PROSPECTIVE STUDY ON CLINICAL PROFILE, RISK FACTORS, MICROBIOLOGICAL PATTERN, AND OUTCOMES OF HOSPITAL ACQUIRED PNEUMONIA AMONG PATIENTS ADMITTED TO A TERTIARY CARE HOSPITAL IN CHANDIGARH, 2025

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ABSTRACT

Background: Hospital-acquired pneumonia(HAP) remains a significant cause of morbidity and mortality among hospitalized patients, particularly in developing countries such as India, where healthcare systems are challenged by resource constraints and high patient loads. HAP is defined as pneumonia occurring 48 hours or more after hospital admission and is considered one of the most serious nosocomial infections. Despite advancements in diagnostic modalities and therapeutic options, HAP continues to contribute substantially to prolonged hospital stays, increased healthcare costs, and elevated mortality rates. The problem is compounded by the emergence of multidrug-resistant (MDR) and extensively drug-resistant (XDR) pathogens, which complicate treatment and highlight the urgent need for targeted prevention and management strategies.

Materials and methods: The present study was conducted at a hospital in Chandigarh, India, over a period of six months, with the objective of evaluating the clinical profile, risk factors, microbiological spectrum, and outcomes of HAP among hospitalized patients. A total of 120 adult patients who developed pneumonia after 48 hours of hospitalization were included in this prospective observational study. Inclusion criteria were based on the Centers for Disease Control and Prevention definition of HAP. Patients with community- acquired pneumonia, ventilator-associated pneumonia at admission, or pre-existing pneumonia at the time of hospital admission were excluded. Data collection encompassed detailed clinical evaluation, recording of demographic details, comorbidities, risk factors, laboratory and radiological investigations, and microbiological profiling through sputum cultures and antibiotic sensitivity testing.

Results: The mean age of the study population was 54.3 years, with the highest prevalence noted in the 51–60 years age group. A male predominance was observed, with males constituting58.3% of the cases. Comorbidities were highly prevalent, with diabetes mellitus being the most common (40%), followed by chronic obstructive pulmonary disease (30%), chronic kidney disease (18.3%), and immunosuppressive therapy (10%). These comorbid conditions likely contributed to increased susceptibility to HAP, aligning with findings from previous studies that emphasize the importance of underlying health status in the pathogenesis of hospital-acquired infections. Risk factors associated with HAP in this study included prolonged hospital stay exceeding seven days in 73.3% of patients, prior antibiotic use in 55% of patients, and the presence of invasive devices such as intravenous lines and urinary catheters in65% of cases.Additional risk factors included recent surgery and the use of proton pump inhibitors. These findings are consistent with global literature that identifies prolonged hospitalization and invasive interventions as significant contributors to the development of HAP.Clinically, fever was the most commonly reported symptom (93.3%), followed by cough with expectoration (75%), dyspnea (63.3%), and chest pain (20%). Auscultatory findings were present in90% of patients,underscoring the importance of thorough physical examination in early detection of HAP. Laboratory investigations revealed leukocytosis in 80% of cases, while biomarkers such as C-reactive protein (CRP) and procalcitonin (PCT) were elevated in the majority of patients, supporting their role in the diagnosis and monitoring of bacterial infections.

Radiological evaluation demonstrated unilateral infiltrates in 60% of cases, bilateral infiltrates in 40%, and pleural effusion in 15%. These findings are consistent with the radiological patterns described in previous studies and highlight the value of chest imaging in confirming clinical suspicions of HAP.

Microbiological profiling identified Acinetobacterbaumanniias the most frequentlyisolated pathogen, accounting for 35% of cases, followed by Klebsiellapneumoniae(21.7%), Pseudomonas aeruginosa(18.3%), and Escherichia coli (15%). Methicillin- resistant Staphylococcus aureus(MRSA) was identified in 6.7% of cases. Alarmingly, a high prevalence of multidrug-resistant and extensively drug-resistant strains was noted, consistent with globalconcerns regarding antimicrobialresistance in nosocomial infections.

