Original Research Article

PROSPECTIVE STUDY ON THE INCIDENCE OF HOSPITAL-ACQUIRED INFECTIONS IN INTENSIVE CARE UNITS

Bharathi Gangumalla[1], Ganedi Seshu Kumari[2], Sannapu Prasanna Kumar[3], Appari Kanaka Maha Lakshmi[4]

[1]Assistant Professor, Department of General Medicine, Rangaraya Medical College, Kakinada, Andhra Pradesh, India.
[2]Associate Professor, Department of General Medicine, Rangaraya Medical College, Kakinada, Andhra Pradesh, India.
[3]Assistant Professor, Department of General Medicine, Rangaraya Medical College, Kakinada, Andhra Pradesh, India.
[4]Associate Professor, Department of General Medicine, Rangaraya Medical College, Kakinada, Andhra Pradesh, India.

ABSTRACT

Background: Hospital-acquired infections (HAIs) are a significant concern in intensive care units (ICUs), leading to increased morbidity, mortality, and healthcare costs. This study aims to determine the incidence, types, risk factors, and outcomes of HAIs in the ICUs.

Materials and Methods: A prospective observational study was conducted, including 100 patients admitted to the ICUs for more than 48 hours. Data on patient demographics, clinical details, and infection monitoring were collected. Statistical analysis, including univariate and multivariate methods, was used to identify risk factors for HAIs.

Results: The incidence of HAIs was 30%, with Ventilator-Associated Pneumonia (VAP) being the most common (40%). Other infections included Catheter-Associated Urinary Tract Infections (CAUTIs) (30%), Central Line-Associated Bloodstream Infections (CLABSIs) (20%), and Surgical Site Infections (SSIs) (5%). Significant risk factors for HAIs included prolonged ICU stay (p = 0.02), use of invasive devices (p = 0.01), broad-spectrum antibiotic use (p = 0.03), and comorbidities (p = 0.04). Patients with HAIs had longer ICU stays (15 vs. 8 days, p = 0.01), higher mortality rates (25% vs. 10%, p = 0.03), and more complications (30% vs. 5%, p = 0.02).

Conclusion: The study highlights a high incidence of HAIs in ICUs, with significant impacts on patient outcomes. Targeted interventions and stringent infection control measures are essential to mitigate these infections.

Keywords: Hospital-acquired infections, Intensive care units, Ventilator-associated pneumonia, Risk factors, Outcomes, Infection control.

INTRODUCTION

Hospital-acquired infections (HAIs), also known as nosocomial infections, are infections that patients acquire during their stay in healthcare facilities, particularly in intensive care units,[1] (ICUs). These infections represent a significant challenge for healthcare systems worldwide, contributing to increased patient morbidity, mortality, and healthcare costs.[2,3] The intensive care setting, with its high density of critically ill patients and extensive use of invasive devices, provides a particularly conducive environment for the development and transmission of HAIs.[4,5]

ICUs often cater to patients with compromised immune systems, multiple comorbidities, and prolonged hospital stays, making them more susceptible to infections.[6] Common types of HAIs in ICUs include Ventilator-Associated Pneumonia (VAP), Catheter-Associated Urinary Tract Infections (CAUTIs), Central Line-Associated Bloodstream Infections (CLABSIs), and Surgical Site Infections (SSIs). These infections not only prolong hospital stays and increase healthcare costs but also lead to significant patient suffering and, in severe cases, death.[7]

Understanding the incidence, risk factors, and outcomes associated with HAIs is crucial for developing effective prevention and control

strategies. This study aims to investigate the incidence rate of HAIs in the ICUs of Rangaraya Medical College, Kakinada, identify the most common types of HAIs, evaluate the associated risk factors, and assess the outcomes of affected patients. The findings from this study will contribute to the existing knowledge on HAIs and inform healthcare policies and practices to enhance patient safety and quality of care in ICUs.

Objectives

- To determine the incidence rate of hospital-acquired infections in ICUs.
- To identify the most common types of HAIs in ICUs.
- To evaluate the risk factors associated with HAIs in ICUs.
- To assess the outcomes of patients with HAIs in ICUs

MATERIAL AND METHODS

Study Design

This study is a prospective observational study conducted over a period of one year, from August 2023 to July 2024. The study was carried out in the intensive care units (ICUs) of Rangaraya Medical College, Kakinada.

