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INCIDENCE OF HOSPITAL-ACQUIRED PNEUMONIA IN PATIENTS WITH COMORBIDITY AND WITH NO PREVIOUS COMORBIDITY IN THE TERTIARY CARE HOSPITAL

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Abstract

Background: *Hospital-acquired pneumonia (HAP) is a leading nosocomial infection associated with significant morbidity, mortality, and healthcare burden, particularly in high-risk patients. Despite its global impact, epidemiological data from South Asia remain limited and heterogeneous. This study aimed to evaluate the incidence, risk factors, microbiological spectrum, and clinical outcomes of HAP in patients with and without comorbidities at a tertiary care hospital in Pakistan.*

Materials and Methods: *This cross-sectional study was conducted at Federal Government Polyclinic Hospital, Islamabad, from November 2024 to April 2025, and included 250 adult inpatients hospitalized for more than 48 hours. Hospital-acquired pneumonia (HAP) was diagnosed using CDC criteria, while comorbidities and smoking history were systematically documented. Microbiological cultures, antimicrobial susceptibility, and clinical outcomes including ICU admission, ventilatory support, mortality, and length of stay were recorded. All data was entered and calculated using SPSS version 23.0. The statistical significance set at $p \leq 0.05$.*

Results: *Among 250 hospitalized patients, hospital-acquired pneumonia occurred in 20.0% of patients and was significantly associated with chronic kidney disease, immunosuppression, malignancy, diabetes, hypertension, chronic lung disease, smoking, and age ≥60 years. Gram-negative bacilli, predominantly Klebsiella pneumoniae, Acinetobacter baumannii, and Pseudomonas aeruginosa, showed high multidrug resistance. Clinical outcomes were severe, with 56.0% requiring ICU care and 24.0% mortality.*

Conclusion: *Hospital-acquired pneumonia affected one-fifth of patients, with older age, comorbidities, and smoking identified as key risk factors. Multidrug-resistant gram-negative bacilli predominated, and HAP was associated with prolonged hospitalization, increased ICU admissions, and high mortality, highlighting the importance of timely prevention and rational antibiotic stewardship.*

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INTRODUCTION

Pneumonia is an acute infection of the lung parenchyma caused by a wide spectrum of microorganisms, including bacteria, viruses, and fungi.[1] It remains a major global health problem and is consistently ranked among the leading causes of morbidity and mortality, particularly in the elderly population aged 65 years or older.[2]

Hospital-acquired pneumonia (HAP) is defined as pneumonia that develops 48 hours or more after hospital admission, excluding cases present at the time of admission or associated with intubation.[3] It is one of the most common and serious nosocomial infections, often leading to severe complications such as respiratory failure, septic shock, and acute kidney injury.[4] Consequently, HAP contributes to prolonged hospitalization, higher healthcare costs, and significantly increased morbidity and mortality.[5]

The reported incidence of HAP ranges between 5–20 cases per 1,000 hospital admissions and is higher among patients admitted to intensive care units.[6] It is considered the second most frequent hospital-acquired infection after urinary tract infections, but it carries the highest mortality burden.[7] Mortality rates have been reported to vary widely, from approximately 9% to over 70%, depending on patient population, comorbidities, and causative pathogens.[8]

Numerous risk factors have been associated with the development of HAP, including advanced age, smoking, chronic lung disease, trauma, diabetes mellitus, and immunosuppression.[9] The microbiological spectrum of HAP is dominated by multidrug-resistant gram-negative organisms such as *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, and *Escherichia coli*, as well as *Staphylococcus aureus*.[10] These pathogens are frequently implicated in ICU settings, where HAP accounts for nearly half of all nosocomial infections and a substantial proportion of infection-related mortality.[11]

In Asian countries, the burden of HAP appears to be particularly high, with reported rates of nosocomial infections ranging from 6% to 15%, and pneumonia constituting a significant proportion.[12,13] However, regional epidemiological data, particularly from South Asia, remain limited and heterogeneous.

