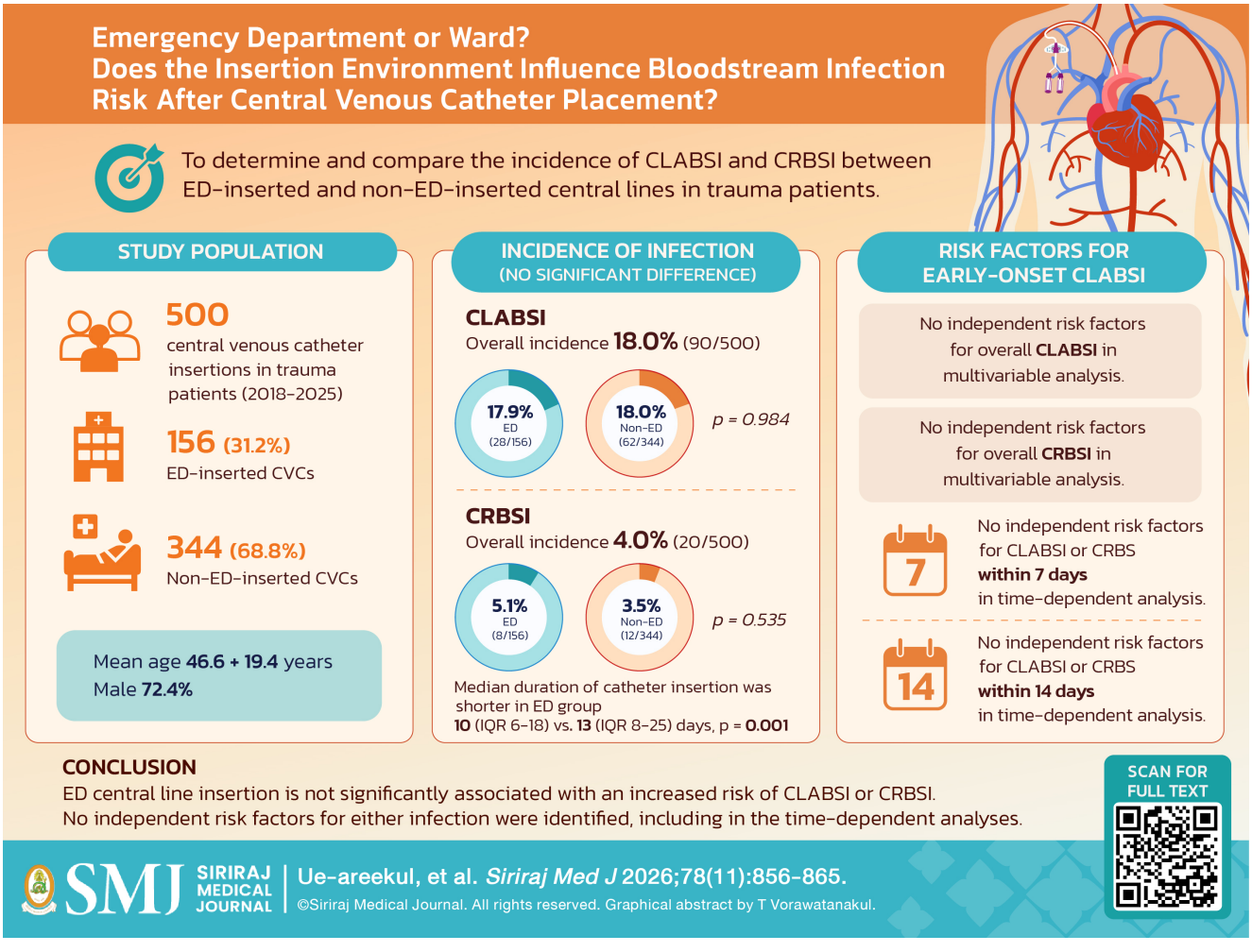
Emergency Department or Ward? Does the Insertion Environment Influence Bloodstream Infection Risk After Central Venous Catheter Placement?

