Effect of Educational Guidelines on Nurses' Knowledge and Practice Regarding Central Line Associated Blood Stream Infection at Intensive Care Unit

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Abstract:

Background: Central line associated blood stream infections are serious but can often be prevented when evidence-based guidelines that are used by critical care nurse through utilized infection control measures during insertion and maintenance of central lines. **Aim of the study** was to evaluate the effect of educational guidelines on nurse's knowledge and practice regarding central line associated blood stream infection at intensive care unit. **Subjects and Method: Research design:** The present study utilized a quasi- experimental research design. **Setting:** The study was conducted at: Anesthesia Intensive Care Unit and Medical Intensive Care Unit of Emergency Hospital affiliated to Tanta Main University Hospital. Neurological Intensive Care Unit of Tanta Main University Hospital. **The study subjects:** All nurses (100) who are providing care for patients with central venous catheters and were having at least one year of experience. **Tools:** Two tools were used to collect the data; structured interviewing sheet and an observational checklist for nurses' practice. **Results:** The main results revealed that there was significant statistical improvement in the total knowledge and practice level among the studied nurses post nursing educational guidelines. **Conclusion:** the implementation of nursing educational guidelines has a positive impact not only in improving nurses' knowledge and practice regarding central line care but also, decrease rate of central line associated blood stream infection**. Recommendation:** it was recommended that nurses should attend in-service training programs for improving their knowledge and enhancing their practice.

Key words: Central Line Associated Blood Stream Infection, Educational Guidelines, Knowledge, Practice.

Introduction

Central lines (CLs) have a multitude of complications that are associated with their placement. Health care associated infection particularly central line associated blood stream infection (CLABSI), contribute to the greatest threat to patient safety in critical care units which lead to increase mortality and morbidity rate. These complications can cause a significant healthcare burden in cost and patient quality of life. Recognition and management of central line complications are important when caring for patients with vascular access, but prevention is the ultimate goal [1, 2].

The central line associated blood stream infection has been defined by the Centers for Disease Control and Prevention (CDC) as a laboratory-confirmed primary bloodstream infection in patients who had a CL for at least 48 hours, which is not related to an infection at another site. The use of CLs is common for critical ill patients. However, CLABSI is caused by microorganisms that colonize the external surface of the device or the fluid pathway when the device is inserted, as well as an infection that occurs over the course of use [3, 4]. CLABSIs are serious but can often be prevented when evidence-based guidelines that are used by critical care nurse through utilized infection control measures during insertion and maintenance of CLs [5].

Following such guidelines which include optimal site selection that avoid femoral vein in adult patients and use of subclavian rather than jugular veins, the use of maximal sterile barrier precautions during catheter insertion, alcohol-based chlorhexidine 2% skin preparation and maximum barrier precautions [6].

Additionally, maintenance guidelines consist of daily review of central line necessity, prompt removal of unnecessary lines, clean the hands with an alcohol-based hand rub solution before any manipulation of the infusion line, disinfect catheter hubs, ports, connectors before using central venous catheter (CVC) and removing any useless catheters [9, 10]. Also, change dressings and disinfect site with alcohol-based chlorhexidine every 48hours and replace administration sets within 24 hours can considerably reduce the risk of infection and mortality in patients [11].

The nurse play a major role in providing care to the patients in all phases of central line insertion to control the infection which can help for decreasing the risk of central venous catheter related blood stream infection [12]. They assist in CL insertion as they select the optimal site for insertion with avoidance of femoral veins in adult

patients. The critical care nurse should maintain aseptic techniques, use maximal protective barrier precautions and use chlorhexidinegluconate 2% skin preparation before insertion [13, 14].

After insertion, the role of the nurse not limited to giving intravenous antibiotic prophylaxis but also include care of dressing, withdrawing a venous blood sample, and delivery of drugs. As well, critical care nurses teach the patients and their family about the care of central venous catheters. Therefore, they contribute to the decline of infection. Besides, integrated infection control programs, including supervision of hospital acquired infections have brought to a notable decline in the rate of infections in the intensive care unit (ICU) with resulting lowered health care costs [15-18].

Significant of the study

Critical care nurses have important roles in preventing CLABSI, so they must have the ability to know how to prevent complications associated with CL insertion and provide high quality of care. This is carried out through demonstrated of best practices utilization for assessment and maintenances of CVCs prior, during and at the end of the hospital duration which is the basic principles in preventing many complications related to CVC utilization [19]. A well trained nursing team on assessment and maintenance of CVC and the application of standardized evidence based guidelines are key success factors strongly influencing the incidence of CVC long term complications [20].

