Effect of An Educational Program on Critical Care nurse's Knowledge and Practice Regarding Complications of Pulmonary Embolism

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Abstract: **The aim of this study was to evaluate effect of an educational program on critical care nurse's knowledge and practice regarding complication of pulmonary embolism. A quasi-experimental research design with pre and post-test assessment was used on 75 participants of nurses working in the medical, surgical, and emergency ICU at Al-Thawra Modern General Hospital Authority in Sana'a - Yemen. Tools utilized for data collection were nursing questionnaire sheet was used to assess nurse's knowledge, an observation checklist for their practice. The results showed marked deficiencies in nurse's knowledge and practices before the program, with statistically significant differences improvements at the post and follow-up evaluations (P<0.000). Conclusion: there was statistical significant difference between the nurse knowledge and practice in pre/post and follow up implementing the program. Therefore, a relatively short-term in service training programs for all nurses working in the medical, surgical and emergency ICU department is implemented to enable nurses to update their knowledge and practice.**

Keywords: **Educational Program; Pulmonary Embolism; Complication.**

1. INTRODUCTION

Pulmonary embolism is the most important emergency in the cardiovascular system with a high rate of mortality without appropriate treatment *(Karaaslan et al., 2018).* Pulmonary embolism occurs when an embolus breaks off a thrombus (blood clot) in a vein and occludes blood vessels of the pulmonary artery tree. *(Huisman et al., 2018).*

Pulmonary embolism (PE) develops when a blood borne substance lodges in a branch of a pulmonary artery and obstructs flow. A common source of PE is deep vein thrombosis (DVT). Other sources are air from intravenous infusions, fat from long-bone fractures, and amniotic fluid. The size and location of the emboli determine the severity and outcome of the condition *(Lewis et al., 2014).*

High blood pressure within the pulmonary circulation (pulmonary hypertension) may result from arterial occlusion and lead to right ventricular failure. This occurs because the right ventricle is unable to push blood into the occluded artery. As a result, the contraction becomes weak, cardiac output falls, and the patient becomes hypotensive *(Williams & Hopper, 2019).*

Prevention of thrombi in the deep veins of the legs is the most important factor in the prevention of a pulmonary embolism. Regular ambulation is advised if the patient is able. If a patient is at risk for DVT or PE, low-dose

subcutaneous heparin or enoxaparin, oral warfarin (Coumadin), or intermittent compression stockings are used to prevent thrombus formation. If a DVT is diagnosed, prompt treatment is essential to prevent PE *(Williams & Hopper, 2019).*

Assess the abrupt onset of pleuritic chest pain for location, duration, severity, and character. Assess lung sounds, monitor pulse oximetry, vital signs, jugular veins for distention, peripheral pulses, and capillary refill. Encourage deep breathing and provide supplemental oxygen as ordered. Monitor results of activated partial thromboplastin time, International Normalized Ratio, prothrombin time, hemoglobin, and hematocrit. Do not massage site if DVT has occurred *(Lewis et al., 2014).*

Significance of the Study:

Despite all advances in the management of pulmonary embolism, the morbidity and mortality rates are increasing. Both the nurse as well as patients play a pivotal role in the under-treatment and mismanagement of the disease. This causes concern in the field of pulmonary embolism complication care. Unless the patient possesses basic knowledge about the ailment and its management, there is no likelihood to make the best use of the available facilities. However, the nurses play a vital role in preventing pulmonary embolism complication or decreasing its severity focusing on the strategy for prevention and control of asthma in order to reduce the disability and mortality. Thus there's a serious need for a nursing education program to provide and improve basic nurses' knowledge and practice for the care of patients with pulmonary embolism and prevention of complications. Therefore, for these reasons, there is a clear need to more effectively educate a nurse with regard to complication pulmonary embolism prevention.

Aim of the Study:

This study was aiming to evaluate the effect of an educational program on critical care nurse's knowledge and practice regarding the prevention of pulmonary embolism complication at Al-Thawra Modern General Hospital Authority in Sana'a - Yemen.

Research Hypothesis:

For fulfilling the aim of this study, the following hypothesis was formulated: There will be positive changes in nurses' knowledge and practice after implementing the educational program on nurses' knowledge and practice regarding prevention of complication pulmonary embolism at intensive care unit at Al-Thawra Modern General Hospital Authority in Sana'a- Yemen.

2. SUBJECTS AND METHOD

Research Design

A quasi-experimental study design was used for the conduction of this study.

Setting

The study was conducted at the intensive care unit and emergency care unit at Al-Thawra Modern General Hospital Authority in Sana'a- Yemen.

Subject

The study involved all available nurses' worked at the intensive care unit at Al-Thawra Modern General Hospital Authority in Sana'a- Yemen about (75 nurses).

