

To Study the Clinical and Microbiological Factors in Determining Hospital Outcome of Patients of Ventilator Associated Pneumonia**Porismita Dutta¹, Manashjyoti Saikia², Nyrvan Baishya³, Niyor Hazarika⁴, Suresh Sharma⁵, Basanta Hazarika⁶**¹Registrar, Gauhati Medical College and Hospital, Gauhati, Assam, India²Assistant Professor, Gauhati Medical College and Hospital, Gauhati, Assam, India³Assistant Professor, Gauhati Medical College and Hospital, Gauhati, Assam, India⁴Assistant Professor, Gauhati Medical College and Hospital, Gauhati, Assam, India⁵Professor, Gauhati Medical College and Hospital, Gauhati, Assam, India⁶Professor & HOD, Gauhati Medical College and Hospital, Gauhati, Assam, India

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Abstract

Introduction: Pneumonia that develops more than 48 hours following intubation and mechanical breathing is known as ventilator-associated pneumonia. Ventilator-associated pneumonia (VAP) impacts 20–36% of critically sick patients in the intensive care unit (ICU), rendering it the most prevalent nosocomial infection in that setting. Multiple variables, such as diagnostic criteria, preventive measures, and patient and geographic disparities, influence the incidence rates, which vary from 2 to 16 incidents per 1000 ventilator days. VAP is a most common nosocomial infection associated with highest morbidity and mortality among ICU patients. Various factors such as clinical and microbiological parameters are involved in determining outcome of patients of Ventilator associated pneumonia.

Materials and Methods: This study was conducted in the Respiratory ICU of Gauhati Medical College and Hospital, GUWAHATI from March 2024 to February 2025 to evaluate Clinical and microbiological factors influencing hospital outcomes in ventilator-associated pneumonia (VAP). The study conducted with a study population of sixty patients after enrolment and considering inclusion criteria and exclusion criteria.

Results: *Acinetobacter* (41.66%) was the most common isolate, with late-onset VAP (56.67%) predominating. Diabetes, hypertension, and specific organisms like *Pseudomonas* and *Klebsiella* were significantly associated with higher mortality. Younger age, lower APACHE II and CPIS scores correlated with better outcomes. The study concludes that APACHE II and CPIS scores are valuable tools in predicting mortality in VAP patients.

Conclusion: The study shows that advanced age, comorbidities like diabetes and hypertension, and infections with *Pseudomonas* and *Klebsiella* significantly impact mortality in VAP patients. Higher APACHE II and CPIS scores are associated with poorer outcomes. Early identification of risk factors and scoring at diagnosis may aid in better prognostication and management of ventilator-associated pneumonia in ICU settings.

Keywords: Pneumonia, respiratory disease, Diabetes Mellitus, Ventilator-associated pneumonia (VAP).

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Introduction

An infection of the pulmonary parenchyma from the respiratory bronchioles to the alveoli is known as pneumonia. [1] An exacerbated cough, dyspnea, pleuritic chest discomfort, purulent sputum, disorientation, fever, hypoxemia, rales, leukocytosis or leukopenia, along with an exacerbated cough, are clinical indicators of pneumonia [2]

Healthcare systems bear a heavy clinical and financial burden from healthcare-associated infections (HAIs). The three different types of

nosocomial pneumonia are 'hospital-acquired pneumonia' (HAP), 'ventilator-associated pneumonia' (VAP), and 'healthcare-associated pneumonia' (HCAP). These three remain a significant cause of healthcare-associated infections (HAIs). [1]

Pneumonia that develops more than 48 hours following intubation and mechanical breathing is known as 'ventilator-associated pneumonia'. [1] 'Ventilator-associated pneumonia' (VAP) impacts 20–36% of critically sick patients in the 'intensive

care unit' (ICU), rendering it the most prevalent nosocomial infection in that setting. [3] Multiple variables, such as 'diagnostic criteria', 'preventive measures', and patient and geographic disparities, influence the incidence rates, which vary from '2 to 16 incidents per 1000 ventilator days'. [3]

We are attempting to prognosticate VAP patients in this study based on clinical and microbiological parameters. As far as my knowledge, no such study has been conducted in this region of the nation; therefore, it is my modest attempt to provide some observations from this demographic to the body of scientific literature.

