# Factors Affecting Nurses' Performance Regarding Prevention of Central Venous Line Associated Infection

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*Abstract*

*Background: The prevention of central venous line associated infection (CVLAI) represents a significant challenge in clinical setting, despite infection control advances. Nurses have a pivotal role in implementing preventive measures of CVLAI and patient care. However, various factors may influence their performance in this area. Study aim: Assess the factors affecting nurses' performance regarding prevention of central venous line associated infection. Design: A descriptive design was used to meet the aim of this study. Setting: Data was collected from surgical intensive care units at Zagazig university hospitals. Subjects: A convenience sample of all available nurses who worked in above mentioned setting. Tools: Three tools were used, Self-administered questionnaire to assess nurses' demographic characteristics and knowledge; observation checklist to assess nurses' practice; and factors assessment questionnaire to assess the factors that affecting nurses' performance. Results: The current study revealed that 54.7% and 69.3% of the studied nurses had unsatisfactory overall knowledge and practice levels, respectively regarding prevention of CVLI. Also, 86.7% of nurses reported that their performance was affected by patient, nurse, and work-related factors. Conclusion: More than half of the studied nurses have an unsatisfactory overall knowledge level regarding prevention of central venous line associated infection as well as more than two third of nurses had unsatisfactory overall practice level. Also, majority of studied nurses' performance was affected by patient, nurse, and work-related factors. Recommendation: The need for current evidence-based practice guidelines in the nursing education curriculum, and ongoing monitoring of staff nurses' practice while practicing central venous line insertion and care.*

*Keywords: CVLAI prevention, Factors Affecting Nurses Performance*

## Introduction

Central venous lines (CVLs) are cannulation devices that are inserted using wire guidance, also known as the Seldinger technique to access the central venous circulation. CVLs are used to deliver parenteral nourishment, blood products, potentially irritating medications, and life-sustaining fluids in an emergency. In different situations, CVLs are utilized to facilitate access for transvenous heart pacing, hemodialysis, and hemodynamic monitoring by the measurement of cardiac output and central filling pressure **(Shalaby, Salama, and Mansour, 2021).**

Even though CVLs are necessary for modern medical care, problems could happen, particularly infections. In the critical-care unit, CVLAI is a serious and dangerous condition for several patients. One of the four categories into which the US Centers for Disease Control and Prevention divides CVLAI is catheter colonization, which is characterized by the absence of clinical signs but a culture from the catheter surface indicates infection. The second CVLAI category includes three different types of local catheter-related infections: infections in the tunnel, pockets, and exit sites **(Safety Committee of Japanese Society of Anesthesiologists, 2020).**

Furthermore. Bloodstream infections connected to infusions make up the third category of CVLAI, which is a bloodstream infection where no other illnesses are present, but a blood culture and injection equipment and materials both contain the same bacterium **(Boulet et al., 2024).** Central venous line-associated bloodstream infection (CVLABSI) is the fourth category of CVLAI. It occurs when the same bacterium is present in both the catheter and the blood culture. The most dangerous and lethal type of CVLAI is CVLABSI **(Sikka et al., 2024).**

A CVLABSI can be caused by CVL in several ways. Infusates, contaminated caps and connectors, and violations of aseptic techniques during access to the CVL are the primary causes of bacterial CVLABSI; as well as flushing procedures may facilitate intraluminal bacterial contamination and colonization **(Haddadin, Annamaraju, and Regunath, 2025).** A CVLABSI is a condition that prevents people from recovering. Consequently, nurses make up the backbone of ICU medical staff, and CVLABSI is viewed as a major work problem for them **(Beville et al., 2021).**

The work of critical care nurses is crucial in preventing CVLABSI. While evidence-based practice are essential for preventing CLABSI, these clinical interventions also require monitoring. Clinical procedures fall into three categories: the first includes procedures at CVL (e.g., hand hygiene compliance, maximal barrier precautions, avoiding the femoral vein if possible, use of chlorhexidine-impregnated dressings, antimicrobial catheters, and antiseptic solution); the second includes procedures during CVL maintenance (e.g., dressing change regimen, care of accessing line, antibiotic lock therapy, changing the intravenous fluid and blood set); and the third includes procedures to minimize exposure to a CVL (e.g., daily assessment of the necessity of CVL and timely removal of unnecessary CVL) **(Rosenthal et al., 2025).**

The CLABSI occurrences and its effect on the patient, family, and healthcare facility have been shown to decrease when nurses properly execute prevention guidelines. In clinical care settings, noncompliance with these guidelines is still difficult because of several factors that impair nurses' performance. To enhance the quality of the care given, these factors must be addressed **(Garcia, 2022).**

