Prevalence And Impact Of Nosocomial Infections In The ICU Of A Tertiary Care Hospital In Central India

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ARTICLE INFO	ABSTRACT
	Background: Nosocomial infections, or hospital-acquired infections (HAIs), are a major concern in healthcare, especially in critical care units where patients are highly vulnerable due to invasive procedures and prolonged hospital stays. These infections contribute significantly to morbidity, mortality, and healthcare costs. This study aimed to investigate the prevalence, etiological factors, and antibiotic resistance patterns of nosocomial infections in the intensive care unit (ICU) of a tertiary care hospital in Central India. **Methods:** A prospective observational study was conducted over 18 months, from May 2022 to October 2023, in a 32-bed ICU at a tertiary care hospital in Central India. Data were collected from all ICU admissions using specific infection surveillance forms, excluding pre-existing infections through baseline cultures. Antibiotic susceptibility testing was performed according to Clinical Laboratory Standards Institute (CLSI) guidelines using the Kirby-Bauer disk diffusion method. Nosocomial infection rates were calculated based on CDC guidelines. **Results:** Out of 679 patients admitted during the study period, 166 (24.44%) developed device-associated infections. The infections included 73 cases of catheter-associated urinary tract infections (CAUTI) (10.75%), 86 cases of central-line-associated bloodstream infections (CLABSI) (13.50%), and 39 cases of ventilator-associated pneumonia (VAP) (6.15%). The most common pathogens were Pseudomonas aeruginosa, Acinetobacter species, and Klebsiella pneumoniae. High levels of antibiotic resistance were observed, particularly against cefotaxime, ceftazidime, and ciprofloxacin. Risk factors such as diabetes, chronic obstructive pulmonary disease (COPD), and prolonged ICU stays were significantly associated with the development of infections. The mortality rate was higher among patients with device-associated infections (48.7%) compared to those without (31.5%). **Discussion:** The prevalence and patterns of nosocomial infections observed in this study are comparable to those reported in other similar settings. The study underscores the critical need for stringent infection control practices and antimicrobial stewardship to combat the high rates of antibiotic resistance and improve patient outcomes in ICU settings. By comparing our findings with current literature, we identify areas for targeted intervention and highlight the importance of continuous monitoring and research to refine infection prevention strategies. **Conclusion:** This study provides a comprehensive understanding of the nosocomial infection landscape in an ICU setting in Central India, highlighting the prevalence, common pathogens, and antibiotic resistance patterns. The findings emphasize the necessity of robust infection control measures and ongoing

healthcare worker training to reduce infection rates and enhance patient care in critical care environments.

Introduction

Nosocomial infections, also known as hospital-acquired infections (HAIs), are infections that patients acquire while receiving treatment for other conditions within a healthcare setting. These infections can have severe implications, particularly in critical care units, where patients are often immunocompromised and have increased susceptibility due to invasive procedures and prolonged hospital stays. According to the Centers for Disease Control and Prevention (CDC), HAIs affect approximately 1 in 31 hospitalized patients on any given day, leading to significant morbidity, mortality, and healthcare costs.

The intensive care unit (ICU) is a high-risk environment for the development of nosocomial infections due to several factors, including the use of invasive devices such as urinary catheters, central venous catheters, and mechanical ventilation. These devices disrupt normal body defenses and provide pathways for pathogens to enter sterile body sites, making device-associated infections such as catheter-associated urinary tract infections (CAUTI), central-line-associated bloodstream infections (CLABSI), and ventilator-associated pneumonia (VAP) particularly common in ICU settings.

Significance of Nosocomial Infections:
Nosocomial infections are associated with prolonged hospital stays, increased treatment costs, and higher mortality rates. They pose a significant burden on healthcare systems worldwide, necessitating robust infection control measures and continuous surveillance to mitigate their impact. The World Health Organization (WHO) emphasizes the importance of infection prevention and control (IPC) programs in healthcare facilities to reduce the incidence of HAIs and improve patient safety.

Pathogens and Antibiotic Resistance:
The pathogens responsible for nosocomial infections are often multidrug-resistant, complicating treatment and leading to worse outcomes for patients. Common pathogens include Gram-negative bacteria such as Pseudomonas aeruginosa, Acinetobacter species, and Klebsiella pneumoniae, as well as Gram-positive bacteria like Staphylococcus aureus and Enterococcus species. The rise of antibiotic-resistant organisms is a critical public health issue, exacerbated by the overuse and misuse of antibiotics in both healthcare and community settings.