So, it is important for improving critical care nurses knowledge and practice which is the key factor in reducing CLABSI through educational guidelines that may result in significant decrease in critically ill patient's morbidity and mortality rate

When staff nurses feel supported from their head nurses to suggest new processes and share their ideas in a supported environment, they will be more

Aim of the Study

Evaluate the effect of educational guidelines on nurse's knowledge and practice regarding central line associated blood stream infection at intensive care unit.

Research hypothesis:

Total level of knowledge and practice mean scores of intensive care unit nurses would be improved post implementation of educational guidelines regarding central line associated blood stream infection.

Subjects and Method

Study design:

The present study utilized a quasi-experimental research design which had been used to evaluate the effect of educational guidelines on nurse's

knowledge and practice regarding central line associated blood stream infection at intensive care unit.

Setting:

The study was conducted at Anesthesia Intensive Care Unit and Medical Intensive Care Unit of Emergency Hospital affiliated to Tanta Main University Hospital. Neurological Intensive Care Unit of Tanta Main University Hospital.

Subject:

All nurses (100) from above mentioned settings who are providing care for patients with central venous catheters and were having at least one year of experience. They were divided as following: 50 nurses from Anesthesia Intensive Care Unit, 30 nurses from Medical Intensive Care Unit and 20 nurses from Neurological Intensive Care Unit.

Tools of data collection

Two tools were used to determine the effect of educational guidelines on nurse's knowledge and practice regarding central line associated blood stream infection, which include the following:-

Tool (I): Structured interviewing:

It was comprised of two parts:

Part A: Socio demographic data of nurses; which included; nurse's code, age, sex, marital status, level of education,

occupation, years of experience and previous training about care of central line.

Part B: Nurse's knowledge assessment sheet:

It was developed by the researcher after reviewing of related literature [21- 24] to

evaluate nurses' knowledge pre, immediate and 2-months later post implementation of educational guidelines regarding central line associated blood stream infection.

Scoring system of knowledge;

Two level of scoring for questions were used as the following:

- Correct and complete answer will be scored (2)

- Correct and incomplete answer will be scored (1)

- Incorrect answer will be scored (0)

The total scoring system of nurses' knowledge was (112) and classified as the following:

-Good →   > 75% of the total score

-Fair   →   ≥ 60% - 75% of the total score

-Poor →   < 60% of the total score

Tool (II): An observational checklist regarding nurses' practice

This tool was developed by the researcher after reviewing relevant literatures [25- 28]to assess nurses' practice pre, during and 2-months post implementation of educational guidelines about reducing CLABSI. It

consisted of (146) subtitles classified under two main parts as the following:

Practice regarding central venous catheter procedure and practice regarding infection control measures.

Scoring System of practice

Two level of scoring for questions were used as the following:

-Done practice takes (1)

-Not done practice takes (0)

The total practices score will be (146) each right answer took one grade. The scoring system calculated (146) and classified as following:

-Satisfactory   →   ≥ 75 % of the total score

-Unsatisfactory   →   ˂ 75 % of the total score

Method

The study was accomplished through the following steps:

1-Administrative process:

a- Official permission from the faculty of nursing was delivered to the appropriate authorities at the two selected units to conduct the study.

b- Permission was obtained from the directors of:

- Anesthesia Intensive Care Unit and Medical Intensive Care Unit of Emergency Hospital affiliated to Tanta Main University Hospital.

- Neurological Intensive Care Unit of Tanta Main University Hospital.

2-Ethical and legal considerations:

a- Nature of the study did not cause any harm or pain to all subjects.

b- An informed consent was taken from every participant patient after complete explanation about the aim of the study.

c- Complete confidentiality and privacy was considered regarding data collection and results. A code number was used rather than names.

d- The nurse was informed the right to withdraw from the study at any time and without any reason.

3-Tools development:

All tools of the study were developed by the researcher to collect the data after extensive review of literature [30, 20, 29, 30, and 31].

4- **Tools of data collection** nurses' knowledge assessment sheet were translated into Arabic language.

5- Validity of Tools:

All tools of the study were reviewed for content validity and clarity by a panel of (5) expertise in the field of Medical Surgical Nursing, critical care nursing, anesthesia, medical and neurological field physicians. Their opinions were elicited regarding tools format and consistency, it was calculated and found to be = (98%).

6- Reliability: The reliability for the study tools was calculated by cronbach's alpha test, it was;

- **Cronbach's Alpha** for **first tool was 0.761** for 64 items applied on 10 nurses.
- **Cronbach's Alpha** for **second tool was 0.802** for 157 items applied on 10 nurses.
- **Cronbach's Alpha** for **the sheet in total was 0.845** for 221 items applied on 10 nurses.

