Nurses' Performance Regarding Prevention of Central Venous Line Infection

Zagazig Nursing Journal
Vol. 21; Issue. 2
July 2025
Received: 1/6/2025
Revised: 25/6/2025
Accepted: 5/7/2025

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ABSTRACT

Background: Central venous line infection (CVLI) are linked to higher rates of sickness, death, and medical expenses and represent a major risk to patient safety. Nurses play a crucial part in preventing CVLI, Through commitment to evidence-based practice. **Aim of the study:** This study aimed to assess the nurses' performance regarding prevention of central venous line infection. **Subjects and methods: Research design:** Descriptive research design. **Setting:** The study was conducted in surgical intensive care units present at New Surgery Hospital at Zagazig University Hospitals. **Subjects**: A convenient sample of all nurses that are working in the above-mentioned setting (75 nurses). **Tools of data collection:** Two tools were used, Self-administered questionnaire and an observation checklist. **Results:** This study revealed that 54.7% and 69.3% of the studied nurses had unsatisfactory overall knowledge and practice levels regarding prevention of CVLI, respectively. **Conclusion:** Over half of studied nurses had unsatisfactory overall knowledge about prevention of CVLI and over two-thirds had unsatisfactory overall practice levels. Furthermore, a significant relation was found between the nurses' overall knowledge and practice. **Recommendations:** Effective and standardized training program that are based on effective interventions can enhance nurses' knowledge and practice application in a variety of healthcare settings and need to be updated on a regular basis.

Keywords: Central venous line, Infection, Nurses' performance, Prevention.

Introduction

A central venous line (CVL) is an indwelling device inserted either into a large, central, or peripheral vein and then advanced until the terminal lumen resides within the inferior vena cava (IVC), superior vena cava (SVC), or right atrium (RA). These devices and the techniques employed to place them are synonymous with "central line" or "central venous access." The placement of a CVL was first described in 1929, and over the following decades, CVL rapidly developed into an essential, indispensable clinical tool in treating many disease processes **(Baldauf et al., 2025).**

The insertion of CVLs has risen over the past decade due to their relative ease

in placement and necessity for many lifesaving treatments for the administration of fluids, foaming medications that cannot be administered through peripheral veins, blood products, parenteral nutrition, support of renal function, and monitoring the hemodynamic status of patients **(Peng, Kong, and Ma, 2022).** Although CVL makes treatment easier for patients, it is linked to several problems, including, embolism formation, and central venous line infection **(Teja et al., 2024).**

The most serious infections linked to CVL is central venous line associated blood stream infection (CVLABSI) **(Wan et al., 2023).** It mostly describes the occurrence of microorganisms that have been found in blood but are also present at the catheter's tip or in blood samples obtained via the catheter **(de Sio et al., 2023).** Therefore, CVLABSI refer to bloodstream infections that are confirmed through laboratory tests and occur in patients who have had a line in place for at least 48 hours **(John et al., 2025).**

The CVLABSIs are largely viewed as preventable if healthcare providers follow the evidence-based directives for the insertion and maintenance of central venous line. Furthermore, it is crucial to adhere to infection control practices like hand hygiene using sterile techniques during insertion and maintenance of the central line and regularly evaluating both the line and dressing **(Zeyada et al., 2021).** Healthcare providers should also use barrier precautions when placing the catheter and utilize alcohol based 2% Chlorhexidine skin preparation **(Buetti et al., 2019).**

Critical care nurses are the healthcare professionals who execute the most direct and frequent central venous line (CVL) procedures. Therefore, when helping with CVL installation and central line care and management, they should be informed and capable. Because nurses with insufficient knowledge may neglect to offer proper care and maintenance for central lines and may unintentionally contribute to the occurrence of CVLABSI, nurses' thorough understanding and documented expertise of the concerns are crucial to ensuring the right use of CVL **(Perumal et al., 2022)**.

