebsiella (33%), and Pseudomonas (34%). Overall, broad-spectrum combination therapies were most commonly effective, with a majority of patients demonstrating antibiotic sensitivity. Among the 100 patients, 80% of isolates demonstrated sensitivity to at least one antibiotic tested.

Table 3: Distribution of Chest X-ray Findings

X-Ray Findings	No. of patients	Percent
Consolidation	14	14.0
Lz Consolid	49	49.0
Z Consolod	37	37.0
Clinical Presentation		
Cough, Dyspnea	10	10.0
Fever, Cough, Dyspnea	81	81.0
Fever, Dyspnea	9	9.0

Radiological findings showed that 49% of patients had left zone consolidation, 37% had zone consolidation, and 14% had consolidation in another specified area (consoloida). The majority of patients (81%) presented with fever, cough, and dyspnea, reflecting classic symptomatic triads for respiratory infections. A smaller fraction exhibited cough and dyspnea without fever (10%) or fever and dyspnea without cough (9%).

Table 4: Distribution of Length of Hospital Stay

Length of Stay (days)	No. of patients	Percent
5.0	10	10.0
6.0	7	7.0
7.0	12	12.0
8.0	5	5.0
9.0	13	13.0
10.0	11	11.0
11.0	10	10.0
12.0	12	12.0
13.0	8	8.0
14.0	12	12.0
Total	100	100.0
Recurrence of Pneumonia		
No	77	77.0
Yes	23	23.0
Total	100	100.0

Hospital stay varied from 5 to 14 days, with the highest frequencies observed at 9 days (13%) and 12 days (12%). The variability reflects differences in disease severity, treatment response, and complications. Recurrence rates mirrored mortality, with 23% experiencing recurrence and 77% remaining free of recurrence.

Table 5: Distribution of mortality and Mechanical Ventilation

Mortality	No. of patients	Percent
No	65	65.0
Yes	35	35.0
Mechanical ventilation		
No	59	59.0
Yes	41	41.0

Mortality occurred in 35% of patients, with 65% surviving. Mechanical ventilation was required in 41% of patients, indicating severe respiratory compromise. The majority (59%) did not require ventilatory support.

DISCUSSION

The present study provides valuable insights into the demographic, microbiological, clinical, and therapeutic characteristics of patients with antimicrobial resistant pneumonia (AMRP), highlighting important epidemiological trends and clinical challenges associated with resistant respiratory infections.

Age and Gender Distribution

The age distribution in the present cohort demonstrated a predominance of middle-aged adults, with over half of the patients (51%) falling within the 39–58 year age group. This observation aligns with findings from Berhe et al,[6] who reported that antimicrobial resistant infections, including pneumonia, are most frequently encountered among hospitalized adults in resource-limited settings. The lower representation of younger adults (23%) and elderly patients (12%) may reflect local demographic patterns and hospital admission practices. Nevertheless, global evidence consistently indicates that susceptibility to resistant infections increases with age.

Molecular studies provide biological support for this observation. Langelier et al,[7] demonstrated an age-dependent expansion of antimicrobial resistance genes (ARGs) in the lung microbiome, with significantly higher ARG burden in adults over 60 years compared to younger populations. He reported a mean age exceeding 60 years among COVID-19 patients with bacterial superinfections, where multidrug resistance was highly prevalent. Although the present study included fewer elderly patients, the findings reinforce the established association between advancing age and increased vulnerability to resistant pneumonia.

A marked male predominance was observed, with males constituting 68% of the study population. This gender disparity mirrors findings reported by Berhe et al,[6] and other global studies, which have consistently shown higher rates of severe and resistant respiratory infections among males. This may be attributed to gender-related differences in occupational exposure, healthcare-seeking behavior, smoking prevalence, and comorbid conditions. Additionally, biological factors such as sex-based immunological and hormonal differences may influence susceptibility and disease severity. Studies by Mohanty et al,[9] further highlight how social vulnerability and gender-related factors contribute to higher resistance burdens and poorer outcomes among men. Recognizing this male predominance is essential for designing targeted preventive and clinical strategies.

Microbiological Profile: The microbiological findings revealed an almost equal distribution of three major Gram-negative pathogens: Escherichia coli (33%), Klebsiella species (33%), and Pseudomonas aeruginosa (34%). This pathogen profile is characteristic of hospital-acquired pneumonia and antimicrobial resistant pneumonia, corroborating observations from Berhe et al,[6] and Alnimr.[10] These organisms are well-known for their intrinsic and acquired resistance mechanisms, including extended-spectrum beta-lactamase (ESBL) production, carbapenemase activity, efflux pumps, and biofilm formation.

