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## Impact of Simulated Education program on Nurses' Performance of Invasive Procedure at Intensive Care Units: Evidence Based Practice

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**Abstract:** Inadequate nurse's knowledge and poor skills associated with negative outcome. EBP help CCNs to apply invasive procedure safely at ICU through simulated education. Aim: To evaluate the impact of simulated education on nurses' knowledge and performance about invasive procedure at Intensive Care Units : evidence based practice. Subject and method: quasi-experimental design, purposive sample of all ICUs nurses, number were 65 nurses whom assigned to work at ICUs of Minia University Hospitals in Minia City, Egypt. Results: More than half of them (61.5%) were female and (38.5 %) male. The majority of them were new graduated less than 5 years of experience (81.6%). (100 %) of CCNs had unsatisfactory knowledge about EBP and ideal performance of invasive procedures before education, after it their knowledge improved to (87.7%) and (84.6) at post and follow up program. After educational program the majority of CCNs apply invasive procedure using EBP satisfactory at the post program and follow up program phase. There were a statistically significant improvement of CCNs mean score in all dimensions related to general performance post program and follow up program. Conclusion: There were a positive correlation between EBP knowledge, procedural intervention and general performance after the simulated education program.

**Keywords:** Education- Evidence biased - Invasive Procedure- Intensive Care Units –Simulated.

### INTRODUCTION

Professional nurses play a necessary role in improving health care globally. Critical care nurses (CCNs) provide comprehensive care and support for patient at intensive care unit (ICU) from the time of admission till discharge. The performance of health care staff, including professional nurses in ICU, link directly and closely to the productivity and quality of care provision within health care organizations. ICU can be pointed as one of the most stressful and necessary location in hospitals for nurses especially for the newly graduated group whom never worked at it previously (Chamberlain, et al 2017).

Awases (2013) denoted that, performance means the current manner of activities to achieve responsibilities according to standards. It is a signal of what is done and how well it is done. In addition, it refers as accomplishment in a productivity of system in the form of service or goods. A growing body of evidence signalize that inadequate nurse's preparation of knowledge and unsatisfactory skills mix are attached with negative outcome especially for critical ill patients (American nurses credentialing center, 2014)

Evidence-based practice (EBP) is a vital part of enhancing critical care nursing practice, which is essential for providing high quality of care to patients. EBP is defined as a problem-solving approach to the delivery of healthcare that incorporates the best available evidence, clinicians' expertise, patient values and preferences. Many researchers suggest that establishing EBP leads to higher quality of care, reduces costs and complications (Craig, J. V., & Smyth, R. L., 2011).

EBP is required due to rapidly changing environment, also professional knowledge and skills is becoming increasingly complex and specialization. Many hospitals now spent almost all the training budgets on formal courses that targeted at improving knowledge of EBP of their personnel in order to improve their performance and better patient outcomes (Badu-Nyarko, 2015).

Health care associated infection in ICU considered one of the most common complications that resulted from a variety of causes, (1)" lower level of knowledge about EBP, (2) the instrumentation procedures required to preserve patient's life and (3) the low level of up-to-date applied research practice. Thus, it is not possible to lower the rate of health care-associated infections merely by limiting the use of invasive procedures (Pottier ,et al., 2012).

De Lima, et al. (2013) reported that EBP strategies will help CCNs to apply many invasive procedure safely at ICU to reduce complications and coast. CCNs can follow EBP during "endotracheal tube (ETT) insertion, care and suctioning this strategies will include following ideal steps in performing routine hand hygiene, and during open suction, oral hygiene using chlorhexidine, etc (Khalil, N. S., 2018). To prevent central venous catheter (CVC) infection the CDC since 2014, published a number of EBP recommendations that help CCNs in reducing its occurrence, this recommendations included EBP for CVC insertion, optimal measurement technique, and skin dressing for the insertion site (Health ,et al., 2014).

