Original paper

Patient Safety: Practice and Barriers to Adherence to Central Line Care Bundle among Doctors at a National Referral Hospital

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Abstract

Background: Safety in central line care is crucial to prevent Central Line Associated Blood Stream Infections (CLABSI), a key aspect of 21st-century healthcare and the Sustainable Development Goals (SDGs). Implementing the Central Line Bundle, which includes insertion and maintenance protocols, is essential for reducing CLABSI rates. Adherence to this bundle varies, averaging 62% in middle- and low-income countries, but higher adherence rates of up to 95% are needed to effectively reduce CLABSI. Various personal and institutional factors affect adherence, which can differ by environment, prompting the need for this study in our local setting.

Objective: This study aimed to assess the current level of adherence to all components of central line insertion bundle among doctors at a national referral hospital in Kenya and determine barriers to adherence to the bundle among doctors.

Methods: This mixed-method study combined quantitative aspects (retrospective chart review, cross-sectional survey) and qualitative aspects (in-depth interviews). Conducted in the adult ICU, renal unit, and specific wards (renal and oncology) at a national referral hospital it reviewed central line insertion records from October 1 to December 31, 2023. The study took place over three months in 2024. Data on central line practices were abstracted from patient files using a checklist. A self-administered questionnaire assessed adherence to the central line bundle and related challenges, completed by doctors in the identified units. Additionally, 12 doctors (Medical Officers, residents, and consultants) were interviewed using a guide, with responses analyzed thematically. Descriptive data was summarized in frequency tables and percentages, and adherence to each bundle component was calculated.

Results: Eighty two participants were recruited for the cross-sectional surveys; 85 records were reviewed and 12 in-depth interviews were conducted. The overall self-reported adherence to the central line bundle was 59.3% while that from the retrospective chart review was 4.7%. Specific components of the bundle showed varying levels of adherence, with hand hygiene exhibiting the highest self-reported adherence at 89%, while maximal barrier techniques recorded the lowest adherence in the retrospective chart review at 3.5%. The overall knowledge score was 82.72%. Various factors were identified as barriers to adherence to the bundle such as: lack of training, lack of organizational policies, lack of supplies, work constraints and attitudes towards adherence.

Conclusion: Adherence to the Central line bundle was low compared to other studies. There were various factors barring adherence to the bundle. This study highlights the need to address the identified barriers in order to increase adherence to the bundle and consequently promote patient safety.

Key words: Patient safety, Practice, Barriers, Adherence, Central line care bundle

Introduction

Patient safety is a key component in Universal Health Coverage (UHC) which is enshrined in the Sustainable Development Goal 3.8 which focuses on ensuring healthy lives and promoting well-being for all at all ages. This can only be ensured if all facets of the SDGs are achieved. Achieving UHC includes 'financial risk protection, access to quality essential health care services, and access to safe, effective, quality, and affordable essential medicines and vaccines for all[1]. Safe health care is a global priority and cuts across all disciplines of medicine. Some of the threats to patient safety include: diagnostic errors, medication errors,

unsafe surgical procedures, unsafe injection practices, health care associated infections, sepsis among many others[2].

Central Line Associated Blood Stream Infections (CLABSI) continue to threaten the lives of patients in hospitals. It is estimated that about 250,000 blood stream infections occur annually with most being attributed to intravascular devices[3]. Different factors are associated with increased risk for central line associated blood stream infections. Firstly, the type of catheter used may determine the risk of infections. Tunneled catheters as opposed to non-tunneled catheters are associated with lesser risk of infections. Similarly mono-lumen catheters are associated with lesser risk of CLABSI[4]. The site of insertion of the central line also determines the risk of CLABSI with the femoral site cited to have increased associated risk with CLABSI. Host factors such as chronic illnesses, immune-suppressed states, malnutrition, total parenteral nutrition, extremes of age, loss of skin integrity (burns) and prolonged hospitalization also increase risk of CLABSI. Provider characteristics such as excessive manipulation, incomplete adherence to safety precautions, low nurse to patient ratio, or staffing ratios have been shown to increase the risk of CLABSI[4].