Among these, Pseudomonas aeruginosa is particularly concerning due to its intrinsic resistance and ability to persist in hospital environments, leading to recurrent and difficult-to-treat infections. The comparable prevalence of E. coli and Klebsiella species further emphasizes the growing threat posed by resistant Enterobacterales in respiratory infections. Similar organism distributions have been reported in critically ill and COVID-19 patients with secondary bacterial infections, underscoring the global relevance of these pathogens as key drivers of AMRP.

Antimicrobial Therapy and Resistance Patterns

The antimicrobial treatment patterns in the present study reflect a reliance on broad-spectrum and combination therapies. Cefoperazone–Sulbactam (29%), Amikacin plus Levofloxacin (27%), and Piperacillin–Tazobactam (27%) were the most frequently used regimens. This approach is consistent with current guidelines recommending empiric broad-spectrum coverage for suspected multidrug-resistant Gram-negative infections.

The use of Imipenem–Cilastatin in 8% of cases highlights the increasing need for carbapenems as last-line agents in severe resistant infections. While carbapenems remain effective against many ESBL-producing organisms, Alnimr,[10] cautions that indiscriminate use accelerates the emergence of carbapenem-resistant pathogens. The limited use of monotherapy with Amikacin or Levofloxacin suggests a preference for combination regimens to enhance efficacy and reduce resistance development, particularly in critically ill patients.

Despite these strategies, 20% of isolates in the present study were resistant to all tested antibiotics, reflecting a substantial burden of multidrug-resistant and potentially pan-resistant organisms. Similar resistance levels have been reported by Berhe et al,[6] underscoring the shrinking pool of effective antimicrobial options. Although 80% of isolates remained sensitive to at least one antibiotic, this therapeutic window remains precarious and highlights the urgent need for antimicrobial stewardship, routine susceptibility testing, and development of novel antimicrobial agents.

Comorbidities and Clinical Presentation

Comorbid conditions were present in 41% of patients, with diabetes mellitus (28%) and hypertension (13%) being the most common.

Diabetes is a well-recognized risk factor for severe and resistant infections due to impaired immune responses and poor glycemic control, as noted by Berhe et al,[6] and Cut et al.[8] Although a majority of patients had no documented comorbidities, the presence of chronic illnesses significantly influences disease severity, treatment response, and outcomes, emphasizing the need for individualized management strategies.

Clinically, the majority of patients (81%) presented with the classic triad of fever, cough, and dyspnea, consistent with bacterial pneumonia. Variations in symptom combinations observed in the remaining patients highlight the heterogeneity of clinical presentation and the challenges of early diagnosis, particularly in settings with overlapping viral infections such as COVID-19. These findings reinforce the importance of integrating clinical assessment with microbiological testing for timely and appropriate therapy.

Radiological Findings and Disease Severity

Chest X-ray findings predominantly showed left zone consolidation (49%) and lobar consolidation (37%), with other patterns accounting for 14%. These radiological features are characteristic of bacterial pneumonia and are commonly associated with severe disease. Previous studies, including Berhe et al,[6] and Alnimr,[10] have demonstrated that extensive consolidation often correlates with higher bacterial load, treatment failure, and poorer outcomes. While radiological findings alone cannot distinguish resistant from susceptible infections, they remain critical in assessing disease severity and guiding management.

Hospital Stay, Ventilation, and Outcomes

The length of hospital stay ranged from 5 to 14 days, with peaks at 9 days and 12–14 days. Prolonged hospitalization is a recognized consequence of AMRP, driven by delayed response to therapy, need for intensive monitoring, and higher complication rates. Similar trends have been reported globally, particularly in patients with ventilator-associated pneumonia and multidrug-resistant infections.

Mechanical ventilation was required in 41% of patients, underscoring the severity of illness in this cohort. Mechanical ventilation not only reflects advanced respiratory failure but also increases the risk of ventilator-associated pneumonia, frequently caused by resistant organisms. This finding aligns with reports by Cut et al,[8] who observed higher ventilation and ICU admission rates among patients with resistant infections.

The mortality rate of 35% observed in this study highlights the grave prognosis associated with AMRP. Comparable mortality rates have been reported in resistant pneumonia and ventilator-associated infections worldwide. Additionally, 23% of patients experienced recurrence of pneumonia, likely due to persistent colonization, biofilm formation, inadequate antibiotic penetration, or limited therapeutic options.

CONCLUSION

Overall, the findings of this study underscore the significant clinical burden of antimicrobial resistant pneumonia, characterized by middle-aged male predominance, Gram-negative pathogen dominance, high resistance rates, prolonged hospitalization, and substantial mortality. These results reinforce the urgent need for robust antimicrobial stewardship, enhanced diagnostic capabilities, infection prevention strategies, and age- and risk-stratified treatment protocols to improve outcomes and curb the escalating threat of antimicrobial resistance.

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