Furthermore, (Galiczewski & Shurpin, 2017) explored that, catheter associated urinary tract infection can be prevented through a published EBP strategies that include: perineal care using disinfection solution, using single sterile catheter and daily necessity review to decrease catheter days, all of these EBP designed to diminished ICU nosocomial infection rates and improves patients outcomes (Health ,et al., 2014).

American nurses credentialing center, (2014) stated that an ideal demonstration and re-demonstration of the invasive procedures using simulation technique followed by real time patient's application by skilled trainers about EBP, this will provide the novice graduated nurses with confidence, trust and competence during their patient management. Genuino, (2018) and (Kim, et al 2012) stated that using simulation in nursing education can positively improve newly graduated nurses' self-confidence, clinical reasoning, knowledge, and skills as opposed to those who only receive traditional teaching strategies.

Eastaugh (2002) added that health care agencies cannot improve and success without productive nursing staff. The performance of health staff depends not only on their competence (knowledge, skills) but also the availability of infrastructure, equipment and support systems, such as, information systems, resources and accountability systems that are in place as well as on their motivation and job satisfaction (Monil&Tahir, 2011). So that Awases (2013) described that improving the productivity and performance of health care workers is a must to ensure that health interventions are efficiently delivered which continues to be a main challenge today.

## SIGNIFICANT OF THE STUDY

Nursing in Egypt faces many challenges and working conditions in health care settings are generally poor. Little is known about the needs of CCNs in Egypt. The literature focuses on the first year of practice and only a small body of research has explored the transition needs within ICU (Gorman & McDowell., 2018)

In our hospitals researchers observed that CCNs whom assigned to work in ICUs had low level of knowledge and skills about EBP. They had deficient knowledge about side effect of many procedures if performed without following the ideal steps of infection control. Large number of them did not have any knowledge about EBP that should be followed to prevent nosocomial infection, also almost of them needs training about the ideal techniques of applying ICU invasive procedures. On the other hand low level of knowledge and practice of the CCNs in our ICUs leads to increased rates of nosocomial infection to be more than 70% with increased mortality rates. Therefore, the current study will provide evidence for conducting simulated educational program to improve CCNs' performance about following EBP during invasive procedure.

## AIM OF THE STUDY

To evaluate the impact of simulated education on nurses' performance about invasive procedure at Intensive Care Units: evidence based practice.

## RESEARCH HYPOTHESIS

The current study hypothesized that: Implementing simulated educational program will improve CCNs performance of invasive procedure following EBP at ICUs.

## SUBJECT AND METHOD

### *Design:*

A quasi-experimental design used to fulfill the study (pre/post-test design).

### *Setting:*

The study was conducted at Minia University Hospitals in Minia City, Egypt.

### *Subject:*

Purposive sample included all nurses whom assigned to work in the following ICU (trauma ICU, cardiology ICU, chest ICU, Urology ICU, and medical ICU), their number were 65 nurses. CCNs agreed to participate in the study because they didn't receive any education programs using the simulator about following EBP during invasive procedure at ICU.

### *Tools of the study:*

Three tools were used for collecting data in this study.

### *1. Nurses knowledge assessment questionnaire included two parts:*

*1st part:* Participants' socio-demographic data as name, age, sex, education level and working years at ICUs.

*2nd part:* Structured multiple choice questionnaire (pre/posttest) developed by the researchers after reviewing the related literatures (Gould, et al 2010), (Klompas, et al 2014), and (Marschall, et al 2014): This tool used to evaluate knowledge level of CCNs about EBP and invasive procedure.

Questions were developed to test the following items: 1. Definitions of (EBP, invasive procedures as endotracheal tube insertion, suctioning, central venous catheter, urinary catheter, and nosocomial infection, etc) (10 questions). 2. The most common items of EBP should be followed during the application of invasive procedures (10 questions). 3. CCNs role during the application of EBP as (ETT insertion and care, suctioning, central venous catheter care and urinary catheter insertion and care) (10 questions). 4. Clinical manifestations of various nosocomial infection conditions that will occur as a result of invasive procedures (10 questions).