Significance of the study

The CVLABSI is a concern in healthcare settings especially critical care units as it jeopardizes patient safety. These infections can lead to rates of illness and mortality as well as increased healthcare costs and a negative impact, on patient's quality of life. Developing countries exhibit a incidence of CVLABSI compared to developed nations as reported by the International Nosocomial Infection Control Consortium in 2016 (**Acharya et al., 2019).**

In Egypt, about 30% of infections in the intensive care units were bloodstream infections. The CVLABSI represent (2.6/1,000 central line days). The nurses have important roles in the maintenance, care, and prevention of CVLABSI. So, they must have the ability to know how to prevent complications and provide high-quality patient care **(Moustafa et al., 2024).**

Aim of the study

This study aimed to assess the nurses' performance regarding prevention of central venous line infection.

Research questions

- What is the level of nurses' knowledge regarding prevention of central venous line infection?

- What is the level of nurses' practice regarding prevention of central venous line infection?

Subjects and methods

Research design

A descriptive research design was applied.

Study setting

The study carried out in surgical ICUs, at Zagazig University Hospitals, Sharqia governorate, Egypt.

Study subjects

A convenient sample of all nurses that are working in the mentioned setting (75 nurses).

Tools for data collection

The present study used of the following two tools:

Tool 1: Self-administered questionnaire:

Based on pertinent literature, the researchers developed a questionnaire to evaluate nurses' knowledge regarding CVLI prevention **(Abdelkader et al., 2021; Said et al., 2020; Sobeih et al., 2018).** It included the following two parts:

Part I: Nurses' demographic characteristics: This part is composed of 10 questions covered age, sex, qualification, social status, income, residence, experience years in nursing field and ICU, attending training courses, availability of booklet or a guide about prevention of CVLI.

Part II: Nurses' knowledge assessment questionnaire: This part was concerned with assessment nurses' knowledge regarding prevention of CVLI it is composed of 71 questions in the form of multiple-choice questions including three sections as the following:

- **First section**: comprises of 36 questions to assess nurses' knowledge about CVL.
- **Second section**: consisted of 14 questions to assess nurses' knowledge about CVLABSI.
- **Third section:** consisted of 21 questions to assess nurses' knowledge about prevention of CVLABSI.

Knowledge Scoring System:

For the knowledge items, a correct answer was valued one point, and an incorrect answer 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 statistical analysis.

Tool 2: Nurses' practices observation checklist:

This tool was designed by researchers based on current literature checklist for **(Ahmed et al., 2021; Said et al., 2020; and Sobeih et al., (2018)** to assess nurses' practices regarding prevention of CVLI**.** It consists of 63 items that cover the following practice areas: 22 items for pre-insertion of CVL, 12 items for during insertion of CVL, 8 items for post-insertion of CVL, 15 items for dressing changes at the CVL insertion site, and 6 items for care maintenance of central venous accessing line.

Practice 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 statistical analysis.

Content validity and reliability

Five professors from the faculty of nursing, Zagazig University's assess the study tool's content validity, certain changes were done based on their reporting. The content validity of the study instruments was examined to evaluate each question separately and ascertain whether it is pertinent and suitable to test the intended outcomes. The internal consistency of the instruments was measured to assess their reliability. Cronbach's Alpha showed a high degree of reliability because knowledge was 0.78 and practice was 0.74.

Field work

The directors of the intensive care unit, Zagazig University Hospital, and New Surgery Hospital granted the researchers all the approvals they required. The researchers went to the study locations, spoke with the director, and described the objectives of the study and the data collection procedure to get their participation. The researchers also planned the schedule to avoid interfering with the nurses' duties.

The researchers distributed a self-administered questionnaire to nurses and explain instructions on how to fill. The researchers is always available to answer questions or correct any ambiguities. The completed form is then collected and verified for accuracy, taking 20 to 30 minutes on average for each nurse. The researchers also fill an observational checklist through observe nurses as they actually practiced with the patients, which took an average of 20 to 30 minutes to complete.

Six months were dedicated to the data collection process for this study, which took place between the start of August 2024 and the end of January 2025. Two days a week, the morning and afternoon shifts were the two times the researcher gathered data.

