

Effect of an Educational Program on Critical Care Nurses' Knowledge, and Practice about Central Venous Catheter Bundle

Noha Osman Sayed¹, Osama Ali Ibraheim², Mona Aly Mohammed³ & Magedda Mohamed Mehany⁴

¹ Master Degree in Critical Care Nursing, faculty of nursing, Alexandria University, Egypt.

² Professor of Anesthesia & Intensive Care, Faculty of Medicine, Assiut University, Egypt.

³ Assistant professor of Critical Care and Emergency Nursing, Faculty of Nursing, Assiut University, Egypt.

⁴ Assistant professor of Critical Care and Emergency Nursing, Faculty of Nursing, Assiut University, Egypt.

Abstract

Introduction: Educational program about central venous catheter bundle plays an important role on critical care nurses' knowledge and practice. Educating, and training health care providers who are inserting and maintaining central venous catheter is must. **Aim:** To evaluate the effect of educational program on critical nurses' knowledge and practice about central venous catheter bundle. **Subjects and Method:** Quasi-experimental research design was used. The study executed at General ICU (18 beds), at main Assiut University Hospital. A sample of 60 critical care nurses' working in General ICU was selected. Two tools were used for this study: knowledge assessment tool, and practice assessment tool. **Results:** There was a significant increase in the percentage of satisfactory knowledge and practice of critical care nurses after educational program compared with that before educational program (86.7% and 100% Vs. 0.00% and 15%) for knowledge and practice, respectively with minimal decline of satisfactory knowledge at follow up to 75 % and 81.7% for knowledge and practice, respectively. **Conclusion:** A significant improvement in the knowledge and practice of critical care nurses regarding central venous catheter after educational program was noted. **Recommendation:** Training programs for critical care nurses to keep up with updated knowledge and evidence practice.

Keywords: *Central venous catheter, Critical care nurses, Education program, Knowledge & Practice.*

Introduction

Patients in intensive care units (ICUs) are usually hemodynamic unstable and they are always at increased risk of actual or potentially life-threatening health complications which required continuous monitoring and resuscitation treatment. This can be done by a specific device called Central Venous Catheter (CVC), which forms a key part of care in all critical ill patients (Ugas, 2012).

CVC is used for hemodynamic monitoring, hemodialysis, ease further complex interventions such as trans-venous pacemaker indwelling, total parental nutrition (TPN) infusion and medication administration for ICU patients. CVC, in situ may lead to the risk of central line associated blood stream infection (CLABSI), bleeding, and pneumothorax (Tarango, et al., 2018 & Xiaoli, 2012). Nevertheless, complications associated with CVCs use are known to affect not only patient morbidity and mortality, but also have other drawbacks as increase hospital costs, and length of hospital stay (Leistner, et al., 2014).

Care bundle is a group of three to five evidence-based practice (EBP) interventions which when the critical care nurse perform it together will have robust improvement inpatient care than if performed individually (Deborah, & Mark., 2012).

Educational program about central venous catheter bundle plays an important role to the critical care nurses' knowledge, and play a pivotal role in influencing the way critical care is practiced. In Egypt, the rate of CVC colonization in six ICUs was 47.8 %. Research indicates that the majority of central line associated blood stream infection (CLABSIs) is preventable (Fathy, et al., 2010).

The goal of the **Centers for Disease Control (CDC) Guidelines** was emphasizing at educating and training health care providers who insert and maintain catheters, using maximum sterile barrier and precautions during CVC insertion, using a 2% chlorhexidine preparation for skin antisepsis, and avoiding routine replacement of CVCs as a strategy to prevention of infection Implementation of a post-insertion care (maintenance) bundle in addition to insertion bundle has been shown to be effective in reducing central line associated blood stream infection (Donald, & O'Grady, 2012).

It is imperative that critical care nurses safeguard the individuals entrusted to their care by controlling diseases and preventing the spread of infection to improve patient's safety. Nursing compliance with established evidence based practice bundle is a challenge effort to prevent the complication of the CVC.

Either due to lack of knowledge or other causes, adherence to evidence-based practices is a known issue that increased CLABSI's incidence (Flodgren, et al., 2013 & Jones, et al., 2015).

The education programs for nursing staff play an important role in assisting staff nurses in developing and enhancing their skills needed to provide high standards of care to their patients. This agreed with the present study as nurse's knowledge and practice improved after implementation of the nursing educational program (Nakagami, et al., 2018).

Significance of the study

There was a study that had been conducted between 2011- 2012 in 46 ICU in 11 hospitals (Ministry of health hospitals & University hospital) in Egypt, and according to CDC it was found that blood stream infection (22%) of Healthcare Acquired Infections (HAIs), which considered (46%) of them related to Central Line Associated Bloodstream Infections (CLABSIs) **Infection Control Prevention Egypt Program(2016)** Other study in Ninety-one ICUs in 28 hospitals contributed to 474,544 patient days and 2,688 HAIs. Of these, 30% were bloodstream infections (M. Talat, et al., 2016).

