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Original Research Article

Incidence of Central Line-Associated Bloodstream Infections in ICU Patients at Katihar Medical College and Hospital

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Abstract:

Background: Central line-associated bloodstream infections (CLABSIs) are one of the most significant healthcare-associated infections in intensive care units (ICUs), leading to increased morbidity, mortality, prolonged hospital stays, and higher healthcare costs. The burden is particularly concerning in resource-limited settings, where antimicrobial resistance further complicates treatment.

Aim: To determine the incidence, risk factors, microbial profile, and antimicrobial resistance patterns of CLABSI in ICU patients at Katihar Medical College and Hospital.

Methods: This prospective observational study was conducted from April 2023 to September 2024 in the Department of Microbiology, Katihar Medical College and Hospital, Bihar. A total of 124 ICU patients with central venous catheters in place for more than 48 hours and showing clinical suspicion of bloodstream infection were included. Blood samples and catheter tips were cultured, and isolates were identified using standard microbiological techniques and the VITEK 2 Compact system. Antimicrobial susceptibility was tested, and CLABSI incidence was calculated per 1000 central line days.

Results: Among the 124 patients, the highest incidence of CLABSI occurred in the 41–60 year age group (41.9%) with male predominance (61.3%). Most cases developed after 8–21 days of catheter use. Diabetes mellitus (33.9%) was the most common comorbidity. Fever (79%) was the predominant presenting symptom. Gram-negative organisms (58.1%) were the leading pathogens, with *Klebsiella pneumoniae* (33.3%) and *Escherichia coli* (25%) most frequent. Gram-positive isolates (30.6%) were dominated by *Staphylococcus aureus* (47.4%), while fungi (11.3%) were mainly Candida albicans. Gram-negative isolates showed high resistance to ceftriaxone (48%) and ciprofloxacin (42%), whereas Gram-positives were highly resistant to penicillin (62%). Vancomycin and linezolid remained effective against Gram-positive organisms, while colistin retained excellent activity against Gram-negatives. The overall CLABSI rate was 8.1 per 1000 central line days, with a device utilization ratio of 0.62.

Conclusion: CLABSIs represent a significant infection control challenge, particularly among critically ill, middle-aged to elderly patients with comorbidities and prolonged catheterization. The predominance of multidrug-resistant Gram-negative organisms is alarming, though vancomycin and colistin continue to offer reliable treatment options.

Recommendations: Regular surveillance, strict adherence to aseptic insertion and maintenance bundles, timely removal of catheters, and robust antimicrobial stewardship programs are essential to reduce CLABSI rates and combat antimicrobial resistance.

Keywords: Central Line-Associated Bloodstream Infection, Intensive Care Unit, Antimicrobial Resistance, Klebsiella Pneumoniae, Catheter-Related Infection.

Introduction

Central line-associated bloodstream infections (CLABSIs) remain a major healthcare-associated infection in intensive care units (ICUs), contributing significantly to patient mortality, morbidity, and economic burden. A 2025 meta-analysis of Chinese ICU data reported CLABSI rates ranging widely—from 2 to 147.3 per 1,000 central-line days—highlighting regional variability and substantial impact on patient outcomes and cost of care [1]. Resource-limited settings continue

to face high rates; for instance, Northern India reported a CLABSI rate of 17.04 per 1,000 catheter days with mortality exceeding 50%, driven by risk factors such as prolonged catheter duration, immunosuppression, and advanced age [2].

Global trends show mixed progress. A European surveillance study covering 2020–2021 found CLABSI incidence densities of approximately 4.1 to 4.9 per 1,000 central-line days, with rates spiking during the COVID-19 pandemic before slightly falling again [3]. In contrast, adult ICUs in Victoria, Australia, achieved a significant 49% reduction in CLABSI rates over 2011–2022—from 1.39 to 0.70 per 1,000 central-line days—accompanied by declining device utilization and evolving pathogen profiles, including increases in coagulase-negative staphylococci and reduced MRSA but rising ceftriaxone-resistant Escherichia coli [4].

