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Device-Associated Hospital-Acquired Infections in ICU and HDU: A Cross- Sectional Study

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ABSTRACT

Background: Hospital-acquired infections (HAIs), particularly device-associated infections, continue to be a major cause of preventable morbidity and mortality in critical care settings. Intensive Care Units (ICUs) and High Dependency Units (HDUs) are especially vulnerable due to frequent use of invasive devices and prolonged hospital stays.

Objective: To determine the incidence and pattern of device-associated hospital-acquired infections in ICU and HDU settings of a tertiary care government hospital and to assess microbiological profiles and sample contamination rates.

Methods: A cross-sectional observational study was conducted over two month in the ICU and HDU of the Medicine Department. Device-days for urinary catheters, central venous lines, and ventilators were recorded. CAUTI, CLABSI, and VAP rates were calculated per 1000 device-days using standardized definitions. Microbiological culture reports were analyzed, and data were subjected to descriptive statistical analysis.

Results: Hospital-acquired infections were observed in 8.4% of admitted patients. Device-associated infection rates were CAUTI 3.37%, CLABSI 2.50%, and VAP 2.53%, with higher rates observed in ICU compared to HDU. Gram-negative organisms predominated, including Pseudomonas aeruginosa, Klebsiella pneumoniae, and Acinetobacter baumannii. Sample contamination rates were notably high, reflecting gaps in aseptic collection practices.

Conclusion: The findings highlight a substantial burden of device-associated HAIs in critical care units. Strengthening infection prevention bundles, improving sample collection practices, and reinforcing antimicrobial stewardship are essential to reduce HAI rates in resource-limited tertiary care settings.

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INTRODUCTION

Hospital-acquired infections (HAIs) represent one of the most significant threats to patient safety and healthcare quality globally. Defined as infections occurring ≥48 hours after hospital admission, HAIs are associated with increased morbidity, mortality, length of hospital stay, and healthcare expenditure.[1,2] Despite advances in infection prevention strategies, HAIs remain highly prevalent, particularly in low- and middle-income countries.

The global prevalence of HAIs ranges from 5 to 7% in developed countries and increases to 10 to 20% in developing nations.[3] In India, the burden is further amplified

by high patient turnover, limited healthcare infrastructure, suboptimal infection control compliance, and escalating antimicrobial resistance.[4] Critical care units, including ICUs and HDUs, represent epicenters for HAIs due to the severity of illness, immunosuppression, and extensive use of invasive medical devices.

Device-associated infections—namely catheter-associated urinary tract infections (CAUTI), central line- associated bloodstream infections (CLABSI), and ventilator-associated pneumonia (VAP)—account for a substantial proportion of HAIs in intensive care settings.[5] These infections can be significantly reduced through adherence to evidence-based care bundles and surveillance systems such as those recommended by the Centers for Disease Control and Prevention (CDC) and National Healthcare Safety Network (NHSN).[6]

The microbiological landscape of HAIs has shifted over the past decade, with increasing dominance of multidrug-resistant Gram-negative organisms, posing serious therapeutic challenges.[7] Inadequate specimen collection techniques further compromise diagnostic accuracy, leading to contaminated cultures, inappropriate antibiotic usage, and amplification of resistance.[8]

Indian studies have consistently reported higher rates of device-associated HAIs compared to global benchmarks, emphasizing the need for context-specific data and targeted interventions.[9] However, limited published data are available from government tertiary care hospitals, particularly from combined ICU and HDU settings.

This study was therefore undertaken to evaluate the incidence, pattern, and microbiological profile of device-associated HAIs in ICU and HDU settings of a tertiary care government hospital, with an emphasis on identifying modifiable infection control gaps.

MATERIALS AND METHODS

Study Design and Setting

A hospital-based cross-sectional observational study was conducted in the ICU and HDU of the Medicine Department of a tertiary care government hospital in India.

Study Duration

The study was conducted over two-month period.

Study Population

All patients admitted to the ICU and HDU during the study period were included.

Inclusion Criteria

Patients requiring urinary catheterization, central venous catheterization, or mechanical ventilation for ≥48 hours.

Exclusion Criteria

Patients admitted for less than 48 hours and those without invasive devices.

Data Collection

Data were collected using a structured observational checklist, including demographic characteristics, device-days, microbiological culture results, and length of hospital stay. Data entry and validation were performed using Microsoft Excel 2016.