Metchanan Ue-areekul, M.D., Kris Keorochana, M.D., Somphon Roeksomtawin, M.D., Chidpong Siritongtaworn, M.D., Nantaporn Namviriyachote, Ph.D., Natthida Owattanapanich, M.D., MACM*

Division of Trauma Surgery, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand.



*Corresponding author: Natthida Owattanapanich
E-mail: natthida.owa@gmail.com
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ORCID ID: http://orcid.org/0000-0001-6499-0187
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ABSTRACT

Objective: To compare the incidence of central line-associated bloodstream infection (CLABSI) and catheter-related bloodstream infection (CRBSI) between emergency department (ED)-inserted and non-ED-inserted central venous catheters (CVCs).

Materials and Methods: This single-center retrospective cohort study evaluated adult trauma patients (aged ≥18) who underwent CVC placement at a Level 1 trauma center from 2018 to 2025.

Results: The study analyzed 500 CVC placements (156 ED, 344 non-ED). The overall mean age was 46.6 ± 19.39 years, and 72.4% were male. Primary diagnoses were predominantly multiple trauma (38.8%) and burn injuries (27.0%). The internal jugular vein was the primary site (69.8%). Overall CLABSI incidence was 18.0% (n = 90), with no significant difference between ED and non-ED groups (17.9% vs. 18.0%, p = 0.984). Overall CRBSI incidence was 4.0% (n = 20), showing no significant difference between groups (ED 5.1% vs. non-ED 3.5%, p = 0.535). Multivariable logistic regression identified no independent risk factors for either CRBSI or CLABSI. Similarly, time-dependent analyses at 7 and 14 days did not identify any significant risk factors for either infection.

Conclusion: ED central line insertion was not significantly associated with an increased risk of CRBSI or CLABSI. No independent risk factors for either infection were identified in this cohort, including in the time-dependent analyses. Larger prospective multicenter studies are needed to further evaluate potential risk factors for central line–associated infections in trauma patients.

Keywords: Central line-associated bloodstream infection; catheter-related bloodstream infection; central venous catheter; emergency department; trauma (Siriraj Med J 2026;78(11):856-865)

INTRODUCTION

Nowadays, the use of central venous catheters (CVCs) has become widespread for administering fluids, nutrition, and medications, as well as for hemodialysis and hemodynamic monitoring. In trauma and emergency care, these procedures are particularly vital. Patients often present with unstable vital signs and require urgent life-saving measures, including endotracheal intubation, cardiopulmonary resuscitation (CPR), and massive fluid or blood resuscitation. In these critical scenarios, central line insertion is essential for assessing shock and evaluating the patient's volume status.

As demonstrated by Glickman et al.,[1] the rate of central venous catheterization procedures in ED settings has experienced a substantial upward trend, driven by the escalating demand for aggressive, early intensive therapies in critically ill and severe trauma patients. This rising procedural volume in acute, high-pressure environments highlights the critical need to continuously evaluate infection risks and establish optimized maintenance protocols specifically tailored for emergency-inserted lines.

Despite their benefits, central line-associated bloodstream infection (CLABSI) remains a major complication and a common healthcare-associated infection. These infections lead to prolonged hospital stays, significant increases in medical expenditures, and higher mortality rates. In the United States, the infection rate in Intensive Care Units (ICUs) is approximately 0.8 per 1,000 catheter-days. Conversely, data from the International Nosocomial Infection Control Consortium (INICC)[2] across 50 countries reported a higher rate of 4.1 per 1,000 catheter-days. In Thailand, tertiary hospitals reported a rate of 5.06 per 1,000 catheter-days in 2013[3], while our center's data from 2017–2024 show an incidence of 2.5 per 1,000 catheter-days.

The practice of routinely replacing central venous catheters placed in the Emergency Department (ED) within 24 hours of hospital admission is an established clinical dogma in many institutions. This policy heavily stems from a conservative interpretation of infection control guidelines[4], such as those by the Centers for Disease Control and Prevention (CDC), which suggest exchanging lines within 48 hours if placed under compromised aseptic conditions during emergent resuscitation. This historical recommendation created a widespread fear that the chaotic nature of the ED environment inherently leads to contaminated lines.

