

Incidence and Risk Factors of Central Line Associated Blood Stream Infections in Private Healthcare Setting in Western Kenya

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Abstract:-

➤ *Background:*

Central line associated blood stream infections (CLABSIs) represent a critical yet often overlooked aspect of healthcare, particularly in settings with limited resources. Several factors contribute to the heightened prevalence of CLABSIs, including age, gender, compromised immune states, and invasive medical procedures such as catheterization, intubation, and central line placements, which can elevate the risk of microbial transmission among patients. Research reveals that a significant portion of hospitalized patients, ranging from 5% to 15%, contract CLABSIs, with a notable percentage, between 9% and 37%, occurring among those admitted to intensive care units (ICUs).

➤ *Broad Objective:*

To determine the incidence and risk factors associated with Central Line Associated Blood Stream Infections in a private health care setting in Kenya.

➤ *Methodology:*

A prospective study was conducted in all patients admitted to the Intensive Care Units showing signs of infection and meeting the inclusion criteria. Data was collected from each inpatient and all intensive care units on weekly basis and analyzed descriptively.

➤ *Results:*

A total of 19 out of 183 CLABSI incidents were identified, which is an incidence of 10.38 % of 183 eligible CLABSI cases and CLABSI to be 13.4 per1000 central-line days. Gram-negative organism was higher at 52.6 % than Gram-positive organisms at 42.1 %. The catheters inserted in the jugular vein 9.3 %(n=7/75) and

Femoral vein 14.2 %(n=1/ 7) are more prone to get infection than those inserted in the sub-clavian vein 10.8 %(n=11/ 101).The duration of central venous catheter is also directly proportional to the incidence of infection, the CVCs > 3-8 days have higher CLABSIs at 57.9% than those with 8 days of central lines with 42.1%.

➤ *Conclusion:*

The study showed a high incidence rate of CLABSIs, raising significant concerns. Infection rates varied by central line insertion site, with jugular and femoral veins posing higher risks. Respiratory diseases were prevalent, suggesting an elevated CLABSI risk for immunocompromised or chronically ill patients. Furthermore, 37% of patients had recent antibiotic exposure, aligning with CDC data linking antibiotics to CLABSI risk.

Keywords:- Healthcare Associated Infections (HAIs), Intensive Care Units, Incidence, Risk factors, Pathogens, Central Line-Associated Blood Stream Infections (CLABSIs), Infections, Central-Line Days.

I. INTRODUCTION

Central line-associated bloodstream infections (CLABSIs) are a type of healthcare-associated infection (HAI) that occurs when bacteria or other pathogens enter the bloodstream through a central venous catheter (also known as a central line). Healthcare-associated infections (HAIs) represent a significantly underestimated aspect of healthcare practices, and their importance cannot be overstated, particularly in resource-limited healthcare facilities, as they have a profound negative impact on patient care. These infections stem from a variety of factors, including patients admitted to both general wards and critical care units,

individuals with compromised immune systems, and those undergoing invasive procedures such as catheterization, intubation, and the placement of central lines during their hospital stays. These factors contribute to an increased risk of microbial transmission among patients.

One particularly concerning manifestation of HCAs is central line-associated bloodstream infections (CLABSIs), which pose a serious threat due to their potential to escalate costs, elevate mortality rates, and extend hospital stays. However, it is important to note that CLABSIs can be effectively prevented through the proper techniques for central line insertion and management. (1)

In different research studies, it has been observed that the prevalence of Healthcare-Associated Infections (HAIs), including Central Line-Associated Bloodstream Infections (CLABSIs), varies across countries. For instance, in Tunisia and Morocco, the prevalence was recorded at 17.8%, (2) while in Mali, it was slightly higher at 18.7%. In Tanzania, it was 14.8%. These figures clearly highlight that the prevalence of HAIs tends to be higher in developing countries. (3)

A recent study conducted in the Critical Care Unit of KNH (Kenyatta National Hospital) revealed a CLABSI prevalence rate of 12%. (4) However, there is currently a lack of data on CLABSI in Western Kenya, which serves a substantial population. At Mediheal Hospital and Fertility Centre, a private level 6 hospital, this study represents the first of its kind on CLABSI incidence, risk factors, and the specific pathogens associated with CLABSI, despite admitting approximately 89 patients per month.