Due to the different factors that play a role in the pathogenesis of CLABSI, it was imperative that a multipronged approach be adopted in the fight against CLABSI. This is what led to the creation of the central line bundle which applies to both insertion and management of central lines. A care bundle is defined as 'a set of evidence-based interventions that are intended to be implemented together, under the theory that the bundled interventions are more effective than implementation of individual interventions separately[5]. The central line insertion bundle consists of the following categories: i) Hand hygiene prior to insertion of the central line, ii) Maximal barrier precautions, iii) Chlorhexidine skin antisepsis; iv) Optimal site selection (avoidance of femoral vein in adults); and v) Daily review of line necessity[6]

This study aimed to examine the practice and barriers to adherence to central line care bundle and explore their impact on patient safety.

Materials and methods

This mixed-method study combined quantitative aspects (retrospective chart review, cross-sectional survey) and qualitative aspects (in-depth interviews). Conducted in the adult ICU, renal unit, and specific wards (renal and oncology) at a national referral hospital, it reviewed central line insertion records from October 1 to December 31, 2023. The study took place over three months in 2024. Data on central line practices were abstracted from patient files using a central line insertion checklist developed from CDC (Centres for Disease Control and Prevention), IHI (Institute of Health Care Improvement), and AHCQ (Agency for Health Care Quality). A self-administered questionnaire assessed adherence to the central line bundle and related challenges, completed by doctors in the identified units. Additionally, 12 doctors (Medical officers, residents, and consultants) were interviewed using a guide, with responses analyzed thematically.

All quantitative data was checked for completeness before being entered into Microsoft Excel sheet 2017. It was then exported to Statistical Package for Social Sciences version 24.0 for analysis. Descriptive data was summarized in frequency tables and percentages, and adherence to each bundle component was calculated.

Results

The results of the cross-sectional survey are as follows:

Cross-sectional survey: Table 1 presents results of the characteristics of the medical practitioners. The mean age was 32.5 (SD 3.7) years, while the median was 32.0 (IQR, 30.0 – 34.0) years. The minimum and maximum age were 26.0 year and the maximum was 43.0 years. Fifty three point three seven percent fell within the age group of 31-35 years with a majority of 65.9% being residents. Sixty five point nine percent had between 5-10 years of experience in the medical field with 63.4% of them working in the in-patient wards. A majority of the respondents, 67.1% had not received training on the central line bundle.

Table 1: Demographic characteristics of the medical practitioners in cross-sectional survey

Characteristic	Frequency, (n=82)	(%)
Age in years		
26 – 30	26	31.7
31 – 35	44	53.7
36 – 40	9	11.0
>40	3	3.7
Sex		
Male	39	47.6
Female	43	52.4
Professional level		
Medical officer	19	23.2
Resident	54	65.9
Consultant	9	11.0
Years of experience in medical field		
<5.0	17	20.7
5.0 – 10.0	54	65.9
>10.0	11	13.4
Current designated workspace		
Accident and emergency	1	1.2
In patient ward	55	67.1
Intensive Care Units	14	17.1
Renal Unit	3	3.7
Surgical Unit	9	11.0
Received any training on the central line bundle		
Yes	27	32.9
No	55	67.1

The second section of the questionnaire assessed knowledge of the central line bundle components. The average knowledge score represented an average of individual scores calculated out of 12 and presented as a percentage. The highest knowledge score was that hand hygiene is a key component of the bundle at 98.8% and the knowledge that assessing the necessity of a central line daily is key at 98.8%. These were followed closely by the knowledge that the choice of optimal site is essential to prevent infection at 97.6%. The lowest score on knowledge concerned the fact that iodine is not the preferred agent for cleaning catheter site at 27% and that the patient should be draped with a full body drape during insertion at 29%.

