

Comparative study regarding the impact of Wound Vacuum Assisted Closure Therapy Training Module on Surgical Nurses Knowledge and Practical Skills

Badria Mahrous Abd El-Hammed Mohammed¹, Amina Ibrahim Badawy²,

¹Lecturer of Medical-Surgical Nursing, Faculty of Nursing, Menoufia University, Egypt, and Affiliated as Assistant Professor of Medical Surgical Nursing, Faculty of Applied Medical Sciences, Nursing Department, Al-Baha University, Saudi – Arabia.

²Assistant Professor Medical-Surgical Nursing, Faculty of Nursing, Menoufia University, Egypt.

Corresponding Author: Dr. Badria Mahrous Abd El-Hammed Mohammed:

Abstract: Negative pressure wound therapy has been very beneficial in the wound care of many different kinds of wounds ranged from pressure ulcers to open fractures.

Aim: The aim of the study was to investigate effect of intervention training module on surgical nurses' knowledge and practical skills regarding wound vacuum assisted closure therapy. **Methods:** Aquasi experimental study with one group pre/post-test was used design was used in this study. **Setting:** surgical unit, surgical ICU units in both of King Fahd hospital, Albaha city, KSA; and Damanhour National Medical Institution, Beheria Governorate, Egypt. **Subject:** A sample of 140 nurses were selected from the participating hospitals. **Tools:** Tool I: A Structured Interviewing assessment questionnaire regarding knowledge of wound VAC therapy: It is consisted of two sections: section 1: Nurses' demographic data sheet: and section 2: Questionnaire to assess nurses' knowledge regarding wound VAC therapy. Tool II: An observational performance checklist regarding VAC therapy: was used for the practical part of the module to assess nurses' performance. **Results:** the current study revealed that, most samples had nursing diploma. There were significant statistical differences were found between mean total knowledge score of studied sample pre-and post the educational module. Significant statistical differences were found in mean practice scores in post than pre-the educational module. There was a strong positive correlation was found among age, experience, knowledge and practice for studied nurses. Moreover, Saudi nurses were having a higher mean total and subtotal Knowledge and Practice Scores than Egyptian nurses. **Conclusion:** Nurses' performance toward VAC was improved after application of a training program on VAC. **Recommendations:** Constructing continuing educational nursing programs and centers in all hospitals which responsible updating and upgrading nurses' knowledge and practice; workshops which emphasizing on the evidence-based practices about new trends regarding wound care technologies within the hospitals, as well as emerging these new trends in novice graduated nurses, the nursing education department in hospital should follow up this educational programme implementation in all hospital surgical unities.

Abbreviations: Vacuum Assisted Closure Therapy, VAC; Surgical Nursing, SN; AbdulAziz University Hospital, KAUH; Negative-pressure wound therapy, NPWT; Centers for Medicare and Medicaid Services (CMS), surgical intensive care unit (SICU)

Keywords: Negative pressure wound therapy, Vacuum Assisted Closure Therapy, Surgical Nursing, Intervention Training Module; Knowledge and Practical Skills.

1. INTRODUCTION

Effective wound care is a major challenge in the clinical settings (Han and Ceilley, 2017) not only to decrease cost but to decrease the mortality and morbidity related to wound infection.(Ingemansson et al., 2013). Several technologies have developed to achieve optimal wound care including negative pressure wound therapy (NPWT) or vacuum-assisted wound closure (VAC). Use of VAC has been justified as effective technique to improve healing and enhance safety (Capobianco and Zgonis, 2009; Tachi and Takeda, 2010).

The VAC therapy works by providing negative pressure on the wound and creating suction effect . In VAC a gauze is inserted into the wound then sealed with adhesive film that protect the wound but allow exchange of gases (Martindell, 2012). Studies reported several advantages for VAC that include reduction of edema in the wound, promote granulation, and reduction in bacterial growth. VAC also save nurses times as it requires less frequent dressing, help to reduce cost, and lower the risk of infection. These advantages justifies its use in traumatic wounds, open abdominal wounds, infected sternotomy wounds, diabetic foot and skin grafts(Costa et al., 2005)(Willy, 2006).

