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Assessment of Nurses' Performance Regarding Central Venous Access Care in Pediatric Intensive Care Unit

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Abstract

Background: The use of central venous catheters is an integral part of modern health care throughout the world, especially among children as central venous catheters are essential elements in the treatment of ill children. **Aim:** to assess nurses' performance regarding central venous access care in pediatric intensive care unit. **Design:** A descriptive design was utilized to conduct the study. **Setting:** The study was conducted at two pediatric intensive care units at Pediatric Hospital of Ain Shams University. **Sample:** A purposive sample of 52 nurses working at the previously mentioned setting were selected. **Tools:** two tools were used: 1st tool was a structured interview questionnaire. 2nd tool was observational checklist. **Results**: The study showed that more than half of studied nurses have unsatisfactory level of knowledge and more than half studied nurses are incompetent in practice. There was a positive correlation between total level of knowledge and practices (P-value ≤ 0.001). **Conclusion:** Based on the current study results, it was concluded that more than half of the studied nurses have an unsatisfactory level of knowledge and are incompetent in practice. The studied nurses' characteristics such as attending training course and their qualifications had significant difference with total level of knowledge while there was no significant difference between age, gender, marital status and experience and total level of knowledge. There was a statistically significant difference between studied nurses' qualifications and their practices. **Recommendations**: it is recommended to conduct in-service education programs for pediatric nurses to update their knowledge and practice.

Key Words: *Central Venous Access; Nurses' performance; Pediatric Intensive Care Unit.*

Introduction

Improvement in supportive care for hospitalized patients, especially in critical care units, has escalated the use of central venous devices (CVDs). CVDs are widely used worldwide; about 27 million insertion procedures of central catheters have been performed annually. The use of central devices has become an integral component of modern-day medical practice in pediatric patients. Central venous catheters are used to administer medications, intravenous fluids, parenteral nutrition, and blood products. Moreover, they can be used as an adjacent to monitor the hemodynamic status of critically ill patients **(Mer 2022).**

Pediatric intensive care unit and central venous access devices have a significant relationship in pediatric care. CVADs are essential for managing various medical conditions in pediatric patients, particularly those admitted to the PICU. PICU is a specialized area within a hospital that provides intensive care for critically ill infants, children, teenagers, and young adults with different health conditions such as respiratory failure, sepsis, shock, trauma, altered mental status, congenital heart defects, and other serious illnesses that need close observation and critical care **(Paterson et al., 2020).**

Central venous access devices are catheters inserted into peripheral veins or central veins in the chest, neck, or the groin, which travels through the venous system, so the distal tip is positioned in the lower third of superior vena cava, cavoatrial or the upper right atrium. CVADs are usually made of non-irritant materials such as silicone or polyurethane, that

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can be left in for as long as clinically indicated **(Gorski 2021).**

In fact, there are many types of CVADs, according to cause, indication of insertion and patient's condition; type of CVADs, they are classified.term -They are mainly classified into long devicterm devices including-es and short four main subtypes; peripherally inserted central catheter, skin tunneled catheters, non-tunneled and implanted port. They can be classified into the following types: peripherally inserted central catheter (PICC), tunneled femoral catheter (TFIC), tunneled cuffed catheter (TCC), non-tunneled central venous catheter (CVC), implanted port and hemodialysis/apheresis catheters (tunneled and non-tunneled) **(Paxton 2021).**

Complications of CVADs in children have significant concern in healthcare settings. Recent research has shown that mechanical complications of CVADs are common in pediatric patients affecting about 17% of all CVADs insertions. Common complications include blockage, dislodgement and infection including catheter related blood stream infection (CLABSI), Catheter-related thrombosis (CRT). Complications of CVADs can be classified into complications during insertion; post-insertion complications and complications and adverse effects during removal of catheters **(Zhang et al., 2022).**

Nurses are essential in ensuring the safe and effective use of central venous catheters in pediatric patients through their direct care, education, and quality improvement efforts. They play a vital role in the care of CVCs in pediatrics, encompassing education, insertion and management, complication prevention and management, quality improvement initiatives, multimodal education and support, discharge planning and support, and research and policy development. Their roles include maintenance and care of CVCs, prevention of complications, planning for discharge plan and providing emotional support and providing multimodal support and education **(Bailie et al., 2021).**

Additionally, inappropriate care of CVADs can cause other serious complications such as Venous Thromboembolism (VTE). Historically, VTE, consisting of deep venous thrombosis and pulmonary embolism, has been rare in children, but recent data demonstrate that the incidence of VTE has increased by 70% to 200% in the last 2 decades with 80% of cases in children due to central venous catheters **(Jaffray et al., 2020).** Financially, CVADs associated infections increase the length of hospital stay and medical cost; the cost of CVADs failure in pediatrics was estimated to be A$826 per episode, and A$165,372 per 1000 CVADs worldwide **(Ullman 2022).** Moreover, there is a gap in nursing research related to nurses' performance regarding central venous access in critically ill children. So, from the research point of view, it is important to assess the pediatric nurses' performance regarding central venous access care in pediatric intensive care unit.

