ESI Preprints **Not Peer-reviewed**

The Effect of the Teaching Program on Nurses' Practices Regarding the Implementation of Patient Care and Safety Measures during Central Venous Pressure Measurement in the Critical Care Units in Syria

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Doi: 10.19044/esipreprint.9.2023.p158

Approved: 03 September 2023
Posted: 06 September 2023

Cite As:
Jaish Y.A.A. (2023). *The Effect of the Teaching Program on Nurses' Practices Regarding the Implementation of Patient Care and Safety Measures during Central Venous Pressure Measurement in the Critical Care Units in Syria.* ESI Preprints.
https://doi.org/10.19044/esipreprint.9.2023.p158

Abstract

The intensive care unit (ICU) is a specialized area of hospitals dealing with the diagnosis, management, and follow-up of critically ill or critically injured patients. Moreover, Critical Care Nurses (CCNs) should have strong analytical, interpersonal, and decision-making skills. Also, they need to continuously improve their knowledge, skills, and safe practice to deliver safe and effective care to their patients. Objectives: This study aimed to assess the effect of the teaching program on CCNs' performance during the measurement of central venous pressure (CVP). Design: The quasi-experimental design was used in this study. Methods: The study was conducted from June to September 2020. This study was conducted to assess the effect of the teaching program on nurses' performance during CVP measurement in the critical care units at Al-Assad University Hospital, Damascus. All available registered nurses (48 nurses) working in the previous ICUs during the data collection period were included in this study. An observational checklist sheet was developed by the researcher after reviewing the related literature. The duration of data collection was about three months, and each nurse was observed once for each procedure during different shifts. The researcher developed and designed the teaching

program based on the nurses' needs according to their performance during the initial assessment. This program continued for two weeks, consisting of four phases, containing workshop practices (8 hours) per day and an educational pamphlet handout. The workshop practice consists of lectures, group discussions, and training scenarios. Every nurse must attend the training sessions daily, for at least one hour. Results: The results showed that the level of knowledge and practice of the studied nurses in CVP measurement was average and poor before the teaching program and the nurse's level improved after the program. There was a variation of improvement regarding the nurses' age, qualifications, and experience. The best performance was for nurses in the age group between 20-24 years, nurses with a master's degree, and nurses with less than five years of experience. Overall, this study found a statistically significant relationship before and after the implementation of the educational program ($p<0.001$). Conclusion: There has been an obvious improvement in nurses' knowledge and performance after the teaching program about age, qualifications, and experience in all selective procedures. It is essential to help nurses to expand their knowledge and practices to provide high-quality care and promote patient safety.

Keywords: Intensive Care Unit, Patient, Care, Safety

Background

The measurement of central venous pressure (CVP) has become an indispensable tool for the management of seriously ill or injured patients. The information gained from measuring CVP is helpful in several clinical contexts, especially when bind with other assessments including blood pressure, pulse, and urine output (Roger, Muller et al. 2017, Bano, Qadeer et al. 2018).

Today, CVP measurement is a nursing responsibility. Therefore, critical care nurses should be able to measure the CVP competently and identify the factors affecting its readings (Hill and Smith 2021).

CVP monitoring is considered one of the significant components of invasive hemodynamic monitoring. It refers to the measurement of the right atrial pressure or the pressure of the great veins within the thorax. It is used to monitor the right ventricular function (Patel 2021).

The accuracy of CVP measurement may be affected by technical factors such as using of incorrect techniques, which may introduce errors in pressure measurement and lead to therapeutic mismanagement of critically ill patients. The best way to deal with these errors is to understand how they can happen and thereby, minimize this risk through knowledge and careful attention to technique (O'Dwyer 2011).

Identifying the physiological factors affecting CVP may help the critical care nurse in interpreting CVP readings. The following are among the physiological factors: venous blood volume and venous compliance which are the main determinants of venous pressure.

The position of the body is among the factors affecting blood distribution, venous return, and CVP. Literature mentioned that CVP can be measured correctly at a backrest position up to 45 degrees. A review of clinical studies indicates that backrest elevation up to 60 degrees don't affect the measurement of intracardiac pressure or cardiac output (Hill 2018, Lesmana, Ose et al. 2019, Kolikof, Peterson et al. 2020, Hill and Smith 2021).

Intensive care nurses face the challenge of caring not only for critically ill patients but also for complex machinery. To improve the delivery of care to the patients, an understanding of the machines and their effects is essential and increases the nurses' confidence and allows them to focus on the patients and associated problems while maintaining safe and informed care (Sannino and Pisani 2018).