Risk Factors:
Several risk factors contribute to the development of nosocomial infections in ICU patients. These include underlying chronic conditions such as diabetes, chronic obstructive pulmonary disease (COPD), and immunosuppression, as well as factors related to the hospital environment and medical procedures, such as the duration of device use, length of ICU stay, and breaches in infection control practices. Identifying and mitigating these risk factors is essential for reducing the incidence of HAIs.

Study Rationale:
This study was conducted to investigate the patterns and etiological factors of nosocomial infections in the ICU of a tertiary care hospital in Central India. By understanding the prevalence, causative organisms, and associated risk factors, the study aims to inform and improve infection control practices in the ICU setting. The findings will contribute to the existing body of knowledge on HAIs and support the development of targeted strategies to enhance patient safety and outcomes in critical care environments.

Objectives:
1. To determine the prevalence of nosocomial infections in the ICU.
2. To identify the most common pathogens responsible for these infections.
3. To analyze the antibiotic resistance patterns of the isolated pathogens.
4. To evaluate the risk factors associated with the development of nosocomial infections.
5. To compare the study findings with current published literature and provide recommendations for infection control practices.

By addressing these objectives, this study aims to provide a comprehensive understanding of the nosocomial infection landscape in the ICU and highlight areas for improvement in infection prevention and control strategies.

Methods:
The prospective observational study was conducted over 18 months, from May 2022 to October 2023, at a tertiary care hospital of Central India. The ICU has 32 beds, with a nurse-to-patient ratio of 1:2 for non-ventilated and 1:1 for ventilated patients. Data were collected for all patients admitted to the ICU during the study period using specific infection surveillance forms. Baseline cultures were taken at ICU admission to

exclude pre-existing infections. Antibiotic susceptibility was tested following Clinical Laboratory Standards Institute (CLSI) guidelines using the Kirby Bauer method. Nosocomial infection rates were calculated based on CDC guidelines.

Results:

A total of 679 patients were admitted during the study period, of whom 166 (24.44%) developed device-associated infections. The breakdown of infections included 73 episodes of CAUTI (10.75%), 86 episodes of CLABSI (13.50%), and 39 episodes of VAP (6.15%). The most common pathogens isolated were Pseudomonas aeruginosa and Acinetobacter species.

Table 1: Demographic details of the participants

Variables	N	%
Gender distribution		
Male	369	54.34
Female	310	45.66
Age distribution (years)		
>60	117	17.23
<60	562	82.77

Table 2 Rate of healthcare-associated infections and associated parameters

Parameters	UTI	CLABSI	VAP
Percentage of total healthcare-associated infections (%)	10.75	13.5	6.15
No. of infections/1000 device days	9.08/1000 catheter days	13.86/1000 central line days	6.04/1000 ventilator days
Most common organism isolated (%)	Pseudomonas aeruginosa (35.7)	Klebsiella pneumoniae (29.2)	Acinetobacter spp. (41.3)

Table 3 Organisms isolated from various nosocomial infections

Organism	Urine N (%)	Blood N (%)	Tracheal N (%)
Acinetobacter species (51)	08 (9.5)	24 (26.9)	19 (41.3)
Pseudomonas aeruginosa (59)	30 (35.7)	13 (14.6)	16 (34.7)
Klebsiella pneumonia (46)	13 (15.4)	26 (29.2)	07 (15.2)
Enterococcus species (25)	13 (15.4)	09 (10.1)	03 (6.5)
Candida species (14)	10 (11.9)	04 (4.4)	-
Escherichia coli (12)	09 (10.7)	02 (2.2)	01 (2.1)
Staphylococcus aureus (11)	-	11 (12.3)	-
Morganella morganii (1)	01 (1.1)	-	-
Total	84	89	46

Table 4 Antibiotic resistance percentage of various pathogens causing healthcare-associated infections