Significance of study

Central venous access devices associated infection is considered one of the most frequent common health acquired infections (HAIs) as it is responsible for about 60% of HAI **(Abdelmoneim et al., 2020).** Specifically, in pediatrics, one in ten children with CVC develops CVADs infections worldwide **(Rickard and Ullman 2018).** For instance, CVC insertion most frequently results in CLABSI that is associated with prolonged ICU stay and increased morbidity and mortality. The rate of CLABSI in developing countries ranges from 1.6 to 44.6 per 100 central lines in PICU with an estimated 50% mortality rate **(Abdelmoneim et al., 2020 & Sedrak et al., 2019).** According to **(Hassan et al 2020),** central line associated blood stream infection is the fifth most common type of HAI in Egypt. Also, pediatrics CLABSI accounts for 14.1 per 1000 central line days (**Abdelmoneim et al 2020).**

Aim of the study:

This study aimed to assess nurses' performance regarding central venous access care in pediatric intensive care unit.

Research question:

- What is the level of nurses' knowledge about care of central venous access in pediatric intensive care unit?
- What is the level of nurses' practice regarding care of central venous access care in pediatric intensive care unit?
- Is there a relation between nurses' characteristics and their performance?

Operational Definitions:

Performance: in this study, performance will represent nurses' knowledge and skills that represents practice.

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Subjects and Methods:

Research design:

A Descriptive design was utilized to conduct the study.

Study Settings

The study was conducted at pediatric intensive care units of Pediatric hospital at Ain-Shams University, the hospital affiliated to Ain-shams University Hospitals. The hospital has two buildings that contain five units for pediatric intensive care where the study was conducted. PICU of the new building is on the third floor where three units are distributed as follows: PICU1 is with capacity of 8 bed; PICU2 of 8 beds as well and isolation PICU that have four beds with two beds in each room.

Study Subjects

A purposive sample of 52 nurses based on inclusion and exclusion criteria from both sexes from the previously mentioned setting were selected to conduct the study under the following criteria:

- work as a full-time nurse at the PICU.
- Have at least one year of experience at PICU.
- Age above 20 years.

Exclusion criteria:

- Internship nurses are excluded

Tools of data collection:

Two tools were utilized in this study and organized as follow:

1st tool: Structured Interview Questionnaire:

This tool was developed by a researcher after reviewing literature. In the light of used literature such as (**(Wilson 2019); (Khalifa et al., 2022) and (Kleiegman and Geme 2019).** The tool was reviewed and approved by the jury committee to gather data in relation to the following parts:

Part I: To Assess the studied Nurses' characteristics:

This part was concerned on obtaining data in relation to nurses' characteristics including age, gender, marital status, qualifications, years of experience and if the participants have any previous courses about central venous access care or not. This section contains 6 questions.

Part II: To Assess the Studied Children's characteristics:

This part was concerned on characteristics of the studied children. This data was obtained by reviewing patients' medical records and it included seven items in relation to the children's age, gender, diagnosis, date of admission, length of stay, type of central venous device and date of CVADs insertion.

Part III: To Assess PICU Nurses' Knowledge About Care of CVADs:

This tool was designed by the researcher after reviewing relevant literatures. This part aimed at assessing pediatric nurses' knowledge regarding central venous access care in PICU. This section is composed of ٣٠ questions that are categorized as follow: 9 questions about background of CVADs including definition, types, uses, indication, complications, most common sites of insertion and incidence rate; 3 questions about pre-insertion preparation including skin preparation, positioning and antiseptic solution used for cleaning prior insertion; 13 questions about maintenance, handling, and daily care in relation to cleaning and sterilization before care, flushing of ports, daily care of CVC dressing, antimicrobial agents used in daily care if needed and care of central line after administration of different products such as fluids, blood products and emulsions and 5 questions about removal in relation to positioning, aseptic technique performed, site preparation and adequate pressure time after central line removal.

Scoring system:

Nurses' knowledge questionnaire contained 30 questions with total score of 30 points; each respondent was given one point for each correct answer and zero for each incorrect answer. Levels of nurses' knowledge were categorized into satisfactory or unsatisfactory level of knowledge. To illustrate, if the respondents got ≥ 85% of total score, this was considered satisfactory level of knowledge while if the respondent got < 85%, this was considered unsatisfactory level of knowledge.