Given the scarcity of local data, especially in Pakistan, there is a pressing need to better understand the incidence, risk factors, microbiological spectrum, and clinical outcomes of HAP in our setting. Such information is essential to guide timely diagnosis, optimize antimicrobial stewardship, and improve patient outcomes. The present study was therefore designed to investigate the incidence, associated risk factors, and outcomes of hospital-acquired pneumonia among patients with and without comorbidities in a tertiary care hospital.

MATERIALS AND METHODS:

This cross-sectional study was conducted at the Department of Medicine, at Federal Government Polyclinic Hospital, (FGPC) Islamabad after approval by the Institutional Ethics Committee. All data were anonymized to maintain participant confidentiality. The study was carried out over a period of 6 months from November 2024 to April 2025, and included 250 consecutive adult patients admitted to medical wards and intensive care units during the study period.

All patients aged ≥18 years who were admitted for more than 48 hours were eligible. Patients with community-acquired pneumonia on admission, those who developed pneumonia within 48 hours of hospitalization, or those with incomplete medical records were excluded.

Hospital-acquired pneumonia (HAP) was defined according to the Centers for Disease Control and Prevention (CDC) criteria as the development of a new or progressive pulmonary infiltrate on chest radiograph occurring ≥48 hours after admission, along with at least two of the following: fever, leukocytosis or leukopenia, and purulent respiratory secretions.[3]

Comorbidities were defined as follows:

- **Diabetes mellitus (DM):** documented diagnosis or use of antidiabetic medication.
- **Hypertension (HTN):** prior diagnosis or use of antihypertensive therapy.

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- **Chronic kidney disease (CKD):** estimated glomerular filtration rate <60 mL/min/1.73 m² for ≥3 months or prior documentation.
- **Chronic lung disease:** included chronic obstructive pulmonary disease, asthma, or bronchiectasis, based on medical records.
- **Immunosuppression:** defined as systemic corticosteroid therapy equivalent to ≥20 mg/day prednisolone for >14 days, chemotherapy, hematological malignancy, solid-organ transplantation, or HIV infection.
- **Malignancy:** presence of active or treated solid or hematological malignancy.

Smoking status was classified as never, former, or current (smoked within the past 30 days).

A structured proforma was used to record patient demographics (age, sex), smoking history, comorbidities, presence of HAP, microbiological data, and outcomes. Microbiological results were obtained from the hospital microbiology laboratory. Pathogens were identified by standard culture techniques, and antimicrobial susceptibility testing was performed according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Clinical outcomes recorded for patients with HAP included requirement for intensive care unit (ICU) admission, need for ventilatory support (invasive or non-invasive), in-hospital mortality, and length of hospital stay.

Data were entered and analyzed using IBM SPSS Statistics version 23. Categorical variables were expressed as frequencies and percentages, and continuous variables as mean ± standard deviation (SD) or median with interquartile range (IQR) as appropriate. Associations between risk factors and the occurrence of HAP were evaluated using the chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS:

A total of 250 patients were included in this study. The mean age was 56.8 ± 15.2 years, with the majority aged 40–59 years (36.0%) and 32.0% aged 60 years or above. Males comprised 60.0% of the cohort. A history of smoking was present in 42.0% of patients, of whom 20.0% were current smokers (Table 1).

Table 1. Baseline Characteristics of Study Population (n = 250)

VARIABLE	n (%)
Age group (years)	
<40	55 (22.0)
40–59	90 (36.0)
60–79	80 (32.0)
≥80	25 (10.0)
Sex	
Male	150 (60.0)
Female	100 (40.0)
Smoking status	
Never	145 (58.0)
Former	55 (22.0)
Current	50 (20.0)

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The most frequent comorbidities were hypertension (44.0%) and diabetes mellitus (36.0%), followed by chronic lung disease (22.0%), chronic kidney disease (16.0%), immunosuppression (10.0%), and malignancy (8.0%). Twenty-four percent of patients had no listed comorbidities (Table 2).