The health care provision requires in-service training programmers for nurses, and they need continuing professional development by education and training after the point of qualification and or registration. This will help the nurses' to improve of patient care and enables professional nurse practitioners to provide high quality of nursing care and service delivery to their patients (Norush, et al., 2014).

Therefore, this study will be the fewer study in this geographical location which will help such group of nurses to maintain proper functioning of the central venous catheter, identify and report symptoms indicative central venous catheter, complications as well as how to maintain catheter free from infection. Furthermore, results of this study could be helpful for health professionals specially nurses in planning and implementing care for such group of patients in the future.

Aims of the study were to:

1. Assess nurses' knowledge, and practice about central venous catheter bundle.
2. Design and implement an educational program for critical care nurses about central venous catheter bundle.
3. To evaluate the effect of an educational program on critical care nurse's knowledge, and practice, about central venous catheter bundle.

Hypotheses:-

To fulfill the aim of the study, the following hypotheses are formulated:

- There is a significant difference between posttest knowledge scores to the pretest knowledge scores following implementation of an educational program.
- There is a significant difference between posttest skills scores to the pretest skills scores following implementation of an educational program.
- There is positive relation will exist between knowledge and skills score obtained by critical care nurses receiving an educational program.

Research design:

Quasi-experimental research design was used to successfully complete this study

Study variables:

- The independent variable was the educational program.
- The dependent variables were critical care nurses' knowledge and skills.

Setting:

The study was executed in the General Intensive Care Unit (18 beds), at Main Assiut University Hospital.

Sample:

All critical care nurses working in General Intensive Care Unit (60 nurse), Assiut University Hospital

Tools:

Two tools were used in this study as follows.

Tool one: "Nurses Knowledge Assessment": -

This tool was developed by the researcher after reviewing the related literatures to assess the knowledge level of CCNs regarding the central venous catheter bundle (Dumont, C., et al 2012; & Infection Control Today, 2013; & Donald L. (2012). This tool was used once before the start of education program. This tool was comprised of two parts:

Part I: "Socio Demographic Data", which included: nurse's age, sex, educational level, experience years, previous training about CVC care and source of their information and knowledge.

Part II: "Nurses' Knowledge Assessment", which assessed nurses' knowledge about definition of central venous catheter, indication and contraindication of central venous catheter, types of central venous catheter, definition of the Central Line- Associated Bloodstream Infections (CLABSI) with risk factors, and bundle of care of central venous catheter .

Tool two: "Nurses Practice Assessment": (observational checklist)

This tool was developed by the researcher after reviewing related literatures to assess CCNs practice level about how they implement and comply with the central venous catheter insertion and maintenance care bundle.

Scoring system:

The complete correct answer was given a score of 2 and incomplete or not done answer was given a score of 1. The total score was summed up and nurses who obtained less than 60 % of total score was considered as having satisfactory knowledge. However, those who obtained less than 60 % of total score were considered as having unsatisfactory knowledge.

Method:**Preparatory phase**

1. A written approval was obtained from the hospital administrative authority to conduct the study after providing explanation of the aim of the study.
2. Permission for voluntary participation was obtained from nurses; the nature and purpose of the study were explained.
3. The two tools that were utilized for data collection in this study were developed by the researcher after reviewing related literature (**The Joint Commission International., 2013**).
4. Before establishing the full study, a pilot study was implemented to estimate the feasibility of the study design and applicability of the items and the necessary modifications were done accordingly. Questionnaire was distributed to Six CCNs in General ICU and the necessary modifications were done as needed, these CCNs were excluded from the study.
5. The two tools were tested for content validity by 5 experts in the critical care field of the study and they agree about the content with some language modifications. The content validity indexes were 0.75, 0.71, and 81.5 for tools 1, 2 and 3, respectively.
6. Internal consistency reliability of tool 1 was confirmed with Cronbach's alpha which $r = 0.879$ and 0.778 , respectively.
7. Reliability of tool 2 was estimated by inter-rater reliability and it was 0.82 .

Implementation phase (Data collection):-

Assessment of knowledge was done three times as follows: Once at the beginning of the study was considered as pretest assessment and as base line data for latter comparison with posttest. The second administration of questionnaire was carried out after implementing the education program immediately to identify its effect on nurses' knowledge. The third administration of questionnaire was carried out three months after implementing of an educational program to identify its effect on nurses' knowledge.

Assessment of nursing skills The CCNs skills were observed using observational checklist tool two before, immediately and after three months after program implementation. The observation was made by researcher over one month. Four visits for each week were scheduled by the researcher. The researcher completed the observational checklist while the insertion and maintaining the central venous catheter care on patient.