The tool of data collection

Tool I: Knowledge nurses assessment tool:

It was developed by the researcher based on the review of recent related literature *(Hinkle & Cheever, 2017; Morton & Fontaine, 2017; Urden et al. 2014)* It was written in simple Arabic language for to assess the nurses' knowledge regarding nursing care provided to prevention of complication pulmonary embolism (pre/immediately post & post three months program implementation). It included two parts:

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Part (A): Socio-demographic characteristics:

It Included items related to demographic characteristics of the studied nurses such as age, gender, marital status, level of education, years of experience and attending training program related to prevention of complication pulmonary embolism.

Part (B): Structured Interview Questionnaire:

Nurses' knowledge about prevention of pulmonary embolism complication, which included 25 questions as (complication, side effect medication of treatment, prevention of complication pulmonary embolism nursing care and health prevention of complication P.E.).

Scoring system for knowledge: each correct answer scored one grade and score zero for an incorrect response. The total score level for the questionnaire sheet was 63 score. The total level of knowledge was categorized as follows: **satisfactory level** for a value equal to or more than 75% ($\geq$ 48 scores) or **unsatisfactory level** for a value less than 75% less than 48 scores).

Tool (II): Nurses Practice assessment tool by using the observation checklist:

This sheet used in pre/ immediately post and post 3 months implementing an observational checklist sheet was constructed after reviewing related literature *(Hinkle & Cheever, 2017; Wilkinson et al. 2016; Burton & Ludwig 2015).* This checklist was developed and modified by the researcher to assess nurse's practice about the prevention of pulmonary embolism complications. The tool covered all steps procedure of nursing care for a patient with pulmonary embolism. The observational checklist comprised of 164 steps as follows:

a. Intensive spirometer procedure which including 13 steps.

b. Deep breathing exercise procedure which including 12 steps.

c. Improving tissue perfusion which including 12 steps.

d. Administering and monitoring intravenous anti-thrombolytic medications which including 27 steps.

e. Elastic compression stocking procedure which including 23 steps.

f. Education patient self-care which including 16 steps.

Scoring system for nurse's practice: it was scored by giving two scores if the step procedure was done correctly, one score if the step was done incorrectly and zero if the step was not done with total score of 206, then it was categorized as **satisfactory** level for value equal to or more than 75% ($\geq$ 155 scores) or **unsatisfactory level** less than 75% (< 155 scores).

Method:

• An official permission to proceed with the proposed study was obtained from the head of the medical, surgical and emergency intensive care unit department as well as the hospital nursing director after explaining the aim and nature of the study.

• The tools were developed by the researcher based on the previous assessment of nurses' knowledge and practices. Available resources and reviews of relevant literature *(Hinkle & Cheever, 2017; Morton & Fontaine, 2018; Wilkinson et al. 2016; Burton & Ludwig 2015; Urden et al. 2014).*

Preparatory Phase

It included reviews of current and post local and international related literature, and theoretical knowledge of various aspects of the study using books, articles, and internet periodicals and magazines in order to develop the data collection tools.

Content Validity

It was ascertained by a Jury consisting of five experts of professors and lecturers in the field of critical care nursing and critical care medicine from Assiut University, who revised the tools for clarity, relevance, comprehensiveness, understanding and ease for implementation, according to their opinion modifications were applied.

Pilot study

The pilot study had been undertaken before starting the data collection phase. It was carried out on 10% of participants to test the feasibility and applicability of the first and second tools and to estimate the time needed to complete the tools according to the pilot study necessary modifications were done. The subjects included in the pilot study were excluded from the study sample.

Reliability: knowledge and practice about pulmonary embolism emergency care were established (Cronbach's Alpha >0.82). Internal consistency reliability for the observation checklist was established (Cronbach's Alpha >0.94).

Ethical Consideration

Explain the aim of the study to the directors of the intensive care unit to take their permission to start this study. Oral consent was taken from the study subjects after explaining the aims and nature of the study to them, and they were assured that the information collected would be treated confidentially and used for the research purpose only, and they have the right to withdraw from the study at any time.

Fieldwork description

The field study was conducted from the beginning of February (2018) to the end of July (2019). The study was carried out through the following phases:

1) Assessment phase

In this phase after the finalization of the tools, the researcher assessed nurses' learning needs using Tool II. Tool II was designed to assess nurses, knowledge related to the prevention of pulmonary embolism complications. The researcher introduced this Tool to each nurse and asked them to fill it out. The time taken to fill the tool was from 30 minutes to 60 minutes. Moreover, the researcher assessed the available place, time, equipment, supplies, and instructional materials for the conduction of patient care.

Assessment of clinical practices provided by nurses to the prevention of pulmonary embolism complications and their families were evaluated using tool II to determine the level of achievement of care practice. Direct observation was conducted by the researcher to appraise nurses' practical level; each nurse was observed by the researcher throughout the different shifts, on an average 8 hours a day- 4 days a week for one month using tool II, the researcher was filling out the observational checklists and was documented nurses' practices related to prevention of complication pulmonary embolism.