Wound care is a major nursing intervention that mandate significant knowledge and competency (Mohamed et al.)(Kaufman and Pahl, 2003). Studies reported significant lack of knowledge and competency among nurses with regard to wound care in general and VAC in specific (Cray, 2017). This defect may affect patients quality of care, increases comorbidity, cost, and rate of mortality. Educating and training nurses is crucial in order to prevent complications and consequence related to wound infection, thus the study aimed to assess the effectiveness of educational and training modules on nurses' knowledge and competency regarding VAC.

1.1. Significance of the Study

Very few studies were conducted in the Middle East to investigate the effect of education and training on nurses' knowledge and competency. Findings from this study is expected to increase the awareness about the importance of mandating post graduate education and training fir IVAC in order to prevent complications related to wound care.

Aim of the Study:

To examine the effect of training module on surgical nurses' knowledge and practical skills regarding wound vacuum assisted closure therapy.

Study Hypotheses:

1. The mean knowledge score of immediately post intervention test regarding wound VAC therapy will be higher than pre-intervention test among study subjects.
2. The mean practice score of immediately post intervention test regarding wound VAC therapy will be higher than pre-intervention test among study subjects.
3. There will be statistical differences in post-test regarding mean knowledge and practice scores among Saudi and Egyptian nurses.
4. There will be a strong correlation between mean of post knowledge and practice scores of the both groups.

2. SUBJECTS AND METHOD

Study variables:

The independent variable in this study is the training module regarding wound VAC therapy however; the dependent variables are surgical nurses' knowledge and practical skills.

Design

A quasi-experimental one group pre/post-test, comparative study, research design was utilized to achieve the aim of the study.

Setting

This study was conducted in surgical, orthopedic inpatient and surgical ICU in Albaha city, Saudi Arabia and Damanhour National Medical Institution, Beheria Governorate, Egypt.

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Subjects

A convenience sample of 70 nurses from each hospital working in previously mentioned settings were selected.

Exclusion Criteria: Nurses were excluded from the study if they: -

- a Not willing to participate in the study.
- b Were in vacations.

Tools for Data Collection

Two tools were developed for data collection by the researcher according to review of relevant literatures.

Tool I: A Structured Interviewing assessment questionnaire regarding knowledge of wound VAC therapy: It is consisted of two sections: section 1: Nurses' Demographic data sheet: It includes age, gender, educational level, years of working experience and attending courses related to wound VAC therapy. Section 2: Questionnaire to assess nurses' knowledge regarding wound VAC therapy. It contains 25 multiple choice questions in which only one correct answer was found.

The correct response for each question was scored as "1" and incorrect as "0".

Scoring system of knowledge levels:

- Poor: (0 to 8.3), below 60% of the total knowledge score.
- Average: (8.4 to 16.7) represent 60% to 75% of the total knowledge score.
- Good: (16.8 to 25) above 75% of the total knowledge score.

The questionnaire covered the following domains:

- 1- Definition, indications and contraindications of wound VAC therapy.
- 2- Parts of VAC machine and foam selection.
- 3- Frequency of changing of VAC dressing
- 4- Patient's consent and VAC therapy.
- 5- Discharge plan of patient with VAC therapy.

Tool II: An observational performance checklist regarding VAC therapy: was used for the practical part of the module to assess nurses' performance. This tool contains 25 items and covers the following items:

- 1- Preparation prior to wound VAC application.
- 2- Holistic patient assessment and application of the VAC therapy.
- 3- Removal of wound VAC dressing.
- 4- Mobilization of patient with VAC therapy.
- 5- Managing troubleshooting of the VAC therapy.
- 6- Patient education during VAC therapy.
- 7- Nursing documentation regarding VAC therapy.

Scoring system of practice levels:

- Poor: (0 to 8.3), below 60% of the total practice score.
- Average: (8.4 to 16.7) represent 60% to 75% of the total practice score.
- Good: (16.8 to 25) above 75% of the total practice score.