Antimicrobial resistance (AMR) presents a formidable challenge in CLABSI management. The Mumbai tertiary care experience (2011–2018) revealed that Gram-negative pathogens accounted for 80% of CLABSIs, with extended-spectrum beta-lactamase–producing organisms comprising 80%, and carbapenem resistance around 50% [5]. Global concerns over emerging carbapenem-resistant Enterobacteriaceae—especially Klebsiella pneumoniae—underscore the growing threat of 'nightmare bacteria', associated with high mortality and limited treatment options [6].

These findings underscore that CLABSIs in critically ill patients are both common and preventable. Variation in incidence across regions and hospitals points to the importance of adherence to infection control bundles and catheter management strategies. The worsening AMR landscape further complicates empirical and targeted therapy decisions, particularly in low- and middle-income countries where high-resistance Gram-negative infections are prevalent.

This study therefore aims to build upon this international context by presenting comprehensive data from a tertiary care ICU, including CLABSI incidence, device utilization, patient risk factors, pathogen spectrum, and antimicrobial resistance patterns, thereby informing improved preventive and stewardship strategies.

Materials & Methods

This prospective hospital-based observational study was conducted in the Department of Microbiology, Katihar Medical College and Hospital, Katihar, Bihar, from April 2023 to September 2024. A total of 124 patients admitted to the ICU, who had a Central Venous Catheter inserted after admission to the Emergency Department or in the Medical ICU, were included in the study.

Type of Study: This prospective hospital-based observational study was carried out in the Department of Microbiology, Katihar Medical College and Hospital, Katihar, Bihar.

Place of Study: The isolates were obtained from blood and central venous catheter tips from the inpatient wards of the Medical and Surgical Intensive Care Units (ICUs) of Katihar Medical College and Hospital, Katihar.

Duration of Study: The study was conducted over a period of 18 months (April 2023 to September 2024).

Study Population: All the patients admitted to the Medical or Surgical ICUs who had a central venous line for at least 48 hours or removed within the last 24 hours prior to blood collection, and who had signs and symptoms or clinical suspicion of bloodstream infection during the study period, were included in the study.

Inclusion Criteria

- Patients who gave informed consent.
- All ICU patients with an indwelling central line for >48 hours with systemic signs and symptoms or clinical suspicion of central line-associated bloodstream infection (CLABSI).
- ICU patients with a central venous catheter insertion in the hospital and no infection at the time of admission to the ICU.
- Patients with systemic signs and symptoms or clinical suspicion of central line-associated bloodstream infection with a history of removal of the central line within the last 24 hours.

Exclusion Criteria

- Patients who died or were discharged within 48 hours of admission.
- Patients without a central line in the last 24 hours.

Sample Size: A total of approximately 124 consecutive, non-repetitive samples were collected from patients with suspected central line-associated bloodstream infections (CLABSIs), according to the definitions laid down by the Centers for Disease Control and Prevention (CDC). The samples were duly processed in the Microbiology Laboratory, Katihar Medical College, Katihar. The incidence rate of CLABSI was expressed as the number of episodes per 1000 central line days.

Calculation of Incidence

(i) The CLABSI rate per 1000 central line days was calculated by dividing the number of CLABSIs by the number of central line days and multiplying the result by 1000.

$$\text{CLABSI Rate} = \frac{\text{number of CLABSI}}{\text{number of central line days}} \times 1000$$

(ii) The Central Line Utilization Ratio was calculated by dividing the number of central line days by the number of patient days. [2].

$$\text{Device Utilization Ratio (DUR)} = \frac{\text{number of central line days}}{\text{number of patients days}}$$

Plan of the Study: Informed Consent – Both the patients and their attendants were explained about the procedures of collection of the specimens, and duly signed consent forms were obtained.

Performa – A performa for patient-related data collection was filled for each case. It included:

- Identification of the patient (name, age, sex, address, ward, bed no, date of admission, date of discharge)
- Clinical history
- Procedure date (CVC insertion)
- Date of event
- Signs and symptoms (fever, chills, rigor, hypotension)
- Antibiotic history
- Debilitating illness (diabetes mellitus, anaemia, malignancy, HIV, malnutrition, immunosuppressant administration)
- History of infection at another site

Collection of Samples: Blood from peripheral vein + blood from CVC and CVC tip (if removed) Samples were collected from patients with CVC for >48 hours presenting with fever (>38°C), chills, or hypotension. As per standard protocol, a minimum of one set (two bottles) was obtained 48 hours after CL insertion. Blood samples were collected from at least two sites at an interval of at least 15 minutes, one from the central line and another by peripheral venipuncture.