2nd tool: Observational Checklist of Central Venous Catheter Care:

This tool was adapted from CVC insertion and care guidelines from the Joint Commission International CLABSI guidelines, Central Line insertion checklist of CDC and Central Line Insertion Care Team Checklist of National Health Service Scotland (Centers for Disease Control and Prevention 2022, Joint Commission 2018 &

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National Health Service Scotland 2012). This tool was used to assess the level of nurses' practice in relation to insertion technique, CVC sites care and dressing, maintenance and patency of ports and removal technique. The tool contains 27 steps, divided into 8 steps about proper insertion practices, 8 steps about proper handling and maintenance of central lines and 11 steps for prompt removal of central lines.

Scoring system:

Nurses' practices observational checklist contained 27 steps with total score of 27. Each step was evaluated as done or not done. The participant was given one point for each step completed while any incomplete steps was scored with zero. The level of nursing practice was classified as competent and incompetent. In other words, if total score was ≥ 90% (i.e. completed 24 steps or more), this is deemed competent while if total score was < 90 % (i.e did not complete 23 step), this is deemed incompetent.

Validity:

Before conducting the study, the adapted tools were evaluated for its clarity, accuracy, relevancy and meaningfulness through jury of three experts consisting of one associate professor of pediatrics nursing from the British university in Egypt and two other associate professors of pediatric nursing from Helwan university. All the required modifications and suggestions identified after jury feedback and revision were applied.

Reliability:

Internal reliability of used tools was assessed using Cronbach's coefficient alpha statistical test. It was 0.763 for nurses' knowledge and 0.841 for practice which reflects high reliability of tool.

Ethical Considerations:

An official permission to conduct the proposed study was obtained from the Scientific Research Ethics Committee of the Faculty of Nursing at Helwan University. Participation in the study was voluntary and subjects were given full information about the aim of the study and their role before signing the informed consent. The ethical considerations included explaining the purpose and nature of the study, stating the possibility to withdraw at any time, and confidentiality of the information where it couldn't be accessed by any other party without taking permission of the participants. Ethics, values, culture, and beliefs were respected.

Pilot Study:

The pilot study was carried out on 10% (6 nurses) of the study sample to test the applicability, feasibility, clarity of questions and the time needed to complete data collection and to identify any potential obstacles that might hinder the process of data collection from side of researcher and participants. There was no modifications or omissions of items were required to be applied so subjects of pilot study were included to study sample.

Fieldwork

The data was collected over 6 months from July 2023 to December 2023. To accurately collect data, the researcher visited PICUs three times per week (Saturday, Sunday and Monday) during morning and afternoon shift from 9:00 am to 4:00 pm. At first, the investigator met head nurses of the previously mentioned settings and clarified the aim of the study, duration of data collection and how data would be obtained, sample size and inclusion criteria. Then, the nurses that met inclusion criteria were included in the study. Later on, tools were completed by the researcher through structured interview questionnaire with an average time of 30-45 minutes through two phases. Firstly, nurses' demographic data and their knowledge about CVADs care in PICUs was obtained. To illustrate, the investigator had interviewed nurses and explained the purpose of the study and reassured them that their data will be confidential, and it would be used only for the research aim. Then, the nurses were asked to complete their data individually in the presence of researcher; it took about 5-10 minutes to complete their data. Regarding nurses' knowledge, nurses' knowledge regarding CVADs questionnaire was used. The questionnaires were distributed to nurses and the researcher read all the questions and was available for any clarification. It took from 30-45 minutes from each participant to complete questionnaire. Regarding nurses' practices, practical skills of nurses were assessed via observational checklist. Firstly, every checklist was

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coded with the same number of demographic data, then it was completed by the researcher throughout the morning shift and at the beginning of the evening shift. It took 10-15 minutes for the investigator to complete the checklists. Regarding the studied children's characteristics, the data was collected by revising the children's medical records.

Statistical design:

After completion of data collection, collected data was revised, coded, and entered using Personal Computer (PC). The obtained data was organized, tabulated, and analyzed using Statistical Package for Social Sciences (SPSS), version 24 for analysis. Data were presented using descriptive statistics in the form of frequencies and percentages. Mean and Standard deviation were used for continuous variables. The chi-square test (X2) was used for relating categorical variables. Pearson correlation coefficient (r) was used to find a linear relationship between two variables .

An appropriate significance was adopted at P value > 0.05 for interpretation of results. The observed associated differences are considered as not significant if P value < 0.05 and they are significant if P value > 0.05. For this study, statistically significant was considered at p-value < 0.05.

Results:

Table (1): Frequency of distribution of the studied nurses' characteristics (N=52).