The questionnaire scorings system for each correct answer scored (1) and the wrong one scored (zero). If the score less than 60% it considered unsatisfactory, but if its 60% or more it considered satisfactory.

*2. Nursing practice check list:* developed after reviewing the related literatures (Gould, et al 2010), (Klompas, et al 2014), (Marschall, et al 2014)and (Pamela, 2014).

- This tool consisted of standardized EBP steps that should be followed during the application of the following invasive procedure: ETT insertion and care, oral hygiene of intubated patients, ETT suction, urinary catheter insertion, and care,

CVC monitoring steps and CVC maintenance and insertion site care.

Scoring system of the practice check list was: correctly done (scored 1), in-correctly done (scored 0). If the nurses practice score was less than 60% from the total it considered unsatisfactory but if its 60% or more it considered satisfactory.

**3. Nurses performance scale:** This tool was developed by (Schwirian, P.M., 1978). It consisted of six dimensions include" assessment, planning, nursing care, teaching/ collaborating, teaching & communication and evaluation" to assess levels of activities in which nurses engage with varying degrees of frequency and skills among them in previous mentioned settings.

#### **Procedures:**

##### **Preparation phase:**

**Pilot study** was carried out on 10% of CCNs to test the applicability of the study and to test clarity of the designed questionnaire. As well as to estimate the time needed for each question. The internal consistency of CCNs knowledge assessment questionnaire achieved significance ( $P < .001$ ) and Cronbach's alpha coefficient of 0.86.

Ethical considerations: researches approval was obtained from the faculty of nursing research ethics committee before initiating the study. The researcher clarified the purpose and aim of the study to all ICU nurses included in the study. Oral consent was obtained from CCNs to ensure willingness to engage in the study. Researcher maintained anonymity and confidentiality of subjects' data. Nurses were informed that they are allowed to withdraw from the study at any time without penalty.

The study was conducted within the period from January 2018 to September 2018. Researchers developed the simulated education program based on the previous assessment of CCNs knowledge, skills, available resources and review of relevant literature related to applying EBP during invasive procedure at ICU. Permission from the faculty of nurses and hospital responsible authorities and ICUs head nurses to conduct the study was obtained after explanation of the aim of the study.

Learning environment: The educational program was conducted firstly at hospital teaching class on the theoretical explanation of the EBP and the invasive procedure. After that researcher uses the faculty clinical lab to apply simulated education using simulation manikin then trainers transferred to real situation evaluation in their selected ICUs at their hospitals.

Educational methods: PowerPoint presentation, prepared by the researchers after reviewing the related literatures (Gould, et al 2010), (Klompas, et al 2014), and (Marschall, et al 2014) it include definition, purposes, and aim of EBP. the recommended EBP steps used during applying the most used invasive procedure at ICU (ETT insertion, care, suctioning, urinary catheter insertion and care and CVC monitoring and care) the EBP preventive measures that should be followed during their application to

prevent its complications and infection. These items were developed in English by the researchers based on reviewing the related literature.

Booklet was developed by the researchers in English language included the previously mentioned items that presented in the power point and provided to the participants before the education program. Videos presents the ideal procedure steps and the application of the various EBP.

Simulation manikin used to help CCNs demonstrate and re-demonstrate the related invasive procedure following EBP. The manikin provide the opportunity to demonstrate Oral hygiene, ETT care, suctioning, urinary catheter insertion, care and irrigation. CVC measurement and insertion site care according to EBP.

##### **Implementation phase:**

1) Arranging the subgroup: For better understanding and performance, the total sample was divided into 6 groups (five included 10 nurses and one group included 15 nurses) each group include about one or two nurses form each unit which present about one third of the manpower at the ICU to not affect the patient care at the ICU day.

2) A pre-test questionnaire (tool 1) was used at beginning of study to assess their knowledge level before beginning of the study to be used as base line data to be compared with the post-test. The pre-test was present to them in their units during their shift.