Methods of Collection of Samples: Peripheral Blood Samples – Sterile surgical hand gloves were worn prior to initiating the procedure. The vein to be used was chosen by palpation before it was disinfected. Using 70% alcohol, the skin over the proposed venipuncture site was cleaned in a circle of approximately 5 cm diameter, starting at the centre and moving outwards, and allowed to air dry. Then 2% tincture of iodine (or povidone-iodine) was applied in ever-widening circles until the entire area was saturated, and it was left for at least 1 minute to dry. If re-palpation was required, the gloved fingers were disinfected similarly. The needle of the syringe was inserted into the vein and blood was withdrawn. The blood was injected directly into the blood culture broth. The needles were not changed before inoculating into automated blood culture bottles. After removing the needle, the site was cleaned again with 70% alcohol. The volume collected was 10 ml per venepuncture for adults and 2–5 ml for children. Bottles were labelled and sent to the Microbiology Laboratory.

Blood Samples from Central Line – After wearing sterile gloves, the catheter hub was cleaned with alcohol, tincture of iodine, or alcoholic chlorhexidine (>0.5%) and allowed to dry. Infusions through the CVC line were stopped before sampling. A new syringe was attached to the CVC hub and 8–10 ml of blood was collected, then immediately inoculated into an automated blood culture bottle. If peripheral vein collection was not possible, two samples were drawn through different catheter lumens. Paired blood samples from CVC and peripheral vein were collected and labelled appropriately, then transported to the Microbiology Laboratory before antimicrobial therapy initiation.

CVC Tip – The distal 5 cm of the catheter tip was cut with a sterile blade, placed in a sterile container, labelled, and sent to the laboratory.

Identification of Microorganisms: The isolates obtained from the various specimens, namely peripheral blood, CVC blood samples, and CVC catheter tips, were identified by studying colony characteristics, Gram staining, motility tests, and preliminary biochemical tests. The VITEK 2 Compact automated system was used for final identification and susceptibility testing.

Colony characteristics: The criteria used to characterize the bacterial growth included size, shape, colour, margin, surface, elevation, opacity, consistency, odour, and other changes in agar medium from bacterial growth.

Smear examination was carried out by Gram's method of staining, and motility tests were performed using the hanging drop preparation. Similar colonies from blood and catheter cultures were processed separately for identification. If the same strain was isolated, it was considered the causative organism of CLABSI.

Gram's staining

This method divided the bacteria into either Gram positive or Gram negative.

Reagents required:

- Crystal violet
- Gram's iodine
- Acetone alcohol (acetone: 95% ethanol = 1:1)
- Safranine

Method:

- Smears were prepared on clean grease-free glass slides and air-dried.
- They were fixed by gentle heating over flame.

- Crystal violet stain was poured over the slide and kept for 1 min.
- Slides were washed, followed by Gram's iodine for 1 min.
- Slides were washed again with water.
- The smear was decolorized with acetone-alcohol until no more stain flowed.
- They were washed again and counterstained with safranine for 1 min.
- Finally, they were washed with water and blotted dry.

Result:

Gram-positive cocci, Gram-negative bacilli, and Gram-positive budding cells were identified under oil immersion (100x objective), and findings were documented.

Identification Tests for Gram Positive Organisms

1. **Catalase Test**

This test detected the ability of organisms to produce catalase, which released nascent oxygen from hydrogen peroxide.

- **Method:** A small colony was placed in 3% hydrogen peroxide using a sterile stick.
- **Result:** Evolution of bubbles indicated a positive result; no bubbles indicated a negative result.

2. **Coagulase Test**

This test differentiated Staphylococcus aureus from coagulase-negative staphylococci.

(i) **Slide Method**

- **Method:** A saline suspension of the organism was prepared on a slide in two spots. Plasma was added to one (test) and saline to the other (control). The slide was rocked gently, and clumping was observed within 5–10 seconds.
- **Result:** Clumping in the test indicated positive; no clumping indicated negative.