Educational sessions: Educational sessions were delivered to all studied CCNs, based on CDC and national guidelines for care and maintenance of CVC bundle (**Donald, L. 2012; Almutairi, & Ludington-Hoe, 2016**) They included the following: A- Lectures were conducted over 1 h/day for 4 successive days per week over two weeks, to cover all participants in all work shifts. The sessions included the theoretical information about insertion, preparation, care, maintenance, complications of CVCs, risk factors and prevention of CLBSIs. B- Demonstration sessions were conducted over 1h/ twice /day four times weekly over three weeks. These sessions included the practical aspect of performing insertion of CVC and maintenance CVC bundle. The educational materials included videos, posters, demonstration models and power point presentations.

Bed side training and guidance: Practical bed side training and guidance for studied CCNs on the different aspects of CVCs insertion bundle and CVC maintenance bundle was delivered to all the participants during their work shifts by the researcher. A total of twelve visits were conducted over two weeks: two visits to each working day.

Pilot study was conducted on 6 CCNs to assess the clarity, feasibility, and time needed to fill the questionnaire and to demonstrate the educational sessions. The necessary modifications were done according to nurses' responses in the pilot study. The time needed for delivering the theoretical and practical sessions was 3 hours. Nurses involved in the pilot study were excluded from the study.

Statistical analysis

Data were coded and transformed into specially designed form to be suitable for computer enter process. Statistical analysis was performed using the software program package SPSS, version 20. Qualitative data were presented as frequency and percentage while quantitative data was presented as mean \pm SD, number and percentage. Chi-square test was used to determine significance between variables. Paired t test was used for comparing quantitative data. Statistical significance was set at $p < 0.05$.

Results:

Table (1): Frequency distribution of demographic characteristics of studied critical care nurses (n=60):

Items	Group	
	No. (n=60)	%
Gender:		
Female	60	100.0
Age (years):		
20 < 30	51	85.0
30 < 40	6	10.0
≥ 40	3	5.0
Mean ± SD	24.55 ±5.4	
Range	21 - 42 years	
Educational level:		
Technical Nursing institute	39	65.0
Bachelor Nursing Degree	21	35.0
Years of experience:		
1 to < 5 years	45	75.0
5 to < 10 years	9	15.0
≥ 10 years	6	10.0
Mean ± SD	2.8 ±3.5	
Range	1 - 13 years	
Attending CVC training program		
Yes	0	0.0
No	60	100.0
Source of Information:		
Educational institution	0	0.0
Infection control unit/program	0	0.0
Practice	60	100.0

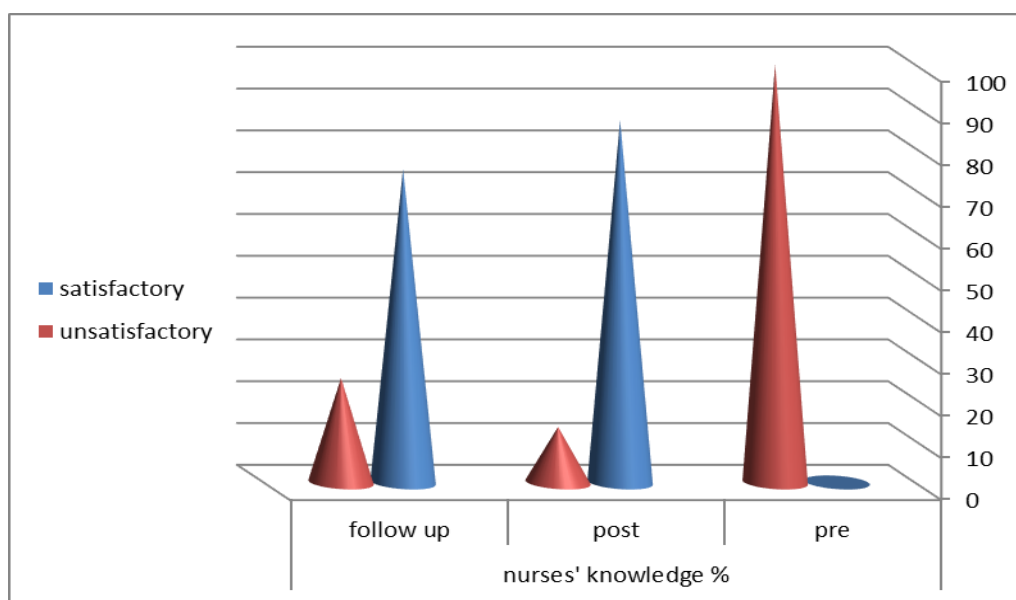


Figure (1): Knowledge level (pre, post, follow up) among the studied nurses (N. =60).