Table 2: Comorbidities (n = 250)

COMORBIDITY	n (%)
Diabetes mellitus	90 (36.0)
Hypertension	110 (44.0)
Chronic kidney disease	40 (16.0)
Chronic lung disease (COPD/asthma/bronchiectasis)	55 (22.0)
Immunosuppression (steroids/chemo/transplant/HIV)	25 (10.0)
Malignancy	20 (8.0)
No listed comorbidity	60 (24.0)

Hospital-acquired pneumonia (HAP) developed in 50 patients (20.0%). The distribution of risk factors between patients with and without HAP is shown in Table 3. The incidence of HAP was significantly higher in patients with chronic kidney disease (37.5% vs. 16.7%, p=0.003), immunosuppression (48.0% vs. 16.9%, p<0.001), malignancy (45.0% vs. 17.8%, p=0.01), and age ≥60 years (28.6% vs. 13.8%, p=0.002). Diabetes mellitus, hypertension, chronic lung disease, and current smoking were also significantly associated with HAP. Male sex and former smoking, however, did not show statistically significant associations.

Table 3. Association of Risk Factors with Hospital-Acquired Pneumonia (HAP)

Risk Factor	HAP Yes (n=50)	HAP No (n=200)	Total (n=250)	p-value*
Diabetes mellitus	26 (28.9%)	64 (71.1%)	90	0.01
Hypertension	28 (25.5%)	82 (74.5%)	110	0.02
Chronic kidney disease	15 (37.5%)	25 (62.5%)	40	0.003
Chronic lung disease	18 (32.7%)	37 (67.3%)	55	0.01
Immunosuppression	12 (48.0%)	13 (52.0%)	25	<0.001
Malignancy	9 (45.0%)	11 (55.0%)	20	0.01
Current smoker	16 (32.0%)	34 (68.0%)	50	0.03
Former smoker	10 (18.2%)	45 (81.8%)	55	0.70
Age ≥60 years	30 (28.6%)	75 (71.4%)	105	0.002
Male sex	34 (22.7%)	116 (77.3%)	150	0.15

* $p \leq 0.05$ was considered statistically significant.

Among the 50 patients with HAP, 40 (80.0%) had positive cultures. Gram-negative bacilli predominated, with *Klebsiella pneumoniae* (35.0%), *Acinetobacter baumannii* (25.0%), and *Pseudomonas aeruginosa* (22.5%) being the most frequently isolated pathogens (Figure 1).

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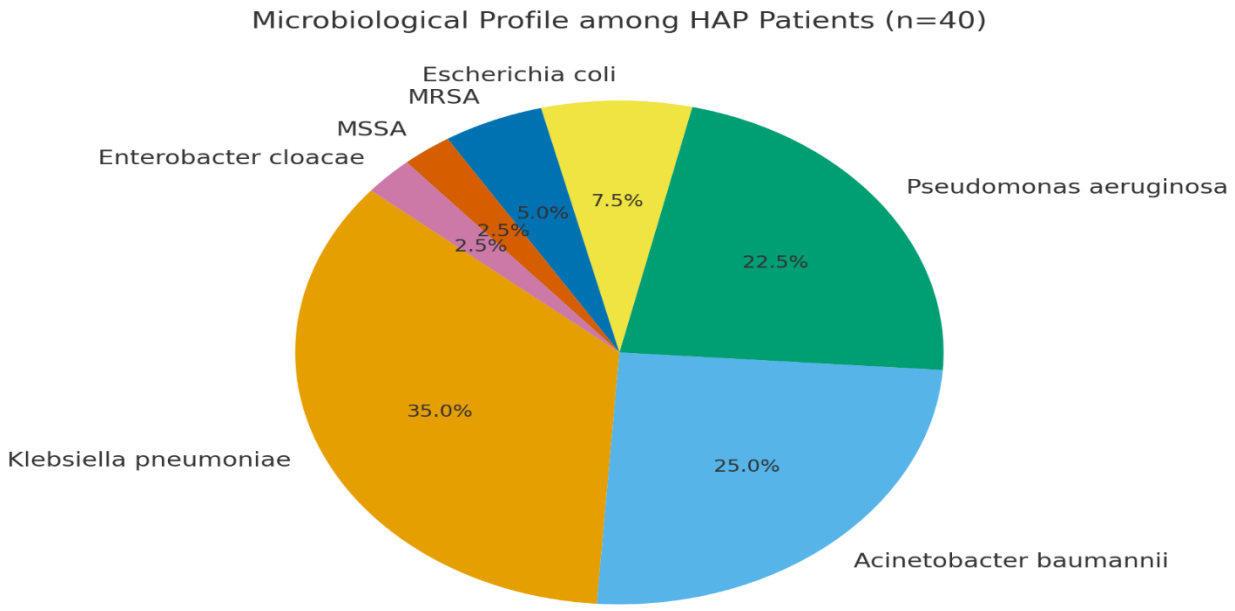