Pilot study

A total of eight nurses 10% of the study population, took part in the pilot study. In addition to identifying any potential issues with data collection, the pilot's goals were to confirm the tools' viability, application, and clarity. Additionally, useful was estimating the time needed to finish the forms. Participants in the pilot study were incorporated into the main study sample since the instrument remained unaltered.

Administration and ethical consideration

Initially, the research proposal was approved by the Post Graduate Committee and Research Ethics Committee (REC) of Faculty of Nursing Zagazig University under the code M.D.ZU.NUR/221/10/6/2024. 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 researchers. 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 researchers promised to keep the data and information collected confidential and use it only for the study.

Statistical analysis

All the data was collected, tabulated, and statistically analyzed using SPSS 20.0 for Windows. Quantitative data was expressed using the mean ± SD and range, whilst qualitative data was expressed using absolute frequencies (number) and relative frequencies (%). To evaluate the link between the different study variables, the correlation coefficient test was computed. P-values were classified as statistically significant (S) if they were less than 0.05 and as statistically insignificant (NS) if they were more than 0.05.

Results

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 institutes, while only 40.0% Bachelors of Nursing, and 57.3% are married. As well as 92.0% had insufficient income and 85.3% are residing in rural areas. Also, 64.0% and 74.0% had less than 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% attending training courses about prevention of CVLI and 64.0% reported that there is a guide booklet about prevention of CVLI in ICU.

Table (2) illustrates that 54.7%, 50.7%, and 62.7% of studied nurses had unsatisfactory total knowledge regarding CVL, CVLABSI, and prevention of CVLABSI, respectively.

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

Table (3) demonstrates that 58.7%, 72.0%, 58.7%, and 57.3% of the studied nurses had unsatisfactory total practice pre-insertion of CVL, during 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 illustrates that 69.3% of the studied nurses had unsatisfactory overall practice regarding prevention of CVLI, while only 30.7% of nurses had satisfactory overall practice level.

Table (4) clarifies that there was a highly significance relation between overall knowledge, and overall practices regarding prevention of CVLI with p value = 0.016.

Discussion

75 nurses made up the current study sample; the largest proportion of these nurses aged from 25 and 30 year. This outcome parallel with **Ouda et al., (2018)** who evaluate the effect of educational program for nurses on central venous catheter maintenance bundle for critically ill pediatric patients, found that the largest proportion of nurses were in the 25–30 age range.

According to the current study, women made up highest numbers of nurses. From the perspective view of the researchers, this might be because nursing is a profession that is dominated by women. This is because male students have been admitted to nursing schools only dates less than two decades, meaning that the nursing workforce is still more feminine. This finding is like that of **Elgazar et al., (2020)** who stated in study entitled " Effects of an educational program on the nurses' performance regarding vascular access infection prevention " that the majority of nurses under study were females.

According to current research result, the largest number of nurses had a technical institute, while the smallest number had bachlores in nursing. This is aligned with **Sayed et al., (2021)** who showed in study entitled " Effect of an Educational Program on Critical Care Nurses' Knowledge, and Practice about Central Venous Catheter Bundle" 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 in study entitled " Factors Affecting Central Venous Catheter's Dwell Time in Critically Ill Patients: Suggested Guideline " that nearly two-thirds of the nurses were married.

In terms of residence, the current study found that a majority of the studied nurses lived in the rural area.This finding is consistent with **El Desouky, Taha and Hafez. (2020)** who demonstrated in study entitled " Factors affecting Nurses'performance regarding the care for patients underwent coronary artery bypass graft" that most of the nurses in the ICU existed in rural regions.

In terms of years of experience in the nursing field, the current study found that nearly two-thirds of the studied nurses had less than five years of experience in nursing. This finding is agree with **Ibrahim, Mokhtar, and Hussein, (2025)** who stated in study entitled " Impact of Educational Program on Nurses' Performance Regarding Care of Central Venous Catheter in Hemodialysis Unit " that slightly less than two thirds of studied nurses had less than five years of experience in nursing field.

Concerning experience years of studied nurses in ICU, the current study revealed that nearly three quarters of nurses had less than five years of experience in ICU. This finding line up with **Ahmed et al., (2019)** who mentioned in study entitled " Assessment of Nurses' knowledge concerning Prevention of Central Venous Catheter Infection in Intensive Care Units at Baghdad Teaching Hospitals " that nearly three quarters of studied nurses had less than five years of experience in ICU.

