Effect of applying nursing guidelines on reducing central venous line related infection among patientsof intensive care units

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ABSTRACT

Background: Central venous lines (CVLs) are widely used in intensive care units (ICUs) to provide long-term vascular access for critically ill patients. While they offer significant clinical benefits, CVLs are also associated with a considerable risk of central line-associated bloodstream infections (CLABSIs). **Aim of the study:** This study aimed to explore the effect of implementing nursing guidelines on reducing central venous line-related Infections among Patients of Intensive Care Units. **Design:** A Quasi-experimental design was carried out. **Subjects:** A purposive sample of 129 adult patients and 129 nurses working in ICUs. **Setting:** The study was conducted in the intensive care units (ICUs) of four hospitals affiliated with the Egypt Healthcare Authority in Port Said governorate: Al-Zohor Hospital, Al-Salam Hospital, El-Shefaa Medical Complex, and Al-Hayat Port-Fouad Hospital. **Tools:** four tools utilized for data collection; central venous line assessment questionnaire, an observational checklist for infection prevention, an observational checklist for line-related infection, and a questionnaire on nurses'personal and work-related characteristics. **Results:** The prevalence of CVL-related infection was 18% before the application of evidence-based nursing guidelines, which decreased to 7.6% afterward. **Conclusion:** The findings revealed that implementing evidence-based nursing guidelines significantly reduced central venous line infections Among ICUs Patients. **Recommendations:** It is recommended to standardize CVL care bundles across ICUs, combined with ongoing nurse training and competency assessments in aseptic techniques and line maintenance.

***Keywords*:** Nursing guidelines, Central venous line, ICU patients, Prevalence.

INTRODUCTION

Central venous line plays an essential role in the management of critical ill patients (Abo seif, Hassanein, Sobh, & abd elrheem, (2021). It is utilized for various indications such as the administration of intravenous fluids, medications, blood products, parenteral nutrition, hemodialysis, hemodynamic monitoring (central venous pressure measurement) and fluid resuscitation (Ball, Singh, 2020). Despite useful of central venous line, it is possibility of subsequent serious complications which can life treating conditions such as pneumothorax, pericardial effusion, bleeding, hematoma, infection, thrombosis, injury to the nerve, arrhythmia and air embolism (Leib, England, Kiel, 2018).

The central venous line is placed into a big vein and terminal lumen in the right atrium, superior vena cava, or inferior vena cava (Kolikof, Peterson, Baker, 2020). There are three primary venous access sites: the jugular vein, the subclavian vein, or the femoral vein. Based on a variety of factors, including the indication of the venous access line, the length of line use, and the type of device, the most suitable sites are chosen (Hicks, Popowicz, Lopez, 2023).

There are various types of central venous lines depending on the length of treatment and the indication of use. There are non-tunneled lines, which are used in emergency situations due to their ease of insertion and short duration of use, tunneled lines, which are used when intravenous access is required repeatedly over an extended period of time, and implanted ports, which are used for long-term use and require more time-consuming surgical implantation (Patel, Patel, Singh, Singh, Khawaja, 2019).

One of the most frequent side effects of a central venous line is central line-associated blood stream infection (CLABSI) (Rabie, Mostafa, Abdel Halim & Ezzat, 2022). It is characterized as a primary bloodstream infection that is unrelated to an infection at another site and occurs in a patient who has a central venous line within 48 hours prior to the onset of the infection (Morris & Jakobsen, 2022).

A central venous line can cause both localized and systemic infection complications, such as fever, chills, swelling, redness, and discharge from the insertion site, or more generalized symptoms like fatigue, hypotension, and altered mental status, even though it provides essential vascular access (Haddadin, Annamaraju, Regunath, 2022; Soliman et al., 2019). The organism's migration along the catheter's inner surfaces from the insertion site is the most frequent method of central line infection. One of the key causes of central line infection is bacterial colonization of the skin, as the skin beneath the dressing serves as the culture organisms' medium (Wang, Huang, & Kuo., 2022).

Critical ill patients are more vulnerable to serious complications of central venous line infection due to many factors such as advanced age, comorbidity, immune-compromised statuses and the rising incidence of antimicrobial resistance. There are factors relate to venous access line also that contribute to increase of incidence of central line infection such as: prolonged time of venous line, multiple lumens, multiple insertions or type of line material (Flint, Jacqueline, Annette. (2020).

The recommendations from the CDC (Central for Disease Control and Prevention, 2024) Guidelines for Prevention of Intravascular Catheter-Related Infections, which helped to significantly reduce central line infection rates (Martin, Renew, Ramakrishna, 2020). These guidelines performed collectively and consistently and implemented together help of Standardize care process improve quality of care and avoidance adverse events outcomes (EL-Hosseini, Shahin, EL-Tahry, 2022).

These guidelines are structured, evidence-based practices, and interventions that, when used together, improve patient outcomes (Devrim et al., 2020). Hand hygiene, site catheter selection, aseptic technique for catheter insertion, skin antiseptic, and daily assessment of line necessity with prompt removal of unnecessary lines are the five components of the guidelines of care bundle to prevent central line infection (Ray-Barruel, Xu, Marsh, Cooke, Rickard, 2019).

According to MOUSTAFA, HUSSEIN, SULTAN, and LOFTY (2024), nurses have crucial role in insertion access, daily care, early detection and management of complications related to central venous line access insertion, and prevention of infections associated with central venous catheters. They also need to be competent in the care of intravascular catheters and use the right infection control measures to prevent infections associated with intravascular catheters.

Importance of Implementing Prevention Guidelines for Central Line–Associated Bloodstream Infections (CLABSIs); Reduced morbidity, mortality even death. Applying evidence-based prevention guidelines helps decrease these risks and lowers the chance of complications such as sepsis (Star et al., 2024). Effective prevention shortens periods duration of hospitalization and ICU stay and reduces the use of healthcare resources (Odada et al., 2023). Managing CLABSI is expensive due to the need for antibiotics, additional interventions, and longer hospitalizations. Preventive measures are considerably more cost-efficient (Rosenthal et al., 2023). Improved antibiotic stewardship and reduced resistanceminimize unnecessary use of broad-spectrum antimicrobials (Gillis et al., 2023).Enhanced quality of care and patient safety through using bundles, checklists, and routine audits promotes standardized practices, which not only improve patient care but also strengthen the overall culture of safety (Star et al., 2024).