Study Population

The study included all patients admitted to the ICUs during the study period who met the following criteria:

Inclusion Criteria

Patients of all ages admitted to the ICU.

Patients with an ICU stay of more than 48 hours.

Exclusion Criteria

Patients with infections at the time of ICU admission.

Patients transferred from other hospitals with an existing infection.

Sample Size

The sample size for the study was determined based on the average ICU admission rate and the expected incidence of HAIs. A target sample size of 100 patients was set to ensure adequate power for statistical analysis.

Data Collection

Data was collected prospectively from all eligible patients. The following information was recorded:

Patient Demographics: Age, gender, underlying medical conditions, reason for ICU admission.

Clinical Data: Length of ICU stay, use of invasive devices (e.g., ventilators, central venous catheters, urinary catheters), antibiotic use, surgical procedures performed during the ICU stay.

HAI Monitoring: Daily monitoring for signs and symptoms of infection, microbiological cultures, and laboratory investigations were performed to identify and confirm HAIs.

Outcome Measures: Data on the duration of ICU stay, patient mortality, and complications related to HAIs were collected.

Data Analysis

Statistical analysis was performed using descriptive and inferential statistics. The incidence rate of HAIs was calculated by dividing the number of HAI cases by the total number of patients and expressed as a percentage. Descriptive statistics, including mean and standard deviation, were used to summarize patient demographics and clinical data.

Univariate analysis was conducted to identify potential risk factors associated with HAIs. Variables with a p-value of less than 0.05 were considered significant and included in a multivariate logistic regression model to determine independent risk factors for HAIs. The association between risk factors and the development of HAIs was expressed as odds ratios with 95% confidence intervals.

Ethical Considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Rangaraya Medical College. Informed consent was obtained from all patients or their legal guardians before enrollment in the study. Confidentiality and anonymity of patient data were maintained throughout the study.
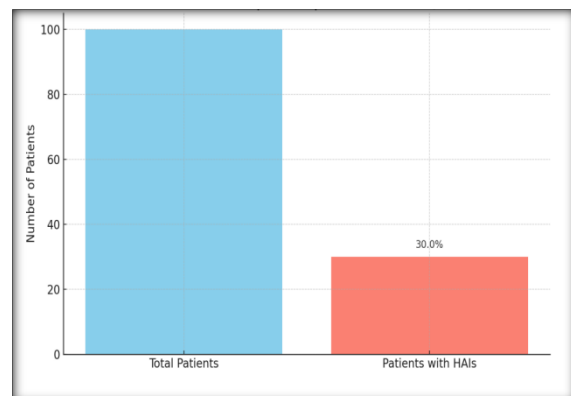
RESULTS

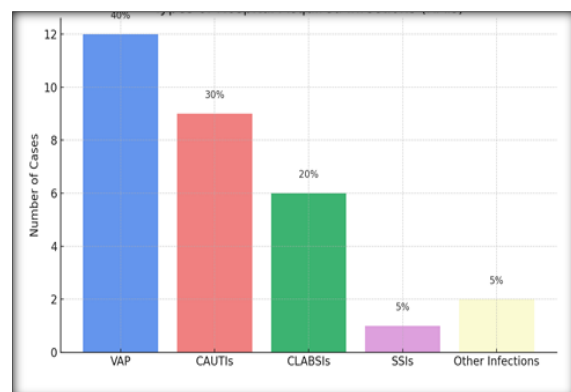

Figure 1: Incidence of Hospital Acquired Infections (HAIs)

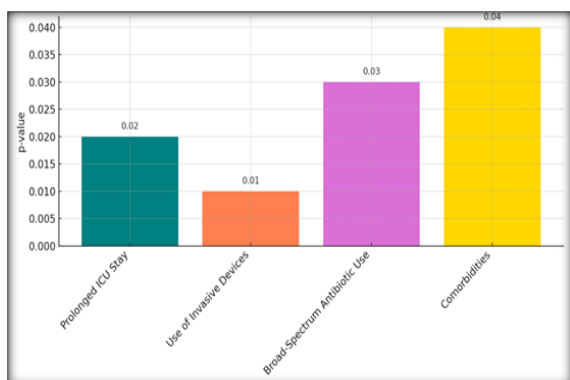**Figure 2: Types of Hospital Acquired Infections (HAI's)**