7-A pilot study:

It was conducted on (10) nurses to test the clarity, feasibility and the applicability of the different items of the determent tools to detect any obstacles during the period of data collection. The needed modification was done by the researcher before study according to the experience gained from this pilot study**.**

8-Data collection:

The subjects in pilot study are excluded from the current study. Data collection duration period was 6 months started from first of November 2019 to the end of May in 2020. The present study was conducted through four main phases (Assessment, planning, implementation and evaluation).

Assessment phase: Assessment of the nurse baseline data that was carried out by using the following: **Tool (I) part (A)** was used to collect baseline data of nurses.

Tool (I) part (B) was used to assess nurses' knowledge regarding central line associated blood stream infection. **Regarding tool (II)**, it was used to assess nurses' practice.

Planning phase: it included; preparation of the content of nursing educational guidelines and preparation of the environment.

Implementation Phase: The educational guidelines was conducted in (6) sessions to the nurses who will be divided into (5) groups, each group was contain (8) nurses three days per week and the time of each session was about 30 minutes.

The evaluation phase: Tool (I) part A was used to collect baseline data about nurses. Tool (I) part B and tool II were used to assess knowledge and practice pre, immediately and 2-months later post implementation of educational guidelines regarding CLABSI.

Statistical analysis:

The collected data were organized, tabulated and statistically analyzed using SPSS software statistical computer package version 26. For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison was done using Chi-square test (χ^2). For comparison between means of two variables in a group, paired samples t-test was used. For comparison between

means for variables during three periods of intervention in a group, or for more than two variables, the F-value of analysis of variance (ANOVA) was calculated.

Correlation between variables was evaluated using Pearson and Spearman's correlation coefficient r. A significance was adopted at P<0.05 for interpretation of results of tests of significance (*). Also, a highly significance was adopted at P<0.01 for interpretation of results of tests of significance (**) [32].

3. Results

Table (1):shows the distribution of the nurses according to their socio–demographic characteristics. **Concerning to age**, this table revealed that more than half (59.0%) of the studied nurses were aged from(21to31) years old, where nearly one-third (31.0%) of them were in the age group from 31to less than 40 years old, with mean age (31.53±5.08).

Regarding to sex and marital status, the majority (86.o % and 80.0%) of the studied nurses were females and married. **In relation to educational level and occupation**, it was seen that nearly half (49.0%) of the studied nurses had bachelor of nursing. Moreover nearly three-quarters (71.0%) of the studied nurses were nursing staff, while more than one-quarter(29%) of them were head nurses. In addition to**;** it was found that nearly half (45.0%) of the

studied nurses had ≥10 years of nursing experience. **According to Previous training about central line related blood stream infection**, nearly four-fifths of the studied nurses (79.0%) did not have previous training about central line related blood stream infection.

Figure (1): The figure showed that there was a highly statistical significant improvement in the total level of nurses' knowledge regarding CVC where more than three-quarters (79%) and (77 %) of the studied nurses had poor and fair level of knowledge pre and post 2 months of nursing educational guidelines respectively, whereas all of them were good immediately after implementation of nursing educational guidelines.

Table (2): illustrates the distribution of the studied nurses according to their knowledge domains regarding CVC throughout all periods of implementation of nursing educational guidelines.

It was observed that there were highly statistical significant among the studied nurses regarding total knowledge mean score pre, immediately and post 2 months after implementation of nursing educational guidelines at p value = 0.000*.

Table (3):illustrates the distribution of the studied nurses according to their main practice domains levels throughout all

periods of implementation of nursing educational guidelines.

The table revealed that there was statistical significant improvement in the total level of nurses practice regarding both CVC and infection control measures pre, immediately and post 2 months after implementation in nursing educational guidelines at P value=0.000*

Table (4): illustrates the correlation between total knowledge domains and total practice domains among the studied nurses throughout all periods of implementation of nursing educational guidelines.

Regarding pre nursing educational guidelines, the table shows that there was positive significant correlation between total knowledge score &total practice score r= 0.227, P=0.023.

In relation to immediately after implementation of nursing e educational guidelines, the table shows that there was positive non-significant correlation between total knowledge score &total practice score (r= 0.149, P=0.14) respectively.

While post 2 months of implementation of nursing educational guidelines, the table shows that there was positive non-significant correlation between total knowledge score &total practice score (r=0.052 P=0.605) respectively.

Table (5):demonstrates the correlation between socio-demographic characteristics and total knowledge score among the studied nurses throughout all periods of implementation of nursing educational guidelines.