Variable	N	%
Age		
< 20 years	4	7.7
20 < 30 years	41	78.8
30 < 40 years	5	9.7
≥ 40 years	2	3.8
Mean($\bar{x}$) ± SD	24.7 ± 5.07	
Gender		
Male	13	25
Female	39	75
Marital status		
Single	28	53.8
Married	23	44.1
Divorced	1	1.9
Qualifications		
Secondary diploma degree	7	13.5
Technical Diploma degree	25	48.1
Bachelor's degree	20	38.5
Experience		
1 < 5 year	10	19.2
5 < 10 year	35	67.3
≥ 10 years	7	13.5
Mean($\bar{x}$) ± SD	6.5 ± 2.7	

Table (1) shows that 78.8% of the studied nurses aged from 20-30 years, with Mean ($\bar{x}$) ± SD 24.7 ± 5.07. 75% of the studied nurses were female, and 53.8% were single. Around 48.1% of the nurses qualified as diploma nurses and almost two-thirds of them (67.3%) had 5 to 10 years of experience, with a mean of 6.5 ± 2.7 years

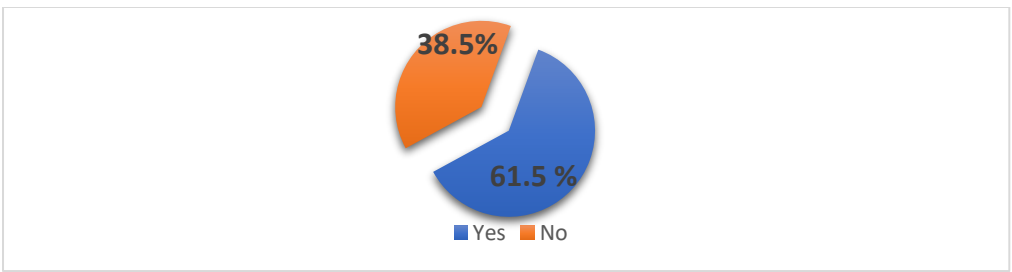

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Figure 1: Percentage of distribution of the studied nurses regarding attending previous training program about CVC care (N=52).

Figure (1) illustrates that almost two-thirds of participants (61.5 %) had attended training programs regarding central venous access care for pediatric patients in the intensive care unit.

Table (2): Frequency of distribution of the studied children's characteristics (N=33).

Variable	N	%
Age/ months		
1 < 6	**6**	**18.2**
6 < 12	**6**	**18.2**
12 < 18	**10**	**30.3**
18 < 24	**8**	**24.2**
≥ 24	**3**	**9.1**
Mean($\bar{x}$) ± SD	**13.6 ± 7.3**	
Gender		
Male	**16**	**48.5**
Female	**17**	**51.5**
Diagnosis:		
Cardiac problems	**9**	**27.2**
Respiratory problems	**20**	**60.6**
Guillain Barre syndrome	**3**	**9.09**
Cerebral hemorrhage	**1**	**3.03**
Length of hospital stay/ days		
1 < 5	**4**	**12.1**
5 < 10	**12**	**36.4**
≥ 10	**17**	**51.5**
Mean($\bar{x}$) ± SD	**11.7 ± 6.4**	

Table (2) showed that less than one-third (30%) of the children who received care were between the ages of 12 to 18 months, with an average age of 13.6 ± 7.3. In terms of gender, female patients made up almost half (51.5%) of the entire sample. Of the children, 60.6% had respiratory problems, and 51.5 % of those required hospitalization for more than 10 days. The average hospital stays for these children 11.7 ± 6.4.

Table (3): Frequency of distribution of the studied nurses related to total knowledge regarding central venous access care in pediatric ICU (n =52).

Item	Correct		Incomplete correct		Incorrect	
	N	%	N	%	N	%
- Background about CVADs.	16	30.8	20	**38.4**	16	30.8
- Preparation of CVADs.	30	**57.7**	-	-	22	42.3
- Daily care handling of CVADs.	26	50	-	-	26	50
- Uses of CVADs.	17	32.7	10	19.2	25	**48.1**
- Removal of CVADs.	28	53.8	-	-	24	46.2

Table (3) shows that 57.7 % of the studied nurses had correct total knowledge regarding the preparation of CVADs knowledge. However, 38.4% of them had incomplete correct total knowledge regarding the background of CVADs. Also, 48.1% of the studied nurses had incorrect Total knowledge regarding the use of CVADs.