The pathogenesis of these infections typically follows two primary routes involving either extraluminal or intraluminal pathways.[5] In the extraluminal pathway, which commonly occurs shortly after catheter insertion, microorganisms, frequently Gram-positive bacteria, migrate from the skin surface through the percutaneous track into the bloodstream. Alternatively, the intraluminal pathway occurs when microorganisms contaminate the

catheter hub or lumen, subsequently adhering to the internal surface to form microcolonies and biofilms that can later release bacteria directly into the systemic circulation.

Risk factors are multifaceted, involving patient-specific conditions such as diabetes, hypertension, dyslipidemia, immunodeficiency, hypoalbuminemia, and length of hospital stay. Furthermore, procedural factors such as catheter type, duration of use, and the use of the femoral site, which is more prone to contamination, play significant roles.[6,7] Notably, in the high-pressure environment of a trauma emergency department, the urgency often leads to the use of femoral sites, incomplete maximal sterile barriers, and insufficient antiseptic contact time. While the CDC[8] recommends skin antisepsis with a >0.5% chlorhexidine preparation with alcohol and maximal sterile barrier precautions during CVC insertion. Ultrasound guidance is recommended to reduce cannulation attempts and mechanical complications. When adherence to aseptic technique cannot be ensured during emergency catheter insertion, the catheter should be replaced as soon as possible, preferably within 48 hours.

The primary outcome of this study was to determine the incidence of central line-associated bloodstream infections within the specific contexts of the Trauma Emergency Department and the Trauma Intensive Care Unit. Secondary outcomes included the identification of factors associated with CRBSI, including patient characteristics and procedural circumstances.

Additionally, the study focuses on pathogen characterization to identify common causative microorganisms and examines the correlation between specific insertion sites, namely the subclavian, internal jugular, and femoral veins, and the resulting frequency of infection. By analyzing these outcomes through a retrospective study at a Level 1 trauma center, this research seeks to provide comprehensive data to optimize sterile practices and improve patient outcomes in emergency settings.

MATERIALS AND METHODS

Study design and setting

This research was a single-center, retrospective cohort study conducted at a Level 1 trauma center. The study was designed to investigate the incidence and impact of CLABSI within the high-pressure environments of the Trauma Emergency Department and the Trauma Intensive Care Unit. The study covered data from January 1, 2018, to April 30, 2025, utilizing medical records and hospital surveillance databases to identify eligible cases.

Selection of participants

The study population comprised trauma patients managed at the facility during the specified period, selected based on predefined eligibility criteria. Inclusion was restricted to adult patients aged 18 years or older who required CVC insertion during either acute emergency resuscitation or subsequent intensive care management. Furthermore, only patients officially admitted to the Trauma Intensive Care Unit (TICU) were considered for analysis. Conversely, patients were excluded from the study if they had incomplete medical records, particularly regarding documented catheterization procedures, site monitoring data, or the essential laboratory results required to definitively confirm a CLABSI diagnosis.

Definitions of CRBSI and CLABSI

CLABSI was defined as a laboratory-confirmed bloodstream infection not secondary to infection at another body site, occurring in a patient with an eligible central line that had been in place for more than two consecutive calendar days and was present on the date of the event or the day before.

For this retrospective study, CRBSI was identified using differential time to positivity (DTP), one of the diagnostic approaches described by the IDSA. CRBSI was defined as growth of the same microorganism from paired catheter-drawn and peripheral blood cultures, with the catheter-drawn culture becoming positive ≥2 hours earlier. Other potential infection sources and antimicrobial timing were not systematically collected.[9]

Sample size calculation

Because CLABSI is a rare event, the required sample size was estimated using the rare-event formula ($n = \ln(1 - \alpha)/\ln(1 - p)$), where represents the expected event rate and α the confidence level. Based on a previously reported CLABSI incidence of 0.6% (169 infections among 27,981 trauma patients)[10] and a 95% confidence level, the minimum required sample size was calculated to be 500 catheter insertions. Accordingly, Catheter insertions were consecutively enrolled in reverse chronological order, beginning with the most recent eligible insertion and proceeding backward until the prespecified IRB-approved sample size of 500 insertions was reached. No selective sampling was performed.