Conducting such studies is crucial as they aid in resource optimization, establish standardized protocols for delivering high-quality hospital care, and, most importantly, contribute to reducing hospital stays and patient suffering

II. METHODS

➤ *Setting*

This study was conducted at Mediheal Hospital and Fertility Centre in Eldoret. It is a level 6 private hospital with approximately 150 inpatient beds. The Mediheal Hospital in Eldoret town is within Uasin Gishu County, Kenya. This hospital currently has multiple departments like Internal Medicine, Surgery, reproductive medicine (Obstetrics and Gynecology) with infertility clinic, Urology & Renal transplant Unit, Nephrology, Cardiology, Pathology, laboratory medicine and Critical care unit. The Mediheal laboratory is currently run by an in-house Pathologist which is a BSL 2 laboratory.

➤ *Study Design*

This study was conducted prospectively and involved collecting data through targeted surveillance. Its main objective was to determine the rate of Central Line-Associated Bloodstream Infections (CLABSIs) in intensive care units between 2022 and 2023.

➤ *Study Population*

All inpatients admitted to Mediheal hospital in different departments including intensive care units.

➤ *Sample Size*

The sample size was 183 participants in 12 months, total number of patients admitted in ICUs (RICU, NICU, HDU, ICU and PICU) was 1056. Since the number was very small, the researcher used census to include all the patients for the study.

➤ *Data Collection*

A proactive, year-long study was conducted at Mediheal Hospital, involving the active surveillance of Central Line-Associated Bloodstream Infections (CLABSIs) in all of its Intensive Care Units (ICUs). The study sought CLABSI cases while patients were still in the ICU or within 24 hours after their discharge. Data collection followed the methodology outlined in the NHSN patient safety manual, which included details about the patients (demographics, central line information, and CLABSI diagnosis) and the number of patients with central line catheters (denominator data). The strategy for identifying CLABSI cases involved daily monitoring of positive blood culture results in ICU patients.

➤ *Data Analysis*

At the end of the surveillance year, the data was reviewed and assessed by the infection control physician (Principal Investigator or PI) and the Microbiologist (Co-Investigator) before undergoing analysis. The data analysis was carried out using the Statistical Package for the Social Sciences (SPSS) program, specifically version 26. Descriptive statistics such as mean (with Standard Deviation - SD) and median (with Interquartile Range) were employed to summarize both the characteristics of the CLABSI cases and the underlying medical conditions associated with them.

➤ *Ethical Consideration*

• *Permits:*

To maintain ethical standards in the study, approval was obtained from the Institutional Research Ethics Committee (IREC) at the Moi Teaching and Referral Hospital/Moi University School of Medicine. Additionally, permission to conduct the study was duly sought from the hospital administration.

• *Consent:*

Participants were provided with a consent form for their review and signature after receiving a comprehensive explanation about the research's objectives, its essence, and its contents. Upon completion of the study, all information that could potentially identify the participants in relation to the collected research data was securely disposed of. Participation in the study was entirely voluntary, and no form of coercion was employed to compel individuals to take part. Participants retained the right to withdraw their participation at any point during the study.

• *Confidentiality and Anonymity:*

The confidentiality of respondents and informants, including their identities and responses, is strictly maintained. Participant logs, which serve as the sole connection between identifying information and assigned code numbers, as well as all data, will be securely stored in a locked file cabinet. Access to these files is restricted to the researcher alone.

III. RESULTS

Out of 1056 patients who were admitted to the inpatient departments from March, 2022 to March, 2023, 183 patients met the inclusion criteria and were enrolled in the present study.

A total of 252 central lines were inserted in the 183 patients during the 12 months’ study period, a total of 1416 central line days and 1868 patient days were recorded. During this study period there were no central line in umbilical arteries in NICU, they were not taken into consideration.

A total of 19 CLABSI incidents were identified, which is 10.3 % of the Eligible CLABSI. We found the incidence

of CLABS to be 13.4 per 1000 central-line days at the ICUs in Mediheal Hospital and Fertility Center as Shown in Table. 1.