Figure 1: Microbiological Profile among Culture-Positive HAP Patients (n = 40)

Antibiotic susceptibility patterns demonstrated high levels of resistance to cephalosporins and piperacillin-tazobactam, with modest activity of carbapenems and aminoglycosides. Colistin remained active against >95% of Gram-negative isolates, while linezolid and vancomycin retained excellent activity against *Staphylococcus aureus* (Table 4).

Table 4: Antibiotic Susceptibility Patterns (% Susceptible)

Antibiotic	K. pneumoniae	A. baumannii	P. aeruginosa	E. coli	*S. aureus* (MRSA/MSSA)
Piperacillin–tazobactam	25	10	35	30	–
Cefepime	22	8	30	28	–
Carbapenems (Meropenem/Imipenem)	40	18	40	55	–
Amikacin	55	25	60	70	–
Levofloxacin	20	12	28	25	–
Tigecycline*	85	70	–	90	–
Colistin/polymyxin B	96	95	98	97	–
Linezolid	–	–	–	–	98
Vancomycin	–	–	–	–	100

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Clinical outcomes among patients with HAP are summarized in Table 5. More than half (56.0%) required ICU admission, and 44.0% required ventilatory support. In-hospital mortality was 24.0%. The median length of stay among HAP patients was 12 days (IQR 8–18), significantly longer compared with patients without HAP.

Table 5. Clinical Outcomes among Patients with HAP (n = 50)

OUTCOME	n (%) / MEDIAN (IQR)
ICU admission	28 (56.0)
Ventilatory support	22 (44.0)
In-hospital mortality	12 (24.0)
Length of stay, days	12 (8–18)

DISCUSSION:

Hospital-acquired pneumonia (HAP) remains a significant challenge in modern healthcare, contributing to substantial morbidity, mortality, and healthcare costs worldwide.[14] Despite advances in antimicrobial therapy and preventive strategies, its incidence and associated outcomes remain unacceptably high, particularly among older patients and those with comorbidities.[15] Variability in epidemiology, risk factors, and microbial patterns across regions underscores the importance of contextual data to guide prevention and management strategies.[16]

In this cross-sectional cohort of 250 hospitalized adults, the overall incidence of hospital-acquired pneumonia (HAP) was 20.0%. The demographic profile showed a mean age of 56.8 ± 15.2 years, with over one-third of patients aged 40–59 years and nearly one-third aged ≥60 years. Males accounted for 60.0% of the cohort, and 42.0% had a history of smoking, of whom 20.0% were current smokers. The most prevalent comorbidities included hypertension (44.0%) and diabetes mellitus (36.0%), followed by chronic lung disease (22.0%), chronic kidney disease (16.0%), immunosuppression (10.0%), and malignancy (8.0%). Notably, 24.0% of patients had no recorded comorbidities.