The performance of nurses in preventing CVLAI is influenced by a variety of factors, including patient, nurse and work-related factors. Therefore, addressing the issues that have a detrimental impact on nurses' performance should be the main goal of human resources strategies patient-related factors that raise the risk of CVLAI include patient with immunocompromised disorders associated with hematologic cancer, neutropenia, malnourishment, extended hospital stays prior to CVL insertion, severe burns, and a body mass index greater than 40 **(Said, Yassien, and Ameen et al., 2020).**

Nurses' performance is hampered by several nurse-related factors, including low nurse-to-patient ratios, frequent catheter manipulations, noncompliance with the sterile insertion method, and failure to remove unnecessary catheters. In addition, work related factors that influence nurses' performance and increase their risk of infection include a lack of tools for managing CVL, confusing instructions for nurses to follow while using CVL, a lack of usage of infection control protocols at work, and lack chance for ongoing training **(O'Grady et al., 2023).**

**Significance of the study:**

The most prevalent type of healthcare-associated infection (HAI) is a CVLAI, and the most severe type of it is a CVLABSI. According to the Centers for Disease Control and Prevention about 80,000 CVLABSI cases are reported in intensive care units (ICUs) in the United States annually. The cost of a single CVLABSI incidence can reach $56,000 **(Malek et al., 2018).** In Egypt a CVLABSI is considered as the fifth most prevalent type of HAI, and according to a study carried out in 46 ICUs across 11 hospitals in Egypt between 2011 and 2012 that about 22% of infection are bloodstream infections in ICUs and 46% of them are CVLABSI **(Hassan et al., 2020; Osman et al., 2021).**

Nurses are the healthcare professionals who execute high-risk CVL procedures. They should therefore be informed and compliant with CVLs care and management, since critical care nurses who do not follow evidence-based guidelines or lack the necessary skills and knowledge are unable to provide proper care and maintenance toward patients with CVLs, which unintentionally increases the incidence of CVLABSI **(Perumal et al., 2022).** Therefore, nursing performance must be regularly assessed, and any factors influencing it must be identified and resolved.

**Aim of the study:** Was to assess the factors affecting nurses' performance regarding prevention of central venous line associated infection

**Research Question:**

1. What is the level of nurses' knowledge regarding prevention of central venous line associated infection?

2. What is the level of nurses' practice regarding prevention of central venous line associated infection?

3. What are the factors affecting nurses' performance regarding prevention of central venous line associated infection?

**Research design:** A descriptive research design was carried out in this study.

**Setting:** The study was carried out in surgical intensive care units present at New Surgery Hospital at Zagazig university hospitals, Zagazig Governorate, Egypt.

**Subjects:** A convenience sample of all available nurses (75) who working in surgical intensive care units present at New Surgery Hospital at Zagazig university hospitals, Zagazig Governorate, Egypt.

**Tools of data collection:**

Three tools were used in this study as the following:

**(1) Self-administered questionnaire**: This tool was designed by the researchers to assess nurses' level of knowledge regarding prevention of CVLAI based on review of relevant literatures **(Abdelkader et al., 2021; Said et al., 2020; Sobeih et al., 2018**). It comprised the following parts:

*Part I: Nurses' demographic characteristics:* This part composed of 10 items which concerned with assessing the demographic characteristics of critical care nurses involved in the study such as age, sex, qualification, social status, income, residence, experience years in nursing field and ICU, attending training courses about CVLAI, and availability of booklet or a guide about prevention of CVLAI.

***Part II: Nurses' knowledge assessment questionnaire:*** It is composed of three sections as the following:

-**The first section** concerned with assessment nurses' knowledge regarding CVL as its definition and description, uses, sites of insertion, types, contraindication, insertion precaution, routine care, recommended flushing method, complication…etc. It consists of 36 questions in the form of multiple-choice questions (MCQ).

-**The second section** concerned with assessment nurses' knowledge about CVLABSI which included 14 questions in the form of MCQ that covered CVLABSI definition, causes, symptom, risk factors, and nursing management…etc.

-**The third section** concerned with assessment nurses' knowledge about prevention of CVLABSI which included 21 questions in the form of MCQ that covered general infection control measures, specific preventive measures of BSI pre, intra, and post CVL insertion, dressing change, and provided care after CVL removal…etc.

• **Scoring system:** - For the knowledge items, a correct response was valued one point, and an incorrect response was valued zero. The mean score for each area of expertise was calculated by adding up all the item scores and dividing the total by the number of items. These scores were converted into percentage scores. Knowledge was deemed satisfactory if the percent score was ≥75% and unsatisfactory if it was under 75%, according to data input and statistical analysis.

**(2) Observational checklists for nurses:** This tool was used to assess the adequacy of nurses practice regarding prevention of CVLAI. It was developed by researchers based on a pertinent literature checklist for **Ahmed et al., (2021); Said et al., (2020); Sobeih et al., (2018).** It is composed of 63 items covering the following areas of practice: pre insertion of CVL, intra insertion of CVL, post insertion of CVL, dressing change of CVL insertion site, and care maintenance of central venous accessing line

• **Scoring system:** A practice task was given a score of two when completed successfully and a score of one when not. These scores were converted into percentage scores. The mean score for each practice area was calculated by adding up all the item scores and dividing the total by the number of things. The practice was deemed satisfactory if the percentage score was ≥75% and unsatisfactory if it was under 75%, according to data input and statistical analysis.