Treatment outcomes revealed a clinical recovery rate of 76.7%. However, significant complications such as septicemia (15%) and acute respiratory distress syndrome (ARDS) (8.3%) were observed. The overall mortality rate was 6.7%, which is within the range reported in earlier studies. Multivariate logistic regression analysis identified prolonged hospitalstay, invasive device use,and prior antibiotic use as independent predictors of HAP. These findings reinforce the importance of infection control measures and judicious antibiotic use to mitigate the burden of HAP in hospitalized patients. vi

Conclusion: In conclusion, this study provides valuable insights into the epidemiology, risk factors, clinical presentation, microbiological spectrum, and outcomes of hospital-acquired pneumonia in a tertiary care setting in India. The findings emphasize the need for early identification of high-risk patients, adherence to infection prevention protocols, and the integration of local antibiograms to guide empirical therapy. Future research should focus on multicenter studies to validate these findings and explore the role of molecular diagnosticsandnoveltherapeuticinterventionsinimprovingpatientoutcomes.

10INTRODUCTION

Hospital-acquired pneumonia(HAP) is an emergent public health problem, especially in low- and-middle-income nations, such as India, where the health care facility witnesses monumental faults in the system. Beingapneumonia developing48 hours after the admission and not having an incubation period during admission, HAP is one of the most frequent causes of morbidity and mortality among hospitalized patients worldwide (Kalil et al., 2016). It is deemed as the second nosocomial infection after urinary tract infections and the leading cause of mortality linked to nosocomial infections (Giuliano et al., 2018). That problem is also escalated in India by the heavy workload per patient, a weak health infrastructure, and a lack of consistency of infection control measures in most of the state-run and commercial health organizations (Ramasubban et al., 2021).

Besides causing a serious burden to the patients who already have to cope with primary diseases, hospital-acquired pneumonia also creates problems in clinical care, extending the length of hospital stay, making the treatment more expensive and risking the development of complications. HAP is acquired by a vast majority of patients during their stay in intensive care units (ICUs) when they are either on mechanical ventilation or have experienced an invasive procedure, including intubation, central line placement, or catheterization (Singh et al., 2019). The case is especially severe in people with weakened immunity or underlying chronic conditions like diabetes mellitus, chronic obstructive pulmonary disease (COPD), kidney disease, cancer, or old age (Kollef et al., 2021). The duration of hospitalization initself is a major risk factor with long stay having a higher chance of being exposed to drug resistant pathogens that are prevalent in the hospital setting (Chastre&Fagon, 2002).

The microbial cause of HAP has changed enormously over the years. Whereas in the earlier cases a wider variation of bacteria was implicated, today Gram-negative bacilli are causing most of the hospital-acquired pneumonia cases. Acinetobacterbaumannii, Klebsiellapneumoniae, and Pseudomonas aeruginosa pathogens have currently become the most commonly isolated pathogens in HAP patients (Kalil et al., 2016; Candel et al., 2023; Mukhopadhyay et al., 2020). Not only are these organisms infamous due to their virulence, but they are also growing as regards multiple antibiotic resistances. The situation is complicated by the appearance of MDR and XDR strains that provide the clinicians with a limited number of effective treatments. It has resulted in such a situation whereby the effectiveness of HAP is dictated not only by the clinical condition of the patient, but also by the resistance pattern of the pathogen that infects him (Kim et al., 2022).

Specifically, India has been dealing with a special combination of circumstances, which predetermines the increased level of hospital-acquired infections, such as HAP, and their reduced manageability. The healthcare system in the country is characterized by the presence of tertiary care facilities and institutes of very high standards on one side and under-staffed district hospitals and primary health centers on the other (Gandra et al., 2017). Most government hospitals are congested, poorly staffed and unable to meet optimum sanitation requirements, factors which aggravate the possibility of developing HAP. Furthermore, a significantly large part of the Indian population seeks care after the illnesses have advanced, which significantly raises the chances of patients being hospitalized in a poor general condition, thereby adding to their vulnerability to nosocomial infections (Borah et al., 2020).

Further abutting this intricacy is the exclusive and frequent misuse of antibiotics in the community and inside the hospitals. Antibiotics in India are sold widelyover the counter and in the hospitals the empirical antibiotic treatment is frequently started prior to the availability of culture results.Although in some cases,these practices may be explained by urgency or theunavailability of diagnostic help, they are one of the principal causes of antimicrobial resistance(AMR)(Laxminarayan&Chaudhury,2016).Surveil lancestudiesintherecent past reveal concerning resistance proportions among popular Gram-negative isolates, and some strains are even resistant to the drugs of last resort, such as carbapenems and colistin (Veeraraghavanet al.,2021).This causes HAP to be not only more difficult to treat,but much deadlier as well. Besides, in cases where the infections cannot be corrected using the available antibiotics, patients suffer prolonged stays in the ICU, excess utilization of healthcare sources, and a rising chance of fatality (WHO, 2021).