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Validity and Reliability:

Questionnaire was reviewed by five experts in the field of medical surgical nursing department, faculty of nursing, KAU. Wound care nurse, and head nurse of surgical unites of in both of King Fahd and King Abdul Aziz University hospitals were reviewed the tool. Questionnaires of the current study were tested by Cronbach's alpha (alpha= 0.79)

Teaching module for VAC therapy:

General Objectives: Upon completion of this teaching module, the nurse will gain knowledge regarding the VAC therapy.

Specific Objectives: Upon completion of this teaching module, the nurse will be able to:

1. Define wound VAC therapy.
2. Identify Contraindications of wound VAC therapy.
3. Describe parts of VAC machine and foam selection.
4. Describe frequency of changing dressing and consent.
5. Enumerate discharge plan of patient with VAC therapy.
6. Describe preparation prior to wound VAC application.
7. Describe Holistic patient assessment and application of the VAC therapy.
8. Describe removal of wound VAC dressing.
9. Describe managing troubleshooting of the VAC therapy.
10. Describe nursing documentation regarding VAC therapy.

Contents:

Theoretical contents: Topics introduced: General information about wound VAC therapy, contraindications of wound VAC therapy, parts of VAC machine and foam selection, frequency of changing dressing, consent, and discharge plan of patient with VAC therapy.

Timing: introduced through one week (3 sessions /week for each group) 15 minutes for each session.

The practical contents: pre surgical skin preparation, techniques of surgical wound dressing.

Timing: introduced through two-week (1 session /week for each group) half hour per the session.

Date: the module begins at 16-2-2018 and ends at 14-6-2018. Teaching methods: lecture, small group discussion, demonstration, and re-demonstration. Audiovisual aids: PowerPoint slides, illustrated charts, illustrated Arabic booklet. Evaluation: formative (quizzes and Asking questions) and summative (post-test).

Teaching methods: small group discussion, role-play, demonstration, and re-demonstration. Audiovisual aids: power-point presentations, videos, illustrated charts, illustrated Arabic and English booklets. Evaluation: formative (quizzes and Asking questions) and summative (post-test).

The three collection points, Pre-teaching, immediately post teaching, and two weeks post teaching of the training module to allow the researcher to examine its effect. The subjects were participating in filling the questionnaire and checklist before any interventions, then introducing the theoretical and practical sessions; then immediately post intervention test by questionnaire and checklist done and after two weeks post interventions. The training module was done for surgical nurses who started from the beginning of study depending on the availability of nurses (conveniences sampling method).

Ethical considerations:

Subjects who were willing to participate, were received a brief explanation about the purpose of the study and assuring them that their work progress would not be affected by if they refuse to participate, where their participation is voluntary with the right to withdraw without any penalty. Furthermore, subjects were assured that all information will be kept

confidential by which the researchers only have the right to review. Coding system of subjects responses were used by researchers to assure confidentiality. Subjects who agreed to participate were received continuous support throughout training program period and researchers will be available for answering all participants' questions related to the study.

Procedure of data collection:

The researchers visited the surgical departments during morning shifts. Then every participated nurse was given the questionnaire to be assessed individually for assessing their knowledge. Nurses were approached individually to oriented them a brief description of research and explain the purpose and the nature of the study and to obtain their consent for participation. Those nurses were given about 30 minutes to fill questionnaire. No internet access or reference materials will be allowed on the ward to ensure that the nurses did not seek any external assistance to answer the questions. Data were collected throughout a period of the four months between May & August, 2019. For theoretical sessions: Both of lectures and group discussion were used as teaching methods. A power point presentation, illustrated pictures and videos; were used for more illumination. Each session lasted (30) minutes, 3 sessions were done for nurses in the morning shift. Continuous feedback and communication were assured to clear any misconception, and to enhance their learning. For the practical sessions, which consisted of 3 sessions each one lasted for 30 minutes and covered around 2 weeks, demonstration and re-demonstrations approach were used to ensure mastery of the VAC skills with using a wound simulator, using audiovisual aids and related you tube videos.

Data analysis:

All statistical analysis was carried out using statistical package for social sciences SPSS version 21. Descriptive statistic was used in term of means, standard deviations, frequencies and percentages for demographic variables. Inferential statistic was carried out to test correlation and significance. One way ANOVA and independent t test was done to test the significance differences between the groups. A correlation between levels of knowledge and practice was determined using Pearson's correlation, to determine if level of knowledge is related to practice.