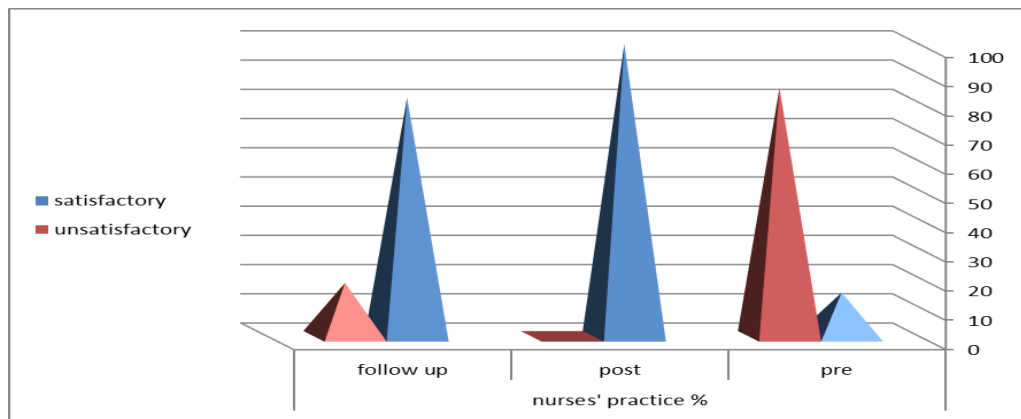


Figure (2): Practice level (pre, post, follow up) among the studied nurses (N. =60).

Table (2): Relation between Nurses' knowledge and Nurses' Practice During three Program Phases (N. =60):

Correlations Nurses' Practice	Nurses' knowledge	
	R	P
Before education	0.047	0.724
After education	.323*	0.012*
follow up	.257*	0.048*

* Statistically Significant Correlation at P. value <0.05

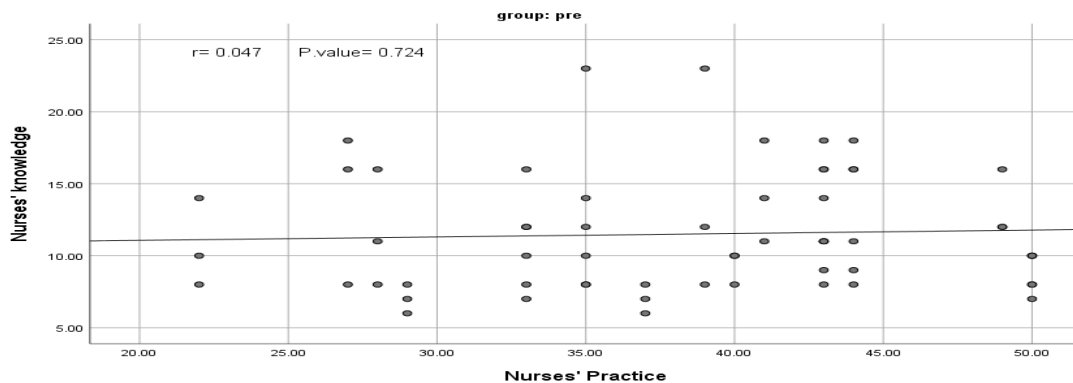


Figure (3): Correlation between total nurses' knowledge and their practice pre educational program about CVC bundle (N. =60):

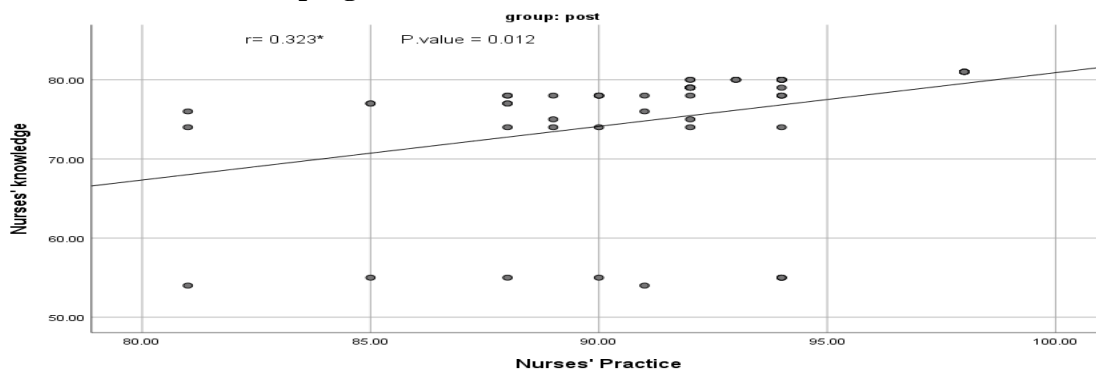


Figure (4): Correlation between total nurses' knowledge and their practice post educational program about CVC bundle (N. =60):