HAP cost implications are also worth of consideration. Economically, HAP raises direct expenses, as it is manifested

in extended stays, close observation, redundant diagnostics, as well as expensive antibiotics. It leads to decreased productivity, emotional sufferings and long time health effects of survivors, indirectly. Researchers have discovered that hospital- acquired pneumonia increases the chances of read mission within 30 days of discharge and the risks of developing long-term respiratory complications (Sikora et al., 2021). In low- and middle-income countries (such as India), where a considerable part of the population is not covered by health insurance and where people have to pay out-of-pocket for healthcare services, the cost of HAP may force families out of poverty or make them prematurely stop treatment (Garg et al., 2018).

The unavailability of region-specific data on HAP in Indian context can be considered among the most burning issues of the Indian context. Although international guidelines are available, including those issued by the Infectious Diseases Society of America (IDSA) and the American Thoracic Society (ATS), they mostly rely on the research conducted in high- income countries with highly different health care ecosystems (Kalil et al., 2016). Use of these protocols in the Indian context is not always ideal and the range of pathogens,resistance rates and resources may vary considerably. Local epidemiological monitoring is therefore imperative in the identification of risk factors, microbial ecology and stream lining of treatment regimens. However, the regular microbial culture, antibiotic sensitivity tests, or real-time infection tracing infrastructures are unavailable in many Indian hospitals (Taneja et al., 2020).

The prevention of HAP demands combined measures on various levels. Evidence-based and simple intervention such as good hand hygiene practice, head of the bed elevation to lessen the aspiration risk, oral care with chlorhexidine and routine suctioning in intubated patients have demonstrated the ability of reducing the occurrence of ventilated-associated pneumonia, which is a form of HAP (Melsen et al., 2013). Execution is however not uniform in all institutions and in most cases lack of awareness, training, or monitoring of compliance are the hindering factors. The infection prevention and control (IPC) committees in most hospitals are either under-staffed or ineffective,and as such,they cannot make much effort in enforcing the standard precautions or isolating infected patients (Mehta et al., 2014).

Moreover, many hospitals either have not developed or have poorly developed antimicrobial stewardship programs (ASPs) that can assist in guiding the reasonable use ofantibiotics. The programs will tend to streamline antibiotic choice, dose, duration and route of administration according to local microbial pattern and resistance information. The lack of these initiatives might cause the inappropriate use of antibiotics, which speeds up the resistance and enhances the chances of unsuccessful treatment (Gopalakrishnan et al., 2018). Enhancing ASPs would not just enhance patient outcome but will also prolong the effective life of available antibiotics, which is vital in view of the few new antibiotics coming into the market.In spite of this magnitude of the problem, there has been little research and policy focus on HAP in India. Whereas the issues of tuberculosis, maternal health, and the vectors borne diseases usually occupy the public health agenda, the hospital-acquired infections lack such exposure. Nonetheless, they have a significant effect,both in the sphere of deaths and the cost to the economy. Some improvements have been achieved through national programs directed toward infection control (like Kayakalp initiative), however, it is not enough to ensure HAP surveillance becomes a part of regular hospital operation (Ministry of Health and Family Welfare, 2019).

Objectives:

To evaluate the clinical profile, risk factors, microbiological pattern, and outcomes of hospital-acquired pneumonia among patients admitted to a tertiary care hospital in Chandigarh, India.

METHODOLOGY

This research was conducted as a prospective, observational study among patients admitted to the inpatient departments of a tertiary care hospital in Chandigarh, India, from January 2025 to May 2025.

Research Setting: -The study was carried out in the Departments of Medicine and Pulmonology at Desh Bhagat University-affiliated hospital in Chandigarh.

Study Population :- The study population comprised adult patients (>18 years) who developed pneumonia ≥48 hours after hospital admission, consistent with the Centers for Disease Control and Prevention (CDC) definition of HAP (Kalil et al., 2016; Giuliano et al., 2018).

Inclusion Criteria

- Patientsaged18yearsandabove.
- Patients who developed clinical features of pneumonia after 48 hours of hospitalization (e.g., fever, cough, purulent sputum, dyspnea, new/worsening infiltrates on chest X-ray) (Kalil et al., 2016).
- Patients willing to provide informed consent or whose legal guardians consented in case of incapacity.