It was noticed that there was a highly negative significant correlation between occupation of the studied nurses and total knowledge score pre educational guidelines as (r= -0.341, P =0.001**) while immediately and 2months after implementing educational guidelines there was non-significant correlation between occupation of the studied nurses and total knowledge score.

On the other hand there was non-significant correlation between age, gender and experience of the studied nurses and total knowledge score pre, immediately &2 months post nursing educational guidelines as p> 0.05 respectively.

Table (6): demonstrates the correlation between socio-demographic characteristics and total practice score among the studied nurses throughout all periods of implementation of nursing educational guidelines.

 It was noticed that there was negative significant correlation between age of the studied nurses and total practice score immediately after implementation of nursing educational guidelines (r = -0.213,

P= 0.033), in contrary with pre and post 2 months of implementation of nursing educational guidelines there were negative non-significant correlation between age of the studied nurses and total practice score P> 0.05 respectively.

Also, there was non-significant correlation between gender, occupation and experience of the studied nurses and total practice score pre &immediately after nursing educational guidelines P> 0.05 respectively.

Table (1): Distribution of the studied nurses according to their Socio-demographic characteristics

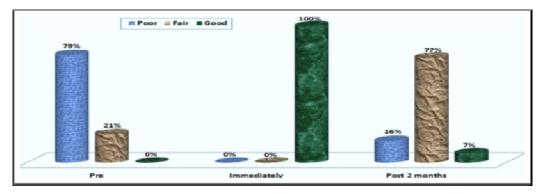| Characteristics	The studied nurses (n=100)	
	no	**%**
Age (in years)		
▪ 21-< 31	59	59.0
▪ 31-< 40	31	31.0
▪ 40-50	10	10.0
Range **Mean ± SD**	**(23-46)** **31.53±5.08**	
Gender		
▪ Male	14	14.0
▪ Female	86	86.0
Marital status		
▪ Single	20	20.0
▪ Married	80	80.0
Educational level		
▪ Technical institute	46	46.0
▪ Bachelor	49	49.0
▪ Post-graduate	5	5.0
Occupation		
▪ Nursing staff	71	71.0
▪ Head nursing	29	29.0
Experience (in years)		
▪ <5	27	27.0
▪ 5-<10	28	28.0
▪ ≥10	45	45.0
Range **Mean ± SD**	**(1-23)** **8.70±4.77**	
Previous training about central line related blood stream infection		
▪ No	79	79.0
▪ Yes	21	21.0
Duration of training program		
▪ None	79	79.0
▪ < 2 weeks	21	21.0

Figure (1): Distribution of the studied nurses according to their total knowledge level regarding CVC throughout all periods of implementation of nursing educational guidelines

Table (2): Distribution of the studied nurses according to their knowledge domains regarding CVC throughout all periods of implementation of nursing educational guidelines

Knowledge domains	The studied nurses (n=100)																		χ^2 P
	Pre						Immediately						Post 2 months						
	Poor		Fair		Good		Poor		Fair		Good		Poor		Fair		Good		
	n	%	n	%	n	%	N	%	n	%	N	%	n	%	n	%	n	%	
1. Knowledge regarding CVC	82	82.00	18	18.00	0	0.00	0	0.00	0	0.00	100	100.00	25	25.00	26	26.00	49	49.00	272.53 0.000*
Range Mean ± SD	(8-19) 13.39±2.84						(24-26) 25.62±0.63						(5-25) 17.47±3.71						F=523.86 P=0.000*
2. Knowledge about technical description, site and care of CVC	82	82.00	14	14.00	4	4.00	0	0.00	0	0.00	100	100.00	25	25.00	23	23.00	52	52.00	286.95 0.000*
Range Mean ± SD	(10-23) 14.11±2.86						(26-28) 27.30±0.73						(9-26) 18.57±3.54						F=635.62 P=0.000*
3. Knowledge about CLABSI																			
a) Definition, causes, types, …	69	69.0	28	28.00	3	3.00	0	0.00	0	0.00	100	100.0	25	25.00	19	19.00	56	56.00	266.89 0.000*
Range Mean ± SD	(7-17) 10.92±2.19						(17-20) 19.56±0.71						(8-18) 13.34±2.49						F=518.26 P=0.000*
b) Assessment, prevention and care of CVC	76	76.0	24	24.00	0	0.00	0	0.00	0	0.00	100	100.0	24	24.00	55	55.00	21	21.0	286.17 0.000*
Range Mean ± SD	(12-27) 20.16±3.19						(36-38) 37.59±0.63						(16-34) 25.30±3.82						F=968.94 P=0.000*
Total knowledge level	79	79.0	21	21.00	0	0.00	0	0.00	0	0.00	100	100.0	7	7.00	77	77.00	16	16.0	381.916 0.000*
Range Mean ± SD	(38-74) 58.58±8.31						(108-112) 110.07±1.18						(51-96) 74.68±7.69						F=1604.02 P=0.000*