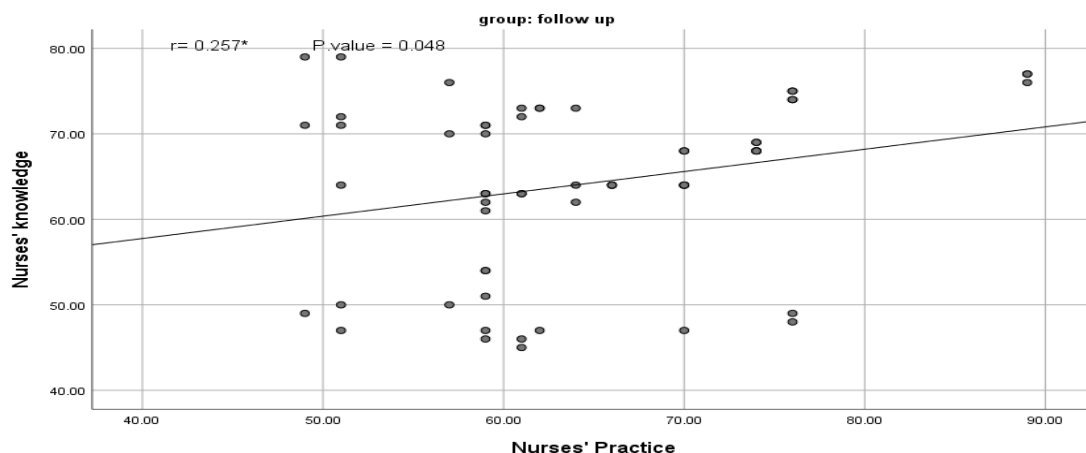


Figure (5): Correlation between total nurses' knowledge and their practice after 3 months of educational program about CVC bundle (N. =60)

Table (3): Correlation Co- efficient between Nurses' knowledge and practice with their Socio demographic data during three Program Phases (N. =60):

Correlations	Nurses' knowledge			Nurses' Practice			
		Before	After	follow up	Before	After	follow up
Age	R	-.312-*	-0.052	0.054	.357**	0.206	0.086
	P	0.015	0.694	0.679	0.005	0.115	0.515
Educational level:	R	-0.213	-0.068	0.009	.489**	0.245	.336**
	P	0.102	0.603	0.946	0.000	0.059	0.009
Years of experience	R	-0.157	0.128	0.131	.486**	0.008	0.066
	P	0.231	0.331	0.318	0.000	0.951	0.618
Received CVC bundle	R	-0.162	-0.025	0.048	-0.140	0.032	-0.072
	P	0.216	0.849	0.713	0.284	0.807	0.583

** Statistically Significant Correlation at P. value <0.01

Table (1): Presents the characteristics of the studied CCN. It is clear from the table that all (100%) of the studied CCN are females, and majority (85 %) aged between (20 to 30) years old with mean ± SD (2.8 ±3.5). More than half (65%) of the studied nurses are graduated from technical institute of nursing– and three quarters (75%) of them has from 1 to more than 3 years of experience with mean ± SD (24.55 ±5.4). In addition, the table showed that all nurses never attend any training programs regarding CVC bundle (100, 95%, respectively) and the main source of their information (100%) was from their practice only.

Figure (1): Reveals that the all (100%) of the studied CCN had an unsatisfactory knowledge level before implementing education program, while majority (86,7%) of them had satisfactory level of knowledge after receiving the educational program for CVC bundle. Regarding the follow up it was found that three quarters (75%) of the studied nurses

had satisfactory level of knowledge. The table shows that there is a highly statistically significant difference between the total nurses' knowledge level pre, post and follow up receiving educational program about CVC bundle (P <0.00001**). Also, the table shows a significant improvement of the studied nurses' total knowledge level after application of the educational program about CVC bundle.

Figure (2): Presents that the majority (85.0%) of the studied CCN has unsatisfactory practice level (pre-test), while all (100%) of them has satisfactory level of practice. Regarding the follow up, it was found that majority (81.7%) of the studied nurses had a satisfactory level of practice. The table showed that there was a highly statistically significant difference between the total nurses' practice level pre, post and follow up receiving educational program about CVC bundle (P <0.0001***). Also, the table showed a significant improvement of the studied nurses' total

practice level after application of the educational program about CVC bundle.

Table (2): Illustrates that there is no statistical significant relation between nurses' practice mean score pre educational program and it Shows that there is a highly significance differences in nurses knowledge mean score between post and 3 months after implementation of education program regarding CVC bundle care.

Figure (3): Shows that there is no correlation between total nurses' knowledge and their practice pre educational program about CVC bundle.

Figure (4): Shows that there is a positive correlation between total nurses' Knowledge and their practice post educational program about CVC bundle.

Figure (5): Shows that there is a positive correlation between total nurses' Knowledge and their practice after 3 months of educational program about CVC bundle.

Table (3): Illustrate that there is no statistical significant relation between nurses' knowledge and practice mean score during three program phases and there demographic statistic.

Discussion

Central venous catheters (CVCs) is considered a life-sustaining device, as they are used for administration of drugs and fluids, as well as for nutrition and intravascular monitoring, mainly in ICU patients but also in outpatients (Vidhya, 2019). However, due to that fact that CVCs break the skin barrier, they pose the risk of CVC-related infections. Moreover, these devices tend to be easily colonized, and they also provide a favorable environment for biofilm formation, which hinders treatment of such infections. In addition, CVC care bundles have been introduced into clinical practice. Official organizations, such as the CDC, also have issued guidelines for the prevention of CVC-related infections (Koutzavekiaris, et al., 2011).