ExclusionCriteria

- Patients with community-acquired pneumonia at the time of admission (Metlayetal., 2019).
- Patients with pneumonia occurring<48hours after admission.
- Patients transferred from other hospitals with existing pneumonia.
- Patients on mechanical ventilation at admission (to exclude ventilator-associated pneumonia cases) (Kalil et al., 2016).
- Patientswhodeclined consent.

Sample Size

A total of 120 patients who met the inclusion criteria were enrolled during the study period. This sample size was determined using standard epidemiological calculations to achieve adequate power to detect significant associations with risk factors, following recommendations by Melsen et al. (2013).

Clinical Evaluation

Each participant underwent a detailed clinical evaluation, including history-taking focusing on:

Age, gender, comorbidities (e.g., diabetes, COPD, immunosuppression)(Kimetal., 2022).

- Prior antibiotic usage.
- History of recent surgeries or invasive procedures.
- Duration of hospital stay prior to pneumonia onset.

Physical examination emphasized respiratory symptoms and signs (e.g.,tachypnea,rales, decreased breath sounds) (Kalil et al., 2016).

Laboratory Investigations

- **Complete Blood Count(CBC):**To assess leukocytosis/ leukopenia(Kalilet al., 2016).
- **Chest X-ray/CT:**To confirm new or progressive infiltrates(Chastre&Luyt,2016).
- **Sputum Cultureand Sensitivity:**Collected from deep cough specimen using sterile technique and processed within 2 hours, as recommended by Candel et al. (2023).
- **BloodCulture:** Two sets of blood samples drawn aseptically before antibiotic administration (Kalil et al., 2016).
- **C-reactiveprotein(CRP) and Procalcitonin(PCT):** As biomarkers for infection severity (Kalil et al., 2016; Vasala et al., 2020).
- **Antibiotic Sensitivity Testing:** Performed for bacterial isolates according toClinical and Laboratory Standards Institute (CLSI) guidelines (Kalil et al., 2016).

Microbiological Diagnosis

Isolation and identification of pathogens were performed using standard microbiological techniques (Ghosh et al., 2009). Identification included Gram staining, culture on blood and MacConkey agar, and appropriate biochemical tests. Sensitivity to commonly used antibioticswas assessed (Kalil et al., 2016).

Data Collection and Management

Data were recorded in a structured proforma, including patient demographics, clinical features, laboratory and microbiological results, risk factors, length of hospital stay, and treatment outcomes (Giuliano et al., 2018).

DataAnalysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY).

Data analysis and interpretation

Table 1 reveals the age distribution of the participants. It was seen that HAP predominantly affects middle-aged to older adults, with the highest frequencyinthe51–60years group(35%). This suggests increased vulnerability in older adults, likely due to age-related immune compromise and higher prevalence of comorbidities (Kalil et al., 2016; Kim et al., 2022). The lower frequency among younger adults (18–30 years) suggests relative resilience or fewer underlying risk factors.

Table1:Age Distribution of Patients with HAP

Age Group(years)	No. of Cases(%)
18–30	12(10%)
31–40	16(13.3%)
41–50	28(23.3%)
51–60	42(35%)
>60	22(18.3%)

Table 2 depicts that males comprised 58.3% of the study population, indicating a slight male predominance. This aligns with earlier studies (Giuliano et al.,2018), possibly due to higher exposure to risk factors like smoking, occupational hazards, and comorbidities in males. However, the difference is not stark, suggesting that both genders are at risk, emphasizing the need for preventive measures irrespective of gender.

Table 2:Gender Distribution of Patients with HAP

Gender	No. of Cases(%)
Male	70(58.3%)
Female	50(41.7%)

Table 3 depicts that Diabetes mellitus emerged as the most common comorbidity(40%),followed by COPD (30%).These conditions are well-known to impair host defenses, making patients susceptible to nosocomial infections (Kalil et al., 2016). CKD and immunosuppressive therapy also contributed significantly, emphasizing the need for vigilant monitoring in these subgroups.

Table 3: Comorbidities among Patients with HAP

Comorbidity	No. of Cases(%)
Diabetes Mellitus	48(40%)
COPD	36(30%)
CKD	22(18.3%)
Immunosuppressive Therapy	12(10%)

Table 4 shows that prolonged hospital stay (>7 days) was the most significant risk factor (73.3%), corroborating findings by Koulenti et al. (2017). Invasive devices (65%) also emerged as key risk factors, consistent with the role of medical devices in introducing pathogens (Kalil et al., 2016). Prior antibiotic use (55%) may contribute to resistant strains, complicating management.