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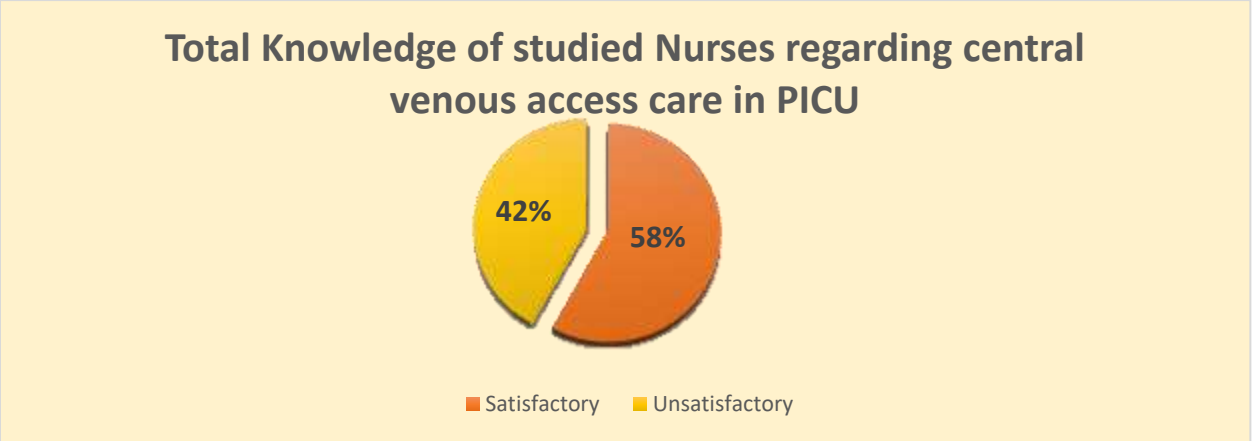

Figure (2): Percentage distribution of studied nurses according to their total knowledge related to central venous access care in the pediatric intensive care unit (N=52).

Figure (2) displays that more than half of the participants (58 %) have unsatisfactory knowledge regarding central venous access care in the pediatric intensive care unit.

Table (4): Frequency of distribution of the studied nurses related to total practice regarding central venous access in pediatric intensive care unit (N=52).

Item	Competent		Incompetent	
	N	%	N	%
Proper insertion practices	42	80.8	10	19.2
Handling and maintaining central lines appropriately	20	38.5	32	61.5
Promptly removing unnecessary central lines	45	86.5	7	13.5

Table (4) shows that out of the studied nurses, 80.8% are proficient in practices related to catheter insertion, while 61.5 % were not competent in handling and maintaining central lines appropriately. Additionally, 86.5 % of the subjects are competent in removing unnecessary central lines opposite to only 13.5% are incompetent.

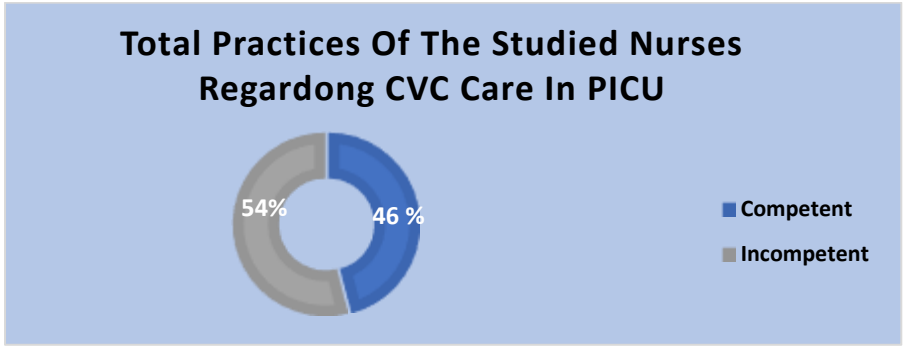

Figure (3) Percentage distribution of studied nurses according to their total practice related to central venous access care in the pediatric intensive care unit (N=52).

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Figure (3) shows the distribution of the studied nurses according to their practice as 46% are competent in caring of central venous access care in the pediatric intensive care unit while 54% are incompetent.

Table (5): Relation between the characteristics of the studied nurses and their total level of knowledge (N=52).

Variable	Total level of Knowledge				Chi-square	
	Satisfactory		unsatisfactory			
	N	%	N	%	X^2	P-Value
Age						
< 20 years	2	4 %	2	4 %		
20 < 30 years	13	26 %	28	56 %	18.37	0.302
30 < 40 years	5	10 %	0	0 %		
≥ 40 years	2	4 %	0	0 %		
Gender						
Male	5	10 %	8	16 %	0.105	0.746
Female	17	34 %	22	44 %		
Marital status						
Single	9	18 %	19	38 %		
Married	12	24%	11	22 %	3.46	0.177
Divorced	1	2 %	0	0 %		
Qualifications						
Secondary diploma degree	3	6 %	4	8 %		
Diploma degree	6	12 %	19	38 %	7.653	0.02*
Bachelor's degree	13	26 %	7	14 %		
Experience						
1 < 5 year	3	6 %	7	14 %		
5 < 10 year	15	30 %	20	40 %	16.356	0.128
≥ 10 years	4	8 %	3	6 %		
Training						
Yes	10	20 %	22	44 %	4.168	0.04*
No	12	24 %	8	16 %		

* P ≤ 0.05, there is a statistical difference.