3. RESULTS

Table (1) shows that about half of both groups Egyptian and Saudi nurses (47.2%, 54.3% respectively) were in the age group from twenty six to thirty years with a mean age of 30.36 ± 6.8 years. Concerning years of experience, less than half of both groups (44.4%, 41.4%) had more than 10 years. With respect to professional educational qualification, it was observed that about two thirds of both groups (64.2%, 70%) had nursing diploma.

Table (2): concerning previous training on VAC therapy, it was observed that, none of Egyptian nurses had previous training on VAC therapy, however, (24.3%) of Saudi nurses had previous training on VAC therapy.

Table (3) and Table (4) reveals that pre teaching program, majority of studied nurses had poor total and subtotal knowledge scores, however, post teaching, the majority of studied nurses during the study period respectively had good total and subtotal knowledge scores. (statistically significant, $p < 0.001$).

Table (5) and Table (6) reveals that pre teaching program, majority of studied nurses had poor total and subtotal practice scores, however, the mean scores of total and subtotal practice scores increased immediately after the teaching module and continued to be high at the following evaluation session. (statistically significant, $p < 0.001$).

Table (7) reveals that pre teaching program, there were no statistically significant differences between Egyptian nurses and Saudi nurses in relation to total and subtotal Knowledge and Practice Scores, however, statistically significant differences between both groups were found immediately after the teaching module and continued Two weeks post intervention. In addition, Saudi nurses were having higher mean total and subtotal Knowledge and Practice Scores than Egyptian nurses (statistically significant, $p < 0.05$).

Table (8) shows that there is a strong positive correlation was found among age, experience, knowledge and practice for nurses.

Table (1): Distribution of demographic characteristics of the Studied Nurses.

Demographic characteristics	Egyptian Nurses group N=70		Saudi Nurses group N=70	
	No	%	No	%
Age (years)				
21-	21	30.0	25	35.7
26-	33	47.2	38	54.2
More than 30	16	22.8	7	10
X±SD	30.36 ±6.8		28.32 ±5.4	
Years of experience				
1-	9	12.8	19	27.1
6-	30	42.8	22	31.4
More than 10 years	31	44.4	29	41.4
X±SD	8.49±4.68		9.50±4.90	
Levels of education				
Nursing diploma	45	64.2	49	70
Bachelor degree	25	35.8	21	30

Table (2): Distribution of the Studied Nurses concerning previous training on VAC therapy.

Previous training on VAC therapy	Saudi Nurses group N=70		Egyptian Nurses group N=70	
	No	%	No	%
yes	17	24.2	0	0
No	53	75.7	70	100
X ² -p value	15.6**			

Table (3) Distribution of total and subtotal knowledge levels and scores among Saudi Nurses throughout study period.

Knowledge items	Pre-intervention N=70		Immediate post intervention N=70		Two weeks post intervention N=70		ANOVA (F)/ p values
	No	%	No	%	No	%	
Definition and indications of wound VAC therapy.							
Poor	51	35.7	5	7.1	5	5.1	F=122 ***
Average	13	18.5	7	10	7	10	
Good	6	8.5	58	82.8	58	82.8	
Mean ±SD	1.98±2.3		4.95±2.7		4.95±2.7		
Contraindications of wound VAC therapy.							
Poor	49	70	7	10	5	5.1	98.40 ***
Average	11	15.71	11	15.7	10	7	
Good	10	7	52	74.2	55	78.5	
Mean ±SD	2.08±2.4		4.75±2.6		4.83±2.5		
Parts of VAC machine and foam selection.							
Poor	50	71.4	6	8.5	5	7.1	69.77 ***
Average	11	15.7	11	15.7	10	14.7	
Good	9	12.8	53	73.7	55	78.5	
Mean ±SD	1.90±2.3		4.85±2.6		4.93±2.6		
Frequency of changing dressing and consent.							
Poor	48	68.5	6	8.5	5	7.1	120.40 ***
Average	11	15.7	6	8.5	7	10	
Good	11	15.7	58	58.8	58	82.5	
Mean ±SD	2.2±2.5		4.90±2.6		4.90±2.6		