Regarding knowledge level:

The current study presented that, the nurses' knowledge before the implementation of the educational program for CVC bundle generally was unsatisfactory. This might be related to the fact that the majority of them hold a technical institute of nursing. In addition, another cause for a lack of knowledge is that most of them were not receiving any previous training about CVC care. As the researcher's opinion, the difference may be due to lack of updating information regarding critically care, and this might be due to the fact that basic critical care knowledge was not incorporated into either diploma or technical institute diploma degree curricula. On the other hand, Egyptian nurses,

particularly those who work in bedside care are overworked because of the shortage in the nursing staff. Therefore, they have limited time to enhance their knowledge about critical care.

These findings are supported by Aysha, & Ahmed, (2019) who found a statistically significant association between nurses' level of knowledge in the post-intervention program compared with the pre-intervention. In this respect, Rajamani, (2019) revealed in his study report a significant increase in the post-test knowledge scores after structured teaching program. The structured teaching program is one of the effective methods in increasing knowledge regarding the prevention of CVC infection among nurses. Moreover, the result agrees with the study done by Mohammed, & Yousif, (2017) who reported that the program has a positive effect on improving the knowledge of nurses in ICU which indicated the difference between the pretest and posttest of the program.

These findings agree with De Jonge, et al., (2019) who found interesting results related to RNs' self-reported CVC knowledge and complication assessment practices. Moreover, this result agreed with those of Ghezeljeh, et al., (2019) who showed that posttest knowledge was higher than pretest knowledge scores. The result is in agreement with Almutairi, & Ludington-Hoe, (2016) who reported a statistically significant difference between the mean pre and post-test scores of nurses' knowledge after the educational program.

However, Earan, et al., (2016) reported that nurses who are working in the intensive care unit needs additional education regarding CVC bundle of care. Moreover, a recently published multi-country survey evaluating the knowledge of ICU nurses regarding CVC-related infections suggested that the need remains to optimize nurses' knowledge regarding the prevention of CVC-related infections (Ferrara, & Albano, 2018).

Regarding the nurses' practice:

The existing study revealed that the majority of the studied nurses had an unsatisfactory practice level (pre-test), while all of them had satisfactory level of practice immediately after the educational program for CVC bundle. Regarding the follow up it was found that the majority of the studied nurses had a satisfactory level of practice. The results also, showed that there was a highly statistically significant difference between the total nurses' practice level pre, post and follow up receiving educational program about CVC bundle. In addition, the study showed a significant improvement of the studied nurses' total practice level after application of the educational program about CVC bundle.

Non-adherence to recommended evidence-based guidelines of CVCs bundle of care could be due to nurses' lack of knowledge of the guidelines as reported by **Bayoumi & Mahmoud, (2017)** who carried out a study about improving nurses' knowledge about CVCs care in ICU. Professional literature was not available to the nurses in the workplace. They added that the lack of time was regarded as a barrier to applying research into practice.

Therefore, nurses' knowledge deficiency was presented as an obstacle to adherence to bundle of care. From the researchers' point of view, findings of the present study may be attributed to several factors, including the lack of adequate hand washing facilities, supplement of masks, gloves, caps, and gowns during CVC insertions, and maintenance care. Moreover, it may also be attributed to nursing staff shortage, nursing work overload in intensive care unit, the time constrains of having to connect or disconnect a large number of patients within a limited time, and lack of knowledge and awareness about CVCs care as a result of a lack of training programs, as our findings illustrated.

The current study results are in accordance with the findings of study held by **Ferrara, & Albano, (2018)** who found that guideline recommendations for routine CVC care are not always followed. In addition, **Aloush, & Alsaraireh, (2018)** revealed that the overall level of nurses' compliance with the recommended evidence based practice (EBP) during CVC insertion in their study was less than half, which is considered low. Less than half of nurses observed followed the maximal sterile barrier precautions during CVC insertion.

The findings of the present study are similar as those reported by **Mohamed, et al., (2019)** who studied nurses during care of CVC in ICUs in 15 developing countries and found that less than half of them used maximal sterile barrier precautions during the insertion of CVCs. The low percentages of nurses' adherence to maximal sterile barrier precautions in the present study could be attributed to several reasons, including inadequate knowledge about the importance of maximal sterile barrier precautions for nurses during CVC insertion and prevention of infection, where the healthcare workers' knowledge about infection prevention guidelines was generally low.

Nakagami, et al., (2018) reported that teaching programs for nursing staff play an important role in assisting staff nurses in developing and enhancing their skills needed to provide high standards of care to their patients. This agreed with the present study

as nurse's knowledge and practice improved after implementation of the nursing educational program.