Significance of the study

Catheter line–associated bloodstream infection (CLABSI) is the most common serious complication associated with central venous access devices (Devrim et al., 2023). In the United States, an estimated 30,000 to 40,000 CLABSI cases occur annually (Odada et al., 2023). According to the World Health Organization (WHO), up to 30% of intensive care unit (ICU) patients develop healthcare-associated infections (HCAIs), with bloodstream infections being the most prevalent (Dyk et al., 2021).

CLABSI ranks as the third most common type of HCAI and can be life-threatening (Latif et al., 2024). The WHO and the International Nosocomial Infection

Control Consortium (INICC) report that the prevalence of HCAIs is 10.1% across hospitals in high-income countries and 19.1% among ICU patients in lower-middle-income nations. Mortality rates for CLABSI range from 12% to 25%, and each case is associated with a significant economic impact, with estimated costs of approximately $45,000 (Star et al., 2024).

The use of care bundles for central venous line insertion and maintenance is a crucial technique for preventing Central Line-associated Bloodstream Infection (CLABSIs) with the goal of enhancing patient outcomes and the care process (Cho., 2020). CLABSI rates have significantly decreased as a result of the multifaceted approach used to implement CLABSI prevention guidelines with care bundles (Rosenthal, Memish, Shweta, Bearman, and Lutwick., 2024).

AIM OF THE STUDY

Explore the effect of applying nursing guidelines on reducing central venous line related infection among patients at intensive care unit.

Objectives

- Implement nursing guidelines for patients with central venous line at intensive care units
- Evaluate effect of implementing nursing guidelines on prevalence of central venous line related infection at intensive care units

Research hypothesis

Central line related infection rate will be decreased after implementing nursing guidelines among patients with central venous line at intensive care unit.

SUBJECTS AND METHOD

Technical Design:

In terms of the technical design of this study, it comprised a description of the setting, subjects, data collection tools and design of research.

Study design:

A quasi-experimental research design was used in this study.

Study Settings:

The research was conducted in the intensive care units (ICUs) of four hospitals affiliated with the Egypt Healthcare Authority in Port Said governorate: Al-Zohor Hospital, Al-Salam Hospital, El-Shefaa Medical Complex, and Al-Hayat Port-Fouad Hospital. Al-Salam Specialized Hospital includes four ICUs with a total capacity of 35 beds. Al-Hayat Port-Fouad Hospital contains two ICUs with 21 beds. El-Shefaa Medical Complex has two ICUs comprising 16 beds, while Al-Zohor Hospital houses a single ICU with 10 beds.

Study subject:

For Patients: A purposive sample of 129 newly admitted adult patients of both sexes who had recently undergone central venous line insertion was included. They were divided into two equal groups to compare prevalence rates before and after the implementation of nursing guidelines aimed at reducing central venous line–related infections (129 patients in each group).

Exclusion criteria:

Patients were excluded if they:

- had impaired immune function,
- were diagnosed with systemic infections, or
- were receiving corticosteroid therapy, chemotherapy, or radiotherapy.

For Nurses: The study also included all 129 nurses working in the critical care units of the previously mentioned hospitals at the time of data collection. Nurses were recruited irrespective of their age, educational level, or years of professional experience, and were classified accordingly.

1	Al-Salam Port-Said hospital	34
2	El-Shefaa Medical Complex (Al-Tadamun hospital)	35
3	El-Shefaa Medical Complex (Elmabara hospital)	19
4	El-Hayat Port-Fouad hospital	19
5	Alzhoor central hospital	22
Total		129 nurses

Sample size:

Sample size of participating patients was calculated according to Steve Thompson formula was utilized to calculate the sample size, at 5% ∞ error (95.0% significance) and 20.0 β error (80.0% power of the study) (**Janet L. Peacock and Phil J. Peacock, (2020).**

$$n = \frac{N \times P\,(1-P)}{(N-1 \times (d2 / Z2)) + P\,(1-P)}$$

n=Sample size

N=Total society size (1924 patients)

Z= the corresponding standard class of significance 95 d=error percentage = (0.05) = 1.96

P=percentage of availability of the character and objectivity= (0.1)

d =error percentage = 0.05

The sample size was calculated to be **129** patients.

Tools for collection of data

The following four tools were used in this study.

Tool I: patient's central venous line assessment questionnaire

It was developed by researchers in the Arabic language based on relevant and recent literature review to collect data related to patient's medical and surgical history, characteristics of central venous line patient health profile (Alfar, El-Sheikh, Hassan, and Selim, (2020); Elbilgahy, Davidson, and Sharps (2019), and it was divided to three parts:

Part one: Personal characteristics of the patients included questions about age, sex, level of education, marital status, occupation, and income

Part two: Patients' medical, surgical history

It involved questions regarding medical history, presence of chronic diseases such as cardio-vascular disease, hypertension, diabetes mellitus, stroke, renal disease, liver disease, previous surgeries (heart -orthopedic vascular).

Part three: Central venous line Criteria. This part contained questions about catheter type, catheter site insertion, number of lumens, date of insertion, antiseptic solution was used, type of dressing and use of prophylaxis antibiotics.

Tool II: Observational checklist for prevention of central venous line infection

It has been adopted from central for disease control and prevention (CDC, 2024), (The Joint Commission., (2023) to collect data regarding preventative care measures which performed to avoid infection of central venous line. it was included: Hand hygiene and aseptic techniques steps (3 items), using sterile supplies and instruments (1 item), disinfect the hub (1 item), flushing the lumens of central venous

line (2 items), dressing techniques (11 items), replacement of administration sets (2 items), replacement of central venous line (1 item) and documentation (5 items).

Scoring system: observational checklists were used to gather data on nurses' practices, and each item was marked as either completed, not completed, or not applicable. The scoring method was established as follows: a correct response received a score of 1 and an incorrect response received a score of 0. The mean score for each section was calculated by adding together all of the scores and dividing that total by the number of items. The scores were transformed into means ±SD and a percentage. (Radwan, 2024) Unsatisfactory practice level < 85% and satisfactory practice level > 85%.