Analysis

Categorical data were analyzed using chi-squared tests and expressed as percentages. For continuous variables, normally distributed variables were presented

as mean ± standard deviation (SD) and compared using the independent-samples t-test, whereas non-normally distributed variables were presented as median and interquartile range (IQR) and compared using the Mann–Whitney U test.

Variables with a p-value <0.20 in univariate analysis and those considered clinically relevant were considered for multivariable analysis. Multivariable analysis was performed using generalized estimating equations (GEE) with a binomial distribution, logit link, independence working correlation structure, patient-level clustering, and robust standard errors to account for repeated catheter insertions within the same patient. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were reported. A p-value < 0.05 was considered statistically significant. All analyses were performed using IBM SPSS Statistics.

Ethical considerations

This retrospective study was approved by the Institutional Review Board (Protocol No. 649/2568 (IRB1)). The requirement for informed consent was waived because of the retrospective nature of the study and the use of anonymized data.

RESULTS

Baseline characteristics of the study population

A total of 500 central venous catheter (CVC) insertions from 333 unique trauma patients were included in the study. Among these patients, 71 underwent more than one CVC insertion. The study population was categorized into two groups based on the location of catheter insertion: the Emergency Department (ED) insertion group (n = 156, 31.2%) and the non-ED insertion group (n = 344, 68.8%). The baseline demographics and clinical characteristics of the participants are summarized in Table 1.

Regarding the primary diagnosis, multiple trauma was the most frequent indication for admission across the entire cohort (38.8%, n = 194), followed by burn injuries (27.0%, n = 135). There was a statistically significant difference in the distribution of primary diagnoses between the two groups (p = 0.014).

TABLE 1. Baseline characteristics of the study population.

Variable	Total (n=500)	ED (n=156)	Non-ED (n=344)	p-value
Age (years), Mean±SD	46.6±19.39	44.48±17.60	47.56±20.10	0.084
Sex, n (%)				0.820
male	362(72.4%)	114(73.1%)	248(72.1%)	
female	138(27.6%)	42(26.9%)	96(27.9%)	
Diagnosis, n (%)				0.014
Multiple trauma	194(38.8%)	72(46.2%)	122(35.5%)	
Isolated TBI	63(12.6%)	16(10.3%)	47(13.7%)	
Isolated chest	9(1.8%)	4(2.6%)	5(1.5%)	
Isolated abdomen	28(5.6%)	14(9.0%)	14(4.1%)	
Burn	135(27%)	34(21.8%)	101(29.4%)	
Others (vascular injury, infection, drowning, isolated extremities, hanging, snake bite)	71(14.2%)	16(10.3%)	55(16.0%)	
Comorbidity, n (%)				
DM	89(17.8%)	23(14.7%)	66(19.2%)	0.229
HT	113(22.6%)	35(22.4%)	78(22.7%)	0.953
DLP	73(14.6%)	19(12.2%)	54(15.7%)	0.296
CVD	23(4.6%)	4(2.6%)	19(5.5%)	0.218
Respiratory disease	16(3.2%)	1(0.6%)	15(4.4%)	0.028
Chronic liver disease	3(0.6%)	0(0%)	3(0.9%)	0.556

Note: In terms of comorbidities, hypertension (HT) was the most common pre-existing condition (22.6%). However, underlying respiratory disease was significantly more common among patients in the non-ED insertion group compared to the ED group (4.4% vs. 0.6%; p = 0.028).

Central line characteristics and infection rates

The procedural characteristics of the inserted central lines are presented in Table 2. The internal jugular vein was the most frequently utilized anatomical site for CVC placement, accounting for 69.8% (n = 349) of all procedures, followed by the subclavian vein (16.6%, n = 83). The distribution of anatomical insertion sites did not differ significantly between the ED and non-ED cohorts (p = 0.246). Fluid replacement (99.6%) and central venous pressure (CVP) monitoring (98.4%) were almost universally indicated in both groups. However, central lines placed for nutritional support were significantly more frequent in the non-ED insertion group than in the ED group (11.3% vs. 1.9%; p < 0.001).