Barton, et al., (2018) in the same line with the current study findings, their study revealed that an improvement in nurses' practice after the attendance at continuing nursing education sessions. Research findings indicated that continued nursing education programs increase knowledge, practice and can also improve attitudes.

Wojnar, & Whelan, (2017) reported that teaching programs for nursing staff constitutes an important part. These programs are urgently designed to assist staff nurses in developing and enhancing their skills needed to provide high standards of care to their patients. This agreed with the present study as nurse's knowledge and practice improved after implementation of the nursing intervention protocol.

Conclusion:

Based on the results of the current study, it can be concluded that:

A significant improvement in the knowledge and practice of critical care nurses regarding central venous catheter after educational program was noted.

Recommendation:

Based on the results of the current study, the following recommendations were suggested:

1. Continuous training programs for critical care nurses to keep up with updated knowledge and evidence-based practice.
2. Include central venous catheter bundle of care in the routine care of critically ill patients.
3. Provide all ICUS with the CVC Bundle guidelines hardcopy to facilitate and help nurses to review any times.

References:

- **Almutairi, W., & Ludington-Hoe, S. (2016):** Kangaroo care education effects on nurses' knowledge and skills confidence. *The Journal of Continuing Education in Nursing*, 47(11), 518-524
- **Aloush, S., & Alsaraireh, F. (2018):** Nurses' compliance with central line associated blood stream infection prevention guidelines. *Saudi Medical Journal*, 39(3), 273.
- **Aysha, Z., & Ahmed, S. (2019):** The Effect of Implementing Clinical Alarm Nursing Intervention Program on Nurses' Knowledge, Practice and Patient Outcomes at Intensive Care Unit. *American Journal of Nursing Research*, 7(5), 824-835.

- **Barton, G., Bruce, A., & Schreiber, R. (2018):** Teaching nurses teamwork: Integrative review of competency-based team training in nursing education. *Nurse education in practice*, 32, 129-137
- **Bayoumi, M., & Mahmoud, N. (2017):** Effect of education program on nurses' knowledge and practice regarding care of central venous line in pediatric hemodialysis: evidence-based practice guidelines. *Egyptian Nursing Journal*, 14(2), 87.
- **Deborah, L., Horner Mark C Bellamy, (2012):** Care bundles in intensive care, *Continuing Education in Anaesthesia, Critical Care & Pain* Volume 12 Number 4, Published by Oxford University Press on behalf of the British Journal of Anaesthesia.
- **De Jonge, S., Boldingh, Q., Solomkin, J., Dellinger, P., Egger, M., Salanti, G. & Boermeester, M. (2019):** Conference on Prevention & Infection Control (ICPIC 2019). *Antimicrobial Resistance and Infection Control*, 8(1), 148.
- **Donald L. Miller, & Naomi P. O'Grady (2012):** Guidelines for the Prevention of Intravascular Catheter-related Infections: Recommendations Relevant to Interventional Radiology for Venous Catheter Placement and Maintenance, clinical practice guidelines, society of Interventional Radiology, 2012; Published by Elsevier Inc.; 23:997–1007.
- **Earan, S., Dhandapani, L., Arunagirinathan, A., & Kantamneni, S. (2016):** Clinical Spectrum and Epidemiological Profile of Patients Admitted to Pediatric Intensive Care Unit at a Tertiary Care Centre in South India. *International Journal of Scientific Study*, 4(3), 187-191.
- **Fathy MH, ElTouny, M. & Nagy, N. (2010):** Central Venous Catheter Microbial Colonization in relation to Insertion and Care Practices in Intensive Care Units of Ain Shams University Hospital. *International Conference on Healthcare- Associated Infections*.
- **Ferrara, P., & Albano, L. (2018):** The adherence to guidelines for preventing CVC-related infections: a survey among Italian health-care workers. *BMC infectious diseases*, 18(1), 606.
- **Flodgren G, Conterno LO, Mayhew A, Omar O, Pereira CR, & Shepperd S (2013):** Interventions to improve professional adherence to guidelines for prevention of device-related infections. *Cochrane Database Syst Rev.*; (3): Cd006559.
- **Frederick, S., (2020):** Infectious Diseases: A Clinical Short Course, 4th Edition, Cardiovascular infections, USA, P196- 197
- **Ghezalje, T., Aliha, J., Haghani, H., & Javadi, N. (2019):** Effect of education using the virtual social network on the knowledge and attitude of emergency nurses of disaster preparedness: A quasi-experiment study. *Nurse education today*, 73, 88-93.
- **Infection Control Prevention Egypt Program (2016):** Center of Disease Control, National Guidance for Infection Control, second edition, 2016, p 52-53.
- **Jones, C., Stewart, C., & Roszell, S. (2015):** Beyond best practice: Implementing a unit-based CLABSI project. *Journal of Nursing Care Quality*, 30(1), 24-30. doi:10.1097/NCQ.0000000000000076.
- **Koutzavekiaris, I., Vouloumanou, E., Gourni, M., Rafailidis, P., Michalopoulos, A., & Falagas, M. (2011):** Knowledge and practices regarding prevention of infections associated with central venous catheters: a survey of intensive care unit medical and nursing staff. *American journal of infection control*, 39(7), 542- 547.
- **Leistner R1, Hirsemann E, Bloch A, Gastmeier P, & Geffers C. (2014):** Costs and prolonged length of stay of central venous catheter-associated bloodstream infections (CVC BSI): a matched prospective cohort study. *Infection*; 42(1):31-6.
- **Maha Talaat, Mona El-Shokry, Jehan El-Kholy, Ghada Ismail, Sara Kotb, Soad Hafez, Ehab Attia, & Fernanda Lessa, (2016):** National surveillance of health care-associated infections in Egypt: Developing a sustainable program in a resource-limited country. *American Journal of Infection Control* 44- 1296-301.
- **Mohamed, W., Altayeb, A., Mohamed, N., & Hussein, A. (2019):** Auditing and Re-auditing Nursing Care for Children Undergoing Central Venous Line Insertion in Pediatric Intensive Care Unit. *Assiut Scientific Nursing Journal*, 7(17), 141-151.
- **Mohammed, S., & Yousif, K. (2017):** Effect of Health Educational Program On Nurses Knowledge & practice Regarding Infection Control in Neonatal Intensive Care Unit at Pediatric Hospitals in Khartoum State, Sudan .
- **Nakagami, Y., Kubo, H., Katsuki, R., Sakai, T., Sugihara, G., Naito, C. & Hashimoto, N. (2018):** Development of a 2-h suicide prevention program for medical staff including nurses and