The third section of the cross-sectional survey assessed self-reported adherence to the central line bundle. Responses given as 'always' and 'usually' represented as A/U on the table were considered adherent while 'sometimes,' 'rarely' and 'never' were considered non-compliant. These were presented on Table 2 under the category labelled S/R/N. The overall compliance was calculated as the proportion that reported compliance to all components of the bundle by responding either 'always' and 'usually' to all components of the bundle. The overall self-reported adherence was 59.3%. The highest self-reported adherence was to hand hygiene at 73%. These results were presented in Table 2.

Table 2: Self -reported adherence from cross sectional survey

	A/U	S/R/N
Performing hand hygiene before inserting a central line	73 (89.0)	9 (11.0)
Wearing maximal sterile barrier precautions (mask, cape, gloves, gown) before inserting a central line	51 (62.2)	31 (37.8)
Using chlorhexidine to prepare the skin before inserting a central line	49 (59.8)	33 (40.2)
Waiting until the skin antiseptic is dry before puncturing the skin	51 (62.2)	31 (37.8)
Using the subclavian site for central line for adult patients	25 (30.5)	57 (69.5)
Documenting the procedure details (date, location, catheter lot number, name and signature of operator)	65 (79.3)	17 (20.7)
Performing daily assessment of the central line necessity and document that in the patient record.	38 (46.3)	44 (53.7)
Removing unnecessary central lines	70 (85.4)	12 (14.6)
Documenting the dressing changing details in the patient record	28 (34.1)	54 (65.9)
Following the recommended policy when changing the administration set.	36 (43.9)	46 (56.1)

Overall reported adherence = 59.3%

The next section addressed attitude towards measurement of central line bundle compliance. These were given as statements which one either responded as strongly agree (SA), agree (A), disagree (D), and strongly disagree (SD). Fifty two percent of the respondents strongly agreed that monitoring of CLABSI related measures stimulate quality improvement while 56.1% agreed that improvement in adherence to central line bundle cannot be improved without measurement. Fifty two point four percent strongly agreed that they would be willing to support a CLABSI monitoring system. Nine point eight percent strongly agreed while 29.3% agreed that data on measurement on adherence to central line bundle could be used against them. These results were presented in Table 3.

The last section of the cross-sectional survey assessed barriers to adherence to the central line bundle. Eighty point five percent expressed lack of training as the leading barrier to central line bundle adherence. This was followed closely by workload constraints at 73.2% and lack of policy at 72%. This was presented in Table 3.

Table 3: Barriers to central line bundle adherence from cross-sectional survey

	Frequency, (n=82)	(%)
Unfamiliar with the central line bundle	54	65.9
Lack of training	66	80.5
Lack of policy about CLABSI bundle	59	72.0
Staff shortages	49	59.8
Lack of appropriate equipment	51	62.2
Lack of skill on use of ultrasound	54	65.9
Workload constraints	60	73.2
Shortage of supplies	55	67.1
Belief that some components of the bundle are more important than others	24	29.3
Lack of consistency in hospital audit and feedback	46	56.1
Time constraints	40	48.8

Results of retrospective chart review: Most central lines were inserted in the renal in-patient ward at 35.3% and renal unit at 31.8%. Most insertions happened as an emergency insertion at 74.1%. The most common indication for central lines was dialysis at 68.2%. The most common site for insertion was the right internal jugular at 48.2%. Most of the catheters inserted were non-tunneled at 74.1%. The general profile of central line management practices at KNH was outlined in Table 4.