Crucially, the incidence of CLABSI (18.0%, n = 90) was nearly identical and showed no statistically significant difference between central lines inserted in the ED and those inserted in non-ED environments (17.9% vs. 18%; p = 0.984). Similarly, the total rate of CRBSI was 4.0% (n = 20), with no significant variation based on insertion location (5.1% in the ED vs. 3.5% in the non-ED group; p = 0.535). The mean duration of central line catheterization was significantly shorter in the ED insertion group compared to the non-ED insertion group (10 [6-18] vs. 13 [8-25] days; p = 0.001).

Microbiological analysis from sequential blood cultures revealed that *Acinetobacter baumannii* (3.2%) and *Pseudomonas aeruginosa* (3.2%) were the most prevalent pathogens isolated. No statistically significant differences in pathogen distribution were observed between the ED and non-ED insertion groups in either sequential blood cultures or catheter tip cultures (p > 0.05).

Multivariable analysis of risk factors

To evaluate potential predictors for overall and time-dependent infection development, multivariable logistic regression models were constructed.

In the standard multivariable analysis evaluating overall risk factors associated with CRBSI (Table 3), variables including age (p = 0.365), burn status (p = 0.387), femoral site (p = 0.425), and ED insertion (p = 0.455) did not demonstrate statistically significant independent associations. Similarly, the multivariable model for overall CLABSI (Table 4) did not identify any statistically significant independent predictors among the evaluated factors, including ED insertion (p = 0.899) and femoral site placement (p = 0.411).

To further explore factors associated with early-onset infection, separate multivariable generalized estimating equation models were performed using fixed time cutoffs after catheter insertion, accounting for repeated catheter insertions within individual patients. For CLABSI occurring within 7 and 14 days after catheter insertion, the GEE analyses identified no statistically significant independent associations. Burn status, femoral site insertion, and ED insertion were not significantly associated with CLABSI at either time point (Table 5).

Similarly, for CRBSI occurring within 7 and 14 days after catheter insertion, no statistically significant independent associations were identified. Burn status, femoral site insertion, and ED insertion were not significantly associated with CRBSI at either time point (Table 6).

DISCUSSION

This single-center retrospective cohort study provides critical insights into the incidence and clinical determinants of CLABSI and CRBSI within a Level 1 trauma center. The primary focus of this investigation was to determine whether the ED environment, characterized by high-pressure resuscitation and potential breaches in elective sterile protocols, inherently elevates infection risks compared to non-ED settings.

According to the Centers for Disease Control and Prevention (CDC) guidelines, maximum sterile barrier precautions for central venous catheter (CVC) insertion strictly require the use of a cap, mask, sterile gown, sterile gloves, and a full-body sterile drape, alongside chlorhexidine-based skin antisepsis.[8,11] At our institution, these measures are incorporated into the standard CVC insertion protocol across clinical settings. Previous work by Limprayoon et al. at our center demonstrated that implementation of a clinical practice guideline incorporating CDC-recommended infection-prevention measures was associated with a reduction in catheter-related bloodstream infections (CRBSIs).[12] However, in the trauma setting, particularly during emergency resuscitation, adherence to individual components of the sterile bundle was not routinely documented or monitored in the present study. Therefore, although the same institutional protocol applied to both ED and non-ED insertions, actual compliance with the sterile bundle could not be verified or compared between settings.

Historically, earlier medical literature heavily questioned the safety of emergency vascular access. A seminal systematic review[13] focusing on Emergency Department (ED)-placed invasive lines, which evaluated 11 studies primarily from the 1980–2010 era[14-24], suggested that ED lines were a substantial source of infection and typically remained in place for prolonged periods. Furthermore, high-quality data from that period highlighted that compliance with strict infection control procedures was frequently poor under emergent conditions, leading to the traditional

TABLE 2. Central line characteristics.