The most isolated organism in this study is *Staphylococcus aureus* 42.1 %(n=8) with one patient have mixed organism of *Pseudomonas aeruginosa* and *Candida albicans*. Majority of the patients who were eligible for CLABSI were male 55.2 %(n=101) while the female was 44.8 %(n=82) as well as the confirmed cases with male patients at 11.8 %(n=12/101) and females were 8.5% (n=7/82). 47.3% of confirmed cases of CLABSI age between 18-37 yrs, with no patient below 5 years old. It is also shown in Table1. that Below 3 days, no patient had CLABSI while 3-8 days is 57.9% and above 8days is 42.1%.

According to this study, the catheters inserted in the jugular vein 9.3 %(n=7/75) and femoral vein 14.2 %(n=1/7) are more prone to get infection than those inserted in the sub-clavian vein 10.8 %(n=11/101). Table 3 shows that respiratory diseases being the common medical diagnosis for the patients of the study group 26.3 %(n=5).The number of patients who died is 21.1 %(n=4). Our study shows that 37% patients were exposed to antibiotics prior within 30 days.

Table 1 General Characteristics of the Study Population who Developed CLABSIs

Characteristics	Eligible CLABSI Cases		Confirmed cases	
	(N= 183)	(%)	(N=19)	(%)
Age in years				
Below 5yrs	0	0	0	0
5 -18	21	11.5	2	10.5
18 – 37	66	36.1	9	47.3
38- 57	44	24.0	4	21.1
58 – 78	49	26.8	3	15.8
78 and above	3	1.6	1	5.3
Gender				
Male	101	55.2	12	63.2
Female	82	44.8	7	36.8
Insertion site				
Subclavian vein	101	55.2	11	57.9
Femoral vein	7	3.8	1	5.3
Internal jugular vein	75	41	7	36.8
Number of line days				
<3 days	28	15.3	0.0	0.0
3 - 8 days	122	66.7	11	57.9
>8 days	33	18	8	42.1

Table 2 12 Months CLABSI Denominator Data

Department	Patient Days	CL Days	Eligible CLABSI
ICU	584	424	69
HDU	444	328	40
RICU	612	534	48
PICU	228	130	26
Total	1868	1416	183

Out of 183 cases that were eligible for CLABSI, 19 Cases were confirmed.