Discharge plan of patient with VAC therapy.							
Poor	48	68.5	5	7.1	6	8.5	133.44 ***
Average	10	14.2	10	14.2	6	8.5	
Good	12	17.1	55	78.5	58	82.8	
Mean ±SD	2.1±2.4		4.39 ±2.6		4.69 ±2.7		
Total knowledge							
poor	50	71.4	9	12.8	7	10	195.0 ***
Average	9	12.8	6	8.5	5	7.14	
Good	11	15.7	55	78.5	58	82.8	
Mean ±SD	6.90 ±3.59		23.90±5.40		24.87±5.49		

Table (4) Distribution of Total and Subtotal Knowledge Levels and Scores among Egyptian Nurses throughout Study Period.

Knowledge Related Variables	Pre-intervention N=70		Immediate post – intervention N=70		Two weeks post intervention N=70		ANOVA (F)/ p values
	No	%	No	%	No	%	
Definition and indications of wound VAC therapy.							
Poor	54	77.14	7	10	6	8.57	F=102.40 ***
Aaverage	11	15.71	10	14.29	9	12.86	
Good	5	7.14	53	75.71	55	78.57	
Mean ±SD	1.50±2.1		4.75±2.6		4.95±2.7		
Contraindications of wound VAC therapy.							
Poor	52	74.29	10	14.29	5	7.14	91.99 ***
Average	11	15.71	9	12.86	10	14.29	
Good	7	10	51	72.86	54	77.14	
Mean ±SD	1.40±2.0		4.65±2.5		4.85±2.6		
Parts of VAC machine and foam selection.							
Poor	53	75.71	7	10	7	10	29.43 **
Average	9	12.86	11	15.71	10	14.29	
Good	8	11.43	52	74.29	53	75.71	
Mean ±SD	1.50±2.1		4.85±2.6		4.85±2.6		
Frequency of changing dressing and consent.							
Poor	53	75.71	5	7.14	5	7.14	110.40 ***
Average	9	12.86	12	17.14	10	14.29	
Good	8	11.43	53	75.71	55	78.57	
Mean ±SD	1.20±1.9		4.56 ±2.5		4.44 ±2.4		
Discharge plan of patient with VAC therapy.							
Poor	54	77.14	8	11.43	5	7.14	83.44 ***
Average	10	14.29	11	15.71	9	12.86	
Good	6	8.57	51	72.86	56	80	
Mean ±SD	1.50±2.1		4.33 ±2.6		4.66 ±2.7		
Total knowledge							
poor	53	75.71	11	15.71	9	12.86	115.0 ***
Average	7	10	6	8.57	6	8.57	
Good	10	14.29	53	75.71	55	78.57	
Mean ±SD	5.90 ±3.52		22.92 ±5.46		23.82±5.40		

**Significant at 0.01

***Significant at 0.001

Table (5) Distribution of Total and Subtotal Practice Levels and Scores among Saudi Nurses throughout Study Period.