Variable	Total (n=500)	ED (n=156)	Non-ED (n=344)	p-value
Site, n (%)				0.246
Internal jugular vein	349(69.8%)	113(72.4%)	236(68.6%)	
Subclavian vein	83(16.6%)	26(16.7%)	57(16.6%)	
Femoral vein	44(8.8%)	14(9.0%)	30(8.7%)	
Brachial vein	24(4.8%)	3(1.9%)	21(6.1%)	
Indication, n (%)				
Fluid replacement	498(99.6%)	156(100%)	342(99.4%)	1.000
CVP monitoring	492(98.4%)	156(100%)	336(97.7%)	0.062
Nutrition	42(8.4%)	3(1.9%)	39(11.3%)	<0.001
Infection, n (%)				
CLABSI	90(18%)	28(17.9%)	62(18%)	0.984
CRBSI	20(4%)	8(5.1%)	12(3.5%)	0.535
Microorganisms identified during catheter-related evaluation, n (%)*				
Yeasts	9(1.8%)	2(1.3%)	7(2%)	0.727
Acinetobacter baumannii	16(3.2%)	4(2.6%)	12(3.5%)	0.785
Bacillus spp.	1(0.2%)	0(0%)	1(0.3%)	1.000
Candida albicans	1(0.2%)	1(0.6%)	0(0%)	0.312
Coryneform bacteria	3(0.6%)	1(0.6%)	2(0.6%)	1.000
Staphylococcus spp.	7(1.4%)	1(0.6%)	6(1.7%)	0.443
Streptococci spp.	1(0.2%)	1(0.6%)	0(0%)	0.312
Staphylococcus haemolyticus	8(1.6%)	4(2.6%)	4(1.2%)	0.264
Streptococcus pyogenes	2(0.4%)	1(0.6%)	1(0.3%)	0.527
Stenotrophomonas maltophilia	8(1.6%)	1(0.6%)	7(2%)	0.445
Klebsiella pneumoniae	10(2%)	2(1.3%)	8(2.3%)	0.731
Enterococcus faecium	4(0.8%)	1(0.6%)	3(0.9%)	1.000
Enterococcus faecalis	1(0.2%)	0(0%)	1(0.3%)	1.000
Enterobacter cloacae	6(1.2%)	2(1.3%)	4(1.2%)	1.000
Escherichia coli	6(1.2%)	2(1.3%)	4(1.2%)	1.000
Pseudomonas aeruginosa	16(3.2%)	8(5.1%)	8(2.3%)	0.107
Citrobacter	2(0.4%)	1(0.6%)	1(0.3%)	0.527
Serratia marcescens	2(0.4%)	1(0.6%)	1(0.3%)	0.527
Duration of central line insertion (days), Median, IQR	12 (7-22)	10 (6-18)	13 (8-25)	0.001

* Percentages were calculated using catheter insertions as the denominator (overall, n=500; ED, n=156; non-ED, n=344). The number of individual blood culture episodes was not collected.

TABLE 3. Multivariable analysis of factors associated with CRBSI.

	p-value	aOR	95% CI Lower	Upper
Age	0.365	0.987	0.959	1.016
Burn status	0.387	1.766	0.487	6.409
Femoral site	0.425	1.722	0.453	6.543
ED insertion	0.455	1.540	0.496	4.782

TABLE 4. Multivariable analysis of factors associated with CLABSI.

	p-value	aOR	95% CI Lower	Upper
Age	0.779	0.998	0.981	1.014
DM	0.804	0.860	0.262	2.820
Male	0.946	0.971	0.411	2.291
Burn status	0.638	0.813	0.344	1.922
Femoral site	0.411	1.389	0.635	3.036
ED insertion	0.899	0.965	0.553	1.682

TABLE 5. Time-dependent multivariable analysis of factors associated with CLABSI.

Variable	CLABSI within 7 days		CLABSI within 14 days	
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Burn status	0.92 (0.30–2.84)	0.882	0.76 (0.29–2.04)	0.592
Femoral site	0.77 (0.19–3.13)	0.716	1.57 (0.64–3.87)	0.325
ED insertion	1.31 (0.65–2.65)	0.450	1.22 (0.65–2.30)	0.530
DM	0.19 (0.03–1.09)	0.062	0.62 (0.16–2.44)	0.491
Male	0.54 (0.19–1.54)	0.251	0.87 (0.24–2.27)	0.784

TABLE 6. Time-dependent multivariable analysis of factors associated with CRBSI.