<60% Poor   (60-75)% Fair   Good > 75%
* Significant at level P<0.05   C.V.C: central venous catheter
CLABSI: central line associated blood stream infection

Table (3): Distribution of the studied nurses according to their main practice domains levels throughout all periods of implementation of nursing educational guidelines

	Pre				Immediately				Post 2 Months				
	Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory		
	n	%	n	%	n	%	N	%	N	%	n	%	
A. Practice regarding CVC procedure	80	80.00	20	20	0	0.00	100	100.00	40	40.00	60	60.00	**33.33 0.000***
Range	(41-80)				(90-99)				(49-85)				646.68
Mean ± SD	61.16±9.39				95.50±2.03				71.41±7.19				**0.000***
B. Practice regarding infection control measures	81	81.00	19	19	0	0.00	100	100.00	0	0.00	100	100.00	**221.91 0.000***
Range	(21-45)				(54-58)				(42-56)				584.45
Mean ± SD	33.37±7.42				56.32±1.28				47.09±3.46				**0.000***
Total Practice level	80	80.00	20	20	0	0.00	100	100.00	11	11.00	89	89.00	**177.95 0.000***

<70% Unsatisfactory   ≥70% Satisfactory   CVC: central venous catheter

* Significant at level P<0.05

Table (4): Correlation between total practice domains and total knowledge domains among the studied nurses throughout all periods of implementation of nursing educational guidelines

Knowledge domains	Practice domains																	
	A. Practice regarding central venous catheter procedure						B. Practice regarding infection control measures						Total practice score					
	Pre		Immediately		Post 2 Months		Pre		Immediately		Post 2 Months		Pre		Immediately		Post 2 months	
	r	P	R	P	R	P	r	P	R	P	r	P	R	p	r	p	R	p
1. Anatomy of the vein	-0.108	0.284	0.024	0.814	0.239	0.017*	0.036	0.721	-0.15	0.144	-0.02	0.883	-0.05	0.61	-0.05	0.611	0.16	0.094
2.Technical description	-0.11	0.278	0.13	0.196	0.076	0.453	-0.003	0.977	-0.28	0.006**	0.208	0.038*	-0.07	0.47	-0.22	0.025*	0.15	0.128
3. CLABSI: Definition, causes, types,…	-0.10	0.318	0.243	0.015*	-0.16	0.109	-0.209	0.037*	0.113	0.263	-0.15	0.142	-0.17	0.08	0.23	0.020*	-0.19	0.062
4. CLABSI: Assessment, prevention, ..	-0.16	0.096	-0.193	0.054	-0.08	0.459	-0.51	0.000**	-0.17	0.089	-0.05	0.631	-0.37	0.000**	-0.22	0.027*	-0.08	0.442
Total knowledge score	-0.16	0.103	-0.028	0.785	0.061	0.548	-0.236	0.018*	-0.27	0.006**	0.017	0.87	0.23	0.023*	0.15	0.149	0.052	0.605

* Significant at level P<0.05   CLABSI: central line associated blood stream infection

** Highly significant at level P<0.01

Table (5): Correlation between socio-demographic characteristics and total knowledge score among the studied nurses throughout all periods of implementation of nursing educational guidelines

| Characteristics of the nurses | The studied nurses (n=100) Total knowledge score | | | | | |
| | Pre | | Immediately | | Post 2 Months | |
	R	P	r	P	R	P
Age (in years)	-0.077	0.445	-0.043	0.669	-0.031	0.763
Gender	0.031	0.762	-0.015	0.883	0.104	0.304
Occupation	-0.341	0.001**	-0.038	0.706	0.023	0.821
Experience (in years)	0.135	0.180	-0.045	0.660	-0.060	0.553

 * Significant at level P<0.05

 ** Highly significant at level P<0.01

Table (6): Correlation between socio-demographic characteristics and total practice score of among the studied nurses throughout all periods of implementation of nursing educational guidelines

| Characteristics of the nurses | The studied nurses (n=100) Total practice score | | | | | |
| | Pre | | Immediately | | Post 2 Months | |
	R	P	r	P	R	P
Age (in years)	-0.015	0.886	-0.213	0.033*	0.059	0.560
Gender	0.121	0.231	0.124	0.221	-0.058	0.568
Occupation	0.044	0.664	-0.104	0.304	0.023	0.821
Experience (in years)	0.038	0.708	0.181	0.072	0.072	0.474

 * Significant at level P<0.05

 ** Highly significant at level P<0.01

Discussion

Nurses in intensive care units have the most direct and continuous role in performing care maintenance of the central venous catheter insertion site procedure and they should be experienced with supportive care measures in the insertion and maintenance of central lines. Therefore must be prepared to be able to contribute to the primary prevention guidelines of central line associated blood stream infection through improved their knowledge and practice toward proper use of CVC to minimize the risk of complications and improve patient's quality of life. So this is study was conducted to evaluate the effect of educational guidelines on nurse's knowledge and practice regarding central line associated blood stream infection at intensive care unit[33, 34].