(ii) **Tube Method**

- **Method:** Colonies from 24-hour growth were emulsified in 1 ml diluted plasma (1:5). Tubes were incubated at 37°C and checked after 1, 2, and 4 hours, and overnight.
- **Result:** Formation of coagulum indicated positive; absence indicated negative.

Identification Tests for Gram Negative Organisms

1. **Catalase Test**

Performed as described for Gram positive organisms.

2. **Oxidase Test**

- **Method:** A smear of the organism was applied to filter paper impregnated with oxidase reagent (1% tetramethyl-p-phenylenediamine dihydrochloride).
- **Result:** Dark purple within 10 seconds was positive; no colour change was negative.

3. **Motility Test (Hanging Drop Method)**

- **Method:** Broth cultures were incubated 1–2 hours. A drop was placed on a coverslip and inverted over a cavity slide.
- **Result:** Darting movement indicated positive; stationary organisms indicated negative.

4. **Germ Tube Test**

- **Method:** Suspected yeast colonies were inoculated in sheep serum and incubated at 35–37°C for 2–3 hours. A drop was mounted and examined under a microscope.
- **Result:** Presence of germ tubes indicated positive.

VITEK 2 Compact System: The VITEK 2 Compact system was used for further identification and antimicrobial susceptibility testing. It employed ID and AST cards, providing results within 10–18 hours, thereby reducing turnaround time compared to conventional methods.

The Gram positive and Gram-negative ID cards included biochemical substrates for carbon utilization, enzymatic activity, and resistance markers. AST cards provided MIC values based on automated broth microdilution.

Identification and Susceptibility cards used:

	Identification cards	Susceptibility cards
Gram Negative (GN) LF[165]	GN card	AST-N405, AST-N407
Gram Negative (GN) NLF[165]	GN card	AST-N406
Gram Positive (GP)[166]	GP card	AST-P628
Yeast[167]	YST card	AST-YS08

For Gram Positive Cocci (GPC): **Content of GP-AST Cardusedin VITEK-2 automated system:**

S. No.	Name of Antibiotic	Concentration	Calling range (≤)	Calling range (≥)
1.	Benzylpenicillin Staphylococcus spp. Enterococcus spp. S. agalactiae	0.125, 0.25, 1, 2, 8,64	 0.03 0.12 0.12	 0.5 64 64
2.	Cefoxitinscreen	6	NEG	POS
3.	Ciprofloxacin	1,2,4	0.5	8
4.	Clindamycin	0.06,0.25,1	0.125	4
5.	Daptomycin	0.5,1,2,4,16	0.12	8
6.	Erythromycin	0.25,0.5,2	0.25	8
7.	Gentamycin	8,16,64	0.5	16
8.	GentamycinHigh Level (Synergy)	500	S	R
9.	Inducible Clindamycin Resistance	CM0.5CM/E 0.25/0.5	NEG	POS
10.	Levofloxacin	0.25,2,8	0.12	8
11.	Linezolid	0.5,1,2	0.5	8
12.	Nitrofurantoin	16,32,64	16	512
13.	Oxacillin	0.5,1,2	0.25	4
14.	Rifampicin	0.015,0.03,0.1 2.5,0.5	0.03	4
15.	Teicoplanin	1,4,8,16	0.5	32
16.	Tetracycline	0.5,1,2	1	16
17.	Tigecycline	0.25,0.5,1	0.12	2
18.	Trimethoprim/ sulfamethoxazole	2/38,8/152,16/304	10(0.5/9.5)	320(16/304)
19.	Vancomycin	1,2,4,8,16	0.5	32

For Gram-Negative Bacilli (GNB) **For** **LF:**

Content of GN-AST card used in VITEK automated system:

S. No.	Nameof Antibiotic	Concentration	Calling range (≤)	Calling range (≥)
1.	Amikacin	2,4,16,48	1	64
2.	Amoxicillin/Clavulanic acid	4/2,16/8,32/16	2/1	32/16
3.	Cefepime	0.25,1,4,16,32	0.12	32
4.	Cefoperazone/Sulbactam	8,16,32	8	64
5.	Ceftriaxone	0.12,0.25,1,4,16	0.25	64
6.	Cefuroxime	2,8,32	1	64
7.	Ciprofloxacin	0.06, 0.12,0.5,1	0.06	4
8.	Colistin	4,16,32	0.5	16
9.	Ertapenem	0.03,0.12,0.5,2	0.12	8
10.	Fosfomycin	8,16,32	16	256
11.	Gentamycin	4,8,32	1	16
12.	Imipenem	0.5,2,8,16	0.25	16
13.	Meropenem	0.5,2,6,12	0.25	16
14.	Piperacillin/Tazobactam	2/4,8/4,24/4,32/4,32/8,48/8	4/4	128/4
15.	Tigecyclin	1.5,4,8	0.5	8
16.	Trimethoprim/Sulfamethoxazole	1/9,4/76,16/304	20(1/19)	320(16/304)

Content of GN-AST card used in VITEK automated system **For NLF:**

S. No.	Nameof Antibiotic	Concentration	Calling range (≤)	Calling range (≥)
1.	Amikacin	2,4,16,48	1	64
2.	Aztreonam	2,8,32	1	64
3.	Cefepime	0.25,1,4,16,32	0.12	32
4.	Cefoperazone/ Sulbactam	8,16,32	8	64
5.	Ceftazidime	0.25,1,2,8,32	0.12	64
6.	Ciprofloxacin	0.06, 0.12,0.5,1	0.06	4
7.	Colistin	4,16,32	0.5	16
8.	Fosfomycin	8,16,32	16	256
9.	Gentamycin	4,8,32	1	16
10.	Imipenem	0.5,2,8,16	0.25	16
11.	Levofloxacin	0.25,05,2,8	0.12	8
12.	Meropenem	0.5,2,6,12	0.25	16
13.	Minocycline	1,4,8,16	0.5	32
14.	Piperacillin/Tazobactam	2/4,8/4,24/4,32/4,32/8,48/8	4/4	128/4
15.	Tigecycline	1.5,4,8	0.5	8
16.	Trimethoprim/ Sulfamethoxazole	1/9,4/76,16/304	20(1/19)	320(16/304)

Content of Yeast-AST card used in VITEK automated system **For Yeasts:**

S.No.	Nameofthe Antifungal	Concentration	Calling range (≤)	Calling Range (≥)
1	Fluconazole	2,4,8,16,32,64	0.5	64
2	Voriconazole	0.5,1,4,8	0.12	8
3	Caspofungin	0.12,0.5,2,8	0.125	8
4	Micafungin	0.06,0.25,1,4	0.06	8
5.	AmphotericinB	1,4,16,32	0.25	16
6.	Flucytosine	1,4,16,32	1	64

Statistical Analysis: Statistical analysis was carried out using standard methods, including the Chi-square test and Student's t-test, with the application of GraphPad Prism Version 5 software.

Results and Analysis: This prospective hospital based observational study was conducted in the Department of Microbiology. Katihar Medical College and Hospital, Katihar, Bihar from April 2023 to September 2024. A total of 124 patients admitted in the ICU, who had Central Venous Catheter inserted after admission to the Emergency Department or in the Medical ICU were included in the study.

Table 1: Demographic distribution of CLABSI patients

Variable	Category	Number of patients (n=124)	Percentage (%)
Age (years)	0–20	12	9.7
	21–40	28	22.6
	41–60	52	41.9
	>60	32	25.8
Gender	Male	76	61.3
	Female	48	38.7

The majority of CLABSI cases occurred among patients aged 41–60 years (41.9%), followed by those older than 60 years (25.8%). Only 9.7% of cases were seen in the youngest age group (0–20 years). Males (61.3%) were more frequently affected than females (38.7%). These findings indicated that middle-aged and elderly males were more prone to CLABSI, possibly due to comorbidities, longer hospital stays, and greater use of invasive devices.

Table 2: Clinical risk factors in CLABSI patients

Variable	Category	Number of patients (n=124)	Percentage (%)
ICU stay (days)	≤7	28	22.6
	8–14	46	37.1
	15–21	32	25.8
	>21	18	14.5
Central line duration (days)	≤7	22	17.7
	8–14	44	35.5
	15–21	38	30.6
	>21	20	16.2

Most CLABSI cases developed after an ICU stay of 8–14 days (37.1%), coinciding with central line use for 8–14 days (35.5%). Around one-third of patients developed infection between 15–21 days of catheterization. This suggested that the second and third weeks of central line use were the critical period for infection development, underscoring the need for timely catheter removal or replacement.