A nursing role for monitoring (CVP):

Hemodynamic monitoring is now considered to be essential in the management of critically ill patients. Highly sophisticated monitoring equipment has been developed which provides precise measurement of hemodynamic parameters. The critical care nurse needs to have an understanding of the functions, benefits, and potential complications of hemodynamic monitoring; as pneumothorax, bleeding, sepsis emboli, and technological advances continue at an ever-increasing rate, nurses must also continue to develop their understanding of the complex data that are subsequently generated (Li, Wang et al. 2017, Bano, Qadeer et al. 2018, Hill and Smith 2021).

The close monitoring and observation of critically ill patients is an essential feature of the role of the nurses working in intensive care units. CVP measurement is a nursing responsibility. Therefore, the critical care nurse needs to be technically and clinically competent in the CVP measurement (Endla, Kabdal et al. 2017, Hill and Smith 2021).

Before the CVP measurement, the nurse should assess and observe for signs and symptoms indicating the need for CVP measurement including low or labile blood pressure, widely diverse intake and output, and fluid administration at a rapid rate. In addition, she should identify the client who potential for fluid imbalance and assess the signs and symptoms of fluid volume excess or deficit and require CVP measurement to correlate the patient's clinical picture with the CVP value (Magder 2007, Von Rueden 2020).

Moreover, critical care nurses should assess all factors that could affect the CVP reading including the patient's diagnosis, hydration status, administered medications, and obesity. In addition, the nurse should prepare herself and wash her hands before measuring the CVP, and explain the procedure to the patient to promote understanding and reduce anxiety; also, she should prepare the needed equipment for CVP measurement and put the patient in the supine position (O'Dwyer 2011, Bano, Qadeer et al. 2018, Hill 2018).

During the procedure, the critical care nurse should place the zero level of the water manometer at the level of the hemostatic axis, and then turn the water manometer stopcock open to the intravenous fluids to permit fluid to fill the water manometer, after that she should open the intravenous (IV) tubing roller clamp so that fluid flows from the IV fluid bag into the water manometer and the critical care nurse should fill the manometer above the level of the expected CVP reading and should understand that if the fluid is allowed to overflow the top of the manometer, contamination can result and under-filling the water manometer will result in an inaccurate CVP measurement and ensure that there are no air bubbles in the manometer.

Then allow the IV fluid to drip rapidly into a client for several seconds, with the stopcock closed to the manometer to assure the patency of the CVP line and should consider that if the fluid does not flow freely, the CVP reading will be inaccurate (Al-Metyazidy and Younis , O'Dwyer 2011, Urden, Stacy et al. 2013, Aloush 2018, Bano, Qadeer et al. 2018, Hill 2018, Hill and Smith 2021).

Then the water manometer stopcock should be opened to the patient and closed to the IV solution to allow fluid to flow into the patient until the fluid column equalizes with the pressure in the right atrium. The fluid column should be observed closely because if the manometer is allowed to empty, air may enter the patient. Take the reading when the fluid level stabilizes at the end of expiration. After that raise the manometer above the patient to allow the IV fluid to infuse into the patient. Finally, turn the manometer stopcock off to the manometer to allow intravenous fluid infusion (Ahmed, Eltayeb et al. 2016, Huang, Tsao et al. 2021).

After CVP measurement, the critical care nurse should regulate the IV fluid rate, record in the nurse's notes or on the flow sheet the CVP reading, the central line access site, report any abnormal values to the physician, and treatment modalities initiated for abnormal value and return the manometer to the bedside intravenous pole, and wash hands (Promnoi 2012, Endla, Kabdal et al. 2017, Atia 2020).

Normal CVP values vary between individuals but are usually between 5 and 12 CmH2O and the readings are influenced by myocardial contractility, vascular tone, and intrathoracic pressure; if the patient is ventilated, the CVP

will be increased (Sathish, Singh et al. 2016, Mansour 2019, Ahmed, Esmat et al. 2021).

Significant of the Study

Critically ill patients admitted to an ICU experience, on average, 1.7 medical errors each day, and many patients suffer a potentially life-threatening error during their stay (Camiré Moyen et al., 2009; Gracia Serrano et al., 2019).

Nurses and all other health care professionals sometimes make mistakes in providing their care services regardless of their level of expertise, knowledge, and precision. Nursing errors can occur at any point in time during nursing activities and procedures, and the outcomes may be subtle or severe (Peyrovi, Nikbakht Nasrabadi et al., 2016).

Like other parts of the world, there are negative patient health and healthcare outcomes in Syria. Therefore, special attention should be paid to the clinical skills and knowledge of nurses working in ICUs (Rezaee Ghaljeh et al., 2020). Therefore, this study was conducted to assess the effect of an educational program on nurses' practices regarding the implementation of patient care and safety measures in the intensive care units in Syria.

Methods

The quasi-experimental design was used in this study (non-random sample and doesn't have control) to determine the relationship and the effect of the teaching program on the improvement of nurses' performance during nursing interventions. This study was conducted to assess the effect of the teaching program on nurses' performance during endotracheal suctioning in the intensive care units at Al-Assad University Hospital, Damascus. All available registered nurses (48 nurses) working in the intensive care units during the data collection period were included in this study.