medical residents: A two-center pilot trial. *Journal of affective disorders*, 225, 569-576.

- **Naomi P. O'Grady, Mary Alexander, Lillian A. Burns, Patchen Dellinger, Jeffery Garland, Stephen O. Heard, Pamela A. Lipsett, Henry Masur, Leonard A. Mermel Michele L. Pearson, Issam I. Raad, Adrienne Randolph, Mark E. & Rupp, Sanjay Saint, (2011):** the Healthcare Infection Control Practices Advisory Committee (HICPAC). Guidelines for the Prevention of Intravascular Catheter-Related Infections, *Clin Infect Dis* 2011; 52:e162–e193.
- **O'Grady, N., Alexander, M., Burns, L., Dellinger, P., Garland, J., Heard, S., Lipsett, P., Masur, H., Mermel, L., Pearson, M., Raad, I., Randolph, A., Rupp, M.E., & Saint, S., (2017):** The Healthcare Infection Control Practices Advisory Committee (HICPAC).
- **Guidelines for the prevention of intravascular catheter-related infection:** Updated recommendations on the use of chlorhexidine-impregnated dressings for the prevention of intravascular catheter-related infections. <https://www.cdc.gov/infectioncontrol/guidelines/bsi/c-dressings/index.html>.
- **Peris Kiarie, Heikki Elillä & Mari Lahti, (2011):** Aspects on patient safety in intensive care unit, Turku University of applied sciences, Degree program Nursing Completion of the thesis, 48, p 6.
- **Rajamani, S. (2019):** A True Experimental Study to Evaluate the Effectiveness of Structured Teaching Programme on Knowledge Regarding III-Effects of Alcohol Consumption among Adolescents in Selected Senior Secondary School at Panipat Haryana. *International Journal of Nursing Education*, 11(4), 24-28.
- **Tarango, C., Kumar, R., Patel, M., Blackmore, A., Warren, P., & Palumbo, J. (2018):** Inferior vena cava atresia predisposing to acute lower extremity deep vein thrombosis in children: A descriptive dual-center study. *Pediatric Blood & Cancer*, 65(2), e26785.
- **The Joint Commission (2013):** Preventing Central Line–Associated Bloodstream Infections: Useful Tools, An International Perspective. Nov 20, 2013. Accessed <http://www.jointcommission.org/CLABSIToolkit>
- **Ugas MA, Cho H, Trilling GM, Tahir Z, Raja HF, & Ramadan S, (2012):** Central and peripheral venous line-associated blood stream infections in critically ill surgical patients. *Ann SurgInnov Res*; 6 (1):8.
- **Vidhya, S. (2019):** Isolation and Phenotypic Characterisation of Bacterial Isolates from Catheter related Blood Stream Infections in Patients on Hemodialysis in a Tertiary Care Hospital (Doctoral dissertation, Coimbatore Medical College, Coimbatore.
- **Wojnar, D., & Whelan, E. (2017):** Preparing nursing students for enhanced roles in primary care: The current state of prelicensure and RN-to-BSN education. *Nursing outlook*, 65(2), 222-232.
- **Xiaoli, G. (2012):** Central venous access sites for the prevention of venous thrombosis, stenosis and infection. *The Cochrane Library of systematic review*;3: doi: 10.1002/14651858.CD004084.pub3