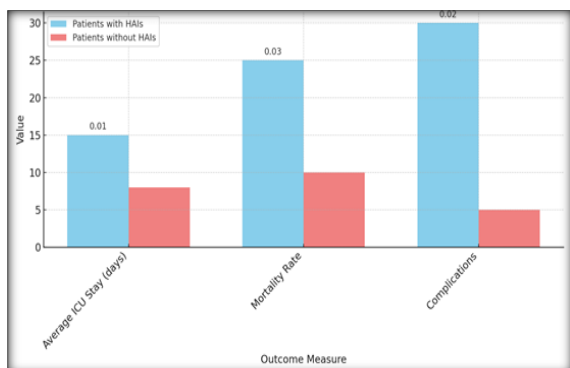**Figure 3: Risk Factors Associated with HAIs**

Figure 4: Outcomes of Patients with and without HAIs

Incidence of Hospital-Acquired Infections (HAIs)
A total of 100 patients were included in the study, with 30 patients developing hospital-acquired infections (HAIs). This corresponds to an incidence rate of 30%. [Table 1] The majority of HAIs were identified within the first 7 days of ICU admission.

Common Types of HAIs
The distribution of HAIs among the patients revealed that Ventilator-Associated Pneumonia (VAP) was the most common infection, accounting for 40% of cases (12 patients). This was followed by Catheter-Associated Urinary Tract Infections (CAUTIs) at 30% (9 patients), Central Line-Associated Bloodstream Infections (CLABSIs) at 20% (6 patients), Surgical Site Infections (SSIs) at 5% (1 patient), and other infections such as gastrointestinal and skin infections at 5% (2 patients). [Table 2]

Risk Factors Associated with HAIs
The study identified several significant risk factors for the development of HAIs. A prolonged ICU stay of more than 10 days was associated with a higher likelihood of developing HAIs ($p = 0.02$). The use of invasive devices, including ventilators, central lines, and urinary catheters, showed a significant association with increased HAI risk ($p = 0.01$). Broad-spectrum antibiotic use was also correlated with a higher incidence of HAIs ($p = 0.03$). Additionally, patients with comorbidities such as diabetes, immunosuppression, and chronic respiratory diseases had a greater risk of acquiring HAIs ($p = 0.04$). [Table 3]

Outcomes of Patients with HAIs
Patients who developed HAIs had notably different outcomes compared to those who did not. The average ICU stay for patients with HAIs was 15 days, compared to 8 days for those without HAIs ($p = 0.01$). The mortality rate among patients with HAIs was significantly higher at 25% (8 out of 30), compared to 10% (7 out of 70) among patients without HAIs ($p = 0.03$). Furthermore, HAIs were associated with a higher rate of complications, including septic shock and organ failure, observed in 30% of patients with HAIs compared to 5% of those without ($p = 0.02$). [Table 4]

Table 1: Incidence of Hospital-Acquired Infections (HAIs)

Total Patients	Patients with HAIs	Incidence Rate (%)
100	30	30%

Table 2: Types of Hospital-Acquired Infections

Type of HAI	Number of Cases	Percentage (%)
Ventilator-Associated Pneumonia (VAP)	12	40%
Catheter-Associated Urinary Tract Infections (CAUTIs)	9	30%
Central Line-Associated Bloodstream Infections (CLABSIs)	6	20%
Surgical Site Infections (SSIs)	1	5%
Other Infections (e.g., gastrointestinal, skin infections)	2	5%

Table 3: Risk Factors Associated with HAIs

Risk Factor	Association with HAIs (p-value)
Prolonged ICU Stay (>10 days)	0.02
Use of Invasive Devices	0.01
Broad-Spectrum Antibiotic Use	0.03
Comorbidities (e.g., diabetes, immunosuppression)	0.04