As regard to attendance of training courses realted to CVLI, this study reported that more than half of studied nurses attended training courses realted to CVLI. This finding aligns with **Ng'ambi, (2018)** who mentioned in study entitled " Opinions of Nurses in ICU on the Importance and Utilization of the CLABSI Prevention Bundle in an Academic Hospital in Gauteng " that more than half of nurses attend training courses.

Concerning total nurses' knowledge about CVL, the current study clarified that more than half of studied nurses had unsatisfactory total knowledge about CVL. This result also aligns with a study by **Latha and Gurung. (2022)** who evaluated the knowledge regarding management of patients with central venous access devices among ICU nurses and found that more than two fifths of the studied nurses had inadequate knowledge about CVL, and a minority of the nurses had adequate knowledge.

Moreover, concerning total nurses' knowledge about CVLABSI, the current study clarified that slightly more than half of studied nurses had unsatisfactory knowledge about CVLABSI. This result is in the same line with **Khan et al. (2024**) who stated

in research title "Knowledge, Attitude and Practice among Nurses Regarding Prevention of Central Line Associated Bloodstream Infection in Tertiary Care Hospital of Peshawar: Prevention of Central Line Associated Bloodstream Infections" that more than half of studied nurses had unsatisfactory total knowledge regarding CVLABSI

The current study demonstrates that over three-fifths of the studied nurses had an unsatisfactory level of total knowledge about prevention of CVLABSI. This finding in the same line with **Chi et al. (2020)** who mentioned in study entitled " Prevention of central line-associated bloodstream infections: a survey of ICU nurses' knowledge and practice in China " that more than three fifth of the studied nurses had unsatisfactory total knowledge regarding pevention of CVLABSI. Since knowledge about healthcare is always developing changing, and updating, nurses should never stop learning to increase their understanding.

Concerning of nurses' overall knowledge regarding prevention of CVLI, the current study revealed that over half of the nurses were unsatisfactory knowledgeable. This result coincides with **Badparva et al. (2023)** who mentioned in her master thesis entitled " Prevention of central line-associated bloodstream infections: ICU nurses' knowledge and barriers " that more than half of studied nurses had overall unsatisfactory level of knowledge regarding CLABSI.

Concerning total nurses' practices regarding pre insertion of CVL, the current study revealed that less than three fifth of studied nurses had unsatisfactory total practice regarding pre insertion of CVL. This result goes in the same line with **Said, Yassien and Ali. (2020)** who revealed in study entiteled "Factors Affecting Nurses' Performance toward Central Line Associated Blood Stream Infection in Critical Care Units" that less than three fifths of studied nurses had unsatisfactory practice regarding pre insertion preparation of CVL.

Concerning total nurses' practices intra CVL insertion, the current study revealed that the highest percentage of studied nurses had unsatisfactory practice intra insertion of CVL. This study's findings are consistent with those of **Said, Yassien and Ali (2020)** who explain that two-thirds of the nurses in the study performed improper central venous access device insertion techniques.

Concerning total nurses' practices post CVL insertion, more than half of the studied nurses have unsatisfactory level practices post CVL insertion. From the researcher's point of view, this result might be related to other factors such as shortage of nurses, and unavailability of hospital protocols and polices for CVL caring. This result was supported by **Khadrawi, (2019)** who conducted a study about " Assessment of nurses' Knowledge and Practice Related to Caring of Central Venous Line at Aldamam hospital " who reported that highest percentage of nurses have inadequate practice after CVL insertion.

Concerning the total nurses' practices about dressing change of CVL, this study revealed that over half of studied nurses had unsatisfactory total practice about dressing change of CVL. This study result was align with **Mohamed et al. (2019)** who explained in study entitled "Auditing and Re-auditing Nursing Care for Children Undergoing Central Venous Line Insertion in Pediatric Intensive Care

Unit " that most of studied nurses had carried out dressing change in an inadequatw manner.