The number of cases in my study may be limited because it is a single center study carried out in Gauhati Medical College and Hospital, Guwahati only, even though a significant number of cases were required to obtain good data for any study.

Every attempt was made to conduct the study with the following goals and objectives while keeping in mind its limitations.

Aims and Objectives

- To study the clinical factors associated with ventilator associated pneumonia
- To study the microbiological factors associated with ventilator associated pneumonia

Materials & Methods

This was a cross-sectional study conducted in Gauhati Medical College & Hospital from October 2023 to October 2024. All adult patients admitted in the ICU of Department of Pulmonary Medicine and Allied Specialties those who developed Ventilator Associated Pneumonia as per the Modified CDC criteria. Patients with age less than 18 yr of age or with Pneumonia before intubation or within 48 hrs post intubation was excluded.

Results and Observation

Age Distribution: The study included total of 60 cases with age distribution summarized in Table 1. The mean age of participants was 46.73 ± 16.18 years. The highest proportion of cases was observed in the 41-50 years age group, accounting for 15 cases (25%), followed by the 31-40 years age group, which had 12 cases (20%) and 51-60 years contributing 11 cases (18.33%). The 18-30 years age group included 10 cases (16.67%), while the 61-70 years group had 8 cases (13.33%). The least represented group was those above 70 years with only 4 cases (6.67%) groups.

Gender Distribution

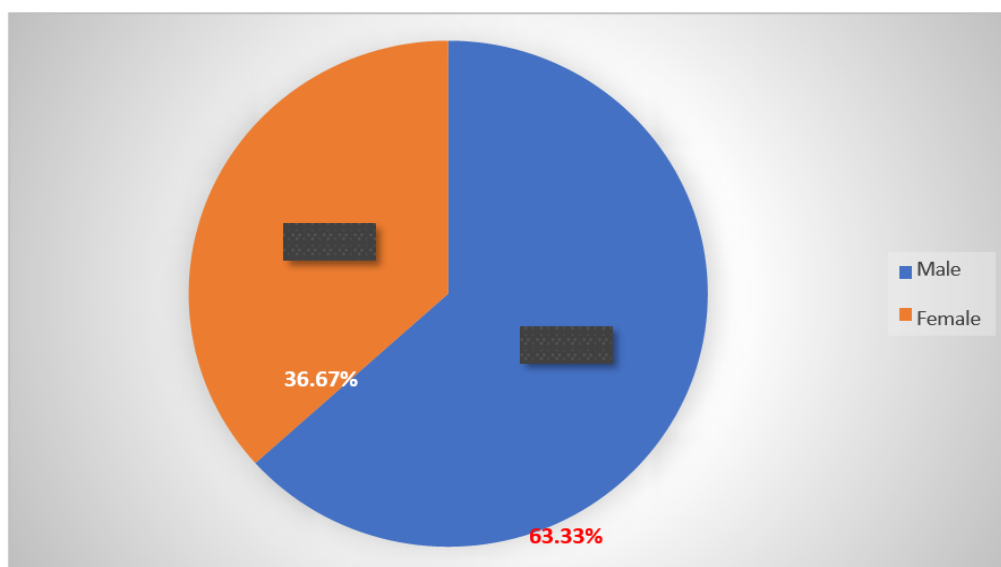


Figure 1:

Comorbidities: The most common comorbidity was diabetes mellitus (61.67%), followed by hypertension (53.33%) and respiratory disease (25%). Other conditions included, cardiovascular

disorders (15%), neurological disorders (13.33%), thyroid disorders (10%), renal disease (10%), liver disease (8.33%), and malignancy (3.33%).