Concerning tosocio-demographic characteristics of the studied nurses, the results of the present study showed that nearly more than half of the nurses were aged from 20 to less than 31 years old. This may reflects the demanding nature of critical care unites service, so that older nurses may find it difficult to cope with the load of work required and prefer the newly graduate to work in the critical care units, as they had the ability to acquire knowledge and change their behaviors

based on submission of up to date knowledge. This finding was in the same line with **Elbilgahy et al. (2019)** [35]who reported that nearly half of the studied nurses who are worked in intensive care units were aged from 20 to less than 30 years old. Moreover, **Abbady and Gaballah (2019)** [36] reported that the mean age of the studied nurses who are caring for central line in intensive care unit was 27.02±2.15. On the other hand, this finding was consistant with **Esposito and Guillari (2017)**[37] who reported that nearly three-quarters of nurses who are caring for patients with central venous cateter were aged from (20<40). The finding parallel to **Bayoumi and Mahmoud (2017)**[38] who reported that three quarter of the nurses who are deal with central line in hemodialysis unit were less than 25 years old. Additionallythis finding disagrees with **Mishras (2016)**[39] who reported that the most of the studied nurses in intensive care unit were aged from (29<39).

Concerning to sex and marital status, the result of the present study showed that the majority of the studied nurses were females and married. This finding was in the same line with **Shah** (**2019**) [40] and **Raghep and Elgazar(2019)**[41] who

reported that the majority of the studied nurses who working in intensive care unit and deal with central venous access device were females and nearly three quarters of them were married

In relation to nurses' educational leveland occupation, it was seen that nearly half of the studied nurses had bachelor degree of nursing. It could be due to hospital policy as they prefer highly qualified nurses in the critical care unites rather than other graduate to be able to carry up their responsibility. This finding was in the same line with **Sami et al.(2018)**[42] and **Muslim et al. (2018)** [43]who reported that most of the studied nurses who providing care for patients with central line were had bachelor of nursing.On the other hand, this finding disagreement with **Moursy and Sharaf(2017)** [44], who study bout "vascular access care at hemodialysis unit; nurses' compliance to infection prevention and control practice"**,** who reported that more than two third of the studied nurses the educational level are diploma.

Concerning to nurses' years of experiences, the present study results showed that nearly half of the studied nurses had ten or more years of nursing experience. This finding was congruent with **Deshmukh et al. (2014)**[45] who conducted that study about vascular access

care among hemodialysis patients and mentioned that nearly of the studied nurses who were providing care to patients had more than twenty years of experiences. On the other hand, this finding was disagreement with **Elbilgahy et al. (2019)** [35] who stated that approximately two thirds of the studied nurses who work in hemodialysis units to care for central venous catheter having 10 years of experience.

According to nurses' previous training about central line related blood stream infection, nearly four fifths of the studied nurses did not have previous training about central line related blood stream infection. This finding was in the same line with**Abdelsatir (2013)** [46]and **Hawkins (2018)** [47]who conducted study about central line and infection control measures and found that the majority of the studied nurses didn't attend any pervious training about central line.Converse to**Moursy andSharaf(2017)** [44], reported that the majority of the studied nurses attended infection prevention training programs about Central line during work in the critical care unit.

Concerning to level of knowledge of the studied nurses regarding central venous catheter, central line associated blood stream infection and its management pre, immediately and post 2 months of

implementation of nursing educational guidelines, the results of the present study showed that, there was statistical significant improvement in the level of nurses' knowledge regarding central venous catheter, central line associated blood stream infection and its management. Where the majority of the studied nurses had poor level of knowledge pre nursing educational guidelines, whereas all of them had good level of knowledge after implementation of nursing educational guidelines.

The poor level of nurses' knowledge about central line and central line associated blood stream infection pre nursing educational guidelines may be related to lack of training program that must be conducted to improve nurses' knowledge and they depending on acquiring their knowledge from the experience of their colleagues. The implementation of nursing educational guidelines has a positive effect on nurses' knowledge as the majority of the studied nurses had good level of knowledge post nursing educational guidelines. This improvement in knowledge indicated effectiveness of the nursing educational guidelines and the teaching sessions that were done by the researcher. Also, this improvement may be related to nurses' desire to acquire new knowledge, active participation and regular

attendance in the sessions of the program that was reflected on knowledge scores of the studied nurses.