Ethical Considerations

- Official permission was granted from the Al-Assad University Hospital, Damascus after explaining the study aim to the manager and head of the intensive care unit.
- The observational checklist sheet was developed by the researcher after reviewing the related literature.
- Nurses' characteristics were recorded once at the beginning of the data collection.
- Each nurse was observed once for each procedure during different shifts.
- The duration of data collection was about three months.

- The survey formats were distributed via the investigator himself with a cover letter indicating the purpose of the study, confidentiality procedures, and hospital review approval.
- Nurses were assured that there will be no harm, risk, or discomfort caused by their participation.

Tools

The tool used in this study was developed by the researcher, and it is divided into two parts: (1) Demographic data of the studied nurses (Table 1), and (2) The observational checklist (Table 2) to observe the nurses' performance regarding the implementation of patient care and safety measures during endotracheal suctioning procedure. Thus, it was developed by the researcher based on an extensive review of the literature (Roberts, 2017; Jones & Fix, 2019; Nunnery, 2019; Smith, 2019; Wilkinson Treas et al., 2019). The tool was translated into the Arabic Language. A pilot study was conducted on 5 nurses to test the tool. Appropriate modifications were performed such as changing some words into Arabic versions.

The safety measures observational checklist was tested for its reliability by using interrater reliability, whereas three experts in the critical care nursing field assessed the tool for its applicability. The reliability coefficients were:

(r) = 0.96 for the safety measures observational checklist.

Cronbach's alpha coefficient is 0.84

Data Collection

Data collection was conducted from June 2020 to September 2020. The data collection went through four stages: (1) *Assessment:* Every nurse was observed once for each procedure at the beginning of data collection to determine the nurses' weaknesses, (2) *Planning*: The teaching program was developed based on the nurses' needs, (3) *Intervention*: Implementing the program through the PowerPoint presentations and training sessions, (4) *Reassessment*: Reassess the nurses' performance after implementing the teaching program.

Statistical Analysis

The data were analyzed using the Statistical Package for Social Science (SPSS version 20.0). Qualitative data were described using numbers and percentages (Armonk, NY: IBM Corp). The Kolmogorov-Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, and standard deviation. The significance of the obtained results was judged at the 5% level.

Educational Program

The program was already designed in the Arabic language. The program is aimed at improving the nurses' knowledge and practices as is related to the measurement of CVP by teaching them the updated knowledge PowerPoint presentations. Also, it allows them to improve their performance through training sessions on manikins.

The program is to run for two weeks, and every nurse must attend the training sessions daily for one hour at least each day. It consists of 8 hours of workshops per day to deliver the PowerPoint presentations and the training sessions.

The program was created and developed through four phases. During the first phase, the researcher assessed the nurses' performance by using the designed and developed CVP measurement checklist. During the second phase, the researcher developed and implemented the teaching program based on the nurses' needs according to their performance during the initial assessment. For the third phase, the researcher delivered the program through power point presentations, demonstrations, and training sessions to provide the nurses with related knowledge and to improve nurses' performance. Finally, for the fourth phase, the researcher reassessed the nurses' performance after the program to determine the nurses' improvement.

Results

The total number of studied nurses was 48, with a mean age of 28 years.

About age, 17 nurses (more than 35%) of the studied nurses were from the 25-29 age group, while there was an equal number of nurses from both age groups from 20-24 and 30-35 (14 nurses for each) (29.2%). 3 nurses were more than 35 years (6.3 %).

Regarding the qualifications, the majority of the studied nurses, 38 nurses (about 80%) have a diploma degree, 7 nurses (about 15%) have a bachelor's degree, and 3 nurses (about 6%) have a master's degree.

Regarding the years of experience, 23 nurses (47.9%) have less than 5 years of experience, 17 nurses (35.4%) have between five to ten years of experience, and 8 nurses (16.7 %) have more than 10 years of experience. The mean of nurses' experience was 6 years (Table 1).

Table (1). The characteristics of the studied nurses

Demographic data	No.	%
Age of the nurse		
20 – 24	14	29.2
25 – 29	17	35.4
30 – 35	14	29.2
Above 35	3	6.3
Mean ± SD.	28.02 ± 5.51	

Qualification of the nurse		
Diploma	38	79.2
Bachelor	7	14.6
Master	3	6.3
Experience of the nurse in the ICU		
Less than 5 years	23	47.9
5- 10 years	17	35.4
More than 10 years	8	16.7
Mean ± SD.	6.27 ± 4.53	