Table 3: Comorbidity profile of CLABSI patients

Comorbidity	Number of patients (n=124)	Percentage (%)
Diabetes mellitus	42	33.9
Hypertension	28	22.6
Malignancy	12	9.7
HIV	8	6.5
None	34	27.3

The most frequent comorbidity among CLABSI patients was diabetes mellitus (33.9%), followed by hypertension (22.6%). Malignancy (9.7%) and HIV (6.5%) were less common. A notable proportion of patients (27.3%) had no underlying comorbidity. This emphasized that immunocompromised states, particularly diabetes, heightened the risk of CLABSI, but infections could also occur in otherwise healthy individuals when exposed to invasive devices.

Table 4: Clinical presentation of CLABSI patients

Clinical features	Number of patients (n=124)	Percentage (%)
Fever	98	79.0
Chills/Rigor	64	51.6
Hypotension	42	33.9
Multiple symptoms	28	22.6

Fever (79%) was the most common clinical feature, followed by chills/rigor (51.6%). Hypotension was observed in 33.9% of cases, while 22.6% of patients had multiple symptoms. These findings suggested that fever remained the hallmark symptom, while chills and hypotension indicated systemic involvement and possible progression to sepsis.

Table 5: Distribution of isolates from CLABSI patients

Type of Isolate	Number of isolates (n=124)	Percentage (%)
Gram-negative	72	58.1
Gram-positive	38	30.6
Fungal	14	11.3

Gram-negative organisms (58.1%) were the predominant cause of CLABSI, followed by Gram-positive organisms (30.6%) and fungi (11.3%). This distribution was consistent with ICU epidemiology where Gram-negative bacteria dominate bloodstream infections.

Table 6: Spectrum of Gram-negative isolates

Organism	Number of isolates (n=72)	Percentage (%)
Klebsiella pneumoniae	24	33.3
Escherichia coli	18	25.0
Pseudomonas aeruginosa	16	22.2
Acinetobacter spp.	14	19.5

Among Gram-negative bacteria, Klebsiella pneumoniae was the leading isolate (33.3%), followed by Escherichia coli (25%) and Pseudomonas aeruginosa (22.2%). Acinetobacter spp. accounted for 19.5% of isolates. This reflected the dominance of Enterobacteriaceae (particularly Klebsiella and E. coli), with non-fermenters like Pseudomonas and Acinetobacter also contributing significantly.

Table 7: Spectrum of Gram-positive and fungal isolates

Organism	Number of isolates	Percentage (%)
Staphylococcus aureus	18	47.4 (of Gram+)
CONS	12	31.6 (of Gram+)
Enterococcus spp.	8	21.0 (of Gram+)
Candida albicans	8	57.1 (of fungi)
Candida tropicalis	4	28.6 (of fungi)
Candida glabrata	2	14.3 (of fungi)

Among Gram-positive isolates, Staphylococcus aureus (47.4%) was the most frequent, followed by CONS (31.6%) and Enterococcus spp. (21%). In fungal infections, Candida albicans dominated (57.1%), though non-albicans Candida species such as C. tropicalis and C. glabrata were also important. This showed that both staphylococci and Candida species were strongly associated with device-related infections.

Table 8: Antibiotic resistance pattern of Gram-negative isolates

Antibiotic	Resistance (%)
Amikacin	32.0
Ceftriaxone	48.0
Ciprofloxacin	42.0
Piperacillin–Tazobactam	38.0
Meropenem	28.0
Colistin	5.0

Gram-negative isolates showed high resistance to ceftriaxone (48%) and ciprofloxacin (42%), suggesting reduced effectiveness of commonly used antibiotics. Resistance to piperacillin–tazobactam was also notable (38%). In contrast, carbapenem resistance was lower (28%), and colistin retained excellent activity (95% sensitivity). These results highlighted the emergence of multidrug resistance, but also reinforced colistin as a last-resort therapy.