3) Assessment of CCNs practice and performance (tools 2-3) during applying invasive procedures at ICU were observed by the researchers once before implementation of simulated education during their ICU shifts. This was done for the previously mention invasive procedures and used as base line for latter comparison with future posttest and follow up test.

4) Divide the education program into different sections.

1. Theoretical explanation was done at the hospital class. Theoretical explanation was done on 18 sessions 3 session for each group of nurses to cover the previously mentioned items that illustrated in the booklet. The booklet was handed for every CCNs. The duration of each session was 2 hours. Each session divided as 10 minutes for discussion, 120 minutes for the theoretical explanation using the PowerPoint presentation, then 30 minutes of discussion and video presentation of the related procedure.

2. Clinical demonstration and re-demonstration of the EBP steps of invasive procedures were done at the faculty clinical lab. Three clinical lab sessions were done for each group about the previous mentioned invasive procedure. This sessions were done using the simulation manikin within 2 hours and half divided 1 hour of researchers demonstration of the procedures. The second hour included the trainers re-demonstration of the procedures following an EBP steps. The rest 30 minutes included the summary of the procedures and discussion for any question that may rise.

3. After the faculty lab sessions, trainers transferred to another 6 sessions at the ICUs of Mina university hospitals, 2 hours for each which provide the trainers with real time

demonstration and re-demonstration under the researchers supervision at their ICUs to provide trainers with trust and ensure competent at applying of the procedures for their critically ill patients.

**Evaluation phase:**

After ending of the simulated educational program, evaluation of CCNs knowledge was done using the post test questionnaire immediately after ending of the educational program and follow up evaluation was done after three months. The result of it was compared with the pre- test questionnaire (*part two in tool 1*).

Evaluating the effect of the simulated educational program on CCNs performance of EBP during applying invasive procedures were done using (*tool 2 and 3*) immediately after ending of the educational program, then follow up was done after three months, this done during their shifts at their ICU.

**RESULTS**

**Table (1): Distribution of nurse according to their demographic data (N=65).**

Characteristics	(N=65)	%
<b>Age</b>		
20-25 years	65	100
26-30years	0	0
<b>Sex</b>		
Male	25	38.5
Female	40	61.5
<b>Years of experience</b>		
Less than 5 years	53	81.6
5 to10years	12	18.4
<b>Units</b>		
Trauma ICU	10	15.4
Chest ICU	15	23.1
Cardiology care unit	10	15.4
Neurology ICU	9	13.8
Urology ICU	9	13.8
Cardiothoracic ICU	12	18.5

**Table (1):** CCNs age group were between 20-25 years. More than half of them (61.5%) were female. The majority of them were new graduated and having less than 5 years of experience (81.6%). ICU nurses included in the study worked in 6 different ICUs "Trauma ICU (15.4 %), Chest ICU (23.1%), Cardiology care unit (15.4%), Neurology ICU (13.8), Urology ICU (13.8) and Cardiothoracic ICU (18.5).

**Table (2): Frequency distribution of CCNs knowledge level about following EBP during invasive procedure (N=65)**

Items	Unsatisfactory (< 60%)		Satisfactory (≥60%)		Mean+SD
	N	%	N	%	
Pre educational knowledge (base line data)	65	100	0	0	15.91±6.66
Post education knowledge	8	12.3	57	87.7	38.55±11.14
Follow up knowledge	10	15.4	55	84.6	39.48±9.83
F					130.9
P					0.000**

**Table (2):** Represents that All nurses (100 %) had unsatisfactory knowledge about EBP and ideal performance of invasive procedures before receiving the educational program. But after it their level of knowledge improved to satisfactory level (87.7%) and at follow up program to (84.6).