Practical related Variables	Pre-intervention N=70		Immediate post-intervention N=70		Two weeks post intervention N=70		ANOVA (F)/ p values
	No	%	No	%	No	%	
Preparation prior to wound VAC application.							
Poor	47	67.1	6	8.5	2	2.8	F=243.40 ***
Average	10	14.2	9	12.8	12	17.1	
Good	13	18.5	55	78.5	56	80	
Mean ±SD	1.90±2.2		4.95±2.7		4.98±2.7		
Holistic patient assessment and application of the VAC therapy							
Poor	52	74.29	5	12.86	3	8.57	175.99** *
Average	7	11.43	11	14.29	11	14.29	
Good	11	14.29	54	72.86	56	78.57	
Mean ±SD	1.70±2.1		4.90±2.6		4.95±2.7		
Removal of wound VAC dressing.							
Poor	52	77.14	5	8.57	5	7.14	154.43 **
Average	5	11.43	11	15.71	9	14.29	
Good	13	11.43	54	75.71	56	78.57	
Mean ±SD	1.99±2.6		4.98±2.7		4.99±2.7		
Mobilization of patient with VAC therapy.							
Poor	51	72.86	5	4.29	6	2.86	190.70 ***
Average	7	14.29	9	20	6	17.14	
Good	12	11.43	56	75.71	58	80	
Mean ±SD	1.50±1.9		4.86 ±2.5		4.97 ±2.5		
Managing troubleshooting of the VAC therapy.							
Poor	50	71.43	3	10	5	8.57	156.49 ***
Average	12	20	12	14.29	9	11.43	
Good	8	8.57	55	75.71	56	80	
Mean ±SD	1.60±2.1		4.49 ±2.6		4.98 ±2.6		
Patient education during VAC therapy.							
Poor	49		3	12.86	1	10	188.04 ***
Average	11	18.57	13	12.86	13	15.71	
Good	10	11.43	54	74.29	56	74.29	
Mean ±SD	1.36±1.8		4.70±2.6		4.79±2.7		
Nursing documentation regarding VAC therapy. .							
Poor	47	72.86	3	14.29	10	15.71	162.0 ***
Average	7	10	11	7.14	5	7.14	
Good	16	17.14	56	78.57	55	77.14	
Mean ±SD	1.99±2.1		4.99±2.7		4.78±2.6		
Total practice							
Poor	47	74.29	10	15.71	8	12.86	175.0 ***
Average	6	8.57	5	7.14	7	8.57	
Good	17	17.14	55	77.14	55	78.57	
Mean ±SD	7.00±3.55		23.99 ±5.49		24.72±5.49		

Table (6) Distribution of Total Practice Levels and Scores among Egyptian Nurses throughout Study Period.

Practical Related Variables	Pre-intervention N=70		Immediate post intervention N=70		Two weeks post intervention N=70		ANOVA (F)/ p values
	No	%	No	%	No	%	
Preparation prior to wound VAC application.							
Poor	50	71.43	6	8.57	6	8.57	F=92.40 ***
Average	10	14.29	12	17.14	9	12.86	
Good	10	14.29	52	74.29	55	78.57	
Mean ±SD	1.40±2.1		4.65±2.4		4.95±2.7		
holistic patient assessment and application of the VAC therapy							
Poor	52	74.29	9	12.86	6	8.57	77.99 ***
Average	8	11.43	10	14.29	10	14.29	
Good	10	14.29	51	72.86	55	78.57	
Mean ±SD	1.41±2.0		4.60±2.5		4.95±2.6		
Removal of wound VAC dressing.							
Poor	54	77.14	6	8.57	5	7.14	69.43 **
Average	8	11.43	11	15.71	10	14.29	
Good	8	11.43	53	75.71	55	78.57	
Mean ±SD	1.59±2.5		4.95±2.6		4.95±2.6		
Mobilization of patient with VAC therapy.							
Poor	51	72.86	3	4.29	2	2.86	110.40 ***
Average	10	14.29	14	20	12	17.14	
Good	8	11.43	53	75.71	56	80	
Mean ±SD	1.20±1.9		4.56 ±2.5		4.44 ±2.4		
Managing troubleshooting of the VAC therapy.							
Poor	50	71.43	7	10	6	8.57	83.44 ***
Average	14	20	10	14.29	8	11.43	
Good	6	8.57	53	75.71	56	80	
Mean ±SD	1.50±2.1		4.30 ±2.5		4.90 ±2.5		
Patient education during VAC therapy.							
Poor	49	70.0	9	12.86	7	10	88.04 ***
Average	13	18.57	9	12.86	11	15.71	
Good	8	11.43	52	74.29	52	74.29	
Mean ±SD	1.06±1.9		4.60±2.5		4.69±2.7		
Nursing documentation regarding VAC therapy.							
Poor	51	72.86	10	14.29	11	15.71	112.0 ***
Average	7	10	5	7.14	5	7.14	
Good	12	17.14	55	78.57	54	77.14	
Mean ±SD	1.09±1.9		4.69±2.6		4.68±2.5		
Total practice							
Poor	52	74.29	11	15.71	9	12.86	105.0 ***
Average	6	8.57	5	7.14	6	8.57	
Good	12	17.14	54	77.14	55	78.57	
Mean ±SD	6.90 ±3.52		23.92 ±5.46		23.82±5.40		

**Significant at 0.01

***Significant at 0.001

Table (7) Differences between Saudi and Egyptian nurses in Relation to Knowledge and Practice Scores throughout Study Period.