$$\text{CLABSI RATE} = 19/1416 \times 1000$$

= 13.4 per 1000 central -line days

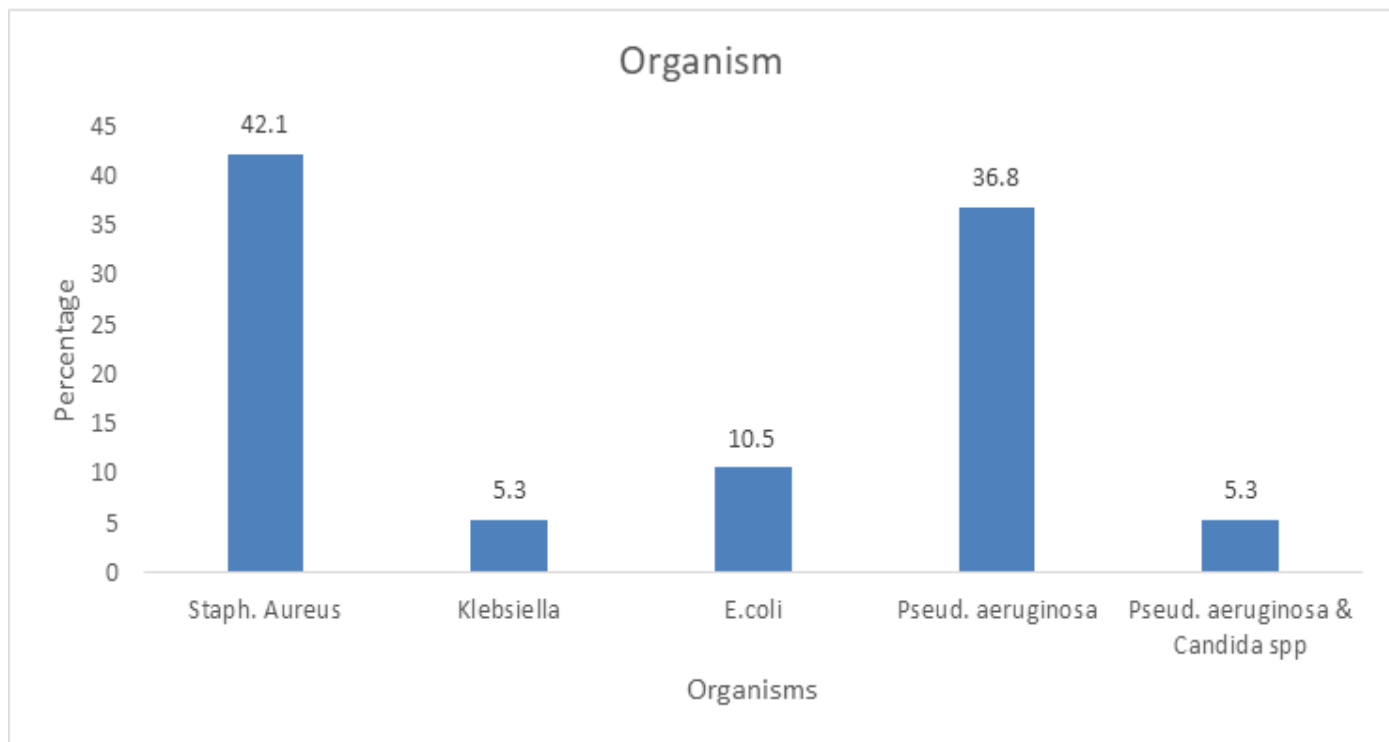


Fig 1 Specific Organisms per Patients

Table 3 Major Diagnosis & Outcome During Hospital Stay

Diagnosis	N=19	
	NO.	%
Respiratory Diseases	5	26.3
Neurological	2	10.5
Gastrointestinal	2	10.5
Diabetes Mellitus	3	15.8
Malignancies	1	5.3
Renal Diseases	3	15.8
Others	3	15.8
Outcome (Deaths)	4	21 %