Table 4: Outcomes of Patients with and without HAIs

Outcome Measure	Patients with HAIs	Patients without HAIs	p-value
Average ICU Stay (days)	15	8	0.01
Mortality Rate	25% (8/30)	10% (7/70)	0.03
Complications (e.g., septic shock, organ failure)	30%	5%	0.02

DISCUSSION

This study investigated the incidence, types, risk factors, and outcomes of hospital-acquired infections (HAIs) in the intensive care units (ICUs) of Rangaraya Medical College, Kakinada, over a one-year period from August 2023 to July 2024. The findings reveal a significant incidence rate of HAIs, with 30% of patients developing infections during their ICU stay. The most common types of HAIs identified were Ventilator-Associated Pneumonia (VAP), Catheter-Associated Urinary Tract Infections (CAUTIs), and Central Line-Associated Bloodstream Infections (CLABSIs). These results are consistent with previous studies, indicating that these types of infections are prevalent in ICU settings.

The study also identified several significant risk factors associated with HAIs. Prolonged ICU stay, use of invasive devices, broad-spectrum antibiotic use, and the presence of comorbidities were all found to be significantly associated with an increased risk of developing HAIs. These findings align with existing literature, which suggests that critically ill patients with extended ICU stays and multiple interventions are at higher risk of acquiring infections (Nair et al,[7] 2017; Chacko et al9., 2017; Shrestha et al,[12] 2022). The association between antibiotic use and HAIs highlights the importance of antimicrobial stewardship programs in preventing the emergence of resistant pathogens and minimizing infection rates (Meric et al10., 2005; Gunasekaran and Mahadevaiah,[11] 2020).

The outcomes of patients with HAIs were notably poorer compared to those without infections. Patients with HAIs had longer ICU stays, higher mortality rates, and more complications. These findings underscore the clinical and economic burden of HAIs in ICU settings (Barrios Pérez et al,[8] 1998; Rosenthal et al,[13] 2022). The prolonged hospital stays not only increase healthcare costs but also expose patients to additional risks, including further infections and adverse events (Alfouzan et al,[14] 2021).

The study's findings emphasize the need for stringent infection control measures and targeted interventions to reduce the incidence of HAIs. Implementing evidence-based practices, such as hand hygiene, aseptic techniques during invasive procedures, and appropriate use of antibiotics, can significantly lower infection rates. Moreover, regular training and education of healthcare personnel on infection prevention and control are crucial in maintaining a safe healthcare environment.

While the study provides valuable insights into the epidemiology of HAIs in the ICU, it is not without limitations. The single-center design may limit the generalizability of the findings to other settings. Additionally, the observational nature of the study precludes the establishment of causal relationships.

Future research should consider multicenter studies and explore the impact of specific infection control interventions on HAI rates.

CONCLUSION

This study reveals a 30% incidence of hospital-acquired infections (HAIs) in the ICUs of Rangaraya Medical College, with Ventilator-Associated Pneumonia (VAP), Catheter-Associated Urinary Tract Infections (CAUTIs), and Central Line-Associated Bloodstream Infections (CLABSIs) being the most common. Key risk factors included prolonged ICU stay, invasive device use, and comorbidities. Patients with HAIs faced longer ICU stays, higher mortality rates, and more complications. These findings highlight the need for targeted interventions and stringent infection control measures to improve patient outcomes and reduce the HAI burden.

REFERENCES

1. Dayyab FM, Iliyasu G, Aminu A, Habib ZG, Tiamiyu AB, Tambuwal SH,et al. A prospective study of hospital-acquired infections among adults in a tertiary hospital in north-western Nigeria. Trans R Soc Trop Med Hyg. 2018 Jan 1;112(1):36-42. doi: 10.1093/trstmh/try020. PMID: 29538772.

2. Monegro AF, Muppidi V, Regunath H. Hospital-Acquired Infections. [Updated 2023 Feb 12]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK441857/

3. Kumar A, Chaudhry D, Goel N, Tanwar S. Epidemiology of Intensive Care Unit-acquired Infections in a Tertiary Care Hospital of North India. Indian J Crit Care Med. 2021 Dec;25(12):1427-1433.