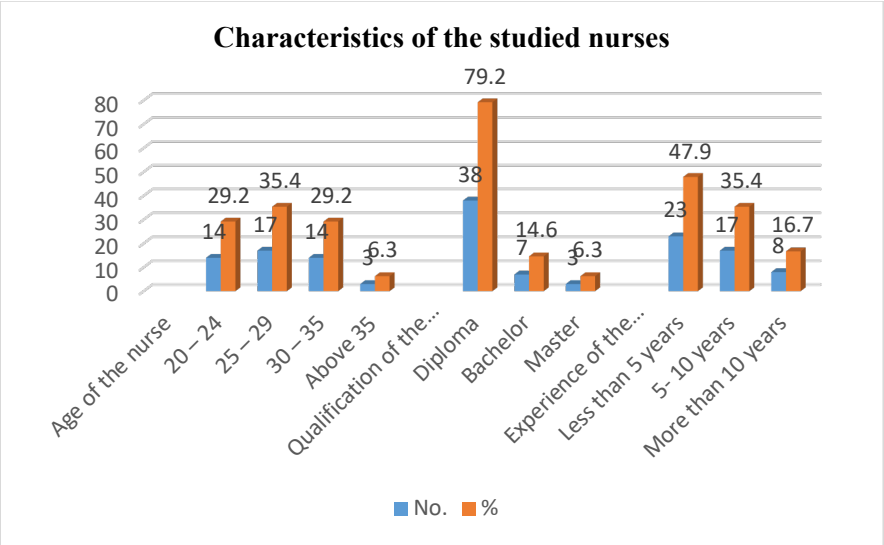


Table (2). Shows the description and implementation of patient care and safety measures of the studied nurses according to the measurement of central venous pressure steps before and after the educational program.

The result shows that the nurses disregarded and didn't implement most of the steps given in this procedure in the correct way before the educational program. The total steps of this procedure were twenty-one with a total score of 84. The nurses didn't implement seven steps correctly at all, while the percentage of the nurses that performed the other fourteen steps correctly ranged from (4.2-100%). Anyway, there were variations and very good improvement in nursing performance after the educational program in all steps, the percentage of nurses that perform the steps correctly ranged from (20.8- 100%). In addition, the nurses' scores were from (42-77) with a mean of (53.92 ± 9.31) before the program to (57-84) with a mean of (75.44 ± 6.93) after the program.

Table (2). The description and implementation of patient care and safety measures of the studied nurses according to the measurement of central venous pressure steps before and after the educational program.

Central Venous Pressure CVP	Frequency (N= 48)														
	Before an educational program								After an educational progra						
	Not done		Done incorrectly		Need more practice		Done correctly		Not done		Done incorrectly		Need more practice		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Assess the patient's respiratory and cardiac status	16	33.3	25	52.1	7	14.6	0	0.0	0	0.0	8	16.7	30	62.5	
Assess the patient's need for measurement	12	25.0	24	50.0	12	25.0	0	0.0	0	0.0	1	2.1	23	47.9	
Prepare all necessary equipment and supplies	0	0.0	25	52.1	16	33.3	7	14.6	0	0.0	0	0.0	10	20.8	
Wash hands	16	33.3	22	45.8	10	20.8	0	0.0	0	0.0	6	12.5	18	37.5	
Wear gloves	13	27.1	12	25.0	20	41.7	3	6.3	2	4.2	1	2.1	13	27.1	
Explain the procedure	16	33.3	23	47.9	9	18.8	0	0.0	0	0.0	6	12.5	16	33.3	
Maintain privacy	18	37.5	24	50.0	6	12.5	0	0.0	0	0.0	5	10.4	27	56.3	
Begin the IV infusion	0	0.0	0	0.0	0	0.0	48	100	0	0.0	0	0.0	0	0.0	
Check the patency of the catheter by flush back	19	39.6	21	43.8	6	12.5	2	4.2	0	0.0	3	6.3	22	45.8	
If there is no flush back check the catheter for clot formation	7	14.6	14	29.2	25	52.1	2	4.2	0	0.0	0	0.0	14	29.2	
If the catheter is patent, close the stopcock in the direction of the patient	0	0.0	0	0.0	5	10.4	43	89.6	0	0.0	0	0.0	2	4.2	
Allow the solution to pass via the manometer line	0	0.0	0	0.0	0	0.0	48	100	0	0.0	0	0.0	0	0.0	
Positioning the patient	0	0.0	12	25.0	28	58.3	8	16.7	0	0.0	0	0.0	8	16.7	
Put the manometer at the fifth intercostal space mid-axillary line of the patient	0	0.0	25	52.1	20	41.7	3	6.3	0	0.0	2	4.2	21	43.8	
Take the CVP reading when fluid stops fluctuating	0	0.0	24	50.0	16	33.3	8	16.7	0	0.0	1	2.1	28	58.3	
Begin an I.V solution such as normal saline	0	0.0	5	10.4	15	31.3	28	58.3	0	0.0	0	0.0	0	0.0	
Return the patient in comfort position	8	16.7	18	37.5	21	43.8	1	2.1	0	0.0	4	8.3	23	47.9	
Return the equipment	0	0.0	26	54.2	22	45.8	48	100.0	0	0.0	0	0.0	13	27.1	
Remove gloves	13	27.1	12	25.0	20	41.7	3	6.3	2	4.2	1	2.1	13	27.1	
Wash hands	5	10.4	20	41.7	23	47.9	0	0.0	0	0.0	5	10.4	23	47.9	
Documentation	5	10.4	18	37.5	19	39.6	0	0.0	0	0.0	0	0.0	9	18.8	
The total score of Central Venous Pressure (21–84) **Min. – Max.** **Mean ± SD**	41.77 – 77 53.92 ± 9.31								57.0 – 84.0 75.44 ± 6.93						
t (p)	**47.844*(<0.001*)**														