Table (5) showed that studied nurses' characteristics such as qualifications, training program had statistically significant difference with the nurses' total level of knowledge with a P-value of 0.02 and 0.04, respectively while there was no significant difference between age, gender, marital status, and experience and total level of knowledge.

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Table (6): Relation between the characteristics of the studied nurses and their total practices (N=52).

Variable	Practice				Chi-square	
	Competent		Incompetent		X^2	P-Value
	N	%	N	%		
Age						
• < 20 years	4	8 %	-	0 %	16.617	0.411
• 20 < 30 years	29	58 %	12	24 %		
• 30 < 40 years	5	10 %	-	-		
• ≥ 40 years	2	4 %	-	-		
Gender						
• Male	8	16 %	5	10 %	2.311	0.128
• Female	32	64 %	7	14 %		
Marital status						
• Single	23	46 %	5	10 %	1.431	0.489
• Married	16	32 %	7	14 %		
• Divorced	1	2 %	0	0 %		
Qualifications						
• Secondary diploma degree	5	10 %	2	4 %	6.153	0.04*
• Technical diploma degree	16	32 %	9	18 %		
• Bachelor's degree	19	38 %	1	2 %		
Experience						
• 1 < 5 year	7	14 %	3	6 %	17.194	0.102
• 5 < 10 year	27	54 %	8	16 %		
• ≥ 10 years	6	12 %	1	2 %		
Training						
• Yes	23	46 %	9	18 %	1.194	0.274
• No	17	34 %	3	6 %		

* P ≤ 0.05, there is a statistical difference.

Table (6) showed that there was a statistically significant difference between the qualifications of the studied participants and their practices regarding the care of central venous devices in the pediatric intensive care unit (P = 0.04, P ≤ 0.05). however, there was no statistically significant difference between age, gender, marital status, experience, and training acquisitions.

Table (7): Correlation between total knowledge and total practice of the studied subjects (N=52).

Items	Total Knowledge of the studied subjects	
	Correlation coefficient (r)	P-Value
Total Practice of the studied subjects	0.469	0.002**

** P ≤ 0.001, there was a statistical significant difference.

Table (7) showed that there was positive correlation (P-value ≤ 0.001) between the total level knowledge and total level of practice of the studied nurses in the pediatric intensive care unit regarding central venous access care.

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Discussion

Central venous catheters are often necessary in the pediatric population. They are useful for hemodynamic monitoring, rapid fluid infusion and administration of hyperosmolar medications such as vasopressors, antibiotics, chemotherapy and parenteral nutrition. Access of central venous catheter may be challenging, and its type has its own unique set of risks and complications. Complications of central access may include infection, which is associated with morbidity and mortality and significant financial costs. Although central access complications are serious, most of these complications can be preventable through the proper performance of healthcare personnel **(Dyk et al., 2021).**

Regarding characteristics of studies sample, the results revealed that the majority of studied participants aged 20-30 years as showed in **table (1),** which is similar to the study conducted by **Perumal et al., (2022), entitled:** knowledge, Skills, and Compliance of Nurses Related to Central Line-Associated Bloodstream Infection in the Cardiovascular Department at King Faisal Hospital and Research Centre, Riyadh, found that the majority of participants fell under the age group of 25-34 years. Conversely, the study conducted by **Ali (2023),** entitled: Nurses' compliance with central line maintenance (Handling) guidelines at guidelines at a tertiary care setting in Kar e setting in Karachi, P achi, Pakistan- A akistan- A descriptive cross-sectional study, revealed that the distribution of age groups within the participants is interesting, with the majority falling within the 30-40 age range. From the researcher's point of view, it is supposed that the age from 20-30 years is appropriate for gaining knowledge and enhancing practical skills. Besides, it is compliant with age group of Egyptian population as this this the labor age in Egypt as the Egyptian population was skewed towards the younger generations, with the population count in each older generation being lower than the one before it.

Concerning gender, more than two thirds of participants were female, which is consistent with the study performed by **Khalifa et al., (2022),** under the title of: Effect of Nursing Care Bundle on Nurse's Performance Regarding Central Venous Line-Associated Blood Stream Infection, that found the majority of participants were female. From the researcher point of view, this may be due to that the percentage of female nurses is significantly higher than that of male nurses in Egypt as only 12% to 13% of nurses are men, making them a minority in the field (**Abdel-Fattah et al., 2019).**

As regard to marital status, the study revealed that more than half of nurses were single, This mismatches with the findings of **Diab and Ibrahim (2019)** in their study of "Factors Leading to Missed Nursing Care among Nurses at Selected Hospitals", that revealed more than of nurses were married. From the researcher's perspective, it seems that single marital status can positively affect quality of care as those nurses do not have familial commitments that may hinder their attendance and punctuality at work.