Regarding nurses' overall CVLI prevention practice, the current study found that over two-thirds of the studied nurses had insufficient overall CVLI prevention practice. According to the researchers, this outcome is due to the hightest percentage of the nurses under the study had at least a few expertise in the ICUs and nursing field, and the smallest percentage had a college degree in nursing. This finding aligns with the findings of **Manurung and Dewi's. (2022)** which showed in their research titile " How is the practice of nurses in preventing infection of central venous catheters in hospitalized patients? -Nurse knowledge and attitudes " that the majority of nurses in the study had inadequate practice about CVLI prevention.

Regarding the relationship between the variables under research, this research found a statistically significant relation between nurses' overall knowledge of CVLI prevention and practice. These results corroborate those of **Said, Yassien and Ali. (2020)** who found a relation between nurses' practice scores and their overall CLABSI knowledge.

Conclusion

The study results led to the conclusion that the nurses in the study settings had unsatisfactory knowledge and practice regarding prevention of CVLI, as more than half of the studied nurses had an unsatisfactory overall knowledge level and more than two thirds of nurses had unsatisfactory overall practice level. Additionally, the current study's conclusion affirms that there was significant correlation between overall nurses' knowledge, and practices regarding prevention of CVLI.

Recommendations

- Effective and standardized training program that are based on effective interventions can enhance nurses' practice application and knowledge and need to be updated on a regular basis.
- 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.
- All ICUs should have standard nursing practices books to help nurses give patients with CVC the care they need
- Ongoing monitoring, assessment, and feedback on nurses' performance who providing care for patients with CVC.

Authors' contributions

N.A.M.; carried out the overall supervision and contributed to aim and research question, tool revision, introduction, significance of the study, review, discussion, conclusion, and recommendations. A.M.M.F; formed the study, explained and gathered data, wrote the original draft, and she is a corresponding author. N.M.T; reviewed and edited the manuscript and provided critical comments, did statistical data analysis and interpretation of data. S.M.E; provided draft of the manuscript before its publication, participated in all the steps of research. All authors participated, revised and approved the final manuscript.

Acknowledgment

The author wants to thank the directors of Zagazig university hospitals for everything they do. We want to express our gratitude to every one of our nurses who took the time to respond to our inquiries.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Funding source

The author received no financial support for the research, authorship, and/or publication of this article.

Table (1): The Frequency and Percentage Distribution of the Studied Nurses' Demographic Characteristics (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 CVLI		
Yes	42	56.0
No	33	44.0
Presence of booklet or a guide about prevention of CVLI		
Yes	48	64.0
No	27	36.0

Table (2): Frequency and Percentage Distribution of Total Nurses' Knowledge Domains Regarding Prevention of CVLI (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%