**(3) Factors affecting nurses' performance Questionnaire:** This tool was used to assess the factors affecting nurses' performance regarding prevention of CVLAI. It included three sets of factors (50 items), namely Patient related factors which composed of 11 items covered the patient's age ,gender, length of stay in the hospital, CVL presence period, degree of consciousness, personal hygiene, presence of chronic disease , immunodeficiency disease, pain, and patient's cooperation , and weight; Nurses' related factors which composed of nine items covered nurses' age, health condition, psychological state, social status , availability of time for providing support, having information about CVL and infection control, having skills about CVL insertion and daily care of it ; Work- related factors which composed of 11 items covered relation with nursing colleagues and other caregivers, work organization condition, and work environment.

• **Scoring system:** Each factor item that observed to affect nurses' performance was scored two, while factor that unaffected was scored one. The scores of the three factors were summed up and the total divided by the number of the items, giving a mean score for the total factors. This was converted into a percentage score. The factor was considered to have a high influence or affected on nurses' performance if the percentage score was ≥ 75% and unaffected on nurses' performance if <75% based on data entering and statistical analysis.

**Administrative and ethical considerations:**

According to letters from dean of the nursing faculty, Zagazig University's explaining the purpose of the study and requesting support, the general director of Zagazig University Hospitals and the head of the

new surgical department gave their consent to carry out the research. The faculty ethical committee approved the study before it started.  Prior to starting, the researcher gave the participating nurses an explanation of the study's objectives and purpose.  The confidentiality and anonymity of the nurses' data were ensured by the researcher.  The nurses participating in the study were informed that they might withdraw from it at any time without providing a reason, and that they could choose not to participate. The researcher promised to keep the data and information collected confidential and use it only for the study.

**Pilot study:**

Ten percent of the primary study sample, or eight nurses, participated in a pilot trial.  In order to detect potential challenges during data collection, the pilot was designed to verify and assess the tools' clarity, application, and feasibility.  It was also useful in estimating the amount of time required to complete the data gathering tools.  The participants in the pilot study were incorporated into the main study sample because no changes were made to the tool.

**Field work:**

The directors of Zagazig University Hospitals, New Surgery Hospital, and the intensive care units granted the researchers all the licences they required. The researchers visited the study settings, met with the director, explained to them the aim of the study as well as the process of collection of the data to have their cooperation during data collection and to set its schedule so that it does not interfere with nurses' work.

The researchers give self-administrated questionnaire to nurses to assess their knowledge and factors affecting their performance regarding prevention of CVLAI and give them instruction on how to complete it, the researchers was always available to address any question or ambiguities. The completed form then gathered and check for accuracy, each nurse spends 15 to 20 minutes, while the observational checklist, on the other hand, took an average of 20 to 30 minutes to complete and was gathered by the researchers by watching the nurses as they worked with patients.

**Content validity & Reliability:**

A panel of five nursing specialists, including five professors of medical surgical nursing from Zagazig University's college of nursing, was shown the data collection instruments after they were produced in their basic version.  These professionals validated the instruments for accuracy, comprehensiveness, ease of use, and relevance.  Small changes were made based on the advice of the experts.  Alph Cronbach's reliability scale yielded values of 0.78 and 0.74 for the knowledge questionnaire and practice checklist, respectively, and 0.87 for the factors.

**Statistical analysis:**

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA 2011). Quantitative data were expressed as the mean ± SD & (range), and qualitative data were expressed as absolute frequencies (number) & relative frequencies (percentage). Correlation coefficient test was calculated to assess relation between various study variables.  P-value < 0.05 was considered statistically significant (S), and p-value ≥ 0.05 was considered statistically insignificant (NS).

**Results:**

Regarding the demographic characteristics of the nurses in the study sample **Table 1** clarifies that 37.3% of the studied nurses age ranged from 25-≤ 30 years with mean age 26.6±4.57and 81.3% are female. Moreover, 60.0% of the studied nurses had technical institute, while only 40.0% bachelor of nursing, and 57.3 of nurses are married. As well as 92.0% of studied nurses had insufficient income and 85.3% are living in rural areas. Also, 64.0% and 74.0% of studied nurses had >5 years of experience in nursing field and ICU unit with mean of years equally 4.80±4.08 and 3.88±3.55, respectively. In addition, the current table shows that 56.0% of studied nurses attending training courses about prevention of CVLAI and 64.0% of nurses reported that there is a booklet or a guide about prevention of CVLAI in ICU.