Considering the educational level of the studied sample, less than half of the participants were diploma nurses (technical institute nurses). This is aligned with **Ahmed & Kafl's (2019) study about "**Knowledge and Practice of Critical Care Nurses on Vascular Access Devices Related Infection" that reported less than half of the studied nurses had technical health institute diploma. On the other hand, **Abd El-Fadel et al., (2022)** in their study entitled Nurses' Knowledge and Practices regarding Care of Children Undergoing Vascular Access and its Related Complications reported that more than half of studied nurses had bachelor's degree of nursing science. The researcher's point of view, this may be associated with increased number of graduate students from technical institutes as it has been estimated that number of technical institute graduates increased from 4415 in 2019 to 5151 in 2020, an increase by 16.7% **(Central Agency for Public Mobilization and Statistics in Egypt., 2020).** Besides, critical areas such as PICU need more skillful qualified nurses.

Regarding years of experience, more than two-thirds had 5 to 10 years of experience, with a mean of 6.5 ± 2.7 years. This is congruent with the study of **Ebrahim et a., (2023)** regarding Nurses' Knowledge Regarding Care Provided to Children on Mechanical Ventilation, that showed 71.7% of studied nurses had 10 years of experience or less. **In contrast, Abd El-fadel et al., (2022)** demonstrated in their study entitled: Nurses' Knowledge and Practices Regarding Care of Children Undergoing Vascular Access and its Related Complications that more than two thirds of the studied nurses had 1<5 years of experiences in the pediatric units. From this point, the researcher supposed that average years of experience that is not too short or too long should be consider when assigning tasks for nurses in critical areas as short period of experience may be associated with inappropriate in such critical areش which is fatal for children while too long period may not be suitable as well as such nurses are usually involved in managerial tasks.

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Regarding domain of training courses, the current study revealed that about two-thirds of participants have training courses regarding central venous access care for pediatric patients in the intensive care unit. This is supported by **Awad et al., (2019) in their study entitled:** Critical Care Nurses' Knowledge and Practices Regarding Central Venous Line Care Bundle at Emergency Hospital, Mansoura University that illustrated that the percentage of attending training programs was in the percentage of 70.7%, 55.2%,.and 50% respectively. Conversely, this disagrees with the study of **Abd El-Fadel et al., (2022)** research about Nurses' Knowledge and Practices Regarding Care of Children Undergoing Vascular Access and its Related Complications that clarified more than three quarters of the studied nurses didn't attend training courses. From the researcher's point of view, continuous training courses are very essential for nursing staff for providing high quality care, but the training is only enough, policies that support adherence to care should be considered.

By evaluating studied nurses' total level of knowledge regarding central venous access care fig (2) illustrated that more than half of the participants have unsatisfactory knowledge regarding central venous access care in the pediatric intensive care unit. This is in consistent with **Awad et al., (2019)** that conducted study entitled "Critical Care Nurses' Knowledge and Practices Regarding Central Venous Line Care Bundle At Emergency Hospital, Mansoura University" that illustrated most (85%) of the nurses had unsatisfactory knowledge level about central line bundle. In contrast, the study disagrees with the study done by **Raynak et al., (2020)** entitled "Nurses' knowledge on routine care and maintenance of vascular access devices: A scoping review" who found that, 65.47% of nurses had satisfactory knowledge regarding VAD for children. From the researcher's point of view, the pediatric nurses have poor level of knowledge regarding CVADs in children due to inappropriate training programs, increased patients' number and workload and lack of nurses' incentives to improve their knowledge and lack of desire to update their knowledge. All these factors may contribute to neglecting the theoretical part beyond practice.

By evaluating the total practice of nurses regarding central venous access in PICU. Fig (3) showed that more than half of nurses are incompetent in caring of children with CVC. This agrees with the result of **Saltah and Abusaad (2021)** in the study entitled "Assessment of Nurses Knowledge and Practice about Peripherally Inserted Central Catheters at Neonatal Intensive Care Units", that reported less than half of studied nurses had incompetent performance level. In contrast, this finding is not harmonized with the result of **Abd El-fadel et al., (2023)** in the study entitled "Nurses' Knowledge and Practices Regarding Care of Children Undergoing Vascular Access and its Related Complications" that revealed the majority of the studied nurses had competent practices towards caring for children undergoing VAD. From the researcher's perspective, there is a positive relation between knowledge and practice; the nurses may experience workload and do not have enough time to update their knowledge. Therefore, they are not always competent in practice.