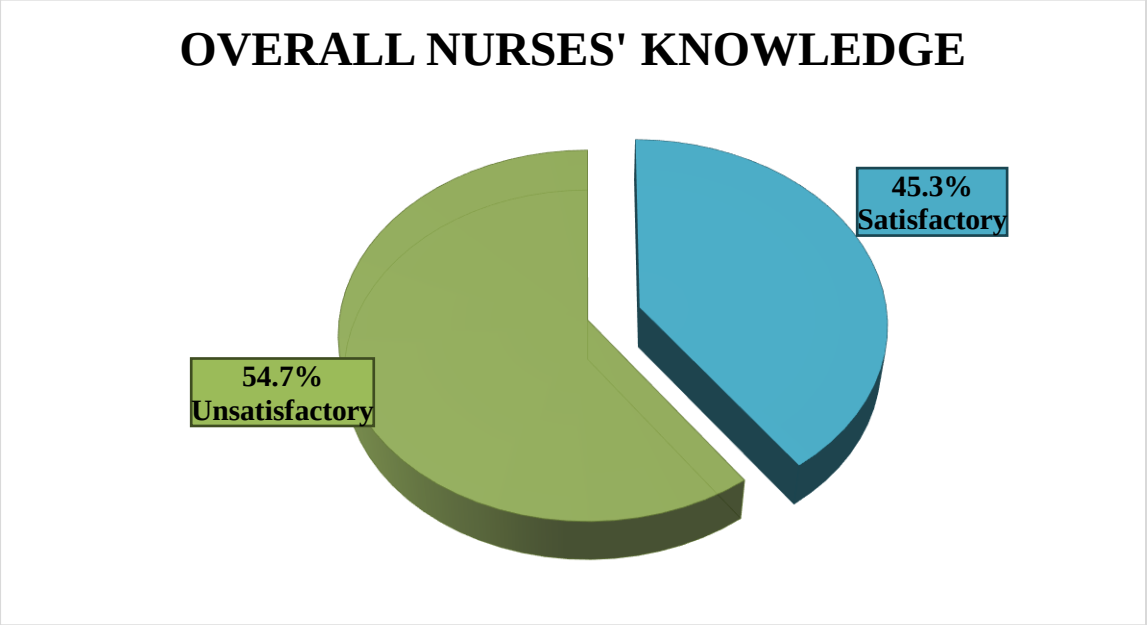

Figure (1): Percentage Distribution of Studied Nurses' Overall Knowledge Level Regarding Prevention of Central Venous Line Infection(n=75).

Table (3): Frequency and Percentage Distribution of Total Nurses' Practices Domains Regarding Prevention of CVLI (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%

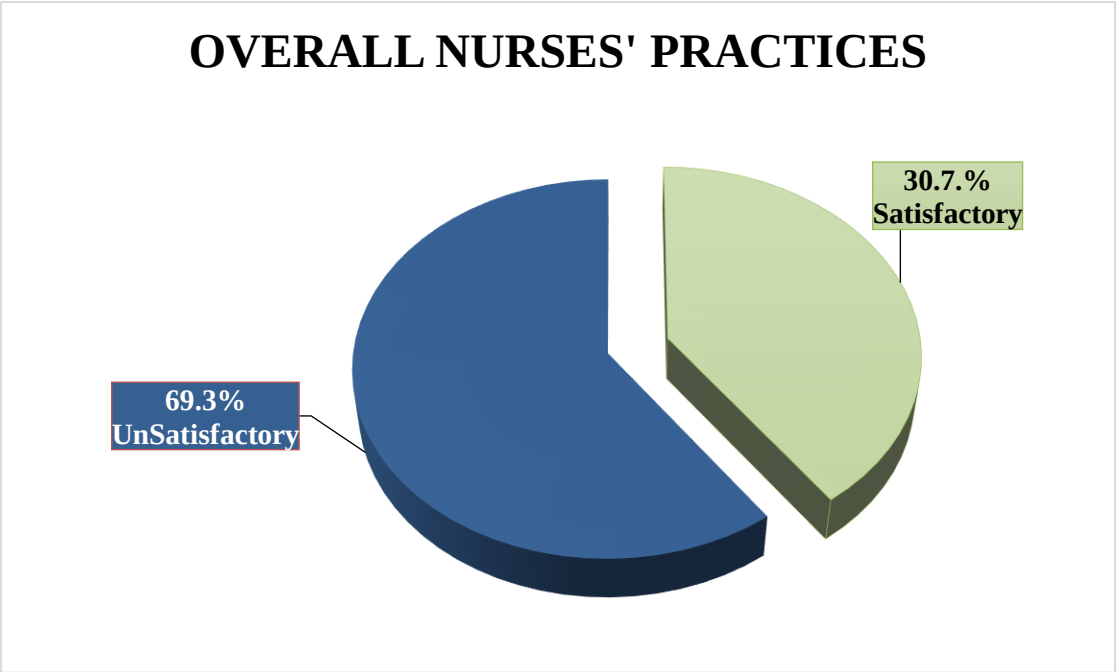

Figure (2): Percentage Distribution of Studied Nurses' Overall Practices Level Regarding Prevention of Central Venous Line Infection (n=75)

Table (4): Relation between overall Nurses' Knowledge, and Practices regarding Prevention of CVLI:

Variable		Overall practices
Overall knowledge	r	.276
	p- value	.016*

r: correlation coefficient test ** significant (p-value <0.05)*

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