Regarding total nurses' knowledge domains, **Table 2** illustrated that 54.7%, 50.7%, and 62.7% of the studied nurses had unsatisfactory total knowledge regarding CVL, CVLABSI, and prevention of CVLABSI, respectively. While only 45.3%, 49.3%, and 37.3% of nurses had satisfactory total knowledge regarding them, respectively.

**Figure 1** shows that 54.7% of the studied nurses had unsatisfactory overall knowledge regarding prevention of CVLAI, while only 45.3% of nurses had satisfactory overall knowledge.

**Table 3** demonstrated that 58.7%, 72.0%, 58.7%, and 57.3% of the studied nurses had unsatisfactory total practice pre-insertion of CVL, intra insertion of CVL, post insertion of CVL, as well as about dressing change at CVL insertion site, respectively. While 85.3% had satisfactory total practice regarding care maintenance of central venous accessing line. **Figure 2** shows that 69.3% of the studied nurses had unsatisfactory overall practice regarding prevention of central venous line associated infection, while only 30.7% of nurses had satisfactory overall practice level

**Table 4** illustrated that 90.7%, 92.0%, and 86.7% of the studied nurses their performance regarding prevention of CVLAI affected by patient, nurses, and work-related factors, respectively.

**Figure 3** shows that 86.7% of studied nurses', their performance regarding prevention of CVLAI was affected by (patient, nurses, and work) overall factors, while only 13.3% of nurses' their performance was unaffected by these factors.

**Table 5** Shows that there was statistically significant correlation of nurse's knowledge, and practice with overall factors that affecting nurses' performance regarding prevention of CVLAI with p value equal .000, and .003, respectively and vice versa. Further, there was a statistically significant correlation between overall nurses' knowledge and their practice (p=.016) and vice versa.

**Table (1): Frequency and Percentage Distribution of Demographic Characteristics for Studied Nurses (n=75):**

| Demographic characteristics | No. | % |
|---|---|---|
| **Age:** | | |
| <25 | 26 | 34.7 |
| 25≤ 30 | 28 | 37.3 |
| 30+ | 21 | 28.0 |
| **Min- Max** | 21-34 | |
| **Mean ±SD** | 26.6±4.57 | |
| **Sex:** | | |
| Male | 14 | 18.7 |
| Female | 61 | 81.3 |
| **Qualification:** | | |
| Technical Institute | 45 | 60.0 |
| Bachelor of Nursing | 30 | 40.0 |
| **Social status:** | | |
| Married | 43 | 57.3 |
| Unmarried | 32 | 42.7 |
| **Income:** | | |
| Sufficient | 6 | 8.0 |
| Insufficient | 69 | 92.0 |
| **Residence:** | | |
| Rural | 64 | 85.3 |
| Urban | 11 | 14.7 |
| **Experience years in Nursing field:** | | |
| <5 | 48 | 64.0 |
| 5-<10 | 14 | 18.7 |
| 10+ | 13 | 17.3 |
| **Min -Max** | 1-13 | |
| **Mean ±SD** | 4.80±4.08 | |
| **Experience years in ICU:** | | |
| <5 | 56 | 74.7 |
| 5-<10 | 9 | 12.0 |
| 10+ | 10 | 13.3 |
| **Min -Max** | 1-12 | |
| **Mean ±SD** | 3.88±3.55 | |
| **Attendance training courses about prevention of CVLAI:** | | |
| Yes | 42 | 56.0 |
| No | 33 | 44.0 |
| **Presence of booklet or a guide about prevention of CVLAI:** | | |
| Yes | 48 | 64.0 |
| No | 27 | 36.0 |

**Table (2): Frequency and Percentage Distribution of Total Nurses' Knowledge Domains Regarding Prevention of Central Venous Line Associated Infection (n=75):**

| Total nurses' knowledge domains | Satisfactory ≥75%: | | Unsatisfactory <75%: | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Total nurses' knowledge about CVL | 34 | 45.3% | 41 | 54.7% |
| Total nurses' knowledge about CVLABSI | 37 | 49.3% | 38 | 50.7% |
| Total nurses' knowledge about prevention of CVLABSI | 28 | 37.3% | 47 | 62.7% |