Table 4: Identified Risk Factors for HAP

Risk Factor	No. of Cases(%)
Prolonged Hospital Stay(>7days)	88(73.3%)
Prior Antibiotic Use	66(55%)
Invasive Devices	78(65%)
Recent Surgery	32(26.7%)
Use of Proton Pump Inhibitors	50(41.7%)

Figure 1 illustrates clinical features of patients with HAP. Majority (93.3%) of patients presented with fever. Around one third (75%) of patients presented with chief complaint of cough with expectoration. 63.3% patients had dyspnea and 20% had chest pain.

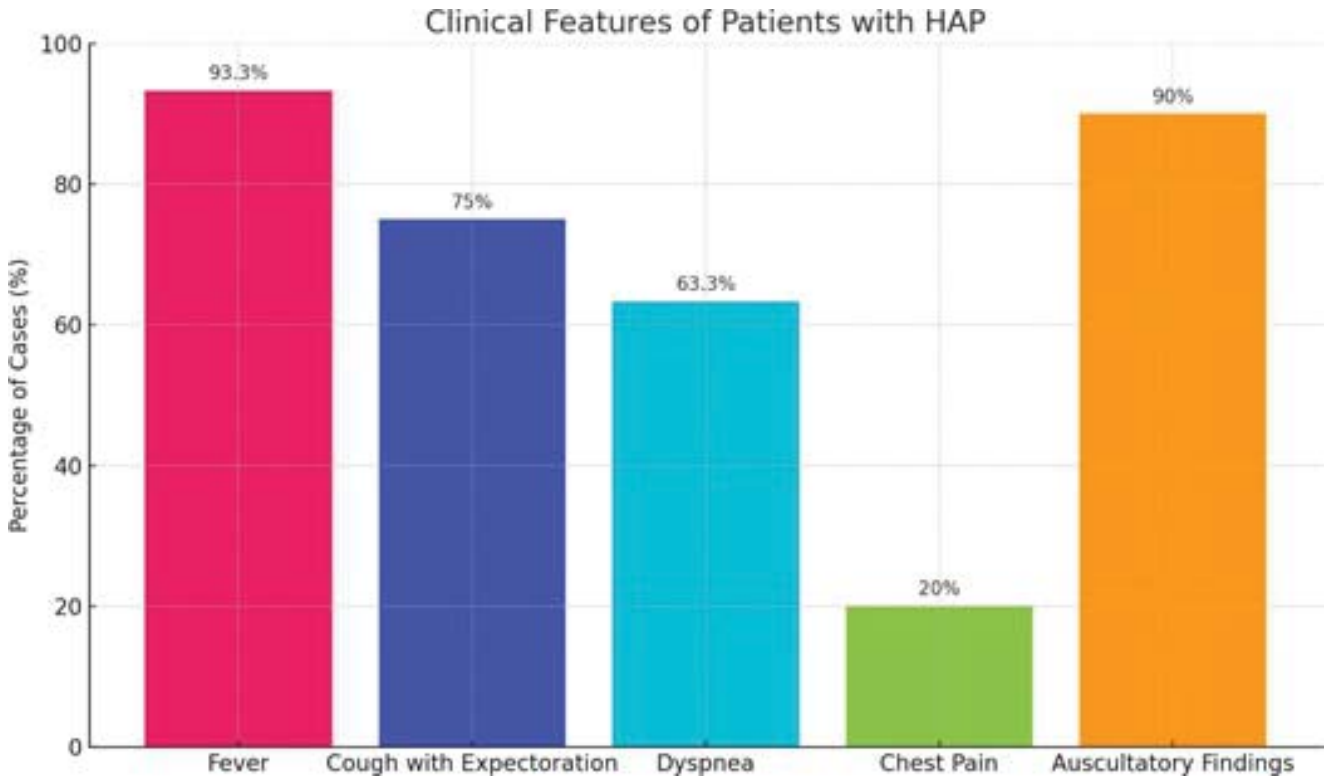

Figure 1 Clinical features of patients with HAP

Table 5 depicts that Leukocytosis was present in 80% of patients, consistent with an acute inflammatory response (Kalil et al., 2016). Elevated CRP and PCT levels further supported the diagnosis of bacterial infection (Vasala et al., 2020). These biomarkers can aid in differentiating bacterial pneumonia from other causes of fever, supporting clinical decision-making.