Tool III: Central venous line related infection observational checklist.

This tool was developed by researcher in the Arabic language based on literature review to collect the data regarding of occurrence of central venous line infection (Abd-EL Salam& Mostafa, (2022); Neill et al.,2018). It was divided to presence of general manifestations of central venous line infection as fever, chills and hypotension. This checklist used to assess localized and generalized manifestations of central venous line related infection among intensive care unit patients e.g., Purulence, swelling, pain, tenderness, Fever ≥ 38C, chills or hypotension.

Scoring system:

These items are scored using a Yes/No rating scale.

Each item's score was determined as follows:

Yes = one point

No = zero

More than one manifestation indicated central line related infection.

Tool IV: A questionnaire about personal characteristics and work-related data of intensive care unit nurses

This questionnaire developed by researcher based on relevant and recent literature review (Wahba, 2016; Hassan, 2018; Soliman, Ouda, Mahmoud, 2019) in the Arabic language and cover two parts:

First part: Nurses personal characteristics E.g., name, age, sex, level of education, marital status.

Part two: Nurses work-related data e.g., years of experience in nursing field, years of experience at intensive care units, Patient-to-nurse ratio in the intensive care unit, previous training courses about central venous line infection control.

II. Operational Design

The operational design included the preparatory phase, study tools, validity, reliability, pilot study, and fieldwork procedures.

Preparatory Phase

This phase involved an extensive review of relevant literature, including theoretical and empirical studies related to the research topic. Resources were gathered from textbooks, scholarly articles, periodicals, and credible scientific databases such as PubMed, Medline, Cochrane Library, and EBSCO.

Validity:

Content validity of the study tools was established through evaluation by a panel of nine experts in medical-surgical nursing. Their feedback was used to refine the instruments in terms of clarity, relevance, comprehensiveness, readability, and applicability.

Reliability

Reliability was assessed using Cronbach's alpha coefficient to determine the internal consistency of the tools. The results demonstrated high reliability, with alpha

values of 0.81 and 0.84 for two of the instruments. Tool III, which measured practice, yielded an alpha of 0.841 (Radwan, 2024), while Tool IV demonstrated an alpha value of 0.910 (Elsayed & Elbiaa, 2023).

Pilot Study

Pilot study was carried out on 15% of the sample to evaluate the clarity and practicality of the tools, estimate the time needed for data collection, and assess the feasibility of the study. Necessary adjustments were made accordingly, and the participants included in the pilot were excluded from the main study sample.

Field work

Data collection was carried out three days per week (Saturday, Sunday, and Monday) during both morning and evening shifts, from 9:00 a.m. to 4:00 p.m. Permission to conduct the study was first obtained, after which the researcher met with head nurses in the selected settings to explain the study objectives. Tools I and II were completed using information obtained from nurses and patient medical records, requiring approximately 20–30 minutes for each case. In addition, each nurse was observed while delivering routine care to patients with central venous lines.

Tool III, the observational checklist for infection prevention, was also applied. The nursing guidelines were taught to nurses over two educational sessions. The first session addressed topics such as hand hygiene with antiseptic soap or alcohol-based rubs, use of sterile supplies and equipment for catheter access, disinfecting access ports or hubs with chlorhexidine before each use, flushing catheter lumens, and promptly replacing wet, soiled, or displaced dressings. The second session included advanced practices such as performing dressing changes under aseptic conditions with sterile gloves, changing gauze dressings every two days or transparent dressings every seven days, disinfecting insertion sites with chlorhexidine, replacing administration sets for continuous infusions every four to seven days, and changing infusion tubing every 24 hours when blood, blood products, or fat emulsions were administered.

Tool IV, the observational checklist for central venous line–related infections, was completed one week after line insertion to monitor both systemic and local signs of infection. General manifestations such as fever and chills were assessed by measuring axillary temperature, while hypotension was defined as blood pressure below 90/60 mmHg. Local symptoms were evaluated through inspection for redness or purulent drainage around the insertion site, with documentation of drainage characteristics. Palpation was performed to detect tenderness or swelling at the site. Pain was measured using a numeric rating scale for conscious patients, while the behavioral pain scale was applied for semi-conscious and unconscious patients.

III- Administrative design

Prior to data collection, the researcher obtained official approval from the hospital directors of the Egypt Healthcare Authority in Port Said city to conduct the proposed study. The directors were informed about the study objectives and subsequently granted written consent. In addition, unit managers, including the supervising physicians and head nurses, provided authorization for data collection. Data were gathered using pre-constructed tools from the designated settings. The study was conducted on 129 patients who met the inclusion criteria, and oral consent was obtained from each participant. The researcher personally observed participants using the specified study instruments.

Ethical Considerations

Ethical principles were maintained throughout the study. The inquiry was authorized by the local ethics committee on 7/9/2025, with permission number NUR (7/9/2025) (53). Informed consent was obtained from all participants after they were clearly informed about the purpose and procedures of the research. Participants were assured of their right to accept, decline, or withdraw from the study at any stage without any consequences. Confidentiality and anonymity were strictly preserved, and all information was used solely for research purposes.

Statistical Design

Data were coded, recorded, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 20.0. Both descriptive and inferential statistical methods were employed, with significance considered at a level of $p \leq 0.05$.

RESULTS

Table (1): The table shows that distribution of studied patient according to their socio-demographic characteristics , most patients were elderly (≥60 years, 65.9%), married (72.1%) male patients represent (55.0%) of studied patients. high education was relatively high 72.1% university level among studied patients, (72.1%) were unemployed. 95.3 reported that the income is enough for expenses.

Table (2):, The table reveals that Distribution of studied patient according to medical and surgical history ,the most majority of studied patients had no previous surgical history (97.6%), kidney disease (31.0%) was the leading cause of intensive care unit admission, followed by, cardiac disease, diabetes complications and pulmonary edema. Almost half of studied patients (48.1%) stayed 1–5 days at ICU, and most of them had no prior hospitalizations (76.0%) or infections (92.2).