2) The program of the care development phase

The program of care was developed based on the identified needs and demands of nurses gathered in the assessment phase and review of related literature. This phase included the following;

Setting objectives

The aim of the program was to improve nurses' knowledge and practice related to the prevention of pulmonary embolism complications.

Preparation of the content

Content covered all areas about the prevention of pulmonary embolism complications.

Planning of action

In this phase, the researcher designed a plan for the program of care implementation.

Implementation phase

After official permission was taken from the concerned study setting. The researcher took the list of nurses who met the inclusion criteria. The participated nurses were divided into 15 groups, each consisted of five nurses. Each group was attended a conference room separately during the morning and afternoon shifts. The purpose and aim of the study were explained, then the researcher collects data about demographic characteristics using the tool (I). This session is considered

an introductory session. At the beginning of each session, a pretest related to the session content was provided to participants, followed by hands out. During the session, the researcher teaches the content in a clear, simple language using lectures, illustrative pictures and discussion giving feedback using positive verbal words. At the end of each session the researcher, close the session by summary for the main points. Posttest was at the end of the 3rd session using tool II. The practical sessions focused on the following items: assessment, how to perform procedures and demonstration of nursing care prevention of complication pulmonary embolism. divided as follows: each week involved two sessions (sixty minutes for each) in small groups about 10 nurses discussing with them in their working area to facilitate the meeting. Each session included displaying simple training videos for practical skills related to nursing care prevention of complication pulmonary embolism using audiovisual aids. Each nurse received the Arabic instructional booklet " prevention of complication pulmonary embolism." to attract her attention, motivate and support her learning and practicing.

Evaluation phase

The program of care was evaluated three times using the tool I and II to evaluate the studied nurses. First time: per-program implementation, second time after immediately, and third time: after three-month program implementation.

Statistical Design

The collected data organized, tabulated and statistically analyzed using statistical package for social science (SPSS) version 25 for windows, running on IBM compatible computer. Qualitative data (categorical data) were expressed as relative frequency (number) and percent distribution, and for comparison between groups, the Chi-square was calculated. Quantitative data were expressed as mean± SD, and for comparison between two means (t) test was calculated. For the interpretation of results, the p-value ≤ 0.05 was considered significant.

3. RESULTS AND ANALYSIS

Table (1): Distribution of studied critical care nurses according to their socio-demographical characteristics (n=75).

Demographical characteristics	Frequency	
	No	**%**
Age:		
• Less than 25yrs	25	33.3
• 25 < 30yrs	35	46.7
• 30 < 35yrs	12	16
• More than 35	3	4
Mean ±SD (range)	**26.39±3.63 (20-38)**	
Gender:		
• Male	30	40
• Female	45	60
Education level:		
• Diploma nurse	54	72
• Bachelorizes nurse	21	28
Years of experience:		
• ≤ 2yrs	25	33.3
• 3-6yrs	29	38.7
• 7-10yrs	17	22.7
• More than 10yrs	4	5.3
Mean±SD	**4.63±3.28 (1-15)**	
Attendance of previous training about P.E		
• Yes	63	84
• No	12	16

ICU setting:		
• Medical ICU	20	26.7
• Surgical ICU	20	26.7
• Emergency ICU	35	46.7

Table (2): Mean and stander deviation distribution of nurses knowledge during three tests question of implementing education program (n=75).

Nursing knowledge	Max score	Pre-implementation test Mean ± SD	Immediately post-implementation test Mean ± SD	3 months post-implementation test Mean ± SD	Comparison			
					P1	P2	P3	P.value
Complication of P.E.	4	1.29 ± 0.866	3.80 ± 0.403	3.53 ± 0.622	<0.001**	<0.001**	0.002*	<0.001**
Emergency nursing of complication P.E.								
Nursing intervention with patient P.E are complain of airway management.	5	2.05 ± 0.80	3.88 ± 0.84	3.13 ± 0.68	<0.001**	<0.001**	<0.001**	<0.001**
Nursing intervention with patient P.E are complain of chest pain	5	1.68 ± 0.86	4.39 ± 0.7	3.6 ± 0.49	<0.001**	<0.001**	<0.001**	<0.001**
Side effect of thrombolytic therapy	11	3.01 ± 1.42	9.76 ± 1.11	9.43 ± 0.5	<0.001**	<0.001**	<0.019*	<0.001**
The drugs should be avoided with antithrombotic and anticoagulant	4	1 ± 0.00	3.47 ± 0.50	2.55 ± 0.50	<0.001**	<0.001**	<0.001**	<0.001**
The necessary precautions during the treatment.	18	4.71 ± 0.78	15.29 ± 1.25	12.08 ± 1.16	<0.001**	<0.001**	<0.001**	<0.001**
Prevention of PE.	16	7.15 ± 2.73	14.05 ± 1.78	12.99 ± 2.63	<0.001**	<0.001**	0.039*	<0.001**
Total of nursing knowledge	63	**20.89 ± 4.16**	**54.64 ± 2.83**	**50.95 ± 2.41**	<0.001**	<0.001**	<0.001**	<0.001**