Table 5: Laboratory Findings among Patients with HAP

Parameter	Finding
Leukocytosis(>11,000/cumm)	96 patients (80%)
Mean CRP	52.5± 14.3mg/L
Elevated PCT Levels	92 patients(76.7%)
Mean PCT	2.4± 0.9ng/mL

Table 6 summarizes that Unilateral infiltrates were the most common radiological finding (60%), in line with typical HAP presentations (Kalil et al., 2016). Bilateral involvement was noted in 40% of cases, often seen in severe or rapidly progressing infections. Pleural effusion, present in 15%, signals potential complications requiring further management

Table 6: Radiological Findings on Chest X-ray

Finding	No. of Cases(%)
Unilateral Infiltrates	72(60%)
Bilateral Infiltrates	48(40%)
Pleural Effusion	18(15%)

Figure 2 shows Chest X-rays and CT-scan of a 65-year-old man pneumonia. Chest X-ray performed the day HAP was suspected seems normal (a), whereas the CT-scan performed the same day showed consolidation of the left inferior lobe (b, d). Bronchoalveolar lavage yielded 105 Enterobacteraerogenes. The next day, chest X-ray showed progression of pulmonary infiltrates (c).

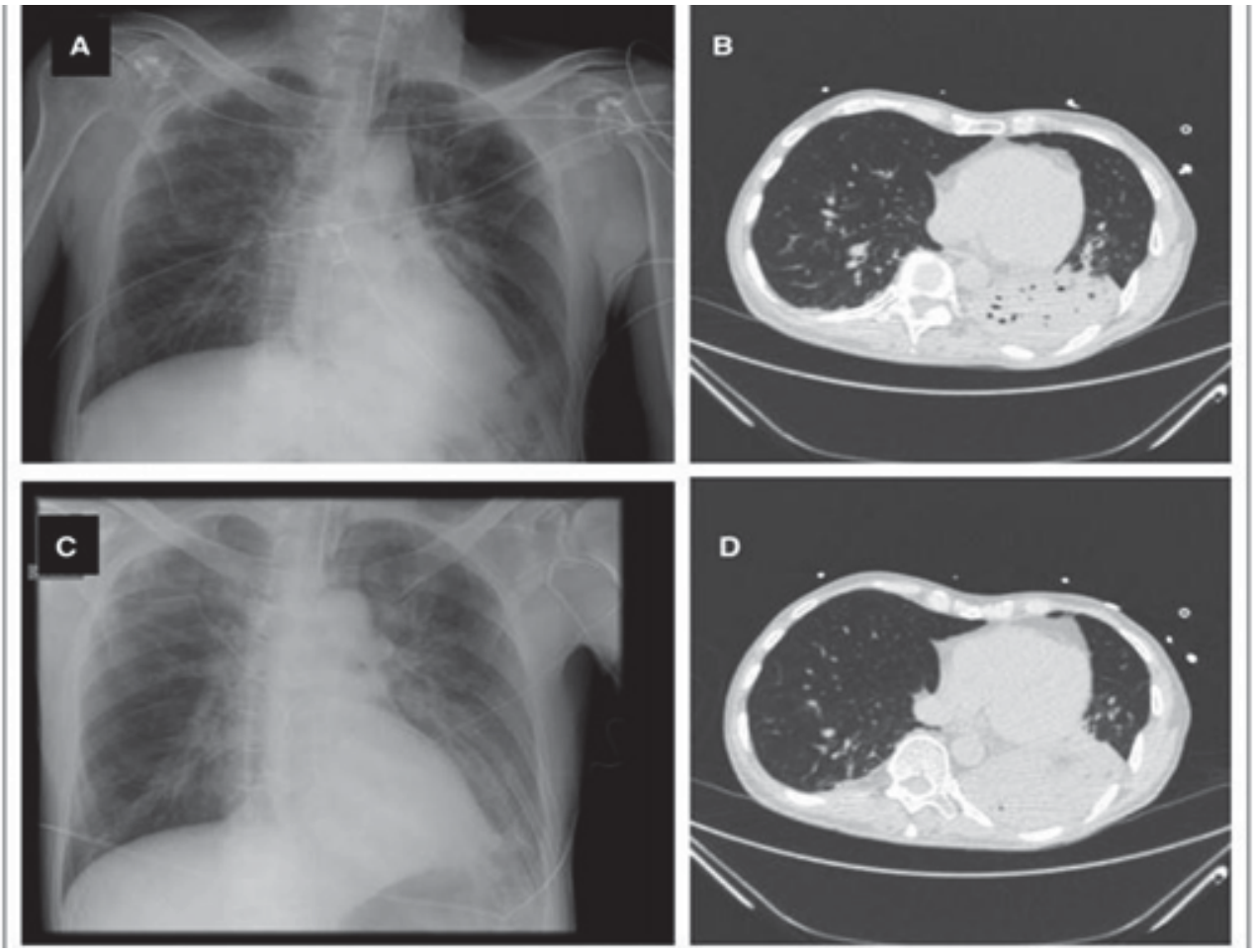

Figure2:Chest X-rays and CT-scanofa65-year-oldmanpneumonia

Table 7 elaborates that Acinetobacterbaumanniiwas the predominant isolate (35%), known for high rates of multidrug resistance (Kalil et al., 2016). The presence of Klebsiella pneumoniaeand Pseudomonas aeruginosa further indicates the complexity of pathogen profiles inHAP. The detection of MRSA (6.7%) highlights the need for appropriate empirical therapy and infection control measures.

Table 7: Pathogens Isolated in Sputum Cultures

Pathogen	No. of Cases(%)
Acinetobacterbaumannii	42(35%)
Klebsiellapneumoniae	26(21.7%)
Pseudomonasaeruginosa	22(18.3%)
Escherichiacoli	18(15%)
Staphylococcusaureus(MRSA)	8(6.7%)
Others	4(3.3%)

Table 8 depicts the recovery rate was encouraging (76.7%), reflecting effective treatment strategies. However, complications like septicemia (15%) and ARDS (8.3%) highlight the seriousness of HAP, aligning with Melsen et al. (2013). A mortality rate of 6.7% underscores the importance of early diagnosis and appropriate management

Table 8: Outcomes among Patients with HAP

Outcome	No.of Cases(%)
Clinical Recovery	92(76.7%)
Septicemia	18(15%)
ARDS	10 (8.3%)
Mortality	8(6.7%)

Table 9: Comparative Summary of Most Common Pathogens and Resistance Patterns

Pathogen	Prevalence	Common Antibiotic Resistance	Notes
Acinetobacterbaumannii	42(35%)	Carbapenems,Cephalosporins, Fluoroquinolones	High prevalence of MDR/XDR strains;major cause of treatment failure