Concerning the relation between nurses' knowledge regarding CVADs acre and their personal characteristics in table (4), the current study shows no significant link between age, gender, marital status, and experience. This finding is in agreement with **Raynak et al., (2020)** in the study entitled " Nurses' knowledge on routine care and maintenance of vascular access devices: A scoping review" who reported that, there was inconsistent relationship between years of experience and nurses' knowledge level regarding vascular access devices. **This agrees with the findings of US & Gurung (2022)** in the study entitled "Knowledge Regarding Management of Patients with Central Venous Access Devices among ICU Nurses" that shows no association of knowledge with selected socio demographic variables including educational qualifications, area of work, professional experience, monthly income and in-service education.

In the same context of correlation between the subjects' qualifications and training and their knowledge in caring for central venous devices in the pediatric intensive care unit in table (4). This study revealed that there is a significant relationship between the subjects' qualifications and training and their knowledge in caring for central venous devices in the pediatric intensive care unit. This finding is matching with the findings of **Turkan et al., (2021)** in the study titled "Determination of the Knowledge Levels of Nurses Regarding Central Venous Catheter Care" that found the positive relationship between the knowledge level and education about CVC care in pediatric nurses. In contrast, this findings disagree with **Abd El-fadel et al., (2019)** in the study titled "Nurses' Knowledge and Practices Regarding Care of Children Undergoing Vascular Access and its Related Complications" that revealed there was no a statistical significant difference as regards their age, gender, qualification, years of experience and training courses related to VAD. From the researcher's point of view, it is supposed that high degree levels of education and continuous training course is associated with high levels of practice.

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As regards the relation between the demographic data of the studied subjects and their total practice in table (5). The present study showed that there is no statistically significant relationship between age, gender, marital status, experience, and training acquisitions. On the other hand, there is a statistical significant relationship between the qualifications of the studied participants and their practices regarding the care of central venous devices in the pediatric intensive care unit. This finding is supported by the study of **Moustafa et al., (2024),** entitled "Assessment of Nurses' Knowledge And Practices Regarding The Maintenance, Care, And Prevention of Central Venous Catheter-Related Infection in Adult Intensive Care Units in A Military Hospital" that signified there were high significant relation between total level of practice and education and years of experience (P <0.001) but, no significant relation was between level of practice and each of age, sex, residence, and training course (P>0.05). On the other hand, the finding is not supported by the findings of **Khadrawi (2019)** in the study titled "Assessment of nurses' knowledge and practice related to caring of central venous line at Aldamam hospital" who showed that no significant statistical differences in nurses' practices and years of experience. From the researcher's perspective, the bachelor degree nurses have a higher level of practice than other nurses. Also, their knowledge is usually higher.

Concerning the relation between total knowledge and total practice of the studied subjects as showed in table (6), the study findings shows that there is a highly significant and positive correlation between the total knowledge and practice of the studied participants in the pediatric intensive care unit regarding central venous access care. This finding agrees with the findings of **Moustafa et al., (2024)** in the study entitled "Assessment of Nurses' Knowledge And Practices Regarding The Maintenance, Care, And Prevention Of Central Venous Catheter-Related Infection In Adult Intensive Care Units In A Military Hospital" that showed a significant positive correlation between total mean score of knowledge and practice about central venous catheter insertion.

Moreover, Manurung and Dewi (2022) in their study titled "How is the practice of nurses in preventing infection of central venous catheter in hospitalized patients?: Nurse knowledge and attitudes" found that there is significant relationship between the level of knowledge and practice of nurses in preventing wound infections in patients with central venous catheters in hospitals. In contrast, the study done by **Zakaria et al., (2022),** titled "Oncology Nurses' Knowledge and Practices regarding Safe Administration of Intravenous Chemotherapy" that showed no statistical significant differences were found between nurses' practice mean scores and their knowledge levels. From the researcher's point of view, it is evident that knowledgeable nurses about CVC care usually show good performance in caring of children with CVC because the knowledge usually enhances evidence-based practice.

Conclusion

Based on the current study results, it was concluded that more than half of the studied nurses have an unsatisfactory level of knowledge and more than half of the studied nurses are incompetent in practice. The studied nurses' characteristics such as attending training course and their qualifications had significant difference with total level of knowledge while there was no significant difference between age, gender, marital status and experience and total level of knowledge. There was a statistically significant difference between studied nurses' qualifications and their practices.

Recommendations:

Based on the result findings of the study, the following recommendations were suggested:

- In- service education programs for pediatric nurses concerning care of children with CVADs using updated manual procedure.
- Periodic assessment of nurses' performance proper guidelines of central line care.
- Development of evidence-based guidelines and protocols for CVAD care should be considered.
- Replication of the same study on a larger sample of PICU nurses in different geographical areas for evidence of the results and generalization.

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