t: Paired t-test

p: p-value for comparing between **Before** and **After** *: Statistically significant at $p \leq 0.05$

The Implementation of Patient Care and Safety Measures Regarding Nurses' Age

In regards to the nurses' age, the result shows that the scores of the nurses in the age group between 20-24 varied from 52-61 out of 84 before the program to 77-79 after the program. Regarding nurses in the 25-29 age group, the scores varied from 41-77 out of 84 before the program to 71-84 after the program. The best performance was for nurses with age groups ranging from 20-24 and 25-29.

Regarding nurses in the 30-35 age group, the scores varied from 41-65 out of 84 before the program to 61-84 after the program.

Regarding nurses with more than 35 years, the scores varied from 41-42 out of 84 before the program to 57-59 after the program. Overall, the results showed that a statistically significant difference was found before and after implementing the program regarding the age of the nurses (P<0.001) (Table 3).

In the same context, the results before the educational program showed that the nurses in the age group between 20-24 got the highest minimum score of 52 out of 84. In addition, the nurses in the age group between 25-29 got the highest maximum score of 77, while the nurses more than 35 years old got the least maximum score of 42. Moreover, variations were found in the improvement of the nurses' scores after the educational program in all age groups. The highest minimum score of 77 was for the nurses in the 20-24 age group, and the highest maximum score of 84 was for the nurses in the 25-29 age group. Consequently, the least minimum and maximum scores (57-59) were for the nurses with more than 35 years respectively. Overall, this study found a statistically significant relationship between this procedure in regards to nurses' age before and after the implementation of the educational program (p<0.001) (Table 3).

Table (3) The description and relationship between nurses' age groups and implementation of patient care and safety measures for CVP measurement of the studied nurses (n = 48)

	Total score	**Age of the nurse**				**p**
		20 – 24 (n=14)	**25 – 29 (n=17)**	**30 – 35 (n=14)**	**Above 35 (n=3)**	
CVP measurement	**Before program**					
	Min. – Max.	52.0 – 61.0	41.0 –77.0	41.0 – 65.0	41.0 – 42.0	0.026*
	Mean ± SD.	57.29 ± 2.23	55.59 ± 11.59	51.14 ± 9.19	41.67 ± 0.58	
	After program					
	Min. – Max.	77.0–79.0	71.0–84.0	60.0–84.0	57.0–59.0	<0.001*
	Mean ± SD.	78.64 ± 0.63	77.47 ± 4.45	73.50 ± 7.62	58.0 ± 1.0	

F: F for the ANOVA test p: p-value for comparing between **the different studied categories** *: Statistically significant at p ≤ 0.05