Klebsiellapneumoniae	26(21.7%)	Carbapenems, Aminoglycosides, Extended-SpectrumBeta-Lactamases (ESBLs)	Frequently ESBL-producing; causes both community and hospital infections
Pseudomonas aeruginosa	22(18.3%)	Piperacillin-Tazobactam, Aminoglycosides,Carbapenems	Shows variable susceptibility; often resistant in ICU settings
Escherichiacoli	18(15%)	Cephalosporins,Fluoroquinolones, ESBLs	Rising resistance in nosocomial settings
Staphylococcus aureus(MRSA)	8(6.7%)	Methicillin,Penicillin	Sensitive to vancomycin;nasal carriage screening useful for stewardship

Key Observations:

- **Acinetobacterbaumanniiis** the most prevalent and also the most drug-resistant pathogen in this cohort.
- **Klebsiellapneumoniae** and **Pseudomonasaeruginosa** also pose serious resistance challenges.
- MRSA presence,though lower in prevalence,demands strict infection control.
- Resistance to **carbapenems** and **ESBL production** is widespread—emphasizing the need for antimicrobial stewardship and rapid diagnostics.

DISCUSSION

Hospital-acquired pneumonia (HAP) remains a significant cause of morbidity and mortality in hospitalized patients, particularly in resource-limited settings like India. The present study conducted at Desh Bhagat University-affiliated hospital, Chandigarh, systematically evaluated the

prevalence, risk factors, microbiological profile, and outcomes of HAP among hospitalized patients. The findings are discussed here in relation to existing literature.

5.1 SociodemographicProfile

In this study, the mean age of patients was 54.3 ± 12.5years, with the highest prevalenceinthe51–60 years age group. This aligns with the findings of Kim et al. (2022), who reported that advancing age is a major risk factor for HAP due to factors like immunosenescence, comorbidities, and prolonged hospitalization. Melsenet al. (2013)also highlighted that elderly patients have increased susceptibility to nosocomial infections, often due to age-related decline in pulmonary defenses.

A male predominance (58.3%) was observed, similar to the study by Giuliano et al. (2018) and Kalil et al. (2016). This trend is often attributed to higher exposure to risk factors such as smoking and chronic respiratory diseases, which are more prevalent among men in many societies. However, the significant proportion of female patients (41.7%) highlights that both genders are at substantial risk and should be equally targeted in prevention strategies.