Table 4: General profile of central line management practices at KNH from retrospective chart review

	Frequency, (n=85)	(%)
Place where the procedure was done		
ICU	23	27.1
Oncology wards	5	5.9
Renal in-patient ward	30	35.3
Renal Unit	27	31.8
Mode of insertion		
Elective	22	25.9
Emergency	63	74.1
Indication of central line insertion		
Chemotherapy	4	4.7
Dialysis	58	68.2
Difficult peripheral line	4	4.7
Emergency venous access	3	3.5
Ionotropic support	12	14.1
Multiple infusions	4	4.7
Catheter site (veins)		
Left femoral vein	6	7.1
Right femoral vein	16	18.8
Right internal jugular vein	41	48.2
Left internal jugular vein	1	1.2
Right subclavian vein	16	18.8
Left subclavian vein	5	5.9
Type of catheter		
Non-tunelled	63	74.1
Tunnelled	22	25.9

The central line insertion practices obtained from the retrospective chart review were then summarized as depicted in Table 5. The table displays the frequency and percentages of records that documented performance of the stated action. Any undocumented action was considered not done. Eighty eight point two percent sterilized the insertion site. Seventy eight point eight percent indicated that draping was done though most did not indicate whether head to toe draping or only partial draping was done. The least adhered to action was dressing using transparent dressing and dating the dressing each at 1.2%.

Table 5: Characteristics of central line insertion practices from retrospective chart review

Before procedure	Frequency, (n=85)	(%)
Obtained consent for procedure	46	54.1
Record of supervision included	7	8.2
Perform patient ID X 2	1	1.2
Announce procedure to be performed	0	0.0
Mark/Assess site – Position patient correctly for procedure	56	65.9
Utilize relevant documents (chart/forms)	3	3.5
Order follow up radiology images (PRN)	50	58.8
Perform hand hygiene	4	4.7
Full PPE donned by the healthcare practitioner	3	3.5
Sterilize procedure site	75	88.2
Indicate antiseptic solution used for sterility	58	68.2
Patient draped from head to toe	67	78.8
Use ultrasound/Sonasite if appropriate	4	4.7
Clamp any ports not used during insertion	26	30.6
Aspirate blood from each lumen	76	89.4
Transparent dressing used for dressing	1	1.2
Dressing was dated	1	1.2

Based on these, the overall compliance based on the retrospective review was calculated. Only 4 files out of 85 files reviewed were found to have documented all actions in the central line bundle placing the adherence rate from chart review to be 4.7%.

In-depth interview results

The following themes were identified from the interviews:

1. Lack of knowledge and training on the central line bundle (n=6)
2. Inadequate supply of bundle components (n=6)
3. Inadequate staffing, large patient burden and time constraints (n=9)
4. Infrastructural factors (n=5)
5. Environmental hygiene factors (n=4)
6. Institutional policies (n=4)
7. Attitude towards the central line bundle (n=4)

