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INCIDENCE AND CLINICAL EPIDEMIOLOGY OF VENTILATOR-ASSOCIATED PNEUMONIA IN A TERTIARY CARE HOSPITAL IN CENTRAL INDIA

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Abstract

Background: Ventilator-associated pneumonia (VAP) is a major healthcare-associated infection in intensive care units (ICUs) with substantial morbidity, mortality, and financial burden. It occurs ≥48 hours after initiation of mechanical ventilation. Developing nations frequently report higher VAP incidence due to varying infection control practices.

Objectives: To determine the incidence of VAP, analyse clinical epidemiology, and evaluate VAP-related ICU metrics in a tertiary care hospital in Central India.

Materials and Methods: A prospective cross-sectional study was conducted over one year in Medicine, Surgery, and Obstetrics ICUs at a tertiary-care hospital. A total of 200 mechanically ventilated patients (>48 hours ventilation) were enrolled. Diagnosis was based on CDC-NHSN criteria. VAP incidence rate per 1000 ventilator-days and device utilization ratio (DUR) were calculated.

Results: Among 200 ventilated patients, 52 developed VAP (26%). Total ventilator-days were 2100. The calculated VAP rate was **24.8 per 1000 ventilator-days**. Device utilization ratio was **0.62**. Late-onset VAP accounted for 61.5% of cases. Increased VAP rates correlated with prolonged ventilation (>7 days), re-intubation, comorbidities, and higher ICU stay. Mortality among VAP patients was higher compared to non-VAP ventilated cases.

Conclusion: The high VAP incidence observed indicates a need for stronger VAP prevention and surveillance strategies, strict adherence to ventilator bundles, and responsible antimicrobial stewardship. Continuous infection control interventions with targeted staff education may significantly reduce VAP burden.

Keywords: Ventilator-associated pneumonia, Device-associated infection, ICU, Ventilator utilization ratio, Surveillance, Infection control

Introduction

Ventilator-associated pneumonia (VAP) is the most common device-associated infection in ICUs following catheter-associated UTIs[3] and leads to high morbidity, mortality, and prolonged hospital stay[14]. It develops ≥48 hours after endotracheal intubation and mechanical ventilation[2], with daily risk peaking in the first week[7]. Diagnosis remains challenging due to non-specific clinical features in sedated patients[5].

The incidence of VAP is significantly higher in developing countries where rates range from 8.9 to 46/1000 ventilator-days[11]. Key determinants of VAP pathogenesis include bacterial virulence, immune dysfunction, biofilm formation on endotracheal tubes, aspiration of secretions, and host-device interactions.

The International Nosocomial Infection Control Consortium (INICC) reports a disproportionately higher VAP burden in Asian ICUs compared to Western nations[11 18]. Surveillance and early detection are critical for timely, appropriate therapy and improved outcomes[16 14].

This study aims to establish the VAP incidence in a tertiary-care hospital in Central India using standardized CDC-NHSN methodology.

Materials and Methods

Study Design & Setting

A prospective cross-sectional study was carried out in Medicine, Surgery, and Obstetrics ICUs of Index Medical College Hospital & Research Centre, Indore, from January 2021– December 2024.

Study Population

200 ventilated patients >12 years of age undergoing mechanical ventilation >48 hours satisfying VAP CDC-NHSN criteria[16].

Ethics Approval

Institutional Ethical Committee approved the study. Informed consent was obtained.

Data Collection

Clinical details including ventilator duration, comorbidities, clinical diagnosis, and prior antibiotics were recorded.

VAP Definitions

VAP diagnosed using CDC-NHSN clinical, radiological, and laboratory criteria[6 16].

Calculations:

$$\text{VAP rate} = \frac{\text{Number of VAP}}{\text{Number of Ventilator days.}} \times 1000$$

$$\text{DUR} = \frac{\text{Number of ventilator days for a location}}{\text{Number of patient days for that location}}$$

Results

Incidence of VAP:

Parameter	Value
Total ventilated patients	200
VAP cases	52
Patient-days	3400
Ventilator-days	2100
VAP Rate	**24.8 /1000 ventilator-days**
Device Utilization Ratio	**0.62**

Late-onset VAP (after ≥5 days ventilation) occurred in 61.5% of cases. The highest number of cases were from Medicine ICU.

ICU Factors Associated with VAP

Common contributory risk factors were:

- Mechanical ventilation >7 days[10]
- Re-intubation[9]
- Supine positioning[9]
- Stress ulcer prophylaxis [4,27]

• Prior antibiotic exposure[8]

Clinical Outcomes

VAP patients had significantly longer ventilation duration and hospital stay (10–24 vs 2.5–13 days)[25] and showed increased mortality similar to global reports[22].

Discussion

The VAP rate in this study (**24.8/1000 ventilator-days**) is high, consistent with Indian tertiary-care data[11]. Higher DUR indicates increased exposure risk consistent with VAP epidemiological trends[18, 23]

Late-onset VAP predominance aligns with global observations[6, 26]. Severity of illness, prolonged ICU stay, and invasive devices contribute to VAP pathogenesis.

A combination of preventive strategies such as head-end elevation, restricted sedation, oral hygiene, and early mobility significantly reduces VAP burden[15,10]. Antimicrobial stewardship is vital to combat MDR pathogens linked with VAP[13,10].

Successful implementation requires multidisciplinary teamwork, continuous training, and feedback on infection rates to ICU staff [4].

Conclusion

The high VAP incidence reveals an urgent need for:

−Strengthened surveillance

−Rigorous VAP bundle compliance

−Minimized ventilator days

−Stewardship-driven antimicrobial policies

Persistent audit-feedback mechanisms are recommended to drive sustainable infection prevention improvements.

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