Microorganism isolates

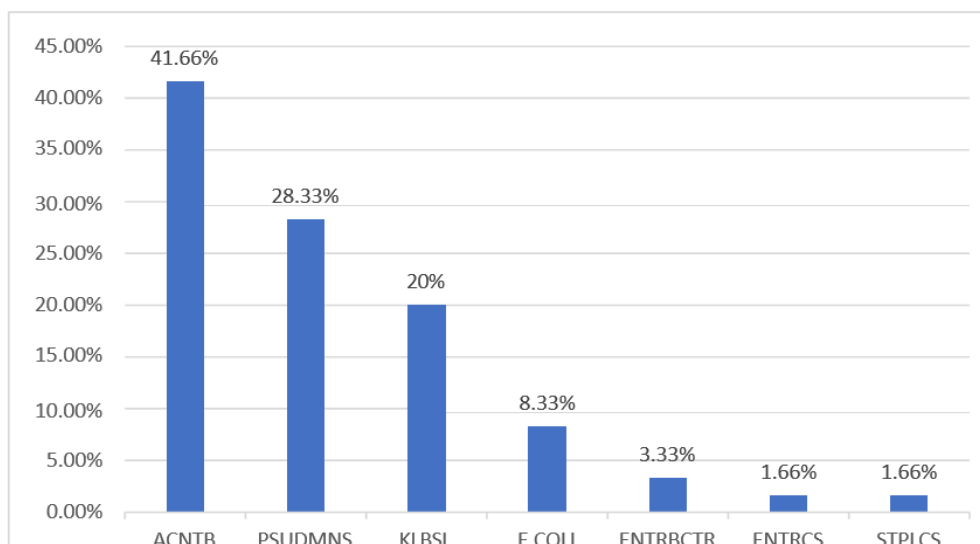


Figure 2:

The most frequently isolated microorganism was *Acinetobacter* (41.66%), followed by *Pseudomonas* (28.33%), *Klebsiella* (20%), *E.coli* (8.33%), *Enterobacter* (3.33%), and *Enterococcus* and *Staphylococcus* (1.66% each)

Polymicrobial Infection: The presence of polymicrobial infection among patients with ventilator-associated pneumonia was analysed. Out of the total cases examined, 10 patients (16.67%) were found to have infections, whereas 50 patients (83.33%) had monomicrobial infections.

Time of Onset of VAP: The time of onset of ventilator-associated pneumonia (VAP) was classified into early onset and late onset.

Out of a total of 60 patients, 26 cases (43.33%) were categorized as early-onset VAP, while 34 cases (56.67%) were classified as late-onset VAP.

Hospital Outcome at Day 30: Out of a total of 60 patients, 34 (56.67%) were discharged, while 26 (43.33%) succumbed to the illness. This indicates that more than half of the patients recovered and were discharged, whereas a significant proportion experienced mortality within 30 days.

Table 1: Association between Age and Hospital Outcome of Patients

Age	Discharged(34)	Expired(26)	Total
≤ 60	33(97.06%)	15(57.69%)	48(80%)
>60	1(2.94%)	11(42.31%)	12(20%)
Total	34(100%)	26(100%)	60(100%)

Pvalue 0.0002, significant association

Among the 60 patients, 48 (80%) were aged ≤60 years, while 12 (20%) were aged >60 years.

Among patients aged ≤60 years, 33 (97.06%) were discharged, whereas 15 (57.69%) expired. In contrast, among patients aged >60 years, only 1 (2.94%) was discharged, while 11 (42.31%) expired.

The statistical analysis revealed a significant association between age and hospital outcome, with a P-value of 0.0002, indicating that older age was significantly associated with higher mortality.