PE: Pulmonary Embolism   **Paired sample t-test**   **P1: pre vs immediately post.**
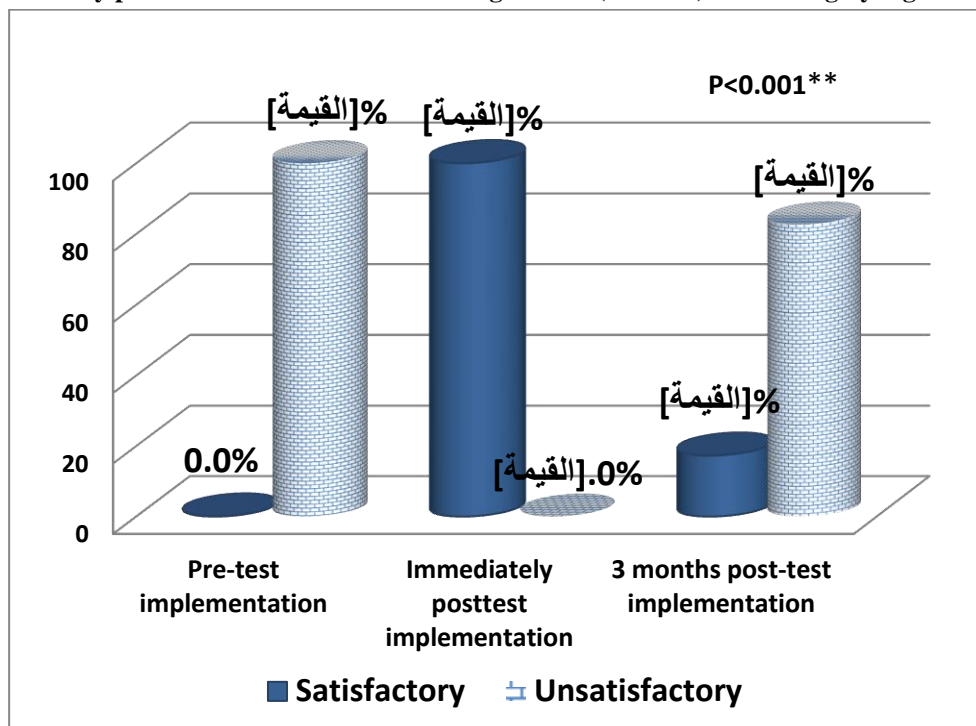
P2: pre vs after 3 months.   **P3: immediately post vs after 3 months.**

P4: pre vs immediately post vs after 3 months.   ***: Significant (P < 0.05)**   ****: highly Significant (P < 0.001).**

Chi square test

*: Significant (P < 0.05)

**: highly Significant (P < 0.001).

Fig. (1): Distribution of the studied critical care nurses' total knowledge level during three tests question of implementing education program (n=75).

Table (3): Mean and stander deviation distribution of nurses practice during three tests question of implementing education program (n=75).

Nurses practice	Max score	Pre-implementation test Mean ± SD	Immediately post-implementation test Mean ± SD	3 months post-implementation test Mean ± SD	Comparison			
					P1	P2	P3	P4
Intensive spirometer	26	9.48 ± 1.60	21.24 ± 1.75	18.95 ± 1.72	<0.001**	<0.001**	<0.002*	<0.001**
Deep breathing technique	24	7.05 ± 1.11	19.61 ± 1.68	18.07 ± 1.70	<0.001**	<0.001**	<0.001**	<0.001**
Tissues perfusion intervention	24	5.45 ± 1.39	17.92 ± 1.44	16.20 ± 1.61	<0.001**	<0.001**	<0.001**	<0.001**
Administering & monitoring intravenous anti-thrombolytic therapy	52	24.88 ± 2.16	45.92 ± 2.07	40.17 ± 4.54	<0.001**	<0.001**	<0.001**	<0.001**
Elastic stocking	46	15.72 ± 2.49	37.95 ± 2.47	36.05 ± 2.43	<0.001**	<0.001**	<0.001**	<0.001**
Education patient self-care	34	9.17 ± 2.44	29.83 ± 1.212	26.55 ± 2.21	<0.001**	<0.001**	<0.001**	<0.001**
Total nurses practice	206	**71.73 ± 5.19**	**172.23 ± 7.42**	**156.63 ± 6.18**	**<0.001****	**<0.001****	**<0.001****	**<0.001****