Scores throughout Study Period	Saudi nurses group (n=70)	Egyptian nurses group (n=70)	(T)	p values
	Mean ±SD	Mean ±SD		
Total knowledge				
Pre-intervention	6.90 +3.59	5.98 ±3.52	1.02	NS
Immediate post intervention	23.90+5.40	21.02 ±5.46	3.9*	0.03

Two weeks post intervention	24.87±5.49	21.80±5.40	3.5*	0.03
Total practice				
Pre-intervention	7.00 +3.55	6.90 +3.52	1.2	NS
Immediate post intervention	23.99 +5.49	20.92 +5.46	4.1*	0.03
Two weeks post intervention	24.72±5.49	20.82±5.40	4.6*	0.03

Table (8) Correlation matrix of age, experience, knowledge and Practice of studied Nurses (n = 140).

Item	Age	Experience	Knowledge	Practice
Age	1.00			
Experience	0.71**	1.00		
Knowledge	0.80**	0.82**	1.00	
Practice	0.91**	0.89**	0.89**	1.00

4. DISCUSSION

The current study showed that about half of both groups Egyptian and Saudi nurses (47.2%, 54.3%) were in the age group from twenty six to thirty years with a mean age of 30.36±6.8years. Concerning years of experience, less than half of both groups (44.4%, 41.4%) had more than 10 years. In line with our findings, AbdulAziz (2014) showed that the average age of nurses was 26.4 ± 4.8 years old. In contrary, recent report by Sabur, Elgamil and Elhadi (2017) noted that the vast majority of nurses aged between 31-40 years old. With respect to professional educational qualification, it was observed that about two thirds of both groups (64.2%, 70%) had nursing diploma this means that majority of nurses dealing with wound and in contact with patient are diploma nurses. Similar to our findings, Margaret et al (2014) reported that almost 50% of the nurses had bachelor or higher degree.

Notably, we found that the mainstream of both groups had poor knowledge of NPWT before involving the educational sessions. In agreement with our findings, Sabur, Elgamil and Elhadi (2017) reported a notable low level of knowledge about VAC therapy among registered nurses.

We postulate that this low level of NPWT knowledge can be secondary to nurses' view towards their role in wound care hierarchy, Emere (2006) demonstrated that a considerable proportion of nurses saw wound care as physician's responsibilities, rather than a nursing duty. Such findings were further confirmed by Surme, Kartın and Curuk (2016). Another explanation is the absence of any accredited wound care-training program in the participated institutions. Lack of standard protocols for wound care in each participated institution, lack of multidisciplinary management of wound, workload, and lack of motivation may be another factors that explain this low level of knowledge about NPWT. The unavailability of standard training programs, which are sponsored by the manufactures producing the VAC, can be considered as another contributor to this low level of knowledge about VAC among nurses.

Interestingly, the nurses in our study had low-to-moderate level of VAC practice before study's enrollment; which can be attributed to the fact that NPWT is a new technology that is mainly performed by physicians in many institutions. Another explanation of this low-to-moderate practice was provided by Hadley and Roques (2006) who hypothesized that the workload combined by the shortage of the nursing staff led to this low level of practice.

In term of the primary outcome of the present study, the results showed that the level of knowledge improved post immediate implementation of the module for both groups to good level with highly statistically significant improvement. This could be due to simple explanation language, recent teaching strategy, media, educational booklet used, re-demonstration, in addition to pen and note were provided to nurses to get feedback and facilitate their understanding. This finding is supported by a previous study by Pancrbo-hidalgo, Garcia-fernandiz, Lopez-ortega and Lopez-medina (2007) that showed that nurses' knowledge was affected by professional training and education. Moreover, an 2015 report demonstrated significant improvement in nurses knowledge about VAC two weeks after educational programs (Tahseen and Batool 2015). Such improvement was further confirmed by Samia, Hala, Warda and Tarek (2011), Kwekkeboom et al (2006), and Clinton et al (2006).