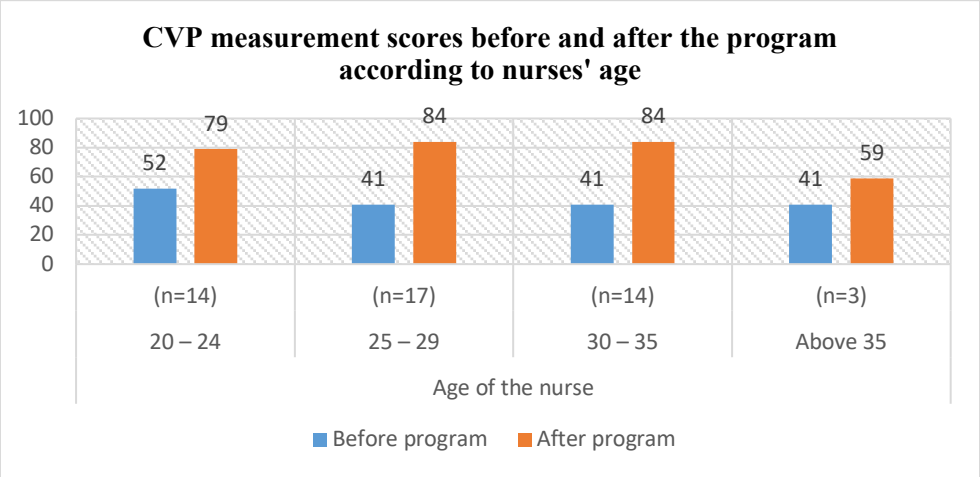
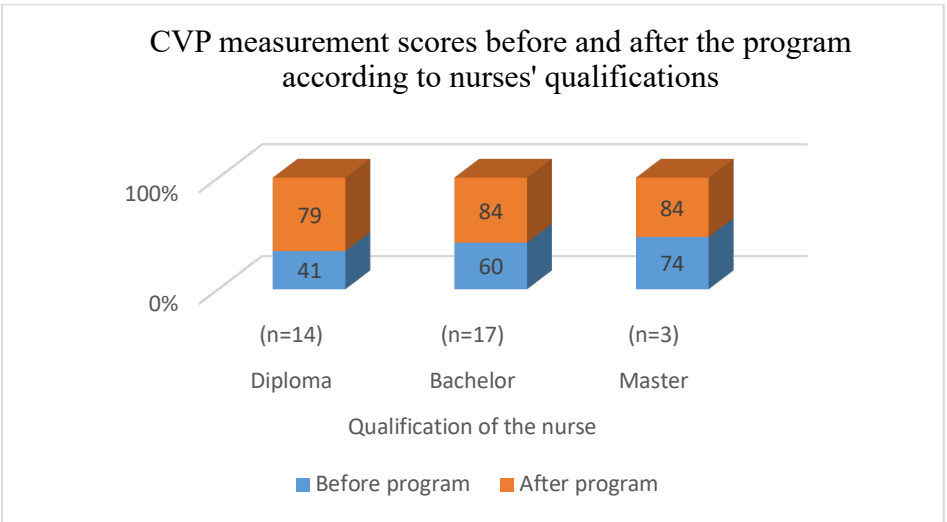


Table 4. The relationship between nurses' qualifications and implementation of patient care and safety measures for central venous pressure measurement of the studied nurses (n = 48)

	Total score	Qualification of the nurse			P
		Diploma (n=14)	Bachelor (n=17)	Master (n=3)	
Central Venous Pressure CVP	**Before program**				
	Min. – Max.	41.0 – 61.0	60.0 – 68.0	74.0 – 77.0	<0.001*
	Mean ± SD.	50.47 ± 6.50	63.43 ± 2.88	75.33 ± 1.53	
	After program				
	Min. – Max.	57.0 – 79.0	80.0 – 84.0	84.0 – 84.0	<0.001*
	Mean ± SD.	73.53 ± 6.52	82.14 ± 1.35	84.0 ± 0.0	

p: p-value for comparing between **the different studied categories** *: Statistically significant at $p \leq 0.05$



The Implementation of Patient Care and Safety Measures Regarding Nurses' Qualifications

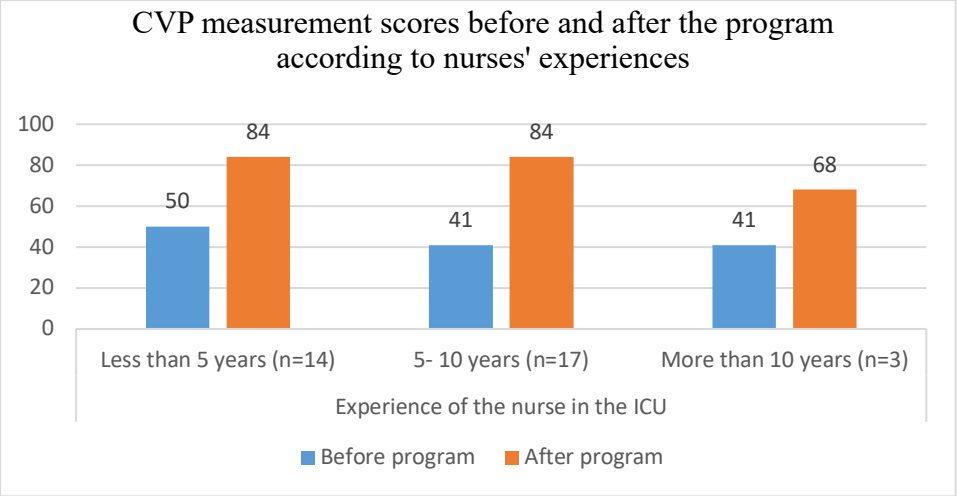
The results above showed that the scores of nurses with a diploma degree before the program varied from 41-61 out of 84 with a mean and standard deviation of 50.47 ± 6.50, while the nurses' scores after the program varied from 57-79 with a mean and standard deviation of 73.53 ± 6.52.
The scores of nurses with a bachelor's degree before the program ranged from 60-68 with a mean and standard deviation of 63.43 ± 2.88 into 80-84 with a mean and standard deviation of 82.14 ± 1.35 after the program.
The scores of nurses with a master's degree before the program ranged from 74-77 with a mean and standard deviation of 75.33 ± 1.53 into 84-84 with a mean and standard deviation of 84.0 ± 0.0 after the program. Overall, the results show a statistically significant relationship was found after implementing the program (P<0.001) (Table 4).