5.2 Comorbidities and Risk Factors

The study identified diabetes mellitus (40%) and COPD (30%) as the most common comorbidities among HAP patients. These findings are consistent with Kalil et al. (2016), who emphasized that diabetes and chronic lung diseases compromise mucociliary clearance and immune responses, increasing the risk of nosocomial infections. Koulenti et al. (2017) further underscored the need for rigorous monitoring of such patients in hospital settings.

Prolonged hospital stay (>7 days) emerged as the most significant risk factor (73.3%), corroborating the findings of Branch-Elliman et al. (2015), who highlighted that length of stay increases exposure to hospital flora and invasive devices. Prior antibiotic use (55%) was also significant, supporting the observations by Candel et al. (2023) that indiscriminate antibiotic use disrupts normal flora and selects for MDR organisms. The association of invasive devices (65%) with HAP aligns with the findings of Chastre and Luyt (2016), who emphasized the role of devices such as intravenous lines and urinary catheters in introducing pathogens.

5.3 Clinical Presentation

The predominant symptoms in this study were fever (93.3%), cough with expectoration (75%), and dyspnea (63.3%). These clinical features align with the classical presentations described by Kalil et al. (2016) and are crucial for the early identification of HAP. Auscultatory findings were present in 90% of cases, supporting the importance of thorough clinical examinations, as noted by Metlay et al. (2019).

5.4 Laboratory and Biomarker Findings

Leukocytosis (>11,000/cumm) was observed in 80% of patients, consistent with systemic inflammatory response patterns reportedbyKimet al. (2022). ElevatedCRP (mean52.5 ±14.3mg/L) and PCT levels (mean 2.4 ± 0.9 ng/mL) further validated the bacterial etiology, as emphasized by Vasala et al. (2020). These biomarkers have been shown to correlate with infection severity and help guide therapeutic decisions, aligning with recommendations by Kalil et al. (2016).

5.5 Radiological Findings

Chest X-ray revealed unilateral infiltrates in 60% of cases and bilateral infiltrates in 40%, consistent with studies by Chastre and Luyt (2016). The presence of pleural effusion (15%) is a known complication that often indicates severe disease progression, as noted by Giulianoetal.(2018). These radiological findings reinforce the need for prompt imaging in suspected HAP cases to facilitate early diagnosis and management.

5.6 Microbiological Profile

The most frequently isolated pathogen was Acinetobacterbaumannii(35%), followed by Klebsiellapneumoniae(21.7%), Pseudomonas aeruginosa(18.3%), and Escherichia coli (15%). This profile mirrors the trends reported by Kalil et al. (2016) and Candel et al. (2023), highlighting the predominance of Gram-negative pathogens in HAP. The detection of MRSA in 6.7% of cases underscores the increasing relevance of resistant Gram-positive organisms, consistent with Parente et al. (2018).

The high rates of MDR and XDR isolates among these pathogens are alarming and consistent with global trends, as reported by Vasala et al. (2020). This highlights the pressing need for effective antibiotic stewardship programs and infection control measures to prevent the spread of resistant strains.

5.7 Outcomes and Complications

The clinical recovery rate in this study was 76.7%, comparable

to outcomes reported in other Indian and international studies (Kalil et al., 2016; Giuliano et al., 2018). Complications such as septicemia (15%) and ARDS (8.3%) were significant contributors to morbidity and mortality, aligning with the findings of Melsen et al. (2013).

The mortality rate of 6.7% is lower than the range reported in earlier studies (5%–13%) by Melsen et al. (2013), which may reflect improvements in early diagnosis, appropriate empirical therapy, and supportive care in this study setting. However, the presence of complications highlights the need for continuous monitoring and aggressive management, especially in high-risk patients.

CONCLUSION

6.2Conclusion

This study highlights that hospital-acquired pneumonia is a serious and preventable complication in hospitalized patients, particularly those with comorbidities and prolonged hospital stays. Middle-aged and elderly males, and patients with diabetes mellitus and COPD, are at higher risk. The high prevalence of MDR pathogens, particularly Acinetobacterb aumannii, complicates treatment and emphasizes the need for appropriate antibiotic stewardship.

Clinical vigilance, combined with laboratory and microbiological support, is essential for early diagnosis and effective management. Radiological confirmation and biomarker evaluation (CRP and PCT) serve as useful adjuncts in clinical decision-making.

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