Figure 1: The details under this were presented in this fishbone diagram

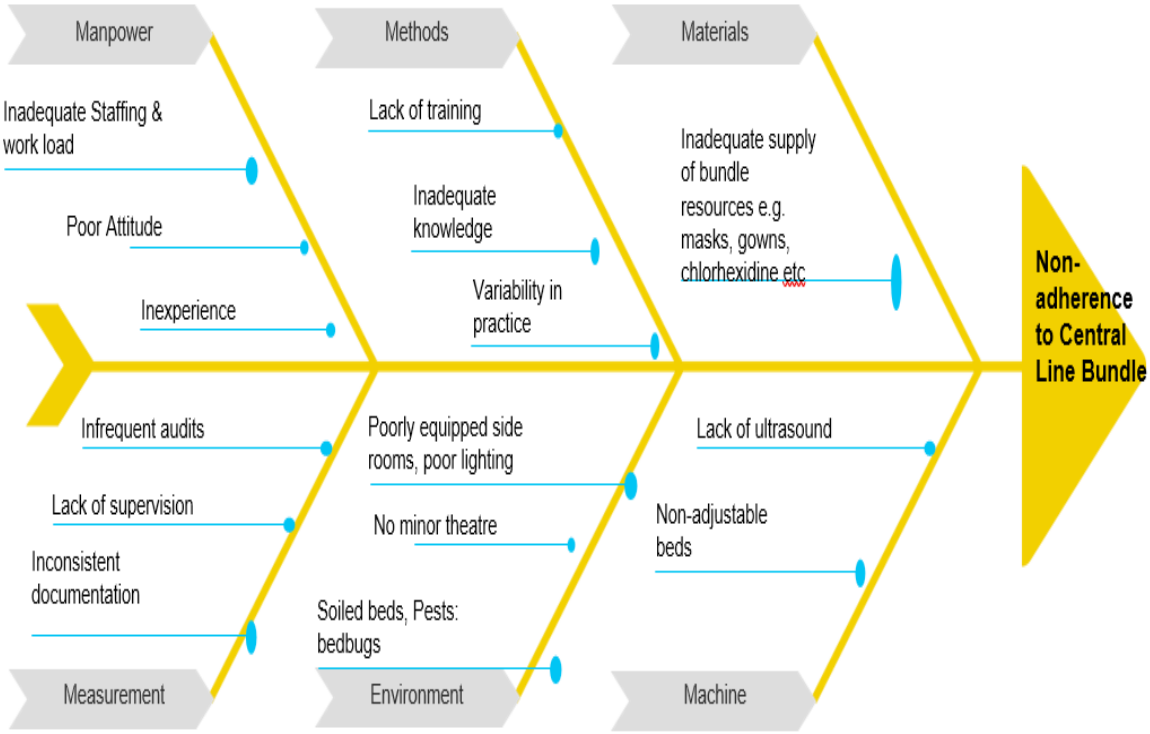
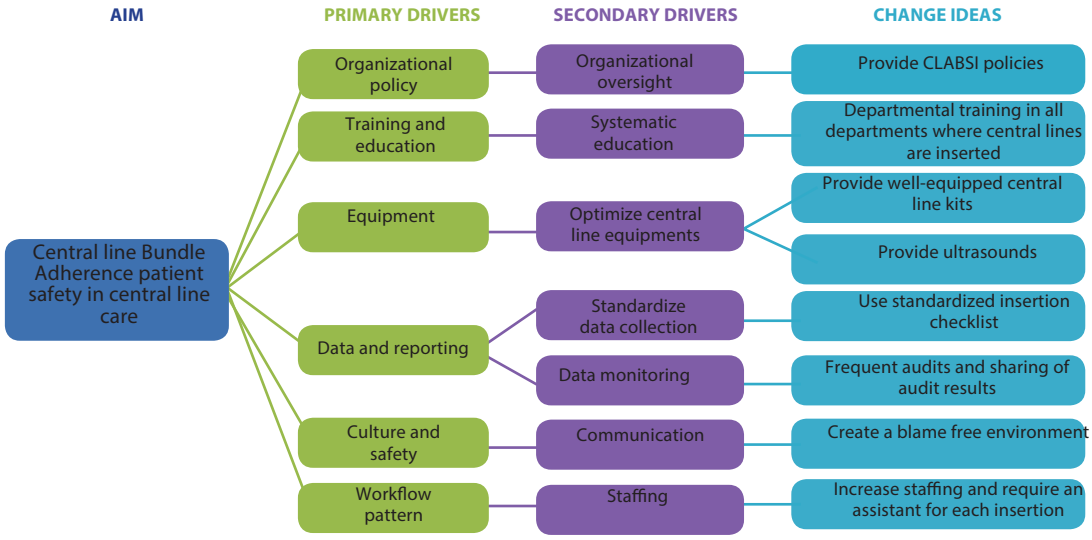


Figure 2: Driver diagram showing recommendations of the study



Discussion

The findings of this study revealed a mixed picture regarding adherence to the central line bundle with the study revealing areas of strength and weakness in the adherence to the central line bundle. The overall self-reported compliance from the cross-sectional survey was 59.3%. This rate falls behind a benchmark from a study done in the United States intensive care unit which revealed that only when high bundle compliance of 95% was achieved was there significant reduction in CLABSI rates[7]. This figure is likely low compared to other regions due to several factors such as lack of resources and infrastructure, lack of policies, inadequate training among other factors which are further expounded in the discussion on barriers.