In the same context, the results before the educational program showed that the nurses with a master's degree were the best and got the highest minimum and maximum scores (77,84) respectively, while the nurses with a diploma were the worst and got the least minimum and maximum scores (41,57) respectively. However, we found an improvement in the nurses' scores after the educational program regarding to the different qualifications. The best performance was for the nurses with a master's degree as they got the highest scores (84), while the worst performance was for the nurses with a diploma as they got the least scores (79). Overall, this study found a statistically significant relationship in all steps of this procedure before and after the implementation of the educational program (p<0.001) (Table 4).

Table 5. The relationship between nurses' experience and implementation of patient care and safety measures during central venous pressure measurement of the studied nurses (n = 48)

	Total score	Experience of the nurse in the ICU			P
		Less than 5 years (n=14)	5- 10 years (n=17)	More than 10 years (n=3)	
Central Venous Pressure CVP	**Before program**				
	Min. – Max.	50.0 – 77.0	41.0 – 65.0	41.0 – 44.0	<0.001*
	Mean ± SD.	59.61 ± 7.37	51.71 ± 7.74	42.25 ± 1.04	
	After program				
	Min. – Max.	77.0 – 84.0	69.0 – 84.0	57.0 – 68.0	<0.001*
	Mean ± SD.	79.52 ± 2.15	79.52 ± 2.15	79.52 ± 2.15	

p: p-value for comparing between **the different studied categories** *: Statistically significant at p ≤ 0.05



The Implementation of Patient Care and Safety Measures regarding the Nurses' Experiences

The results above showed that the scores of nurses with less than five years of experience before the program varied from 50-77 out of 84, with a mean and standard deviation of 59.61 ± 7.37 to 77-84, with a mean and standard deviation of 79.52 ± 2.15 after the program.

The scores of nurses with five to ten years of experience before the program ranged from 41-65 with a mean and standard deviation of 51.71 ± 7.74 to 69-84, with a mean and standard deviation of 79.52 ± 2.15 after the program.

The scores of nurses with more than ten years of experience before the program ranged from 41-44 with a mean and standard deviation of 42.25 ± 1.04 to 57-68, with a mean and standard deviation of 79.52 ± 2.15 after the program. Overall, the results show a statistically significant relationship was found before and after implementing the program ($P<0.001$) (Table 5).

In the same context, the results before the educational program showed that the best performance was for the nurses with less than five years of experience as they got the highest minimum and maximum scores (50,77) respectively, while the worst performance was for the nurses with more than ten years of experience as they got the least minimum and maximum scores (41, 44) respectively. However, we found variations in nurses' improvement after the educational program regarding all groups of nurses' experience: the nurses with less than five years of experience were the best and got the highest scores (77,84), while the nurses with more than ten years of experience were the worst and got the least scores (57,68). Overall, this study found a statistically significant relationship in all steps of this procedure before and after the implementation of the educational program ($p<0.001$) (Table 5).

Discussion

CVP measurement remains widely used in the ICU, critical care nurses are responsible for central venous pressure measurement, which is considered an essential tool in the management of critically ill patients. CVP monitoring should only be undertaken by healthcare professionals who have good knowledge and skills to do so (Hill 2018, Hill and Smith 2021). The observation of the nurses during CVP measurement in this study revealed that some of the nurses implemented patient care and safety measures, Moreover, the majority of studied nurses neglected to apply some items to ensure the patient's safety. The total steps of this procedure are twenty-one with a total score of 84. 45 nurses (93.8%) of the studied nurses failed (got less than 80%) before the program. There were variations in the nurses' improvement after the program, thirty-seven (77.1%) of the nurses got at least 80% and passed, and the percentage of improvement was 70.8% after the program. The results show a statistically significant relationship in the nurses' performance before and after implementing the program. The overall nurses' performance scores for CVP measurement ranged from (42 -77) out of 84 before the educational program with a mean score of (53.92 ± 9.31), while after the educational program ranged from (57-84) with a mean score of (75.44 ± 6.93) (Table 2). Regarding the nurses' age, the results before the educational program showed that the nurses in the age group between 20-24 got the highest minimum score of 52 out of 84, in addition, the nurses in the age group between 25-29 got the highest maximum score 77, while the nurses with the other three age groups from 25-30, 30-35, and more than 35 got the least minimum scores (41), and the nurses with more than 35 years got the least maximum and minimum scores (42). Moreover, we found an improvement in the nurses' scores after the educational program in all age groups, the highest minimum score (77) was for the nurses in the 20-24 age group, and the highest maximum score (84) was for the nurses with 25-29, and 30-35 age groups, while the least minimum and maximum scores were for the nurses above 35 years (57-59) respectively. Overall, this study found a statistically significant relationship in all steps of this procedure before and after the implementation of the educational program ($p<0.001$).