Table 4 Antibiotic use within 30 days

Use	N = 19	Percentage
Exposed	7	37
Not exposed	12	63

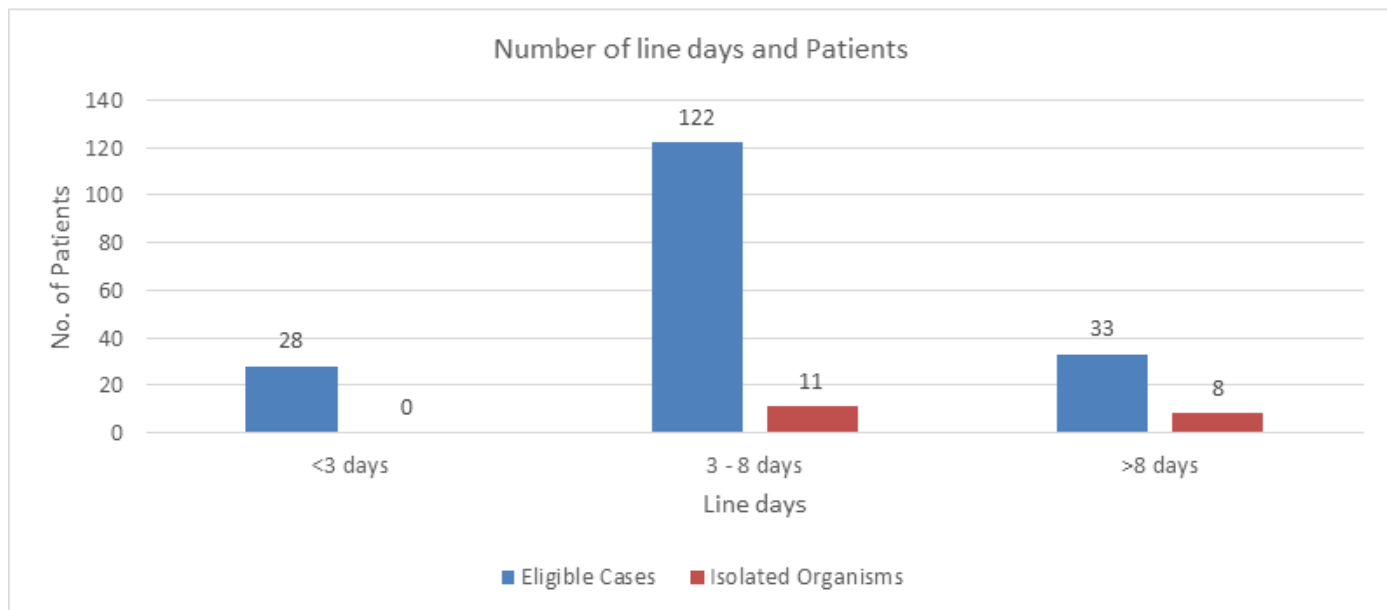


Fig 2 Number of line days and patients

Table 5 Insertion Site: Anatomical Location of Central Lines

Insertion site	ELIGIBLE (n=183)	%	CONFIRMED (n=19)	%
Subclavian vein	101	55.2	11	10.8
Femoral vein	7	3.8	1	14.2
Internal jugular vein	75	41	7	9.3