Table (3): The table reveals that Distribution of studied patients according to central venous line characteristics (n=129), most central venous line were inserted at ICU (72.8%) by charge physician, (87.6%) of central venous line were non-tunneled, (86.8%) had triple-lumen. Jugular vein was the most common insertion site for central venous line (62.0%), transparent dressing was the suitable bandage for majority of studied patients (73.7%). All patients (100%) received IV prophylactic antibiotics and povidone-iodine antiseptic

Figure (1): the figure show that distribution of studied patients according to the antibiotics administered, a Ceftriaxone was the most frequently used prophylactic antibiotic, (41.1%) followed by Meronem (12.40%).

Table (4): The table shows that Comparison of nurses' practice regarding central venous line care before and after implementing nursing guidelines, before implementation, correct practices were generally very low (ranging from 7.8% to 32.6% across different items, The best pre-test practice was avoiding topical antibiotics/creams (32.6%), still less than one-third. After guidelines, correct practices increased dramatically, with almost all items reaching 91–100% compliance. Hand hygiene before access rose from 11.6% → 96.9%, Wearing PPE rose from 7.8% → 99.2%. Several practices (e.g., sterile supplies, disinfecting access points, dressing changes, documentation) achieved 100% compliance.

Table (5): The table shows that Comparison of nurses' practice regarding central venous line care before and after implementing nursing guidelines, before implementation, correct practices were generally very low (ranging from 7.8% to 32.6% across different items, The best pre-test practice was avoiding topical antibiotics/creams (32.6%), still less than one-third. After guidelines, correct practices increased dramatically, with almost all items reaching 91–100% compliance. Hand hygiene before access rose from 11.6% → 96.9%, Wearing PPE rose from 7.8% → 99.2%. Several practices (e.g., sterile supplies, disinfecting access points, dressing changes, documentation) achieved 100% compliance.

Table (6): the table reveals that Central venous line-related infection, onset, and clinical manifestations after applying evidence nursing guidelines ,the prevalence of central venous line infection was 7.6%, all signs and symptoms of infection were reduced after implementing nursing guidelines, 93.2%of studied patients reported that no pain, and 0.8 % reported sever pain was manifested in insertion site.

Table (1): Distribution of the studied patients according to their demographic characteristics (n=129).

Variables	No.	%
Gender		
Male	71	55.0
Female	58	45.0
Marital status		
Single	11	8.5
Married	93	72.1
Widowed	18	14.0
Divorced	7	5.4
Age (years)		
20–39	12	9.3
40–59	32	24.8
≥60	85	65.9
Mean ± SD	**63.76 ± 11.74**	
Education		
Read and write	10	7.7
Primary education	4	3.1
Secondary education	22	17.1
University	93	72.1
Working status		
Working	36	27.9
Not work	93	72.1
Income		
Enough	123	95.3
Not enough	6	4.7

Table (2): distribution of studied patient according to medical, surgical history (n=129).

Variables	No.	%
Previous surgical history		
No	126	97.6
Open heart surgery	1	0.8
Orthopedic surgery	1	0.8
Cholecystectomy	1	0.8
Diagnosis on admission		
kidney disease	40	31.0
Cardiac disease	14	10.8
Diabetes	15	11.6
Pulmonary edema	13	10.1
COPD	10	7.7
Hemorrhage	9	6.9
Stroke	8	6.2
Cardiac arrest	7	5.4
Pneumonia	7	5.4
Respiratory failure	6	4.6
Acute coronary syndrome	6	4.6
Hyponatremia	5	3.8
Seizure	4	3.1
Hyperkalemia	4	3.1
Anemia	3	2.4
Hypertensive crisis	3	2.4
Liver disease	3	2.4
Head trauma	1	0.8
Intestinal obstruction	1	0.8
Duration of hospital stay		
1-5 days	62	48.1
5-10 days	41	31.8
10-15 days	14	10.9
15-20 days	8	6.2
20-25 days	1	0.8
25≥ days	3	2.3
Previous hospitalizations		
Yes	31	24.0
No	98	76.0
History of the previous infection		
Yes	10	7.8
No	119	92.2

Table (3) Distribution of studied patients according to central venous line characteristics (n=129).

Variables	No.	%
Unit		
Emergency room	10	7.8
Operation Room	25	19.4
Intensive care unit	94	72.8
Health care provider charge for insertion		
Physician	104	80.6
Anesthesiologist	16	12.4
Vascular Surgeon	9	7.0
Central venous line type		
Non-tunneled	113	87.6
Dialysis	16	12.4
Central venous line, insertion site		
Femoral	10	7.8
Jugular	80	62.0
Subclavian	39	30.2
Number of lumens		
Double	17	13.2
Triple	112	86.8
Indication for insertion		
Fluid/Medication Administration	80	62.0
Total Parenteral Nutrition (TPN) administration	49	38.0
Type of used antiseptic solution		
Povidone-iodine10%	129	100.0
Type of dressing (bandage)		
Gauze dressings	34	26.3
Transparent dressings	95	73.7
Prophylaxis antibiotics used		
Yes	129	100.0
Route of administered antibiotics		
Intravenous	129	100.0