Regarding the nurses' qualifications, the results before the educational program showed that the nurses with a master's degree got the highest minimum and maximum scores (74-77) respectively out of 84, while the nurses with a diploma degree got the least minimum and maximum scores (41-61) respectively. Moreover, we found an improvement in the nurses' scores after the educational program in the different qualifications, the nurses with master's and bachelor's degrees got the highest scores (80-84) respectively, while the least scores were for the nurses with diplomas (57-79). Overall, this

study found a statistically significant relationship in all steps of this procedure before and after the implementation of the educational program ($p<0.001$).

Regarding the nurses' experience, the results before the educational program showed that the nurses with less than 5 years of experience got the highest maximum and minimum scores (50-77) respectively out of 84, while the nurses with 5-10 years and the nurses with more than 10 years of experience got the least minimum scores (41), and the nurses with more than 10 years of experience got the least maximum score (44). Moreover, we found an improvement in the nurses' scores after the educational program in the different years of experience, the highest minimum score (77) was for the nurses with less than 5 years of experience, and the highest maximum score (84) was for the nurses with less than 5 years of experience and nurses with 5-10 years of experience, while the least scores (57-68) were for the nurses with more than 10 years of experience. Overall, this study found a statistically significant relationship in all steps of this procedure before and after the implementation of the educational program ($p<0.001$).

These findings are different from (Magder 2005) who reported that the clinical application of central venous pressure measurements, demonstrated that the practice of the nursing staff for CVP measurement was very high. In addition, the results of the current study are different from those (Cox, Johnson, et al. 2005) who report that the results of the studied nurses were high for improving patient safety within the CVP measuring.

These findings are different from (Magder 2006) who reported that his results showed that most nurses have good skills and understanding of CVP measurement techniques.

Our findings are supported by (Hill 2018) who reported that nurses should have good knowledge and practice and should adhere to local policies and procedures for CVP monitoring, as well as infection prevention and control procedures.

Conclusion and recommendations

In conclusion, this study assessed the effect of the teaching program on nurses' performance during endotracheal suctioning in the critical care units in Syria. Our findings highlighted that there was a lack and scarcity of nurses' knowledge, and also in performance as regards the endotracheal suctioning procedure in this study. The nurses were upset because they didn't follow the protocol due to a lack of training programs, too many patients, not enough time, and many other reasons. After receiving the program, the nurses were satisfied with their performance, and with receiving the new guide and protocol. There were actual and variations of improvement in nurses' knowledge and performance regarding nurses' age, qualifications, and years of experience after receiving the program. It was recommended to help these

nurses to improve their knowledge and practices. Furthermore, it is necessary to increase nurses' awareness regarding the quality of care and patient safety. Poor nurses' knowledge and practice reflect a negative impact on the quality of care and patient safety. In addition, nurses with inadequate knowledge and practice do require all the necessary support to undergo educational programs and additional training to improve their performances to reach the optimal quality of care and patient safety (RN Thompson et al., 2007; Sharma, Sarin et al., 2014; Ahmed, 2019).

In regards to nurses' qualifications, the best performance for providing a high quality of care was for nurses with master's degrees, then nurses with bachelor's, and finally nurses with a diploma. Regarding the nurses 'age, the findings showed that the nurses with age groups 20-24 and 25-29 were the best, while the nurses more than 35 years old were the worst. In the same context, the findings of the present study showed that the best nurses' performance was for nurses with less than five years of experience, followed by nurses with five to ten years of experience, and finally, nurses with more than ten years of experience were the worst.

Nursing staff should focus on participating in and attending educational and training programs to improve their knowledge and performance regarding all the necessary skills and procedures needed in the intensive care units. This is aimed at providing high-quality care for critically ill patients and also improving patient safety. By improving these methods and giving much more educational and training support, the quality of care and safety can be improved (Ahmed, 2019; Bayatmanesh Zagheri Tafreshi et al., 2019).

On the other hand, there was a lack of written policies and procedures, a lack of staff training, a lack of providing leadership for patient safety initiatives, a lack of improving reporting systems, and a lack of resources, knowledge, and practices of the nursing staff (Ahmed, 2019).

Based on the findings of the present study, the following recommendations are suggested:

- Health care organizations must develop teaching and training programs for their staff to provide a high quality of care, promote patient safety and make them up to date.
- The nursing procedures should be done by experienced and qualified nurses to provide high-quality patient care and promote patient safety and minimize the occurrence of hazards.
- Regular updates about the implementation of safety and prevention hazards should be provided for all critical care nurses.
- The nurse must document any serious complications that might occur.
- Developing policies and procedures related to practices and infection control practices in the intensive care unit.

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