Paired sample t-test
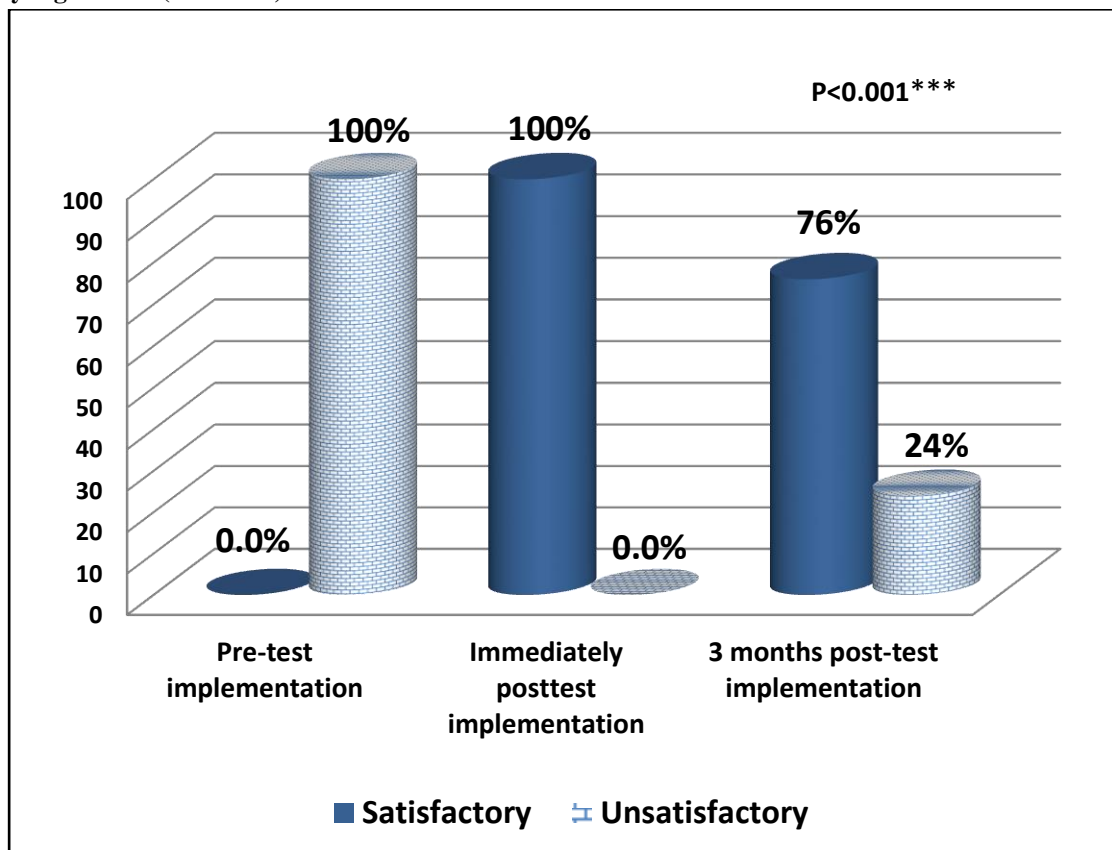
P1: pre vs immediately post.

P2: pre vs after 3 months.

P3: immediately post vs after 3 months.

P4: pre vs immediately post vs after 3 months.

*: Significant (P < 0.05)

**: highly Significant (P < 0.001).

Chi square test

*: Significant (P < 0.05)

**: highly Significant (P < 0.001).

Fig. (2): Distribution of the studied critical care nurses total practice level during three tests question of implementing education program (n=75).

Table (4): Correlation between total knowledge & practice score during three tests question of implementing education program (n=75).

Total practice score	Total knowledge score						Total	
	Pre-implementation test		Immediately post-implementation test		3 months post-implementation test			
	R	P	R	P	R	P	R	P
	0.230*	0.047	0.979**	0.000	0.755**	0.000	0.979**	<0.001**

Table (5): Relationship between studied critical care nurses' total knowledge level and demographic data during three tests question of implementing education program (n=75).

Demographic data	Total knowledge level		
	Pre-implementation test	Immediately post-implementation test	3-months post-implementation test
	Mean ± SD	Mean ± SD	Mean ± SD
ICU setting:			
• MICU	20.65 ± 3.88	54.53 ± 2.50	50.70 ± 2.29
• SICU	19.55 ± 4.37	54.50 ± 3.32	51.00 ± 2.22
• ERICU	21.80 ± 4.07	54.78 ± 2.77	51.06 ± 2.62
P-value	**0.148**	**0.923**	**0.867**
Age:			
• Less than 25yrs	22.16 ± 4.38	54.68 ± 2.70	50.60 ± 2.67
• 25 < 30yrs	19.89 ± 4.19	54.80 ± 3.10	51.03 ± 2.53
• 30 < 35yrs	20.67 ± 3.23	54.75 ± 2.42	51.17 ± 2.04
• More than 35yrs	23.00 ± 3.00	52.00 ± 1.00	52.00 ± 1.00
P-value	**0.158**	**0.439**	**0.753**
Gender:			
• Male	20.13 ± 4.47	54.90 ± 2.81	50.70 ± 2.63
• Female	21.40 ± 3.91	54.48 ± 2.86	51.11 ± 2.27
P.value	**0.198**	**0.536**	**0.473**
Education level:			
• Diploma nurse	20.26 ± 3.79	54.75 ± 2.89	50.91 ± 2.56
• Baccrulureate nurse	22.52 ± 4.69	54.35 ± 2.70	51.05 ± 2.04
P.value	**0.033***	**0.596**	**0.823**
Years of experience:			
• ≤ 2yrs	20.76 ± 4.27	54.84 ± 3.21	50.36 ± 2.94
• 3-6yrs	20.79 ± 4.80	54.59 ± 2.80	51.48 ± 2.18
• 7-10yrs	21.06 ± 3.34	54.65 ± 2.50	51.12 ± 1.90
• More than 10yrs	21.75 ± 2.22	53.75 ± 2.63	50.00 ± 1.83
P-value	**0.972**	**0.915**	**0.310**
Educational training:			
• Yes	20.33 ± 4.36	53.17 ± 2.52	51.50 ± 1.78
• No	21.00 ± 4.15	54.92 ± 2.81	50.84 ± 2.51
P-value	**0.614**	**0.048***	**0.389**