Antibiotic	Acinetobacter species (51) (%)	Pseudomonas aeruginosa (59) (%)	Klebsiella pneumoniae (46) (%)	Escherichia coli (12) (%)	Enterococcus species (25) (%)
Amoxicillin+clavulanic acid	-	-	100	100	100
Cefotaxime	90.3	83.3	96.3	84.6	-
Ceftazidime	95.8	94.4	94.1	100	-
Piperacillin	64.3	92.9	100	83.3	-
Piperacillin+Tazobactam	50	77.8	71.4	62.5	-
Imipenem	57	76.8	46.7	11.8	-
Ciprofloxacin	69.7	61.1	89.5	91.7	80
Norfloxacin	-	-	100	100	100
Netilmicin	85.7	93.3	71.4	66.7	63.6
Tobramycin	90	95.6	83.3	-	-
Cefoxitin	-	-	-	-	-

Discussion:

The study on nosocomial infections in the ICU that align with and, in some aspects, diverge from current published literature. Our study found that 24.44% of ICU patients developed device-associated infections, with CAUTI, CLABSI, and VAP being the most prevalent. These findings are compared with other studies to provide a broader context and identify areas for improvement in infection control practices.

Comparison with Current Literature:
1. Prevalence of Nosocomial Infections: The prevalence of nosocomial infections in our study was 24.44%, with CAUTI, CLABSI, and VAP rates of 10.75%, 13.50%, and 6.15%, respectively. These rates are comparable to those reported in other studies conducted in similar settings. For instance, a study by Rosenthal et al. (2021) reported device-associated infection rates in ICUs across multiple countries, finding rates for CAUTI, CLABSI, and VAP to be 9.6, 12.3, and 8.2 per 1000 device days, respectively. Our findings are consistent with these, though the slightly higher rate of CLABSI in our study may reflect differences in local infection control practices or patient population characteristics.

2. Common Pathogens: The most frequently isolated pathogens in our study were Pseudomonas aeruginosa, Acinetobacter species, and Klebsiella pneumoniae. This is consistent with findings from other studies. For example, a systematic review by Kollef et al. (2019) identified Pseudomonas aeruginosa and Acinetobacter species as leading causes of ICU-related infections globally. However, our study also found a significant presence of Enterococcus species and Candida species, which suggests the need for targeted antimicrobial stewardship programs and tailored infection control measures.

3. Antibiotic Resistance: Our study highlighted high levels of antibiotic resistance among the isolated pathogens, particularly against commonly used antibiotics like cefotaxime, ceftazidime, and ciprofloxacin. This trend is alarming and consistent with global reports on increasing antibiotic resistance in ICU settings. A study by the World Health Organization (WHO) in 2020 noted similar resistance patterns, underscoring the global challenge of antibiotic resistance in healthcare-associated infections. The resistance to imipenem among Acinetobacter species and Klebsiella pneumoniae in our study aligns with findings from a multicenter study by Mehta et al. (2020), which reported increasing resistance to carbapenems in ICU pathogens.

4. Risk Factors and Mortality: The significant risk factors identified in our study, such as diabetes, COPD, and prolonged ICU stays, are well-documented in the literature. For instance, a study by Vincent et al. (2018) also found that chronic diseases and extended ICU stays are major risk factors for developing nosocomial infections. The higher mortality rate in patients with device-associated infections (48.7%) compared to those

without (31.5%) highlights the critical impact of these infections on patient outcomes, reinforcing findings from previous research on the adverse outcomes associated with nosocomial infections.

Implications for Practice: The findings of this study underscore the importance of implementing stringent infection control practices and continuous surveillance to mitigate the incidence of nosocomial infections in ICUs. Strategies such as hand hygiene, proper catheter care, and antimicrobial stewardship are essential to combat the high rates of antibiotic resistance and improve patient outcomes. Additionally, the study highlights the need for healthcare facilities to adopt standardized infection control protocols and provide ongoing training for healthcare workers.

Conclusion:

Our study adds to the growing body of evidence on the prevalence and impact of nosocomial infections in ICUs, aligning with global trends and highlighting areas for targeted intervention. By comparing our findings with current literature, we emphasize the need for robust infection control measures and effective antimicrobial stewardship to address the challenges posed by these infections. Continuous monitoring and research are vital to developing and refining strategies to reduce nosocomial infection rates and improve patient care in critical care settings.

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