CVLABSI: central venous line associated blood stream infection          CVL: central venous line
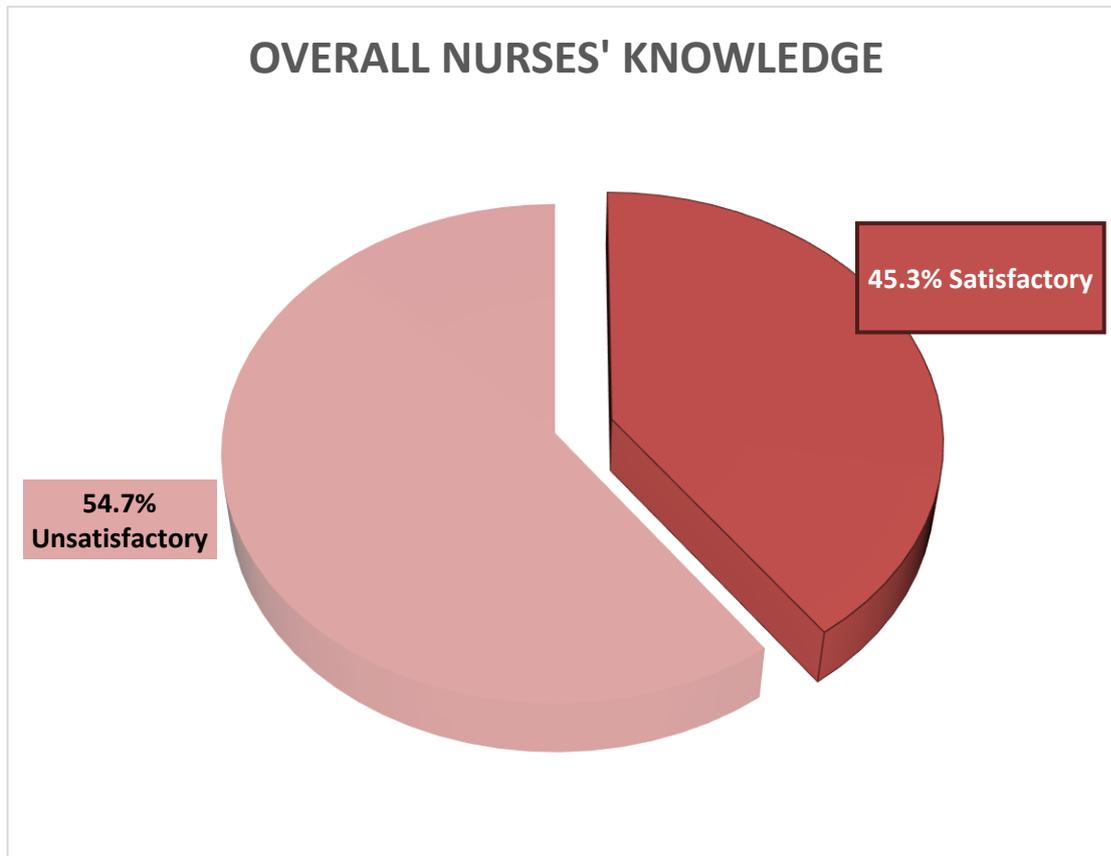


**Figure (1):** Percentage Distribution of Studied Nurses' Overall Knowledge level Regarding Prevention of Central Venous Line Associated Infection (n=75).

**Table (3): Frequency and Percentage Distribution of Total Nurses' Practice Domains regarding Prevention of Central Venous Line Associated Infection (n=75):**

| Total nurses' practice domains | Satisfactory ≥75% | | Unsatisfactory <75% | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Total nurses' practice pre-Insertion of CVL | 31 | 41.3% | 44 | 58.7% |
| Total nurses' practice intra Insertion of CVL | 21 | 28.0% | 54 | 72.0% |
| Total nurses' practice post Insertion of CVL | 31 | 41.3% | 44 | 58.7% |
| Total nurses' practice about dressing change of CVL insertion site | 32 | 42.7% | 43 | 57.3% |
| Total nurses' practice about care maintenance of central venous accessing line | 64 | 85.3% | 11 | 14.7% |