Association between Gender and Hospital Outcome of Patients: The association between gender and hospital outcomes of patients was analyzed in a study of 60 patients. Among them, 38 patients (63.33%) were male, while 22 patients (36.67%) were female. Among the 34 patients who

were discharged, 22 (64.71%) were male, and 12 (35.29%) were female. Similarly, among the 26 patients who expired, 16 (61.54%) were male, while 10 (38.46%) were female. Statistical analysis yielded a p-value of 0.8, indicating no significant association between gender and hospital outcomes

Association between Co-Morbidities and Hospital Outcome of Patients: Patients with Diabetes Mellitus shows significant statistical association with mortality. Patients with Hypertension shows significant statistical association with mortality. Patients with known cardiovascular disorders shows significant statistical association with mortality.

Patients with Renal disease shows NO significant statistical association with mortality.

Patients with Neurological disorders shows

significant statistical association with mortality

Patients with Respiratory diseases shows highly significant statistical association with mortality

Patients with Liver diseases shows NO significant statistical association with mortality

Patients with Malignancy shows NO significant statistical association with mortality

Association between Acinetobacter Isolates and Hospital Outcome of Patients

-shows NO significant association

Association between Pseudomonas Isolates and Hospital Outcome of Patients

-shows significant association

Association between Klebsiella Isolates and Hospital Outcome of Patients

-shows significant association

Association between E. coli Isolates and Hospital Outcome of Patients

-shows NO significant association

Association between Enterobacter Isolates and Hospital Outcome of Patients

-shows NO significant association

Association between Polymicrobial and Hospital Outcome of Patients

-shows significant association

Association between Time of Onset of VAP and Hospital Outcome of Patients

In patients with early-onset VAP, 20 (58.82%) were discharged, whereas 6 (23.08%) expired.

In contrast, among those with late-onset VAP, only 14 (41.18%) were discharged, while a significantly higher proportion, 20 (76.92%), expired.

There was significant association between early or late-onset VAP and hospital outcome ($p=0.69$).

Summery

The salient features of the study are summarized below:

- The study included 60 cases with a mean age of 46.73 ± 16.18 years. The highest proportion was in the 41-50 years group (25%), followed by 31-40 years (20%). The smallest group was those above 70 years (6.67%).
- Males (63.33%) outnumbered females (36.67%) in the study.
- Diabetes mellitus (61.67%) and hypertension (53.33%) were the most common. Other conditions included respiratory disease (25%), cardiovascular disorder (15%), neurological disorder (13.33%), and renal disease (10%).

- Acinetobacter (41.66%) was the most frequently isolated organism, followed by Pseudomonas (28.33%) and Klebsiella (20%).
- 16.67% of cases had polymicrobial infections, while 83.33% had a single microorganism.
- Late-onset VAP (56.67%) was more common than early-onset (43.33%).
- 34 patients (56.67%) were discharged, while 26 patients (43.33%) expired.
- Patients aged ≤ 60 years had a significantly higher survival rate (97.06%), while mortality was higher in those >60 years (42.31%) ($p=0.0002$).
- No significant difference in outcomes between males and females ($p=0.8$).
- Higher mortality was significantly associated with Diabetes mellitus ($p=0.0002$), Hypertension ($p=0.0001$), Cardiovascular disorder ($p=0.002$), Neurological disorder ($p=0.006$), respiratory disease ($p=0.006$). No significant impact on mortality was found for renal disease ($p=0.6$), liver disease ($p=0.4$), and malignancy ($p=0.84$).
- Significant association with higher mortality: Pseudomonas ($p=0.0001$), Klebsiella ($p=0.01$). No significant association with Acinetobacter ($p=0.09$), E. coli ($p=0.71$), and Enterobacter ($p=0.84$).
- Significant association was found between polymicrobial infections and hospital outcome ($p=0.01$).
- As statistically significant association was found between early or late-onset VAP and patient survival ($p=0.69$).