Age ≥60 years was significantly associated with HAP (28.6% vs 13.8%; p = 0.002), aligning with existing literature that identifies advanced age as a key risk factor for nosocomial pneumonia. For instance, a recent meta-analysis in hip fracture patients Yao et al. reported an odds ratio (OR) of increased HAP risk with advancing age (OR 1.07 per year; 95% CI 1.05–1.10).[17]

Chronic kidney disease (CKD) showed one of the strongest associations with HAP in our cohort (37.5% vs 16.7%, p = 0.003). Epidemiological studies corroborate this finding: Chou et al. reported an adjusted hazard ratio (aHR) of 2.17 (95% CI 2.07–2.29; p < 0.001) for inpatient pneumonia among patients with CKD, independent of other comorbid conditions.[18]

Immunosuppression (48.0% vs 16.9%; p < 0.001) and malignancy (45.0% vs 17.8%; p = 0.01) were also strongly predictive of HAP. This is consistent with general data describing immunocompromised states—including cancer, HIV, or immunosuppressive therapy—as known risk factors for HAP. Further, studies on immunosuppressed cohorts demonstrate a higher HAP incidence and worse outcomes, as noted in transplant-specific analyses.[19]

Diabetes mellitus, hypertension, chronic lung disease, and current smoking were all significantly associated with HAP (p-values ranging from 0.01 to 0.03). These align with broader evidence linking systemic comorbidities (such as DM, COPD) and smoking status to increased vulnerability to hospital-acquired infections. For example, Yao et al. identified COPD as a strong predictor (OR 3.44; 95% CI 2.83–4.19).[17]

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Male sex and former smoking exhibited no significant association ($p > 0.05$), suggesting that current rather than remote smoking, and certain biological factors tied to acute disease rather than sex alone, may more strongly influence HAP risk.

Of the 50 patients with HAP, 40 (80.0%) had positive cultures. Gram-negative bacilli dominated: *Klebsiella pneumoniae* (35.0%), *Acinetobacter baumannii* (25.0%), and *Pseudomonas aeruginosa* (22.5%). Comparable pathogen distributions have been reported in other Asian settings. For instance, Rongrungruang et al. observed *A. baumannii* as the most frequent isolate (44.2%), followed by *P. aeruginosa* (34.6%) and *K. pneumoniae* (28.3%).[20] Similarly, in a study from Pakistan's ICU, Imran et al. reported *P. aeruginosa* (30.6%) as dominant, followed by *Acinetobacter* and *Candida*—with *Klebsiella* accounting for a smaller proportion (~10.2%).[21]

Antimicrobial susceptibility patterns in our cohort showed considerable resistance to cephalosporins and piperacillin–tazobactam, with moderate susceptibility to carbapenems and aminoglycosides. Colistin maintained >95% activity, and vancomycin and linezolid remained highly effective against *S. aureus*. These resistance trends echo regional surveillance data: carbapenem resistance in *A. baumannii* and *Klebsiella*, and preserved efficacy of colistin and tigecycline in highly resistant strains, are consistent with other reports from Pakistan and neighboring regions.[22]

In our study, HAP was associated with substantial morbidity: 56.0% required ICU admission, 44.0% required ventilatory support, and in-hospital mortality stood at 24.0%. The median length of hospital stay was 12 days (IQR 8–18), presumably longer than for non-HAP patients. Similar mortality rates have been reported elsewhere: Imran et al. documented a mortality rate of 47.7% among HAP patients in a Pakistani ICU cohort.[21] Sangmuang et al. identified mechanical ventilation, acute kidney injury, and malignancy as predictors of mortality in HAP, with mortality reaching 28.7% within 28 days.[23] These findings reinforce the serious prognosis of HAP, particularly in patients with comorbidities and organ dysfunction.

Limitations of this study include its single-center, cross-sectional design. Lack of multivariable adjustment may overestimate risk for collinear factors; and regional pathogen distribution may limit generalizability

CONCLUSION:

Hospital-acquired pneumonia occurred in 20% of patients and was significantly associated with older age, comorbidities, and smoking. Gram-negative bacilli, particularly *Klebsiella pneumoniae*, *Acinetobacter baumannii*, and *Pseudomonas aeruginosa*, predominated and showed high antimicrobial resistance. HAP was linked with prolonged hospitalization, greater ICU utilization, and high mortality, underscoring the need for early risk stratification, infection control, and rational antibiotic use.

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