CVL: central venous line
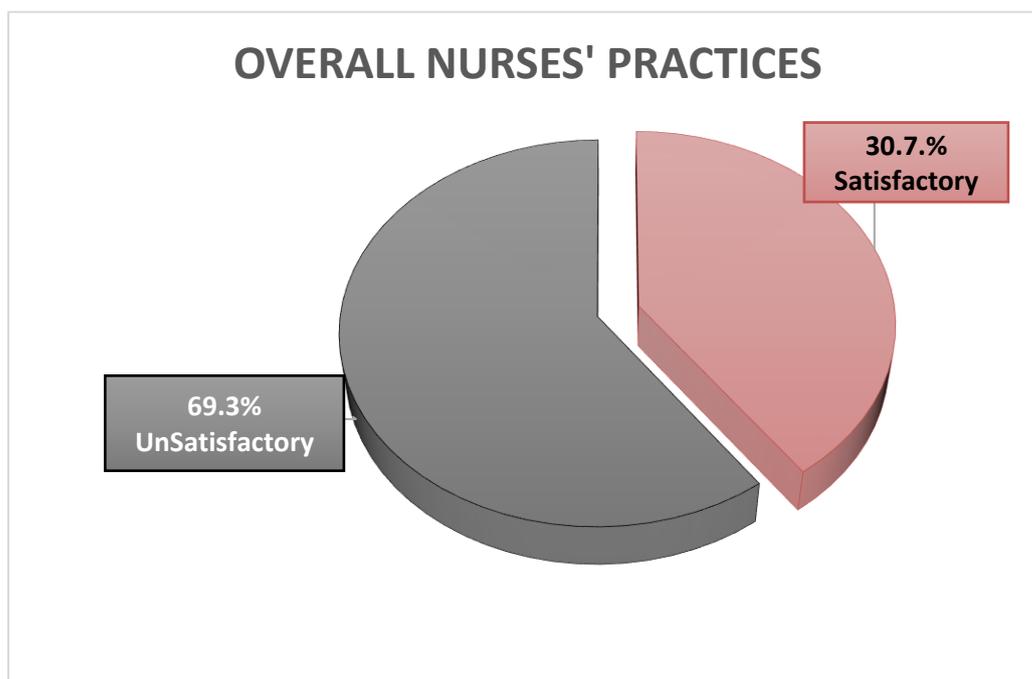


**Figure (2):** Percentage Distribution of Studied Nurses' Overall Practices Level Regarding Prevention of Central Venous Line Associated Infection (n=75).

**Table (4): Frequency and Percentage Distribution of Total Factors Affecting Nurses' Performance Regarding Prevention of Central Venous Line Associated Infection (n=75):**

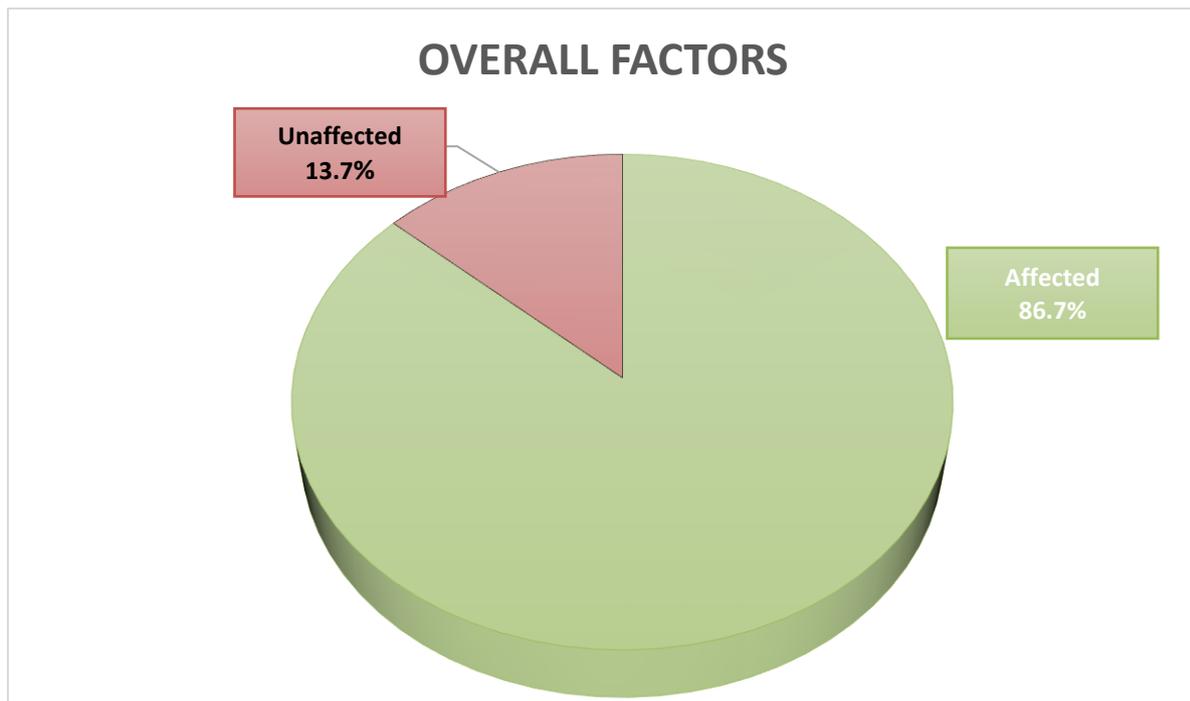| Total factors affecting nurses' performance | Affected ≥75% | | Unaffected <75% | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Total patient related factors | 68 | 90.7 | 7 | 9.3 |
| Total nurses' related factors | 69 | 92.0 | 6 | 8.0 |
| Work-related factors: | | | | |
| A. The relation with nursing colleagues | 65 | 86.7 | 10 | 13.3 |
| B. The relationship with other caregivers | 65 | 86.7 | 10 | 13.3 |
| C. The work organization condition | 70 | 93.3 | 5 | 6.7 |
| D. The work environment | 54 | 72.0 | 21 | 28.0 |
| Total work-related factors | 65 | 86.7 | 10 | 13.3 |



**Figure (3):** Percentage Distribution of Overall Factors Affecting Studied Nurses' Performance Regarding Prevention of CVLAI (n=75).