ANOVA t test

***: Significant (P < 0.05)**

****: highly Significant (P < 0.001).**

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Table (6): Relationship between studied critical care nurses' total practice level and demographic data during three tests question of implementing education program (n=75).

Demographic data	Total practice level		
	Pre-implementation test	**Immediately post implementation test**	**3 months post-implementation test**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**
ICU setting:			
• MICU	70.80 ± 6.61	173.45 ± 4.72	156.90 ± 6.59
• SICU	72.10 ± 4.95	173.30 ± 4.05	156.35 ±5.41
• ERICU	72.06 ± 4.45	173.03 ± 4.05	156.63 ± 6.51
P.value	**0.649**	**0.934**	**0.962**
Age			
• Less than 25yrs	71.56 ± 5.12	172.76 ± 3.88	157.00 ± 5.34
• 25 < 30yrs	72.46 ± 5.31	173.80 ± 4.61	156.51 ± 5.64
• 30 < 35yrs	71.08 ± 4.85	172.42 ± 3.99	154.83 ± 8.99
• More than 35yrs	67.33 ± 5.69	173.33 ± 2.52	162.00 ± 4.58
P.value	**0.389**	**0.964**	**0.341**
Gender:			
• Male	72.80 ± 5.47	173.97 ± 4.33	157.03 ± 5.40
• Female	71.02 ± 4.92	172.71 ± 4.05	156.36 ± 6.70
P.value	**0.147**	**0.205**	**0.645**
Education level:			
• Diploma nurse	70.54 ± 5.08	172.09 ± 3.63	155.81 ± 6.67
• Baccrulureate nurse	74.81 ± 4.18	176.10 ± 4.21	158.71 ± 4.19
P.value	**0.001****	**0.000*****	**0.068**
Years of experience			
• ≤ 2yrs	71.56 ± 4.79	172.36 ± 3.84	155.44 ± 5.46
• 3-6yrs	71.14 ± 6.03	172.83 ± 3.88	156.38 ± 5.61
• 7-10yrs	72.82 ± 4.93	175.41 ± 4.84	159.06 ± 7.15
• More than 10yrs	72.50 ± 0.577	172.00 ± 3.37	155.50 ± 9.47
P.value	**0.749**	**0.094**	**0.295**
Educational training:			
• Yes	73.33 ± 6.40	176.25 ± 5.38	157.75 ± 8.16
• No	71.43 ± 4.92	172.63 ± 3.70	156.41 ± 5.79
P.value	**0.246**	**0.005***	**0.496**

   ANOVA t test

   *: Significant (P < 0.05)

   **: highly Significant (P < 0.001).

This table (1) demonstrated that the studied sample consists of 75 nurses (20 were from the medical intensive care unit, 20 from the surgical intensive care unit and 35 from the emergency intensive care unit). Shows that 46.7% of nurse's age group was 25 and less than 30 years of age, females were 60%, 72% were level of education was diploma degree, 38.7% had (3-6) years of experience, 84% of nurses were not previously of attended training courses about prevention of complication pulmonary embolism.

Table (2) this table shows the compression of mean score the studied critical care nurses knowledge regarding complication pulmonary embolism during pre/post and post 3 months of implementing education program. There were statistical significance differences (P=<0.001) between the mean score of knowledge nurses pre/post and post 3 months implementation program regarding the prevention of pulmonary embolism complications.

Figure (1) shows all nurses of intensive care units obtained a score of less than 75% pre-implementation of the program and reached a score of equal to more than 75% immediately post-program implementation. Three months later after program implementation, 62 nurses obtained score more than or equal to 75%, while 13 nurses obtained score less than 75%. However. The knowledge level differences between pre, immediately post-program and 3 months later were statistical significant differences (p-value = 0.001).

Table (3) this table shows compression of mean score the studied critical care nurses practice regarding complication pulmonary embolism during pre/ immediately post and post 3 months of implementing education program. There were statistical significance differences (P=<0.001) between the mean score of practice pre/ immediately post and post 3 months implementation program regarding complication pulmonary embolism.