**Table (3): Frequency distribution of CCNs application of EBP during invasive procedures (N=65).**

Items	Pre Program		Post Program		Follow-up		F	P
	Un satisfactory N= < 60 (%)	Satisfactory N≥60 (%)	Un satisfactory N= < 60 (%)	Satisfactory N≥60 (%)	Un satisfactory N= < 60 (%)	Satisfactory N≥60 (%)		
<b>1- Endotracheal tube (ETT) care</b>	45 (69.2)	20 (30.8)	0	65 (100)	4 (6.2)	61 (93.8)	107.3	0.000**
<b>Mean ±SD</b>	11.82 ±7.46		22.62 ±1.12		22.09 ± 3.22			
<b>2- Oral care for intubated patient</b>	55 (84.6)	10 (15.4)	2 (3.1)	63 (96.9)	8 (12.3)	57 (87.7)		
<b>Mean ±SD</b>	8.91± 6.28		22.82±2.50		21.65±3.91		190.1	0.000**
<b>3- ETT Suctioning</b>	45 (69.2)	20 (30.8)	6 (9.2)	59 (90.8)	8 (12.3)	57 (87.7)	55.95	0.000**
<b>Mean ±SD</b>	17.71±12.8		34.23±7.69		33.20±8.63			
<b>4- Urinary catheter insertion</b>	50 (76.9)	15 (23.1)	3 (4.6)	62 (95.4)	8 (12.3)	57 (87.7)		
<b>Mean ±SD</b>	16.31±9.64		31.80±5.50		30.32±7.33		80.49	0.000**

5- urinary catheter care	50 (76.9)	15 (23.1)	4 (6.2)	61 (93.8)	11 (16.9)	54 (83.1)	64.75	0.000**
Mean $\pm$ SD	12.69 $\pm$ 5.89		21.98 $\pm$ 3.87		20.62 $\pm$ 5.10			
6- CVC monitoring	55 (84.6)	10 (15.4)	7 (10.8)	58 (89.2)	6 (9.2)	59 (90.8)	112.8	0.000**
Mean $\pm$ SD	9.48 $\pm$ 3.34		15.09 $\pm$ 2.19		15.92 $\pm$ 2.29			
7- CVC skin site dressing and care	57 (87.7)	8 (12.3)	3 (4.6)	62 (95.4)	9 (13.8)	56 (86.2)	127.24	0.000**
Mean $\pm$ SD	11.18 $\pm$ 3.42		18.97 $\pm$ 2.43		18.28 $\pm$ 3.28			

Table (4) Frequency distribution regarding to performance of EBP among ICU nurses (N=65)

Items	Pre Program			Post Program			Follow-up			F	P
	ND N=(%)	DI N=(%)	DC N=(%)	ND N=(%)	DI N=(%)	DC N=(%)	ND N=(%)	DI N=(%)	DC N=(%)		
1-Assessment	61 (93.8)	4 (6.2)	0	0	3 (4.6)	62 (95.4)	0	5 (7.7)	60 (92.3)	354.1	0.000**
Mean $\pm$ SD	1.62 $\pm$ 2.42			19.54 $\pm$ 2.11			19.23 $\pm$ 2.68				
2-Planning	47 (72.3)	18 (27.7)	0	0	4 (6.2)	61 (93.8)	0	6 (9.2)	59 (90.8)	503.4	0.000**
Mean $\pm$ SD	2.49 $\pm$ 4.05			17.45 $\pm$ 2.18			17.17 $\pm$ 2.62				
3-Nursing care	47 (72.3)	18 (27.7)	0	0	3 (4.6)	62 (95.4)	0	4 (6.2)	61 (93.8)	590.4	0.000**
Mean $\pm$ SD	7.20 $\pm$ 11.72			50.80 $\pm$ 5.49			50.40 $\pm$ 6.29				
4-Teaching/ Collaborating	41 (63.1)	24 (27.7)	0	0	3 (4.6)	62 (95.4)	0	5 (7.7)	60 (92.3)	453.1	0.000**
Mean $\pm$ SD	2.95 $\pm$ 3.89			15.63 $\pm$ 1.69			15.38 $\pm$ 2.14				
5-Interpersonal relation/ Communication	47 (72.3)	18 (27.7)	0	0	1 (1.5)	64 (98.5)	0	5 (7.7)	60 (92.3)	629.1	0.000**
Mean $\pm$ SD	2.22 $\pm$ 3.60			15.88 $\pm$ 0.99			15.38 $\pm$ 2.14				
6-Evaluation	37 (56.9)	28 (43.1)	0	0	4 (6.2)	61 (93.8)	0	7 (10.8)	58 (89.2)	353.7	0.000**
Mean $\pm$ SD	1.72 $\pm$ 1.99			7.75 $\pm$ 0/96			7.57 $\pm$ 1.25				