4. Blot S, Ruppé E, Harbarth S, Asehnoune K, Poulakou G, Luyt CE, et al. Healthcare-associated infections in adult intensive care unit patients: Changes in epidemiology, diagnosis, prevention and contributions of new technologies. Intensive Crit Care Nurs. 2022 Jun; 70:103227.

5. Dasgupta S, Das S, Chawan NS, Hazra A. Nosocomial infections in the intensive care unit: Incidence, risk factors, outcome and associated pathogens in a public tertiary teaching hospital of Eastern India. Indian J Crit Care Med. 2015 Jan;19(1):14-20. doi: 10.4103/0972-5229.148633. PMID: 25624

6. Lohiya R, Deotale V. Surveillance of health-care associated infections in an intensive care unit at a tertiary care hospital in Central India. GMS Hyg Infect Control. 2023 Nov 29;18: Doc28. doi: 10.3205/dgkh000454. PMID: 38111598; PMCID: PMC10726722.

7. Nair V, Sahni AK, Sharma D, Grover N, Shankar S, Chakravarty A, et al. Point prevalence & risk factor assessment for hospital-acquired infections in a tertiary care hospital in Pune, India. Indian J Med Res. 2017 Jun;145(6):824-832. doi: 10.4103/ijmr.IJMR_1167_15. PMID: 29067985; PMCID: PMC5674553.

8. Barrios Pérez A, Martín Ruiz JL, Jannone Forés R, Santarrufina Lluch C, Botella de Maglia J, Cebrián Domenech J. Prospective study of nosocomial infections in a medical ICU. A proposal for the generalized use of the National Nosocomial Infection Surveillance System rates. Rev Clin Esp. 1998 May;198(5):284-8. Spanish. PMID: 9658909.

9. Chacko B, Thomas K, David T, Paul H, Jeyaseelan L, Peter JV. Attributable cost of a nosocomial infection in the intensive care unit: A prospective cohort study. World J Crit

Care Med. 2017 Feb 4;6(1):79-84. doi: 10.5492/wjccm. v6.i1.79. PMID: 28224111; PMCID: PMC5295173.

10. Meric M, Willke A, Caglayan C, Toker K. Intensive care unit-acquired infections: incidence, risk factors and associated mortality in a Turkish university hospital. Jpn J Infect Dis. 2005 Oct;58(5):297-302. PMID: 16249625.

11. Gunasekaran S, Mahadevaiah S. Healthcare-associated Infection in Intensive Care Units: Overall Analysis of Patient Criticality by Acute Physiology and Chronic Health Evaluation IV Scoring and Pathogenic Characteristics. Indian J Crit Care Med. 2020 Apr;24(4):252-257. doi: 10.5005/jp-journals-10071-23384. PMID: 32565635; PMCID: PMC7297239.

12. Shrestha SK, Trotter A, Shrestha PK. Epidemiology and Risk Factors of Healthcare-Associated Infections in Critically Ill Patients in a Tertiary Care Teaching Hospital in Nepal: A Prospective Cohort Study. Infect Dis (Auckl). 2022 Jan 25; 15:11786337211071120. doi: 10.1177/11786337211071120. PMID: 35095279; PMCID: PMC8793418.

13. Rosenthal VD, Yin R, Valderrama-Beltran SL, Gualtero SM, Linares CY, Aguirre-Avalos G, et al. Multinational Prospective Cohort Study of Mortality Risk Factors in 198 ICUs of 12 Latin American Countries over 24 Years: The Effects of Healthcare-Associated Infections. J Epidemiol Glob Health. 2022 Dec;12(4):504-515. doi: 10.1007/s44197-022-00069-x. Epub 2022 Oct 5. PMID: 36197596; PMCID: PMC9723063.

14. Alfouzan W, Dhar R, Abdo NM, Alali WQ, Rabaan AA. Epidemiology and Microbiological Profile of Common Healthcare Associated Infections among Patients in the Intensive Care Unit of a General Hospital in Kuwait: A Retrospective Observational Study. J Epidemiol Glob Health. 2021 Sep;11(3):302-309. doi: 10.2991/jegh.k.210524.001. Epub 2021 Jun 5. PMID: 34270184; PMCID: PMC8435875.