Outcome Measures

Device-associated infection rates were calculated per 1000 device-days using standardized formulas:[6]

- CAUTI rate
- CLABSI rate
- VAP rate

Statistical Analysis

Descriptive statistics were used to summarize data and results were expressed as percentages and rates.

Ethical Considerations

Ethical approval for this study was obtained from the Institutional Ethics Committee in accordance with ethical guidelines and principles. IEC number 391/Ethics/2024 dated 17/05/2026. The study involved no direct patient interaction. Confidentiality and anonymity of patient data were strictly maintained.

RESULT

Study Population and Patient Characteristics

During the two-month study period, a total of 237 patients were admitted to the Medicine Department, including 36 patients in the ICU and 201 patients in the HDU. All patients included in the study had exposure to at least one invasive

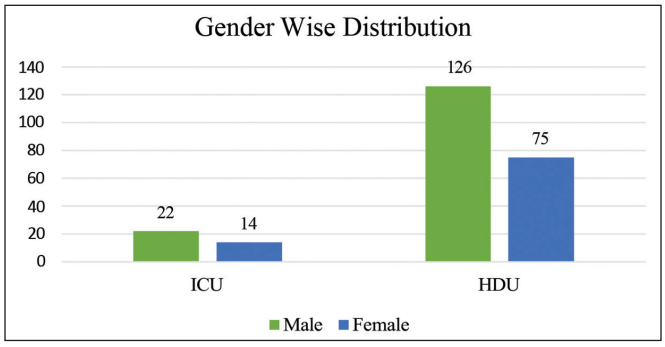

Figure 1: Bar graph of gender-wise distribution of study population.

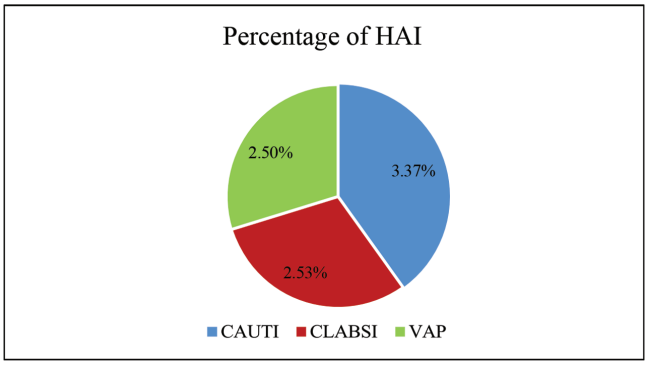

Figure 2: Distribution of Device Associated HAI.

medical device for more than 48 hours. The gender-wise distribution in both units is presented in Figure 1.

Overall Incidence of Hospital-Acquired Infections

Out of the total study population, 20 patients (8.4%) developed hospital-acquired infections during their hospital stay. The incidence of HAIs was higher among patients admitted to the ICU (13.9%) compared to those admitted to the HDU (7.5%).

Distribution of Device-Associated Infections

Among the identified hospital-acquired infections, device-associated infections constituted the majority. The overall distribution of device-associated HAI (Figure 2) was as follows:

- Catheter-associated urinary tract infections (CAUTI): 3.37%
- Central line-associated bloodstream infections (CLABSI): 2.50%
- Ventilator-associated pneumonia (VAP): 2.53%

Unit-Wise Distribution of Device-associated Infection Rates

In the ICU, higher rates of device-associated infections were observed compared to the HDU. The infection rates per 1000 device-days were presented in Table 1 and Figure 3.

Microbiological Profile of Isolated Organisms

Analysis of microbiological culture reports revealed a predominance of Gram-negative organisms. Distribution of the most commonly isolated pathogens is presented in Figure 4.

Table 1: Unit-wise Distribution of Infection rate.