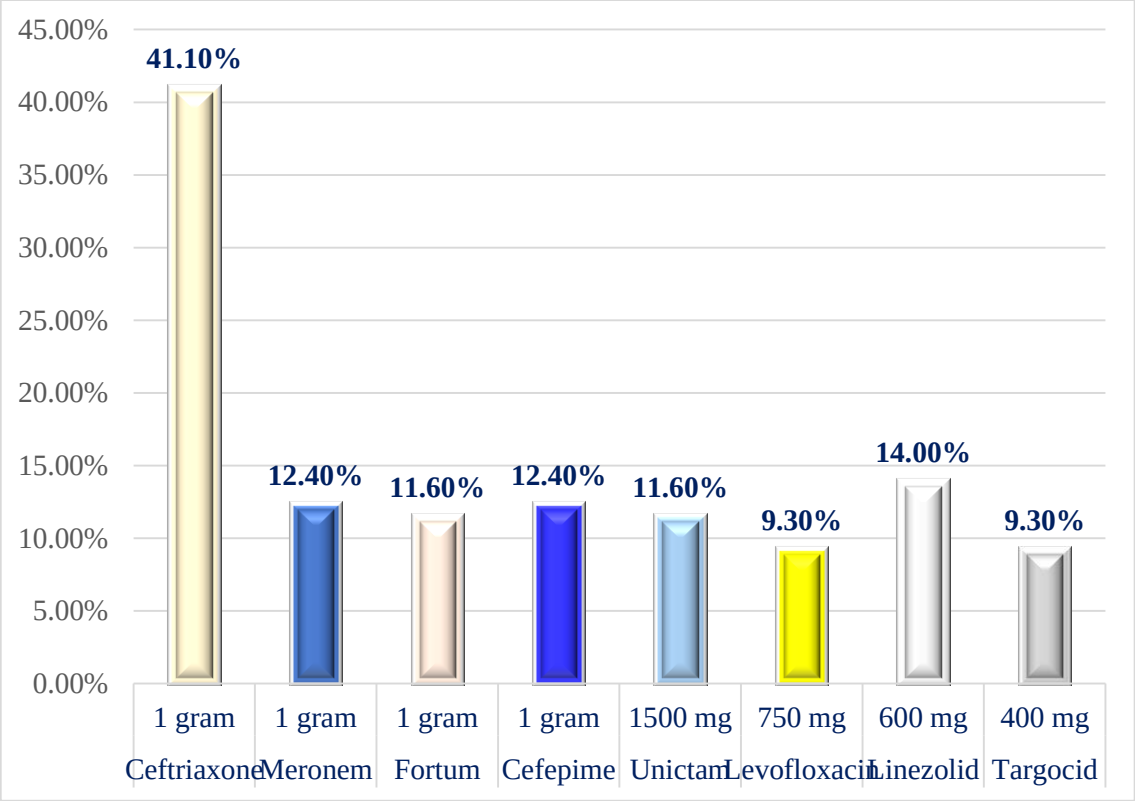

Figure 1: Distribution of studied patients according to the antibiotics administered (n=129).

Table 4: Comparison of nurses' practice regarding central venous line care before and after implementing nursing guidelines (n = 129)

Variables	Pre-test				Post-test (After 48 hours of CVL insertion)				χ^2	p-value
	Done correctly		Not done		Done correctly		Not done			
	No.	%	No.	%	No.	%	No.	%		
Hand Hygiene and Aseptic Technique										
Perform hand hygiene (ABHR or soap and water) before CVL access	15	11.6	114	88.4	125	96.9	4	3.1	182.45	<0.001*
Wear PPE (clean/sterile gloves and mask)	10	7.8	119	92.2	128	99.2	1	0.8	200.36	<0.001*
Perform hand hygiene after CVL access	20	15.5	109	84.5	123	95.3	6	4.7	168.22	<0.001*
Sterile Technique										
Use only sterile supplies and instruments to access CVL	25	19.4	104	80.6	129	100.0	0	0.0	185.66	<0.001*
Disinfect access points before use	30	23.3	99	76.7	129	100.0	0	0.0	162.14	<0.001*
Flushing the CVL Lumens										
Flush lumens before administering	28	21.7	101	78.3	122	94.6	7	5.4	150.33	<0.001*
Flush lumens after administering	35	27.1	94	72.9	120	93.0	9	7.0	132.12	<0.001*
Dressing Technique										
Perform hand hygiene before dressing change	22	17.1	107	82.9	118	91.5	11	8.5	146.45	<0.001*
Disinfect the site with an antiseptic	40	31.0	89	69.0	129	100.0	0	0.0	130.22	<0.001*
Allow the site to dry before dressing	35	27.1	94	72.9	129	100.0	0	0.0	142.13	<0.001*
Avoid touching after the antiseptic	33	25.6	96	74.4	129	100.0	0	0.0	144.55	<0.001*
Place a new dressing over the CVL exit site	38	29.5	91	70.5	129	100.0	0	0.0	135.66	<0.001*

Change dressing if damp/loose/soiled	37	28.7	92	71.3	129	100.0	0	0.0	137.22	<0.001*
Avoid topical antibiotics/creams	42	32.6	87	67.4	129	100.0	0	0.0	126.55	<0.001*
Change gauze every 2 days	39	30.2	90	69.8	129	100.0	0	0.0	132.44	<0.001*
Change the transparent dressing every 7 days	36	27.9	93	72.1	129	100.0	0	0.0	138.33	<0.001*
Inspect the site during dressing change	41	31.8	88	68.2	129	100.0	0	0.0	128.44	<0.001*
Remove dressing for full site exam if infection suspected	39	30.2	90	69.8	129	100.0	0	0.0	132.44	<0.001*
Perform hand hygiene after dressing change	34	26.4	95	73.6	129	100.0	0	0.0	140.55	<0.001*
Changing Tubing										
Change administration set for continuous infusion ≤ every 4 days	31	24.0	98	76.0	129	100.0	0	0.0	154.33	<0.001*
Change tubing after blood/blood products within 24h	29	22.5	100	77.5	129	100.0	0	0.0	158.66	<0.001*
CVL Replacement										
Do not routinely replace CVL to prevent infection	32	24.8	97	75.2	129	100.0	0	0.0	150.55	<0.001*
Documentation										
Consent form completed and documented	40	31.0	89	69.0	129	100.0	0	0.0	130.22	<0.001*
Procedural time-out documented	36	27.9	93	72.1	129	100.0	0	0.0	138.33	<0.001*
Date/time/site/indication documented	35	27.1	94	72.9	129	100.0	0	0.0	142.13	<0.001*
Dressing labeled with date/time	34	26.4	95	73.6	129	100.0	0	0.0	140.55	<0.001*
IV tubing labeled with time/date/initials/content	33	25.6	96	74.4	129	100.0	0	0.0	144.55	<0.001*

Table (5) -: Total Nurses' Practice Level Regarding Central Venous Line Care Before and After Implementing Nursing Guidelines (n = 129)