This finding was consistent with **Raghep and Elgazar(2020)** [41] who revealed that the majority of the studied nurse's had unsatisfactory level of knowledge pre educational program intervention and reached to satisfactory level immediate and post program regarding care of patients during insertion of central venous catheter.

In addition, this result was supported by **Fayed et al. (2016)**[48] who illustrated that the lack of continuous education and training programs about central line led to poor level of nurses' knowledge pre-program implementation, while all of them had good knowledge after program implementation. Additionally, the finding of the present study was in the same line with **Sakshi (2019)** [49]who reported that the implementation of educational program regarding care of central venous catheter led to statistical significant improvement of knowledge level among nurses who were working in intensive care unit.

This finding was consists with **Aloush (2018)**[50] who reported that the majority of nurses had poor level of knowledge pre educational guidelines about procedure of central line. In addition the finding of the present study was in the same line with **Al Qadire (2017)** [51] who revealed that

nurses of intensive care units had insufficient knowledge about central line associated blood stream infection.

Also, this result was supported by**Venkatesan et al. 2018** [52] who reported that all nurses who were providing care for patients with central line in intensive care unit had satisfactory level of knowledge post educational program regarding prevention of central line associated blood stream infection .In addition to ,this result agreed with **Chen et al. (2015)** [53] who revealed that there was statistical improvement of knowledge scores among nurses who were providing care for patients with central line in intensive care units post completion of educational guidelines.

Concerning to level of practice of the studied nurses regardingcentral venous catheter procedures and infection control measures, the present study showed that there was a statistical significant improvement in the level of nurses' practice regarding both central venous catheter and infection control measures, where the most of studied nurses had unsatisfactory level of practice pre nursing educational guidelines whereas all of them were had satisfactory level of practice immediately after implementing nursing educational guidelines .

The unsatisfactory level of nurses' practice regarding central venous catheter and infection control measures pre educational guidelines may be related to inadequate level of nurses' knowledge pre guidelines, shortage of nursing staff, lack of updating knowledge, lack of continuous education and deficiency of in-service training program. The implementation of educational guidelines has a positive effect on nurses' practice as the majority of studied nurses had satisfactory level of practice post educational guidelines. This improvement indicates effectiveness of the nursing guidelines that led to enhancement of nurses' knowledge which reflected on nurses' practice.

This finding was in the same line with **Bayoumi (2017)** [38] who reported that there was a highly statistical significant difference between nurses' practice pre and post implementation of educational guidelines as the majority of nurses had adequate level of practice post implementing the nursing educational program regarding central line.

Additionally, this finding was in the same line with **Yousifet al.(2017)** [54] who reported that there was a highly statistical improvement in the level of nurse' practice regarding infection control measures of central line care where about more than half of the studied nurses were had in

competent practice at the pre-educational guidelines .While more than three quarter of them had a competent practice at post intervention phase.

Moreover, this finding was the same line with **Tang et al. (2014)**[55] who reported that there was highly significant improvement in the level of nurse' practice regarding central line associated blood stream infection after implementation of infection control bundle. This finding was supported with **Sacks et al. (2014)**[56]who reported that majority of the studied had low level of practice regarding care of patients with central line in pre intervention, while the majority of them had good level of practice after nursing intervention.

Also, this finding was supported with **Kun et al.(2017)**[57] who reported that there was a highly statistical improvement in the level of nurses practice regarding care of peripherally inserted central catheter after and catheter maintenance after educational program.

Moreover, this finding was the same line with **Wright et al. (2013)**[58] who reported that there was a highly statistical improvement in the level of nurses' practice regarding disinfection of catheter hubs and prevention of central line associated blood stream infection.

Concerning correlation between both of total knowledge score, total practice score and their domains, findings of the present study reported that there was positive significant correlation between total knowledge score and practice score of the studied nurses pre nursing educational guidelines. It may be related to the nurses poor training can be skilled to unsatisfactory practice. This finding was in the same line with **Esposito et al. (2017)** [37]who showed thatthere was significant correlation between total knowledge score and practice score of the studied nurses during nursing educational guidelines. Moreover, this finding agreed with **El-Solet al. (2017)**[59] who conducted a teaching moduleregarding prevention of central-line associated blood stream infection on intensive care unit nurses and reported that implementation of the program that is organized according to the needs of nurses has beneficial effect in improving the nurses knowledge and practice.