Indicators	ICU	HDU
CAUTI	10	13.3
CLABSI	5.5	12.5
VAP	8	8.9

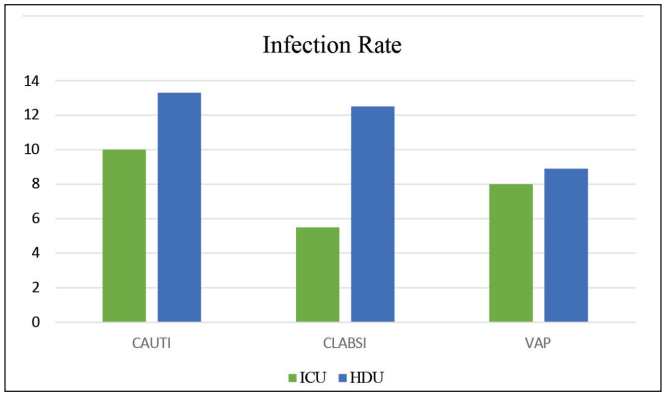

Figure 3: Bar graph of Unit wise Distribution of Infection rate.

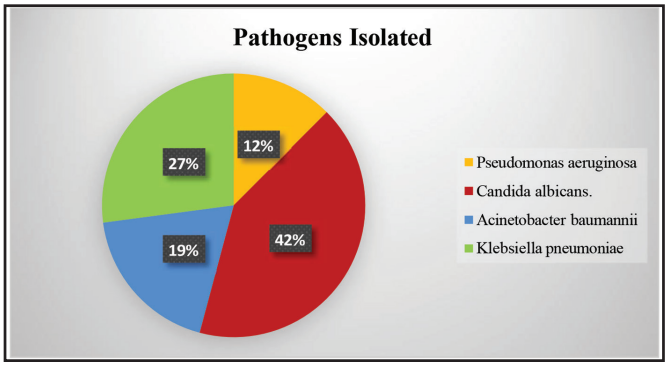

Figure 4: Pie Chart of pathogens isolated in the study.

Contaminated Laboratory Samples

A substantial proportion of laboratory samples were reported as contaminated. The contamination rate was 19.44% in ICU and 25.87% in HDU, primarily attributed to inappropriate sample collection techniques. The data is presented in Figure 5.

Length of Hospital Stay and Outcome

Patients who developed hospital-acquired infections demonstrated a longer duration of hospital stay compared to

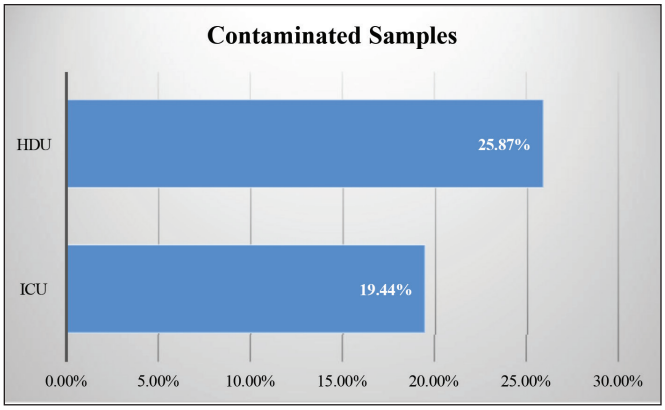

Figure 5: Bar Graph of contaminated samples distribution from the units.

non-infected patients. However, no statistically significant mortality difference was assessed due to the descriptive nature of the study.

DISCUSSION

The present study demonstrates a significant burden of device-associated hospital-acquired infections in ICU and HDU settings, with an overall HAI rate of 8.4%. This finding aligns with previously reported Indian data but remains higher than rates reported from developed healthcare systems.[3,6]

The predominance of Gram-negative pathogens such as Pseudomonas aeruginosa, Klebsiella pneumoniae, and Acinetobacter baumannii mirrors trends reported in other Indian and international studies.[7,9] These organisms are frequently associated with multidrug resistance, complicating clinical management and contributing to adverse outcomes. Higher infection rates observed in ICU compared to HDU patients can be attributed to increased severity of illness, longer device utilization, and higher exposure to invasive procedures. The notable rate of contaminated samples highlights deficiencies in aseptic sample collection practices, underscoring the need for targeted staff training and protocol reinforcement.

Implementation of standardized infection prevention bundles, regular surveillance, and antimicrobial stewardship programs has been shown to significantly reduced device-associated infection rates.[10-12] The findings of this study reinforce the importance of sustained institutional commitment to infection control practices in tertiary care government hospitals.

CONCLUSION

Device-associated HAIs remain a substantial challenge in ICU and HDU settings. Strengthening infection control bundles, improving sample collection practices, and reinforcing antimicrobial stewardship are essential to reduce HAI burden in resource-constrained tertiary care hospitals.

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