Practice Level	Pre-test				Post-test immediately (After 48 hours of CVL insertion)				χ^2	p-value
	Done correctly		Not done		Done correctly		Not done			
	No.	%	No.	%	No.	%	No.	%		
Satisfactory (≥85%)	18	14.0	111	86.0	129	100.0	0	0.0		
Unsatisfactory (<85%)	111	86.0	—	—	0	0.0	—	—	207.45	<0.001*
Mean ± SD	**Satisfactory??**				**Unsatisfactory???**					
	62.35 ± 8.42				96.88 ± 2.15					

Table (6): Central venous line-related infection, onset, and clinical Manifestations after applying evidence nursing Guidelines (n = 129)

Variables	Yes		No	
	No.	%	No.	%
Central venous line-related infection present	10	7.6	122	92.4
Diagnosing of infection				
≤ 3 days	19	14.72	110	85.27
4–7 days	24	18.6	105	81.4
> 7 days	12	9.3	117	90.7
Fever (≥ 38.5°C)	8	6.1	124	93.9
≤ 3 days	65	50.4	64	49.6
4–7 days	20	15.5	109	84.5
> 7 days	8	6.2	121	93.8
Chills	6	4.5	126	95.5
≤ 3 days	52	40.3	77	59.7
4–7 days	15	11.6	114	88.4
> 7 days	6	4.6	123	95.4
Hypotension (SBP < 90 or MBP = 65 mmHg)	5	3.8	127	96.2
≤ 3 days	46	35.7	83	64.3
4–7 days	10	7.7	119	92.3
> 7 days	4	3.1	125	96.9

DISCUSSION

In an intensive care unit, the most crucial procedure is the placement of a central venous line. Even so, there are numerous advantages to using a central venous line, such as collecting blood, administering medication, and measuring CVP. However, several consequences are linked to it, including infection, bleeding, thrombosis, and death. As far as consequences go, infections are the most frequent. The rate of infection varies depending on the type of catheter, asepsis precautions, the patient's health status, and the location and length of the insertion (Mathur et al., 2021).

Establishing infection control protocols, such as aseptic catheter insertion procedures, universal precaution standards, catheter placement duration, appropriate antibiotic use, protocols for identifying antibiotic-resistant microorganisms, and the necessity of patient isolation, must be the responsibility of the intensive care unit nurses (Abdelghafour, Gad, Abdelbaky, & Mohammed, 2021). In this regard, the current study's main goal was to find out how following nursing standards affected the number of infections linked to central venous lines among patients in the critical care unit.

The results of the current study showed that the majority of central venous catheter insertions occurred in the intensive care unit and were performed by ICU physicians, according to the data from the patients under review. The fact that most of the nurses in the study had just one to five years of experience in the intensive care unit and that the subclavian insertion technique is challenging and requires more skill during insertion, could be the reason for this conclusion.

These result in the same line with the study by Alfar, EL-Sheikh, Hassan, & Selim, (2020) in Egypt who studied the effect of applying nursing care bundle on controlling central venous line infection in neonatal intensive care units and found that more than three quarters of nurses had less than 5 years working in the intensive care units. Also, supported by Lin, Murphy, Martinez, & Marshall (2022) who conducted an audit of central venous catheter insertion and management practices in an Australian

tertiary intensive care unit and revealed that CVCs are commonly inserted at the patient's bedside in ICUs by ICU doctors.

These findings of studied nurses are consistent with a study conducted in Egypt by Alfar, EL-Sheikh, Hassan, and Selim (2020), which examined the impact of implementing a nursing care bundle on preventing central venous line infections in neonatal intensive care units. The study also revealed that over three-quarters of the nurses had worked in the intensive care units for less than five years. Furthermore, according to Lin, Murphy, Martinez, and Marshall (2022), who audited the insertion and management procedures of central venous catheters at a tertiary critical care unit in Australia, ICU physicians frequently insert CVCs at the patient's bedside.

The majority of catheters were non-tunneled lines, and the right side was the most often used insertion site. The jugular vein was utilized more often than the femoral and subclavian veins according to anatomical position. When compared to insertion through the internal jugular or femoral veins, the subclavian vein may lower the CVC-related infection rate in patients with severe injuries. Additionally, this may be related to mediators such as sputum coughing, catheter fixation issues, and frequent dressings, which can encourage colonization of the skin near the jugular vein.

Nearly half of the study and control groups had subclavian vein catheters implanted, according to Abdelghafour et al. (2021) in Egypt, who investigated nursing standards and their impact on lowering central line-related infections in traumatized patients. The current findings concurred with their findings. Additionally, the Chinese study by Sun, Bao, Guo, and Yuan (2020) titled "Positive effect of care bundles on patients with central venous catheter insertions at a tertiary hospital" found that care bundles had a positive impact on patients who had this procedure done.

The majority of central lines in critically ill patients were triple-lumen, and the unit's standard povidone-iodine antiseptic for CVC dressings was used. These findings are in line with Rajandra et al.'s (2025) study on the prevalence, compliance, and risk

factors associated with central line-associated bloodstream infection (CLABSI) in intensive care unit (ICU) patients.

Furthermore, a study by Lunnemar, Taxbro, and Hammarskjöld (2024) in Sweden titled "An analysis of central venous catheter-related bloodstream infections in patients treated in intensive care unit" demonstrates that over three-quarters of the catheters were multi-lumen catheters and suggests using sterile, transparent, semipermeable polyurethane dressings for short-term CVCs, changing them every seven days (as opposed to every two days for gauze).

The current study revealed that the most widely used preventive antibiotic was ceftriaxone (1 gram), which was followed by linezolid 600 mg. It is not proof that ceftriaxone 1 g is the standard prophylactic for CVC insertion, but this result was in line with Buetti et al. (2022), who investigated methods to prevent central line-associated bloodstream infections in acute-care hospitals and demonstrated that ceftriaxone is still selected for short-course prophylaxis in specific situations.

A primary goal was to compare the onset, clinical symptoms, and infection associated to central venous lines before and after nursing standards were put into place. With statistically significant differences between pre- and post-implementation nursing recommendations scores, the current data showed that the incidence of central venous line-related infection dramatically decreased after two days of implementation. Moreover, following the nursing standards resulted in a noticeable change in the onset of infections linked to central venous lines. Early infection detection and treatment have been shown to decrease the percentage of late-onset cases.