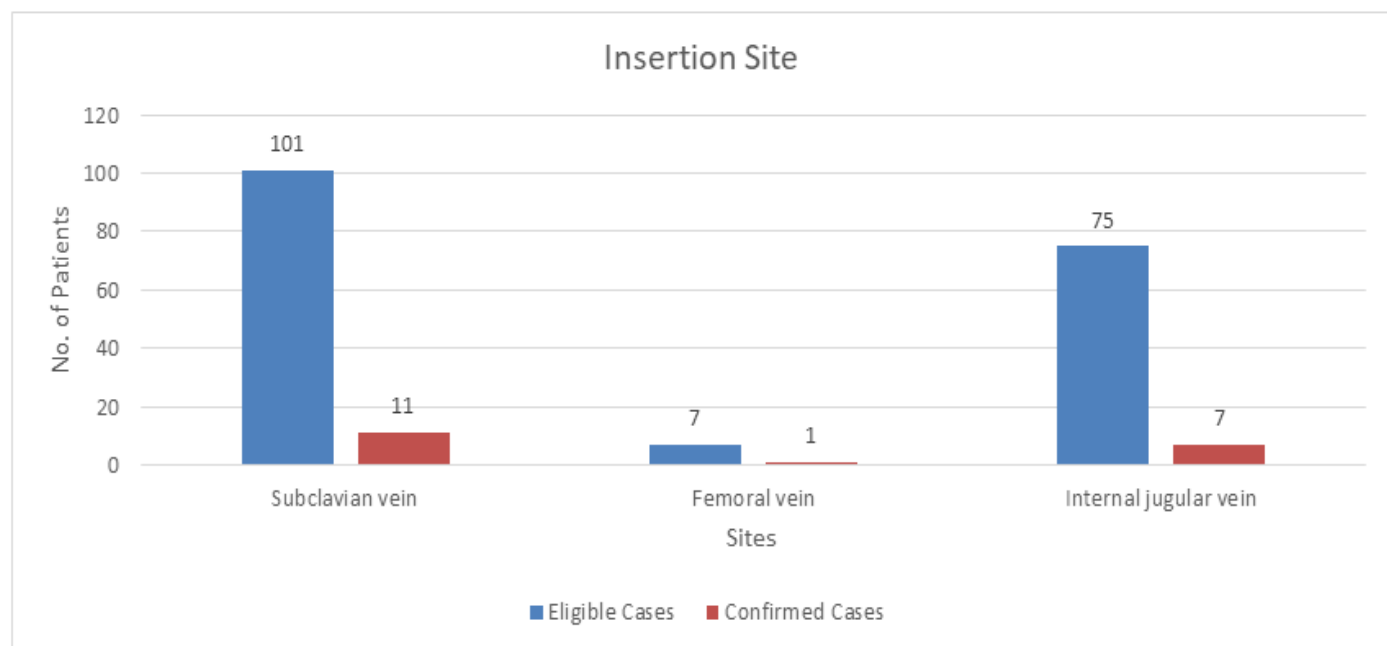


Fig 3 Insertion site of Central Lines with Reference to Anatomical Location

IV. DISCUSSION

The study conducted at Mediheal Hospital and Fertility Center investigated the incidence and risk factors of central line-associated bloodstream infections (CLABSIs). During the study, 252 central lines were inserted, resulting in 1416 central line days and 1868 patient days. The study identified 19 CLABSI incidents, accounting for 10.3% of eligible CLABSIs, with an incidence rate of 13.4 per 1000 central-line days in the hospital's ICUs.

Comparatively, a 2019 systematic review and meta-analysis in African countries reported an overall CLABSI incidence rate of 6.1 per 1,000 central line days, while in Kenya, it was 8.0 per 1,000 catheter days based on data from three hospitals in Nairobi. This study's findings indicate a higher incidence of CLABSI compared to previously published studies in the region. (5)

In this study, *Staphylococcus aureus* was the most frequently isolated organism, accounting for 42.1% of cases. There was one instance of a mixed organism infection involving *Pseudomonas aeruginosa* and *Candida albicans*.

Regarding demographic characteristics, 55.2% of eligible CLABSI patients were male, while 44.8% were female. Among confirmed CLABSI cases, 63.2% were male and 36.8% were female. This aligns with a similar U.S. study where CLABSI incidence was higher in males, though the difference was not statistically significant. (6)

Furthermore, 47.3% of confirmed CLABSI cases occurred in patients aged 18-37, with no cases observed in patients under 5 years old. The study also highlighted that no CLABSI cases occurred within the first 3 days of central line placement. However, 57.9% of cases occurred between days 3-8, and 42.1% occurred after 8 days, emphasizing the importance of addressing risk factors to prevent CLABSIs and enhance patient outcomes.

Regarding the insertion site of central lines, the study revealed that catheters placed in the jugular vein (9.3%) and femoral vein (14.2%) exhibited a higher susceptibility to infection compared to those inserted in the subclavian vein (10.8%). It is also shown that respiratory diseases constituted the most prevalent medical diagnosis among the study's patients, representing 26.3% of cases (n=5). Patients with specific underlying medical conditions, such as immunocompromised individuals or those with chronic illnesses like diabetes mellitus, may face an elevated risk of CLABSIs. However, by implementing appropriate preventive measures like rigorous hand hygiene, the use of sterile techniques during central line placement, and daily central line assessments, the incidence of CLABSIs can be substantially reduced. (7)

The study also examined patients' exposure to antibiotics before the onset of CLABSI and found that 37% of patients had received antibiotics in the 30 days. This aligns with data from the Centers for Disease Control and Prevention (CDC), which reports that approximately 30-40% of CLABSI patients had prior antibiotic exposure within the same timeframe. (8)

V. CONCLUSION

The incidence rate of CLABSIs in this hospital's ICUs was notably higher (13.4 per 1000 central-line days) than the rates reported in most of the studies. This highlights a significant concern regarding CLABSIs in this healthcare setting.

The study revealed varying infection rates based on the insertion site of central lines. Catheters inserted in the jugular vein and femoral vein showed a higher susceptibility to infection compared to those in the subclavian vein.

Respiratory diseases were the most common medical diagnosis among the patients, suggesting that certain comorbidities, such as immunocompromised states or

chronic illnesses like diabetes mellitus, may elevate the risk of CLABSIs.

A significant percentage (37%) of patients had been exposed to antibiotics in the 30 days preceding the development of CLABSI. This aligns with data from the CDC, indicating that antibiotic exposure is a potential risk factor for CLABSIs.

RECOMMENDATION

The hospitals can work towards reducing CLABSI rates, improving patient safety, and enhancing overall healthcare quality within its ICUs, not only in Kenya but even in other parts of the world.

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➤ Conflict of Interest

The authors assert that they have no conflicts of interest to disclose, and this manuscript has not been submitted for publication elsewhere.

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