**Table (5): Correlation between Overall Nurses' Knowledge, Practice and Factors Affecting Nurses' Performance Regarding Prevention of CVLAI:**

| Variable | | Overall knowledge | Overall practice | Overall factors |
|---|---|---|---|---|
| Overall knowledge | r | 1 | .276 | .585 |
| | p-value | | .016* | .000** |
| Overall practice | r | .276 | 1 | .341 |
| | p-value | .016* | | .003* |
| Overall factors | r | .585 | .341 | 1 |
| | p-value | .000** | .003* | |

r: correlation coefficient test        * significant        ** Highly statistically significant.

**Discussion:**

75 nurses made up the current study sample: the largest proportion of these nurses among 25 and 30 years. This outcome parallel with **Ouda et al., (2018)** who evaluate the effect of nursing education program on CVL maintenance bundles, found that the largest proportion of nurses were in the 25–30 age range. According to a recent study, women made up highest numbers of nurses participating in these studies. From the perspective view of the researcher, this might be because nursing is a profession that is dominated by women. This is because male students have only been admitted to nursing schools for a little over 20 years, meaning that the nursing workforce is still more feminine. This finding is similar to that of **Elgazar et al. (2020)** who found that most nurses were female in their study that evaluating the impact of an educational programme on nurses' role in preventing vascular access infections.

According to current research result, the largest number of nurses had a technical institute, while the smallest number had graduate from faculty of nursing. This is align with **Sayed et al., (2021)** who assess in their study on the impact of an educational program on nurses' knowledge and practice about CVL Bundle, showed that nearly two-thirds of nurses were graduates of technical institutes. In terms of social status, the current study found that over half of the nurses under study were married. This finding corresponds with **Abdelkader et al. (2019)** who showed that nearly two-thirds of the nurses were married in their research of factors influencing the length of stay for CVL in patients in critical condition.

In terms of residence, the current study found that a majority of the nurses under assessment lived in the countryside. This finding is consistent with **El Desouky, Taha, and Hafez (2020)** who assessed nurses' performance regarding the care for patients underwent coronary artery bypass graft, that the majority of the nurses in the ICU existed in Agricultural regions. In terms of years of experience in the nursing field, the current study found that nearly two-thirds of the nurses under study had less than five years of experience. This result is consistent with the findings of **Ibrahim, Mokhtar, and Hussein (2025)** who looked at how educational program affected nurses' role in caring for CVL in hemodialysis units, that slightly less than two-thirds of the nurses in the study had less than five years of nursing experience as a nurse.

The recent study found that nearly three-quarters of the nurses had less than five years of ICU experience. This result aligns with **Ahmed et al. (2019)** who assessed nurses' knowledge of CVLI prevention in ICUs at Baghdad Teaching Hospitals, that approximately three-quarters of the nurses in their study had fewer than five years of ICU experience. According to this study, more than half of the nurses attending training courses related to prevention of CVLI. This result noted by **Ng'ambi, (2018)** on their study that assess ICU nurses' views on the value and application of the CLABSI Prevention Bundle, that more than half of nurses engage in training courses.

Over half of the nurses in the thesis had unsatisfactory total knowledge about CVL. This finding is also consistent with a study by **Latha and Gurung, (2022)** which assessed ICU nurses' knowledge of managing patients with central venous access devices and found that over two-fifths of the nurses had insufficient knowledge of CVL device and about one fifth have moderate knowledge, while only a small percentage had sufficient knowledge. Concerning total nurses' knowledge about CVLABSI, the current study made it clear that slightly over half of the nurses under study possessed unsatisfactory knowledge. This outcome is consistent with a study conducted by **Khan et al. (2024)** which evaluated nurses' knowledge, attitudes, and practices for CVLABSI prevention and found that over half of the nurses in their thesis lacked enough general knowledge of CVLABSI.

Additionally, the present study elucidates that greater than three-fifths of the nurses under research experienced an unsatisfactory total knowledge about CVLABSI prevention. It has been proposed that the lack of opportunities to attend workshops and seminars is the reason for the nurses' low level of expertise. Furthermore, approximately three quarters of them had fewer than five years of ICU experience, and three fifths had technical institute.
This finding is consistent with **Chi et al. (2020)** who noted in their study "Prevention of central line-associated bloodstream infections: a survey of ICU nurses' knowledge and practice in China" that over three-fifths of the nurses in the study had inadequate general knowledge about CVLABSI prevention. As a result, nurses ought to keep learning novel information to improve their knowledge, as health care knowledge is always developing.

The current study showed that over half of the nurses under study had unsatisfactory overall knowledge regarding prevention of CVLAI. This finding is consistent with **Badparva et al., (2023)** noted in study titled "Prevention of central line-associated bloodstream infections: ICU nurses' knowledge and barriers," that over half of the nurses in the study had an overall inadequate level of knowledge upon CLABSI prevention.