This finding fulfilled the current study hypothesis, which states that the rate of infection associated with central lines will decrease in intensive care unit patients with central venous lines following the implementation of nursing guidelines. This results from using a chlorhexidine solution when changing the dressing and using friction to scour the hub or access port right before each use.

There was a highly statistically significant difference between the study and control groups regarding the presence of localized signs of infection at the sixth day, as indicated by p-value =0.000. This result is consistent with Manasa & Rani's (2024) assessment of the effectiveness of an informative booklet regarding practice among intensive care unit (ICU) staff nurses regarding prevention of central line associated blood stream infection (CLABSI).

Additionally, this result is consistent with a study by Buetti et al. (2020) titled "Local signs at insertion site and catheter-related blood stream infections: an observational post hoc analysis using individual data of four RCTs," which found that local signs were significantly linked to catheter-related blood stream infections in the intensive care unit (ICU) in the control group. Local indicators raised the control group's chance of observing CRBSI throughout the first seven days of catheter care.

Local infection symptoms at the site of central venous catheter placement by time of onset before and after following nursing instructions. The current findings clarified that following the use of nursing standards, there was a decrease in the overall symptoms of local inflammation. After following nursing guidelines, there was a significant decrease in the presence of redness, soreness, hotness, and edema at the central venous catheter insertion site within ≤ 3 days. These findings show that early and mid-onset edema has significantly decreased after nursing guidelines have been followed.

According to the beginning timing of local infection symptoms at the site of central venous catheter implantation before and after following nursing instructions. The current findings demonstrated that, following the implementation of nursing standards, the overall symptoms of local inflammation decreased. The presence of redness, discomfort, hotness, and swelling at the site of the central venous catheter insertion within three days was shown to have dramatically decreased once nursing guidelines were put into practice. These findings demonstrate a definite decrease in early and mid-onset edema after nursing guidelines were followed.

The results of the current study are consistent with those of Zeyada, El-Hay, Seham, and Al-Metyazidy (2021) in Egypt, who investigated how nurses' practices regarding central line-associated blood stream infections at the Intensive Care Unit were affected by educational guidelines. They found that there were highly significant differences between the scores obtained before and after the educational guidelines regarding infection signs of redness and skin swallowing.

Additionally, within three days of following nursing guidelines, there was a significant decrease in purulent discharge, catheter occlusion, and pain at the central venous catheter insertion site. These results show a significant decrease in discomfort, catheter occlusion, and early and mid-onset purulent discharge after nursing guidelines were followed. This might be because the study group's incidence of CVC-related infections, particularly purulent drainage, was considerably decreased when they changed their dressings with chlorhexidine solution. Therefore, in accordance with the guidelines, chlorhexidine was administered in this study to treat skin antisepsis at the catheter insertion site.

The current findings are consistent with a study by Fell et al. (2020) titled Optimizing Duration of Empirical Management of Suspected Central Line-Associated Bloodstream Infections in Patients with Intestinal Failure. The study found that neither the study group nor the control group experienced purulent drainage on the first day, but that the majority of the control group and a minority of the study group did develop purulent drainage on the sixth day. Additionally, the presence of chills and purulent drainage at the sixth day was a highly statistically significant difference between the study and control groups, as indicated by the p-value of 0.000.

This finding also aligned with the findings of a study conducted in Hungary by Hammoud (2022) that examined the impact of nurses' knowledge of infection control measures on patient and family education. The study found that nurses can prevent and delay catheter occlusion and pain at the central venous catheter insertion site by paying close attention to septic technique when maintaining and changing the dressing in

emergency cases, as well as when the catheters are accessed for hemodynamic measurements or to obtain samples for laboratory analysis.

The current findings demonstrated that there were statistically significant variations between the mean scores for localized signs of central venous line infection before and after the implementation of nursing guidelines. In contrast to the pre-mean score, the post-guidelines mean score for catheter occlusion was lower. This outcome was linked to an improvement in the patients' overall health and a decrease in the rate of catheter-related infections among nursing guidelines patients.

The present findings are consistent with those of a study conducted by Abdelghafoury et al. (2021), which showed that the study and control groups differed significantly in terms of their overall infection score at day six. This result also aligned with the findings of a study by Farley (2019) in the United States of America titled "Development of Nursing Staff Education for Central Line Maintenance," which found statistically significant differences between mean scores for central venous line infections before and after the program.

According to the current findings, there was a statistically significant rise in patients' absence of pain and a substantial drop in those with mild discomfort in relation to the duration of pain associated with central venous lines before and after nursing recommendations were implemented. The current results are consistent with a study conducted in 2022 by Quadros, Stocco, Cristoff, Alcantara, Pimenta, and Machado, which examined adherence to a central venous catheter maintenance bundle in an intensive care unit and discovered a statistically significant reduction in patients' insertion site pain following the implementation of the bundle.

The current findings showed statistically significant improvements in the proportions of patients in each category of facial expression, upper-limb movement, and ventilator compliance after implementing nursing guidelines, with regard to the patients' localized manifestations of central venous line infection before and after the guidelines were put into practice. This could account for the study participants' needless use of

CVC, which could result in the development of CVC infection symptoms and a reduction in uncomfortable ones. Additionally, because the study participants' administration settings for continuous infusions are changed every four to seven days, and the dressings are changed daily or as needed.

These findings are similar to those of Şanlı, Sarıkaya, and Pronovost (2023), who use an evidence model to study the impact of care provided to intensive care patients on preventing bloodstream infections linked to central lines. They discovered that the patients' symptoms of central venous line infections improved statistically significantly after the intervention.

Additionally, the study by İskender and Karadeniz (2025) examined how nurses' care practices were affected by central venous catheter care training that followed evidence-based guidelines. They explained that the implementation of evidence-based guidelines resulted in a significant decrease in the incidence of localized manifestations of central venous line infection.

Evaluating the impact of implementing the nursing care guidelines on the prevalence of central line-related infections was another important goal of the current study. The findings showed that the proportion of patients without infection increased in tandem with a statistically significant decrease in the prevalence of central venous line-related infections. This may be because the study group took enough measures when using CVC, particularly for blood transfusions, which makes the catheter an unsuitable medium for the growth and multiplication of bacteria.