	CRBSI within 7 days		CRBSI within 14 days	
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Burn status	3.1 (0.9–11.0)	0.078	2.4 (0.9–6.4)	0.084
Femoral site	2.6 (0.5–13.2)	0.248	1.9 (0.5–7.0)	0.331
ED insertion	1.8 (0.5–6.3)	0.344	1.3 (0.5–3.4)	0.569
DM	0.9 (0.2–4.0)	0.882	0.8 (0.3–2.5)	0.762
Male	1.1 (0.3–4.3)	0.852	1.0 (0.4–2.9)	0.973

assumption that ED-placed CVCs inherently yield higher CLABSI rates.

Our principal finding demonstrates that the location of CVC insertion, specifically ED versus non-ED environments, does not significantly affect the overall incidence of CLABSI or CRBSI. The infection rates were not significantly different between the two groups (17.9% in the ED group versus 18.0% in the non-ED group). This finding is particularly notable given that emergency CVC insertions in the ED often occur under suboptimal conditions where standard maximal sterile barriers might be partially bypassed due to the urgency of life-saving interventions. A plausible explanation for the lack of a statistically significant difference is that the duration of catheter insertion was significantly shorter in the ED group than in the non-ED group (10 (6–18) vs 13 (8–25) days; p = 0.001). The shorter indwelling time of ED-placed lines likely mitigated the cumulative infectious risk typically associated with emergency placement, balancing out the initial potential for contamination. Similarly, a retrospective study by Inhofer et al. reinforced this perspective, noting that no significant difference in infection rates was detected even though ED clinicians more frequently utilized the femoral vein site.[25]

Furthermore, the clinical workflow at our trauma center features a sequential resuscitation approach that inherently mitigates procedural urgency. In our practice, peripheral intravenous lines are heavily prioritized for initial volume expansion and early resuscitation in the Emergency Department. Central venous catheters are generally deferred until the patient's hemodynamic status has achieved initial stabilization, thereby transforming what could have been a chaotic, high-pressure procedure into a more controlled one. This strategic delay, combined with the uniform application of strict aseptic techniques, minimizes the risk of compromising the sterile barrier during acute resuscitation, further explaining the equivalent infection rates observed between our ED and non-ED settings.

The overall multivariable analyses did not identify any significant independent predictors of CRBSI or CLABSI. Similarly, GEE analyses using fixed time cutoffs at 7 and 14 days did not identify significant associations with early-onset infection. In particular, burn status, femoral site insertion, and ED insertion were not significantly associated with early CRBSI or CLABSI.

Burn patients experience a disrupted skin barrier, localized hypervascularity, and profound systemic immunodeficiency, which collectively accelerate both extraluminal and intraluminal bacterial colonization. Microorganisms rapidly colonize the burn wound and adjacent skin, migrating along the external surface of the catheter into the bloodstream, predominantly within the first two weeks of acute care. Thus, burn patients are inherently at increased risk of bloodstream infection. Previous studies have shown that this population is particularly vulnerable to CLABSI, with reported rates two to three times higher than those in other ICU populations.[26,27] However, in the present study, burn injury was not independently associated with early-onset CRBSI or CLABSI at either 7 or 14 days after catheter insertion. This finding should be interpreted cautiously, as the lack of a significant association may reflect limited statistical power from the small number of infection events.

Centers for Disease Control and Prevention (CDC) guidelines, which advise against the femoral site due to its proximity to the perineal flora and higher local bacterial density. This elevated risk is primarily attributed to the anatomic proximity of the inguinal region to the perineum, resulting in a higher density of local skin flora, as well as the mechanical difficulty in maintaining dressing integrity over a mobile crease. This anatomic vulnerability is further quantified by Pitiriga et al.,[28] who demonstrated that the femoral insertion site yielded the highest incidence of both CLABSI. However, this finding contrasts with the previous meta-analysis by Marik et al.,[29] which included two randomized controlled trials and eight cohort studies, comprising 17,376 catheters and 113,652 catheter-days. Despite earlier studies suggesting a lower risk of catheter-related bloodstream infection with internal jugular compared with femoral access, their analysis of more recent studies found no significant difference in infection risk among the subclavian, internal jugular, and femoral sites. In our study, multivariable GEE analysis did not demonstrate a significant association between femoral catheter insertion and CRBSI or CLABSI. This may reflect standardized catheter care, selective avoidance of femoral access in patients with groin contamination or injury, and limited statistical power due to the small number of infection events.