In terms of total nurses' practices pre insertion of CVL, the current study found that slightly less than three-fifths of the nurses under evaluation had unsatisfactory total practice pre insertion of CVL. The findings of this study are consistent with those of **Said, Yassien, and Ali (2020)** who found that less than three-fifths of the nurses in their study, "Factors Affecting Nurses' Performance towards Central Line Associated Blood Stream Infection in Critical Care Units," had inadequate pre- CVL insertion preparation practice.

Furthermore, the current study found that the largest proportion of nurses under study had unsatisfactory total practice intra insertion of CVL. The findings of this study concur with those of **Said, Yassien, and Ali (2020)** who clarify that two-thirds of the nurses in the study performed the central venous access device insertion method in an unacceptable manner.

Furthermore, the total nurses' practices about CVL dressing changes, the current study found that over half of the nurses under study had unsatisfactory total practices. The findings of this study are consistent with those of **Mohamed et al. (2019)** who reported in their study titled "Auditing and Re-auditing Nursing Care for Children Undergoing Central Venous Line Insertion in Pediatric Intensive Care Unit" that the majority of the nurses in the study had insufficient CVL dressing change practice.

*Concerning the overall nurses' practices regarding prevention of CVLAI*, more than two-thirds of the nurses who were examined had an overall practice level that was unsatisfactory for preventing CVLAI. According to the researchers, this outcome is because highest percentage of nurses in the study had at least one year of experience in the ICUs and nursing field, and the smallest percentage had a bachelor's degree in nursing. Inadequate supervision, poor resources, and the workload of nurses may also be contributors to that poor practice level.

This result goes in the same line with **Manurung & Dewi, (2022)** who demonstrated in study entitled " How is the practice of nurses in preventing infection of central venous catheters in hospitalized patients? -Nurse knowledge and attitudes " that majority of studied nurses had poor practice upon CVLAI prevention.

According to the current study, patient-related factors affected the performance of majority of studied nurses. This finding is consistent with **El Desuoky, Taha, and Hafez (2020)** who noticed that factors related to patients influenced the performance of most of the nurses in their study.

Concerning nurses' factors that affecting their performance regarding prevention of CVLAI, the current study showed that most of nurses' performance was affected by nurses' related factors. This finding was in line with **Ahmed et al., (2021)** research titled "Factors Affecting Nurses Performance Regarding Care for Patients with Permanent Pacemaker," which showed that most of nurses' performance were influenced by factors related to nurses.

Concerning work factors that affecting nurses' performance regarding prevention of CVLAI, the current finding reported that the majority of studied nurses their performance was affected by work related factors. This finding concurs with **El desuoky, El Said, and El-Shaer, (2021)** who clarified in study titled " Organizational culture, individual innovation and their relation to nursing staff's work engagement" that all studied nurses their performance were affected by factors related to work.

*With respect to overall factors affecting nurse' performance regarding prevention of CVLAI,* the results of the present study revealed that majority of the studied nurses their performance affected by patient, nurse, and work-related factors. While only less than one fifth of nurses are unaffected. This result accepted with that of **Mohamed, Taha, and Moghazy (2021)** who found that the majority of nurses' performance was influenced by nurses, patients, and work-related factors in their study titled "Factors Affecting Nurses' Performance Regarding Thrombolytic Therapy among Patients with Acute Myocardial Infarction."

*Concerning the correlation between the present study variables*, the present study revealed that there was a statistically significant correlation between nurses' knowledge regarding prevention of CVLAI and practices as well as factors affecting their performance, and vice versa. These results agree with **Said, Yassien, and Ali, (2020)** who demonstrated that there was a significant correlation between nurses' total knowledge score, total practice score and total factors score about CLABSI.

**Conclusion:**

The study results led to the conclusion that the nurses in the study settings had unsatisfactory knowledge and practice regarding prevention of CVLAI, as more than half of the studied nurses had an unsatisfactory overall knowledge level and more than two third of nurses had unsatisfactory overall practice level. Also, the studied nurses had a high perception of the factors that affecting their performance as majority of the studied nurses their performance was affected by patient, nurse, and work-related factors. Additionally, the current study's conclusion affirms that there was significant correlation between overall nurses' knowledge, practice and factors that affecting their performance regarding prevention of CVLAI.

**Recommendations:**

Based upon the findings of the present study, the following recommendations can be deduced:

1. Developing a Strong, standardized training program that are based on effective interventions could enhance knowledge and practice application across a variety of healthcare settings and need to be updated regularly.

2. Workshops and on-the-job practical training program are strongly advised to address nurses' deficits in these specific areas: pre, intra, and post CVL insertion, dressing changes at the site of CVL insertion, and care maintenance of central venous accessing lines.

3. All ICUs should have standard nursing practices books to help nurses give patients with CVC the care they need.

4. Ongoing monitoring, assessment, and feedback on nurses' performance who providing care for patients with CVC.

5. Nursing and hospital management should address the factors that influencing nurses' performance.

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