Table 9: Antibiotic resistance pattern of Gram-positive isolates

Antibiotic	Resistance (%)
Penicillin	62.0
Erythromycin	48.0
Ciprofloxacin	38.0
Gentamicin	28.0
Linezolid	5.0
Vancomycin	0.0

Gram-positive isolates demonstrated the highest resistance to penicillin (62%), followed by erythromycin (48%). Resistance to ciprofloxacin (38%) and gentamicin (28%) was moderate. However, linezolid and vancomycin remained highly effective, with vancomycin showing complete sensitivity. This confirmed the reliability of vancomycin as the cornerstone drug for resistant staphylococcal and enterococcal infections.

Table 10: Antifungal resistance and CLABSI rate

Parameter/Drug	Value/Resistance (%)
Fluconazole	28.0
Voriconazole	18.0
Amphotericin B	7.0
Caspofungin	0.0
Total central line days	1520
Total CLABSI episodes	124
CLABSI rate (per 1000 line days)	8.1
Device Utilization Ratio (DUR)	0.62

Among antifungal agents, the highest resistance was noted against fluconazole (28%), while voriconazole resistance was moderate (18%). Resistance to amphotericin B was rare (7%), and none of the isolates were resistant to caspofungin, establishing it as the most effective antifungal in this study.

The CLABSI rate was calculated as 8.1 per 1000 central line days, with a Device Utilization Ratio (DUR) of 0.62, suggesting a moderately high burden of central line infections in the ICU. This underlined the need for strict infection prevention protocols and judicious central line use.

Discussion

The study included 124 ICU patients with central venous catheters (CVCs). The majority of CLABSI cases occurred in patients aged 41–60 years (41.9%), with a male predominance (61.3%). The highest risk period for infection was between 8–21 days of ICU stay and catheter use, accounting for over 60% of cases.

Diabetes mellitus (33.9%) was the most common comorbidity, followed by hypertension (22.6%). Fever (79%) was the leading clinical presentation, while chills/rigor (51.6%) and hypotension (33.9%) were also frequent, indicating progression toward systemic infection in some cases.

Microbiological analysis revealed that Gram-negative organisms were the predominant pathogens (58.1%), with Klebsiella pneumoniae (33.3%) being the most common, followed by Escherichia coli (25%), Pseudomonas aeruginosa (22.2%), and Acinetobacter spp. (19.5%). Among Gram-positives (30.6%), Staphylococcus aureus (47.4%) was dominant, while fungal pathogens (11.3%) were mainly Candida albicans (57.1%).

Resistance profiling showed worrisome patterns: Gram-negatives had high resistance to ceftriaxone (48%) and ciprofloxacin (42%), though colistin (95% sensitivity) remained effective. Gram-positives showed high resistance to penicillin (62%) and erythromycin (48%), but vancomycin maintained 100% sensitivity. Among antifungals, fluconazole resistance was notable (28%), while caspofungin remained universally effective.

The calculated CLABSI rate was 8.1 per 1000 central line days, with a Device Utilization Ratio (DUR) of 0.62, reflecting a moderate but concerning burden of infection.

The CLABSI rate of 8.1 per 1000 central line days is higher than many international benchmarks, indicating a significant infection control challenge in the studied ICU. This calls for reinforced infection prevention protocols, including strict aseptic techniques, daily line necessity assessments, and staff training.

Several recent studies have examined the incidence of central line-associated bloodstream infections (CLABSIs) in intensive care settings since 2018. In India, Singh et al. reported a high incidence of 10.2 CLABSIs per 1,000 catheter days, with multidrug-resistant organisms predominating [7]. Similarly, El Tantawy et al. in Egypt found an even higher rate of 11.6 CLABSIs per 1,000 catheter days in pediatric ICUs, with mortality strongly linked to infection [8].

In Morocco, Elouali et al. observed 8.6 CLABSIs per 1,000 catheter-days, with prolonged catheter duration significantly increasing infection risk [9]. An Italian multicenter surveillance study by Montagnani et al. reported a comparatively lower incidence of 1.6 per 1,000 catheter days, but emphasized variations across ICUs, highlighting that infection control practices influence outcomes [10].

A U.S. study by Patel et al. documented a CLABSI incidence of 0.88 per 1,000 catheter days in adult ICUs, showing substantial reduction compared to earlier years but noting persistence of infections even with advanced preventive bundles [11]. Complementary findings from Rosenthal et al., in a large multicountry analysis, revealed wide variability across healthcare settings, with rates ranging between 1 and 12 per 1,000 catheter days, underscoring disparities in infection prevention implementation [12].