Conclusion

Ventilator-associated pneumonia (VAP) remain a significant challenge in intensive care settings, with significant implications for patient outcomes. Our study, conducted in the Respiratory ICU of Gauhati Medical College and Hospital, provides valuable insights into the clinical and microbiological factors influencing the prognosis of VAP patients. Among the 60 cases studied, we observed that VAP predominantly affected middle-aged individuals, with a higher prevalence in males. Comorbid conditions, particularly diabetes mellitus and hypertension, emerged as strong predictors of poor outcomes, highlighting the need for vigilant management of underlying diseases in critically ill patients.

From a microbiological perspective, Acinetobacter species was the most frequently isolated pathogen, yet infections with Pseudomonas and Klebsiella species were significantly associated with higher mortality. The presence of polymicrobial infections further compounded the risk, emphasizing the complexity of microbial interactions in VAP. The study also reaffirmed the prognostic value of clinical scoring systems. Higher APACHE II and

CPIS scores at the time of VAP diagnosis were significantly associated with increased mortality, underscoring their utility in early risk stratification and guiding the therapeutic interventions. Additionally, age played a crucial role, with patients above 60 years facing a markedly higher risk of death.

These findings reinforce the need for a comprehensive, patient-specific approach to managing VAP. Early identification of high-risk individuals, aggressive infection control measures, and targeted antimicrobial therapy remain key strategies in improving survival. By integrating clinical and microbiological parameters into routine practice, we can enhance decision-making and optimize patient outcomes in ventilator-associated pneumonia.

This study contributes to the growing body of evidence on VAP and underscores the importance of timely intervention, personalized care, and robust antimicrobial stewardship in the fight against this life-threatening infection. Future research should focus on refining predictive models and exploring novel therapeutic strategies to further improve prognosis in VAP patients.

Bibliography

1. Grippi MA, Antin-Ozerkis DE, Dela Cruz CS, Kotloff RM, Kotton GV, Nelson C, et al., editors. Fishman's pulmonary diseases and disorders. Sixth edition. New York: McGraw-Hill LLC; 2023. 1 p. (McGraw-Hill's Access Medicine).
2. Howroyd F, Chacko C, Mac Duff A, Gautam N, Pouchet B, Tunnicliffe B, et al. Ventilator-associated pneumonia: pathobiological heterogeneity and diagnostic challenges. *Nat Commun*. 2024 Jul 31;15(1):6447.
3. Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America - PubMed [Internet]. [cited 2025 Apr 6]. Available from: <https://pubmed.ncbi.nlm.nih.gov/31573350/>
4. Gupta D, Agarwal R, Aggarwal A, Singh N, Mishra N, Khilnani G, et al. Guidelines for diagnosis and management of community- and hospital-acquired pneumonia in adults: Joint ICS/NCCP(I) recommendations. *Lung India*. 2012;29(6):27.
5. Farag AM, Tawfik MM, Abozeed MY, Shaban EA, Abo-Shadi MA. Microbiological profile of ventilator-associated pneumonia among intensive care unit patients in tertiary Egyptian hospitals. *J Infect Dev Ctries*. 2020 Feb 29;14(2):153–61.
6. Rea-Neto A, Youssef NCM, Tuche F, Brunkhorst F, Ranieri VM, Reinhart K, et al. Diagnosis of ventilator-associated pneumonia: a systematic review of the literature. *Crit Care*. 2008 Apr 21;12(2):R56.
7. Prevalence and Outcomes of Infection Among Patients in Intensive Care Units in 2017 - PubMed [Internet]. [cited 2025 Apr 7]. Available from: <https://pubmed.ncbi.nlm.nih.gov/32207816/>
8. Changes in Prevalence of Health Care–Associated Infections in U.S. Hospitals
9. | New England Journal of Medicine [Internet]. [cited 2025 Apr 7]. Available from: <https://www.nejm.org/doi/full/10.1056/NEJMoal801550>
10. Chastre J, Fagon JY. Ventilator-associated pneumonia. *Am J Respir Crit Care Med*. 2002 Apr 1;165(7):867–903.