From a microbiological perspective, *Acinetobacter baumannii* and *Pseudomonas aeruginosa* were the most prevalent pathogens isolated from sequential blood cultures. The high prevalence of Gram-negative bacilli reflects the typical nosocomial pathogen profile of intensive care units in tropical regions and tertiary centers in Thailand. It underscores the transition from the traditional extraluminal pathway (dominated by skin-surface Gram-positive cocci) to the intraluminal pathway, where multidrug-resistant Gram-negative bacteria contaminate catheter hubs and form robust biofilms within the controlled ICU environment.

Our findings align with a recent 5.5-year retrospective evaluation by Atilla et al.,[30] which similarly demonstrated that Gram-negative bacilli, particularly *Acinetobacter baumannii*, represent the predominant pathogens driving CLABSI in intensive care settings. Furthermore, their study re-emphasized that clinical factors such as prolonged catheter duration and patient disease severity significantly dictate infection outcomes, rather than the initial environment of catheter placement.

Several limitations must be acknowledged when interpreting these results. First, the retrospective nature of this study relies heavily on the accuracy and completeness of existing electronic medical records, which introduces an inherent risk of documentation bias. Variations in documentation of catheter insertion techniques, sterile-barrier compliance, catheter maintenance practices, unrecognized temporal changes in clinical practice and local insertion-site findings could not be fully standardized, and these variables were therefore unavailable for analysis. Second, the limited number of infection events precluded adjustment for several potentially important confounders, including injury severity and burn severity (e.g. total body surface area). Third, CRBSI was identified using differential time to positivity as the operational diagnostic criterion. Other potential infection sources and antimicrobial exposure before blood culture collection were not systematically assessed, which may have resulted in misclassification of some CRBSI events. Moreover, the limited number of CRBSI events (n=20) relative to the number of predictors may have resulted in model overfitting and unstable effect estimates. The multivariable findings should be considered exploratory and interpreted with caution. Finally, as a single-center study conducted at a Level 1 trauma center, the findings, pathogen profiles, and clinical practices may reflect local institutional protocols and may not be fully generalizable to other settings.

CONCLUSION

In conclusion, the incidence of CLABSI and CRBSI did not differ significantly between central venous catheters inserted in the ED and those inserted in non-ED settings among trauma patients. The internal jugular vein was the most common anatomical site for CVC insertion in this cohort. Multivariable GEE analyses identified no significant independent risk factors for CRBSI or CLABSI, including analyses using fixed 7- and 14-day time cutoffs.

However, a notable limitation of this investigation is its single-center, retrospective design, which relies on historical electronic medical records and is inherently subject to documentation variance and localized pathogen profiles. To validate these findings, mitigate baseline confounding factors, and establish robust, standardized emergency protocols for critical trauma care, a multi-center prospective evaluation is warranted.

Data Availability Statement

The data supporting this study are available from the corresponding author upon reasonable request.

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DECLARATIONS

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Conflict of Interest

All authors have affirmed that they have no conflicts of interest to declare.

Registration Number of Clinical Trial

Not applicable.

Author Contributions

Conceptualization and methodology, N.O. and M.U.; Investigation, M.U.; Formal analysis, M.U. and N.O.; Visualization and writing – original draft, M.U. and N.O.; Writing – review and editing, K.K., S.R., C.S., N.N. and N.O.; Funding acquisition, None; Supervision, K.K., S.R., C.S., N.N. and N.O. All authors have read and agreed to the final version of the manuscript.

Use of Artificial Intelligence

Artificial intelligence tools were used for language editing and grammar refinement. All scientific content, interpretation, and conclusions were developed and verified by the authors.

Institutional Review Board Statement

This study has been reviewed and approved by the Institutional Review Board (Protocol No. 649/2568(IRB1)).

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