Moreover,this finding was agreed with **Cooper et al. (2014)**[60] who implemented an educational program regarding central line care and confirmed that enhanced nurses' knowledge led to improve nurses' practice. Also, this finding agreed with **Awad et al. (2019)**[61] Who reported that there was significant correlations between

total knowledge scores and total practice scores regarding central venous catheter care bundle on critical care nurses at emergency department.

Moreover,this finding was consistent with **Caetano et al. (2014)**[62] with who found that enhanced nurses' knowledge regarding central venous catheter led to improve nurses' practice regarding prevention of central line complications. In addition, **Kadium (2015)** [63] who conducted a study in hemodialysis unit and found that there was statistical significant correlations between total knowledge scores and total practice scores regarding central venous catheter care.

Concerning to correlation between socio-demographic characteristics and total knowledge score among the studied nurses pre, immediately and post 2 months of implementation of nursing educational guidelines, the findings of the present study reported that there was a negative statistical significant correlation between occupation of the studied nurses and total knowledge score pre nursing educational guidelines. It may be related to that, head nurses were poor level of knowledge score due to absence of educational training program about central line and they were occupied with administrative work. This finding was in the same line with **Kadium et al. (2015)**[63] who clarified that there

was a statistical significant correlation between occupation of the studied nurses and total knowledge score pre nursing educational guidelines. In the same line with **Yousef (2017)**[54] who noticed that nurses' knowledge scores were in significant relation with socio-demographic data of nurses. This finding agreed with **Barbosa1 et al. (2017)**[64] who observed that there was a statistical significant correlation between total knowledge score and age and years of experiences post implementation of educational program regarding central line care.

Moreover, this finding was agreed with **Koutzavekiaris et al. (2017)**[65] who reported that there was negative statistical correlation between age of the studied nurses and total knowledge score pre implementation of educational guidelines. Also, this finding was in the same line with **Kokila (2018)**[66] who noticed that there was significant correlation between occupation and total knowledge score about central line care in hemodialysis unit.

Concerning correlation between socio-demographic characteristics and total practice score of among the studied nurses pre, immediately and post 2 months of implementation of nursing educational guidelines, the finding of the present study

revealed that there was a statistical significant correlation between age of the studied nurses and total practice score immediately after implementation of nursing educational guidelines**.** It may be related to that, the majority of nurses were aged from 20 to 40, this increasing their experiences and consequences lead to satisfactory level of practice regarding central line care and prevention of infection.This finding was in the same line with **Caetano et al. (2019)**[62] who reported that there was a statistical significant correlation between age of the studied nurses and total practice score pre nursing educational guidelines. This finding agreed with **Fayed et al. (2016)**[48] who observed that there was a statistical significant correlation between total practice scores and age &years of experiences post educational guidelines regarding central line In addition,**Yousif et al. (2017)**[54]who reported that there was a positive correlation between age and total practice score pre implementing nursing educational program about central line associated blood stream infection.

On the other hand, this finding disagreed with **Aloush (2018)**[50] who noticed that there was no significant correlation between total practice scores and socio-demographic characteristics of the studied nurses throughout the educational program regarding central line.

Conclusion

Depending on the finding of the present study, it was concluded that:

Central venous catheter is a common procedure that is performed in intensive care units for a variety of indications. Central lines are known to be associated with risk of complications as infections and hemorrhage, thus good nurses' knowledge and practice of care are crucial in limiting these risks, also the nurse to be supposed to integrate safe care practice into their care to improve patients outcome [33].

- The implementation of nursing educational guidelines have a positive impact in improving nurses' knowledge and practice regarding prevention of central line associated blood stream infection.

- There was a significant statistical improvement in the nurses' total knowledge and practices mean scores pre, immediately and 2 months post nursing educational guidelines.

- There was a positive significant correlation between total knowledge score &total practice during and after 2 months of implementation in nursing educational guidelines.

- There was a statistical significant correlation between socio-demographic characteristics and total knowledge and practice score among the studied nurses throughout all periods of implementation of nursing educational guidelines.

Recommendations

Depending on the results of the present study, it was recommended that:

Nurses should attend the seminars and the in-service training programs about central line associated blood stream infection and care for implanted ports for gaining updated knowledge and enhancing their practice.

- The nurses must attend external training courses and conferences to upgrade their knowledge and practices in their field and the evidence based guidelines for CLABSI prevention should be incorporated in all nursing curricula.
- Nurses should use central line insertion checklist to decrease mistakes and avoid infection.
- Nurses should be congruent with infection control guidelines in care of patients with central line.
- Nurses should be aware about pre discharge instructions that are given to the patient with implanted ports to prevent infection.

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