Figure (2) shows all nurses of intensive care units obtained a score of less than 75% pre-implementation of the program and reached a score of equal to more than 75% immediately post-program implementation. Three months later after program implementation, 57 nurses obtained score more than or equal to 75%, while 18 nurses obtained score less than 75%. However. The practice level differences between pre, immediately post-program and 3 months later were statistically significant differences (p-value = 0.001).

Table (4) this table shows that there is no statistically significant association between nurses' ICU setting, age, gender, years of experience, educational training and their mean of knowledge concerning pulmonary embolism at (pretest, immediately post- and 3 months post) of educational program follow up (p-value > 0.05). However, there is a statistical significant association between nurses' level of education and their mean of knowledge concerning pulmonary embolism at (pretest) of the educational program (p-value > 0.033).

Table (5) clarify that age and years' experience were no statistically significant association with nurse practice through all phases of implementing the training program. In addition, education level was a statistical significant association with nurse practice through pretest, immediate post and after 3 months of implementing the training program all practice items (<0.001, 0.000, 0.006 respectively). Moreover, educational training was a statistical significant association with nurse mean of practice through posttest months of implementing the training program (p-value < 0.005).

Table (6) shows that there was a positive relationship between pretest knowledge score and total pretest practice, immediately posttest knowledge and immediately posttest practice, three months posttest knowledge score and three months posttest practice score (r= 0.230, 0.979, 0.755 respectively) with statistically significant differences (p<0.000).

4. DISCUSSION

Nurses should be aware of and able to conduct regular assessments of VTE risks and should be attentive to the signs and symptoms of DVT and PE. Nurses are well-positioned and play a central role in educating patients and their families about the signs, symptoms, treatment and prevention of VTE. The risks of omitting an important assessment and the necessary preventive care may decrease with the use of clinical protocols as part of regular nursing practice. The ongoing use of clinical protocols could also help nurses maintain their quality education and subsequently improve patient outcomes and nurses' self-efficacy in practicing VTE prevention care. *(Oh, Boo, & Lee, 2016).*

To evaluate the effect of an educational program on nurses' knowledge and practice regarding the prevention of pulmonary embolism complication.

The current study showed that all the nurses' unsatisfactory knowledge regarding the complication of pulmonary embolism regarding the content in their nursing curricula. This is obviously detected on the nurses' complications, the side effects of drugs used, nursing prevention of complication P.E. This might be related to the fact that the majority of them hold a nursing diploma and all of the books are written in English and their learning in Arabic. In addition, another cause for a lack of knowledge is that most of them were not receiving any previous training about respiratory care. *Duff (2013)* identified four local barriers to the uptake of VTE prevention guidelines: A lack of motivation to change; a lack of systems support; a knowledge or awareness deficit; and disputed evidence. *Ali & Hassan (2016)* who mentioned nurse's knowledge toward venous thromboembolism was insufficient skills of basic prevention are caused by a lack of training and appropriate instruction, limited practice, lack of self-efficacy, and poor skill retention at the pretest period experience.

On comparison of pre-test and post-knowledge scores, the study result shows that there is a significant enhancement in the overall knowledge score of participants regarding the prevention of pulmonary embolism complications. It shows that need-based training is effective in enhancing knowledge regarding the prevention of nursing care for pulmonary embolism. This result was in agreement with the study of *Jagannathan (2015)* who mentioned the study revealed a significant increase in the post-test knowledge scores after a structured teaching program. The structured teaching program is one of the effective methods in increasing knowledge regarding the prevention of deep vein thrombosis among nurses. In the same line, *Barp et al. (2018)* who reported the role of nurses exceeds to watch and manage, and patient education is inherent to their routine work. They are responsible for patients, family members and even the nursing staff and health officials. Moreover, nurses must continuously train and supervise the nursing staff to perform preventive care for VTE.

In his respects *Chen et al. (2018)* mentioned clinical nurses are a key group that can serve as first-line health care providers, to identify, and respond to risks for VTE. Adequate knowledge of VTE symptoms and risk factors may lead to effective nursing practice and more favorable prognoses. Nurse trainers should develop comprehensive educational programs that are focused on these aspects, with the aim to improve knowledge of thromboprophylaxis. In the same line, *Abdul-hamza & Aziz, (2017)* reported nurses to play a central role in educating patients and families about VTE. This indicates a need to improve resources that support nurses in educating their patients about VTE. Through education, nurses can have a vital impact on reducing the incidence of this preventable and potentially fatal complication. Providing greater information to patients could encourage their involvement in their care by increasing self-reporting of symptoms during hospitalization and following discharge.

In addition, these findings were in agreement with the study of *Antony et al. (2016)* their study assessed of knowledge and self-reported clinical practice on prevention of deep vein thrombosis among staff nurses who reported staff nurses working in critical care units 100% had unsatisfactory knowledge on prevention of DVT among hospitalized patients.