The present results are consistent with the findings of a study conducted in Iran by Edalati, Bozorgnejad, Najafi, and Haghani (2024), which examined nurses' practices in preventing bloodstream infections linked to central lines in intensive care units and found statistically significant differences in the prevalence of central line-associated infections after surgery.

Additionally, the current findings are in line with those of Al-Yateem, Tawash, Al Jiffri, Abdraboh, Nerona, and Al-Yateem (2021) in the Kingdom of Saudi Arabia,

who investigated the prevention of bloodstream infections linked to central lines and found that the adoption of the educational bundle significantly decreased the prevalence of central line-related infections.

Regarding the studied nurses' central venous line care practices before and after implementing nursing guidelines, the current findings demonstrated that the nurses' correct practices were generally very low before the nursing guidelines were implemented. However, they improved with regard to nearly all items, particularly those pertaining to hand hygiene, wearing personal protective equipment (PPE), and a number of practices (e.g., sterile supplies, disinfecting access points, dressing changes, documentation).

The current findings were consistent with a study conducted in Egypt by Khalifa, Omar, El-Gendy, Ahmed, and Saad (2022) that examined the impact of nursing care bundles on nurses' performance in relation to blood stream infections associated with central venous lines. The study found that the implementation of nursing care bundles resulted in a statistically significant improvement in the ICU nurses' practices regarding central venous line care.

Regarding the overall level of practice of the nurses under study with regard to central venous line care, the current findings showed statistically significant differences between the nurses' total level of practice before and after implementing nursing guidelines. This suggests that nurses' performance was successfully improved by the nursing guidelines. This might be connected to the methods of instruction used in the sessions, which assisted nurses in learning and refining their procedures in accordance with the recommendations for the management of central venous lines. Throughout the sessions, the care instructions for central venous line surgeries were shown and repeated. Additionally, nurses felt empowered to help patients with central lines reduce bloodstream infections associated with central venous lines by using the care guidelines for a central venous line.

The current findings are consistent with those of Khalifa et al. (2022), who explained that the majority of nurses were incompetent on the pretest and that there were very highly statistically significant differences between the level of nurses' practice on pre, post, and follow-up tests ($P<0.001$). In the meantime, most nurses performed well on the post-test and follow-up exam.

Furthermore, a study conducted in Egypt by Mahmoud, Salah El-Dien, and Salah (2021) on nursing compliance with regard to the central line associated blood stream infection bundle in neonatal intensive care units found that nurses' pre-test routines for the insertion and management of CVC catheters were generally subpar, with a notable difference between the pre-test and post-test.

CONCLUSION

The findings of this study demonstrate that the application of evidence-based nursing guidelines plays a critical role in reducing central venous line–related infections among intensive care unit patients. Implementing standardized protocols for catheter insertion, maintenance, and daily assessment significantly improved nurses' knowledge and practice, which in turn contributed to lowering infection rates. These results highlight the importance of continuous training, strict adherence to infection-prevention bundles, and regular monitoring to sustain improvements. Therefore, integrating nursing guidelines into routine ICU care is an effective strategy to enhance patient safety, reduce complications, and improve overall quality of care.

RECOMMENDATIONS

1. Consistent adherence to standardized nursing guidelines encompassing aseptic insertion techniques, proper catheter site care, and maintenance practices proved effective in lowering both local access site infections and catheter-associated bloodstream infections.
2. The pivotal role of nursing interventions in infection prevention and underscore the importance of ongoing training, monitoring, and reinforcement of best practices within ICU settings.

3. Implementing such guidelines not only enhances patient safety and clinical outcomes but also reduces healthcare costs associated with prolonged hospitalization and infection-related complications.
4. integrating structured nursing care protocols into routine practice should be prioritized as a critical component of quality improvement strategies in intensive care units

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تأثير تطبيق الإرشادات التمريضية علي الحد من العدوي المرتبطة بالخط الوريدي المركزي لدي مرضي وحدات العناية المركزة.

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الخلاصة

تُستخدم القساطر الوريدية المركزية على نطاق واسع في وحدات العناية المركزة لتوفير وصول وريدي طويل المدي للمرضى ذوي الحالات الحرجة. ورغم فوائدها الكبيرة، إلا أن القساطر الوريدية المركزية ترتبط أيضًا بمخاطر مرتفعة للإصابة بعدوى مجرى الدم المرتبطة بالقسطرة. هدف الدراسة: هدفت هذه الدراسة إلى فحص تأثير تطبيق الإرشادات التمريضية في تقليل معدلات العدوى المرتبطة بالقساطر الوريدية المركزية لدي مرضى العناية المركزة. التصميم: تم استخدام تصميم شبه تجريبي لاجراء الدراسة بمستشفيات الهيئة العامة للرعاية الصحية بمحافظة بورسعيد وهما : مستشفى السلام , مستشفى الزهور , مستشفى الحياة بورفؤاد و مجمع الشفاء الطبي؛ شملت الدراسة129 مريضًا بالغًا يستخدمون قساطر وريدية مركزية، بالإضافة إلى 129 ممرض/ة من العاملين في وحدات العناية المركزة بمستشفيات هيئة الرعاية الصحية في محافظة بورسعيد. وقد أظهرت النتائج أن نسبة انتشار العدوى المرتبطة بالقسطرة الوريدية المركزية 18% قبل تطبيق الإرشادات التمريضية المبنية على الأدلة، وانخفضت إلى 7.6% بعد التطبيق. وقد تلخصت الدراسة بوجود تطبيق الإرشادات التمريضية المبنية على الأدلة يقلل بشكل كبير من معدلات العدوى المرتبطة بالقساطر الوريدية المركزية بين مرضى العناية المركزة. وأوصت الدراسة بتوحيد حزم رعاية القسطرة الوريدية المركزية في جميع وحدات العناية المركزة، إلى جانب التدريب المستمر للممرضين وتقييم كفاءتهم في تقنيات التعقيم وصيانة القسطرة.

الكلمات المرشدة: الإرشادات التمريضية، القسطرة الوريدية المركزية، العدوى، مرضى العناية المركزة، معدل الانتشار.