N.B: \*ND: Not Done, \*DI: Done Incomplete, \*DC: Done Completely

**Table (3):** Shows only (30.8 %) of the ICU CCNs follow EBP steps during ETT care, (23.1%), urinary catheter insertion and care and Only (12.3) apply CVC skin site care according to an EBP technique. But after receiving the simulated educational program the majority of CCNs perform the previously mentioned procedure in satisfactory way at the post program and follow up program phase in high percentage there were statistical significant difference between the three different phases presented by P value (0.000).

**Table (4):** demonstrated that, the CCNs performance was generally "not done" by two third of percentage and the rest of percentage go to "done incompletely" at the pre- program phase. On the other hands, the majorities of them were "done completely" the activities related to general nurses performance after demonstrating the simulated educational program, post and follow up program. In addition table (4) shows that there were a statistically significant improvement

of CCNs mean score in all dimensions related to general performance post program and follow up program.

Table (5) correlation between knowledge, procedural practice and performance among CCNs (N= 65)

Variable	Knowledge	Procedural practice	Performance
EBP Knowledge	1	.291 .133	.627 .061
EBP procedure practice	-	1	.261 .179
Performance of EBP.	-	-	1

**Table (5):** Revealed that, there were a positive correlation between knowledge, procedural practice and CCNs performance after delivering of the simulated education

program about following EBP during invasive procedure.

## DISCUSSION

CCNs facing many challenges during providing nursing care for critically ill patients. The number of challenges increases if the level of experience was low and also if the CCN was novice graduated and did not have the needed experience at ICU (Morton & Fontaine 2015).

El-Soussi & Asfour (2017) stated that new graduated nurses whom assigned to work at ICU needs enough preparation and educational support about the EBP in order to limit the occurrence of ICU infection rates and to overcome the number of challenges.

The present study shows the impact of simulated educational program on improving Nurses' performance of invasive procedure at intensive care units: Evidence based practice.

The present study was applied on the following CCNs whom had the related demographic characteristics. (61.5%) of them were female, and (81.4 %) of them had less than 5 years' experience. The decrease in the experience years will have a negative effect on their performance level which intern affect their patient care delivery system if not supported with continuing educational program to re-enforce them. The present study found at the pre-program phase that (100 %) of CCNs had unsatisfactory knowledge level about following EBP during invasive procedure at ICU.

Also their mean score and standard deviation that presents their knowledge score were also lower at the pre-program phase ( $15.91 \pm 6.66$ ). But after the application of the simulated educational program their knowledge mean score and standard deviation was significantly improved to ( $38.55 \pm 11.14$ ) and ( $39.48 \pm 9.83$ ) at the post and follow up of the program phases.

This result prove a picture that CCNs did not have enough education and training about the EBP. Also new graduated CCNs provide patient care according to their previous education studies and the personal experience of the older nurses at ICU and head nurses whom did not have chance of knowledge about the updated EBP and ideal procedure steps that related to patient care.

The present study was in line with (Ali, 2013) whom stated that all CCNs, irrespective of their different educational levels, years of experience or area of work had unexpectedly unsatisfactory (90%) knowledge level about ventilator associated pneumonia (VAP) EBP prevention. The researcher suggested that majority of nurses in this part acquire their knowledge of taking care of critically ill patients from their basic educational programs, or from hospital policies and procedures.