These findings were in agreement with study *Tang et al. (2015)* who reported the knowledge of VTE prophylaxis among the medical staff of ICUs deficient, which may lead to a lack of standardization of VTE prophylaxis. Strengthened and standard training may help medical staff to improve their understanding of relevant guidelines.

The present study showed that the majority of nurses mean score in pre-implementing less than those of the post-implementing practice score with highly statistical significantly regarding complication pulmonary embolism. This might be due to the absence of a training program, booklet and stander for care inside each unit during period program implementation. In the same line with *Khalil (2018)* who reported this might be related to many factors, lack of education on assessment tools, lack of availability of assessment tools, lack of familiarity with tools, nursing workload, lack of protocols and guidelines management and no designing area for charting.

This present result was congruent with *Abdelgadir et al. (2018)* who reported improvement in the performance of the nurse. In the pre-intervention the mean rank was 1.23, while in the post-intervention there was much improvement in the performance of the nurses, the mean rank was 2.87.

These results are in agreement with those *Kaur & Charan (2018)* who reported the pre-test practice mean score less than after implementation program had a mean score with significant differences in his study sample (P-value <001). Also, this result finding with *Thorat et al., (2017)* who reported staff nurses are received a planned teaching program had higher mean knowledge scores in the post-test than in the pre-test.

These results were in congruence with *Mersal (2014)* who illustrated that in the majority of the caregivers, the practice was inadequate regarding the prevention of deep venous thrombosis and maintenance of a healthy diet.

After three month post-test, the present study revealed that the percentages were slightly decreased in comparison to the posttest immediately; this indicated that the improvement in knowledge and practice was slightly decreased three months after implementing a training program. This result might be explained by the fact that knowledge retention is usually affected by time. In this study, the researcher measure nurse's knowledge and practice in different intervals to measure their knowledge retention. In this, regards *Mohammed (2017)* founded that, direct relationship between memory loss and length of time that lapses after a certain educational event. In addition, they reported that nurses who had poor level

knowledge and/ or practice before the exposure to a training program underwent a significant improvement after the implementation of the program but this improvement usually decreases by time.

Regarding the relationship between knowledge and practice. The findings of this study, there was a positive correlation between the nurse's knowledge and practice scores. This reflects the importance of integration between theory and practice. In the same line *El-sayedead et al. (2016) and Das & Sahoo (2014)* who found that a positive significant correlation between nurses knowledge and practice related to deep vein thrombosis pre and post-education program. Moreover, *Khalil et al. (2018)* reported a significant correlation between critical care nurses' knowledge and practice regarding life-threatening diseases.

The present study shows that there were no statistically significant differences between total knowledge score and socio-demographic in nearly all items of socio-demographic. It indicates that there was no effect of socio-demographic data on teaching programs regarding knowledge. This result agreement with *Ali & Hassan (2016)* who reported that no significant association between post-test practice score with selected socio-demographic variables- age, sex, years of experience and in-service program were found to be non-significant at p-value >0.05. In the same line *Al-husaunawy (2015)* found that there no significant differences between knowledge of nurses' and age, sex, years of experience.

The present study showed that significant relation was found between the level of education and total practice score through all the study periods, this means that registered nurses might have good readiness for learning and practicing new things as well their awareness about the continuing education. This result agrees with *Bayoumi & Mahmoud (2017)* who reported that there was a highly statistically significant correlation in nurses' practice in relation to their educational level at the pre-implementation phase or immediately after implementation, and 6 months after implementation. In the same line *Mohammed (2017)* showed that there a statistically significant difference association between the nurse practice and level of education in all phases of program implementation.

Finally, the program had achieved its objectives by improving the knowledge of critical care nurses. Moreover, improvement in nursing practice was noticed through identification, prevention of complication pulmonary embolism.

5. CONCLUSION

Based on the result of the present study, it was concluded:

- A statistical significant difference improvement was found between critical care nurses' knowledge in pre and post-implementing educational programs regarding the prevention of pulmonary embolism complications.

- A statistically significant difference improvement was found between critical care nurses' practice in pre and post-implementing educational programs regarding the prevention of pulmonary embolism complication.

- There is a correlation found between knowledge and practice scores obtained by critical care nurses receiving educational programs.

6. RECOMMENDATIONS

Based on the results of the present study the following be recommended:

- There must be standardized written nursing care of prevention pulmonary embolism complication in intensive care units and the emergency departments. In addition to the making of nursing library and net including all different nursing sciences.

- Clinical protocols specific to VTE assessment and prevention, as well as a risk assessment toolkit, should be developed for and used by clinical nurses in daily practice.

- Continuing education for clinical nurses and organizational in-service education is required to improve VTE assessment and prevention for best practice and patient safety.

- Replication of the study on a larger probability sample acquired from the different geographical areas in Yemen to figure out the main aspects of these problems.

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