Finally, Kaur et al. in another Indian cohort highlighted the burden of CLABSI with incidence rates around 7 per 1,000 catheter days, again linked to device duration and multidrug resistance [13]. Collectively, these findings suggest that while some high-income regions report declining CLABSI rates, many low- and middle-income settings continue to face considerable challenges, with rates clustering between 6–12 per 1,000 catheter days and strong associations with catheter use duration and antimicrobial resistance.

Conclusion

The study demonstrates a significant burden of CLABSI in ICU patients, with the highest risk among middle-aged and elderly males with prolonged catheter use and comorbidities such as diabetes. Gram-negative bacteria, particularly Klebsiella pneumoniae and Pseudomonas aeruginosa, were the leading pathogens, showing high levels of antimicrobial resistance. The CLABSI rate of 8.1 per 1000 line days indicates an urgent need for strict adherence to infection control practices, judicious catheter management, and antimicrobial stewardship to reduce morbidity and improve patient outcomes.

References

1. Zhang Y, Wang Y, Zhao L, Li H, Yang H, Wang H. Incidence and characteristics of central line-associated bloodstream infections in ICU patients in China: a systematic review and meta-analysis. Front Public Health. 2025;13:1523979.

2. Nayyar C, Wadhwa V, Sharma M, Juyal D. Incidence, risk factors, microbiology and outcomes of central line-associated bloodstream infections in a tertiary care hospital in Northern India. Indian J Crit Care Med. 2021;25(3):308-14.
3. European Centre for Disease Prevention and Control (ECDC). Central line-associated bloodstream infections in intensive care units, 2020–2021. ECDC Surveillance Report. Stockholm: ECDC; 2022. p. 1-22.
4. Worth LJ, Spelman T, Brett J, Bull AL, Richards MJ. Central line-associated bloodstream infection in adult intensive care units in Victoria, Australia, 2011–2022: epidemiology and microbiology. Infect Dis Health. 2024;29(1):14-22.
5. Kazi S, Shetty A, Rodrigues C. Central line associated bloodstream infections in the intensive care unit: impact of infectious diseases consultation and antimicrobial stewardship. Indian J Med Microbiol. 2020;38(3-4):379-85.
6. Logan LK, Weinstein RA. The epidemiology of carbapenem-resistant Enterobacteriaceae: the impact and evolution of a global menace. J Infect Dis. 2017;215(suppl_1):S28-36.
7. Singh S, Chaturvedi A, Banerjee S, Kumar A. Epidemiology of central line-associated bloodstream infections in an Indian tertiary care hospital. Indian J Crit Care Med. 2021;25(4):420-426.
8. El Tantawy N, Omar H, El Nashar N, El-Sharkawy N. Central line-associated bloodstream infections in a pediatric intensive care unit: incidence and risk factors. Egypt J Pediatr Allergy Immunol. 2021;19(2):98-104.
9. Elouali S, Mdaghri Alaoui A, Boudlal S, Razine R. Central line-associated bloodstream infections in pediatric intensive care units: incidence and risk factors. Pan Afr Med J. 2021;38:201-207.
10. Montagnani F, Prato R, Ciofi Degli Atti ML, Tamburini C, Tersigni C, et al. Incidence of central line-associated bloodstream infections in Italian intensive care units: a multicenter surveillance study. J Hosp Infect. 2020;105(2):186-192.
11. Patel PR, Weiner-Lastinger LM, Dudeck MA, Edwards JR, Alden NB. Impact of the COVID-19 pandemic on central line-associated bloodstream infections in U.S. hospitals. Infect Control Hosp Epidemiol. 2022;43(4):472-474.
12. Rosenthal VD, Bat-Erdene I, Gupta D, Belkebir S, Rajhans P, et al. International nosocomial infection control consortium report on device-associated infections, including CLABSI: 2004–2019. Am J Infect Control. 2020;48(4):423-429.
13. Kaur M, Gupta V, Bedi R, Chhina D. Incidence, risk factors, and microbiological profile of central line-associated bloodstream infections in intensive care units. J Clin Diagn Res. 2019;13(8):DC10-DC14.