Jain, et al (2015) stated that doctors and nurse had suboptimal knowledge level about urinary catheter preventive EBP strategies. Furthermore (Bayoumi & Mahmoud, 2017) found in their study that "evaluated the effect of evidence-based practice educational program on nurses knowledge and performance about CVC maintenance and care", the result explored that, less than half of nurses

had knowledge about CVC and CVC EBP strategies; but after the provision of the education program vast majority of them had improvement in their knowledge score immediately and 6 months after EBP strategies implementation with highly statistically significant difference ( $P \leq 0.00$ ). In the similar spirit, (Rojjanasrirat, & Rice, 2017) stated in their study that "evaluate the changes of nurses knowledge, attitudes, and Practice about EBP", they found that nursing students' mean post-test scores for knowledge, attitude and practice of EBP were significantly higher than the mean pre test scores.

The majority of CCNs were unsatisfactory apply the related invasive procedure at the pre-program phase and did not follow the EBP during the performance of ETT care, urinary catheter insertion, care, and CVC monitoring and care. But after receiving the simulated educational program the majority of staff nurses had significant and satisfactory implementation of the ICU invasive procedure and follow the EBP at the post program and follow up phase.

The results of the study conducted were in line with (Behzadi, et al., 2018) are in agreement with the present study and found that applying an educational program for CCNs about following EBP during oral hygiene for mechanically ventilated children, had statistical significant improvement in the intervention group that received the educational program ( $P$  value  $< 0.05$ ) and have a positive effect on the patient outcomes. However, there was no statistically significant difference between the mean performance scores of the control group before and after the implementation of the education program ( $p > 0.05$ ).

In addition, (Crowe, et al., 2018) agreed with the present study and found that knowledge using simulation as a form of education for CCNs provided an environment that allow them to explore and critically think through deteriorating cases, resulting in increased knowledge and confidence of nurses to the patient's condition and needs. (Turkelson & Keiser, 2017) stated that demonstrating of standardized EBP checklists linked with repetitive simulations education improved CCNs involvement to critical safety practices of invasive procedure as well as sufficiency and self-confidence for caring of the critical ill patients.

(Lin, et al., 2011) stated that encouraging nurses to learn more about EBP using diverse educational resources will enhance their knowledge and improve their practice.

(Sodhi, et al, 2013) concluded that CCNs had fairly good knowledge level about ICU EBP infection prevention and also stated that educational programs on its control and standard must be included in ICU.

The current study showed that mean scores of CCNs were a statistically significantly improved post program and follow up program than preprogram in all dimensions related to general performance of EBP. This finding due to attending of the simulated educational program about invasive procedure; this improves knowledge and skills for all dimensions related to general performance of staff nurses which include "assessment, planning, nursing care, teaching

/collaborating, interpersonal relation/communication and evaluation".

This is consistent with a study of (Kim, & Shin., 2017 & Mabrouk, 2009) whom found that nurses had unsatisfactory knowledge and skills before training program, which reflected on their level of performance in the hospital which was unacceptable. While knowledge levels and skills had improved after education program and had become satisfactory this in turn resulted in higher performance of staff nurses.

Also (Tefaye, et al, 2015) revealed that competent, motivated and skilled health care providers are cornerstone for better performance of health care organization. The present study clarified that, there were a positive correlation between knowledge, procedural practice and performance after delivering of the simulated education program. This study was supported by (Fort & Voltero, 2004) which stated that nurses perceived knowledge, skills and feedback on performance appraisal had positive relation with EBP performance.

## CONCLUSION

The findings of the current study revealed presence of a positive correlation between knowledge, procedural application and EBP performance after delivering of the simulated education program.

## RECOMMENDATIONS

Based on the study findings the following recommendations are suggested:

- There is a need for a continuous planned education and training program offered on regular basis for CCNs to improve their knowledge, practice, performance toward following EBP in invasive procedure.
- Head nurse or nurse supervisor should be trained on objective assessment and evaluation of their in unit nurses about EBP.
- Head nurse or nurse supervisor should receive EBP education and training about the recent knowledge and skills to transfer it to their nurses at the ICU through teaching sessions or programs.
- Head nurse or nurse supervisor should create EBP environment at the ICU to be reflected on their patient care.

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