Comparatively, compliance rates in other regions, including Mongolia and various low- and middle-income countries, surpassed the findings at KNH. For instance, in Mongolia baseline compliance to the bundle before interventional efforts was 68.5%[8], in low- and middle-income countries in which Kenya is part the compliance rate was found by Valencia *et. al*[9] to be 62%. Some of the countries included in this study from Africa included South Africa and Sudan. In South Africa initial adherence rates before educational intervention was found to be 73.1%[10]. Additionally, a study done in Saudi Arabia revealed the overall self-reported compliance rate at 87%[11].

The overall compliance rate from the retrospective chart review was 4.7%. This figure was notably low due to poor documentation at the hospital. The lack of a central line insertion checklists contributes to lack of clinically relevant information and hence difficult to calculate compliance rates from the medical records. Checklists for insertion are the recommended tool to be used during insertion and to document central line insertion procedures worldwide. This is the tool that was used to assess adherence in the retrospective chart review. Moreover, there were also differences in format of documentation making calculation of an overall adherence rate difficult from the retrospective chart review. However, considering the principle that if not documented it was not done; it would be a dreadful consideration that it is likely that this figure would represent the actual adherence rate to the central line bundle.

The challenges in documentation are not unique to KNH; In a study in Sweden 62% of clinically important variables in CVC insertions were missing in patient records[12].

Adherence to maximal barrier techniques was likely the lowest in the retrospective chart review due to various challenges which were revealed in the qualitative study. It was evident from the qualitative study that the hospital experienced various shortages of lack of essential components of the central line bundle including drapes. Some respondents reported having to make do with whatever was available for draping leading to inadequate draping, or no draping at all. Lack of knowledge on how draping should be done is also likely to have influenced this outcome. The knowledge score regarding this component, as assessed in the cross-sectional survey, was notably low. Only 35.4% of participants were aware of the necessity to drape the patient from head to toe during central line insertions. In contrast, doctors in a study conducted in Saudi Arabia demonstrated significantly higher knowledge scores on the same component, with 96% awareness[11]. This was mainly attributed to training in this study.

Eighty point five percent of the respondents pointed to a lack of training as a major barrier to adherence to the central line bundle. Additionally, 65.9% mentioned being unfamiliar with the bundle as a hindrance. The study's average knowledge score of 82.72% aligned with similar research in Saudi Arabia (82%)[11] and Pakistan (74%)[13], but exceeded knowledge scores from studies conducted in Brazil (42%)[14]. The knowledge scores reveal that there is still a training and knowledge gap among doctors at KNH.

In-depth interviews underscored the lack of training on the bundle and unfamiliarity with its components. This resulted in different techniques for insertion and influenced adherence behaviors. Infrequent training was also cited as a reason for non-adherence to the central line bundle. In this study, only 27% received training in the cross-sectional survey. Training is directly correlated with knowledge scores and promotes adherence as was proposed by Almahmoud *et. al*[11] in his study. After all, you cannot implement what you do not know.

Work constraints was the second leading reason cited as a barrier to adherence to the central line bundle at 73.2% in the cross-sectional survey. Workflow patterns are essential in maintaining patient safety. The Institute for Healthcare Improvement's framework for safe, reliable, and effective care emphasizes the importance of continuously improving work processes to enhance patient safety[15]. Staffing shortages and heavy workloads imposed on already stretched human resources undoubtedly disrupt workflow, thereby contributing to non-adherence to the bundle.

Limitations

1. A limitation of this study was the retrospective chart review, which faced challenges due to missing clinically relevant information.
2. The study experienced recall bias in the cross-sectional survey and social desirability bias from respondents self-reporting their actions. This study attempted to reduce this bias significantly by making cross-sectional survey anonymous to increase honesty.

Conclusion

The study confirmed non-adherence to the bundle through both inadequate documentation and self-reports, highlighting the need for measures to promote adherence. Identified barriers included lack of training, unfamiliarity with the bundle, high patient burden, time constraints, inadequate staffing, and absence of policies on auditing, documentation, and insertion practices. These recommendations can be summarized in the driver diagram (Figure 2).

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