This study revealed that a statistical significant progress in the studied nurses' for total and subtotal practice scores immediately post and after 2 weeks of the module's interference was present. This high statistically significant progress after the module application might be as a result of the program's effect which not only stressed on the gaining the

knowledge, but also it did stress on applied training to increase the information and alter the work practice by means of appropriate sessions, different teaching approaches as lectures, discussions, demonstrations and re-demonstrations, usage of media as handout with pictures and information in addition to the obtainability of adequate supplies and resources required for the work achievement. This encouraged the studied nurses to attain the anticipated purposes through rewarding and encouraging positive attitude and discouraging negative attitudes. Furthermore, repeated reinforcement for both practice and knowledge was done in every session and their awareness to have a good annual report as the authority supported the researcher to motivate nurses by having a good annual report.

This result is consistent with Mohamed, Abdl Elmoniem, Elmowafi, Shebl, (2019) and Ibrahim's study (2013) that showed progress in the total practice score of nurses after the program's application with statistical significant difference between before and after the program's application. The previously mentioned result can be clarified by Eslamian, Moeini and Soleimani (2015) argument which stated that the continuous education was proved to raise the professional behavior of the nursing staff and increase the patient management awareness and nursing practice, so, the second hypothesis supported as well, which stated that "The mean practice score of immediately post intervention test regarding wound VAC therapy will be higher than pre-intervention test among study subjects."

Furthermore, this current study reveals that pre teaching program, there were no statistically significant differences between Egyptian nurses and Saudi nurses in relation to total and subtotal Knowledge and Practice Scores, however, statistically significant differences between both groups were found immediately after the teaching module and continued Two weeks post intervention. In addition, Saudi nurses were having higher mean total and subtotal Knowledge and Practice Scores than Egyptian nurses. This may be due to none of Egyptian nurses had previous training on VAC therapy, however, (24.3%) of Saudi nurses had previous training on VAC therapy. hence, the third hypothesis was supported which stated that "There will be statistical differences in post-test regarding mean knowledge and practice scores among Saudi and Egyptian nurses.

As well, the fourth hypothesis was supported which stated that "There will be a strong correlation between mean of post knowledge and practice scores of the both groups, as this current study revealed that there is there is a strong positive correlation was found among age, experience, knowledge and practice for nurses. These findings agreed with a lot of studies (Yatin et al., 2014),(Janet, 2016), and (Hussein and Zatoon, 2019).

Yet, Carol (2012) found that there is a weak positive relation between level of education, age and nurses' knowledge score. It was also found that the number of experience years did not have any effect on the level of knowledge as it is often presumed that many years of experience in wound management must lead to knowledge. Though, when suitable educational feedback is not delivered by the organizational management and reinforced by health care policy makers, and knowledge sharing is not tracked across the staff, as might be the case in many clinical institutes, years of experience are not a guarantee of proficiency Zarchi, Latif, Haugaard, Hjalager and Jemec(2014).

The investigator found that the participants' level of knowledge could be improved by providing them with the continuous educational programs to enrich the retaining of knowledge. The educational intrusions and program should emphasize on the understanding and meaning instead of memorization, along with adequate time to learn the complex subjects and planned practical engagement with tasks. In the study there were a highly significant difference in nurses' knowledge and practice pre and post application of the program and the study hypothesis was achieved.

5. CONCLUSION

The current study concluded that there were a lack of surgical nurses' knowledge and practice pre-intervention of the module, while a significant improvement of their knowledge and practice occurred immediately post intervention were observed. While as this improvement seems to be declining over time two weeks post intervention. Furthermore, it was observed that there was an association between age, years of experience, knowledge, Practice among surgical nurses in different setting.

6. RECOMMENDATION

The study recommended establishment of continuing nursing education centers which responsible for continuous updating nurses' knowledge and practice; as well as development of strategies which guarantee the continuity to nursing skills improvement. These centers will provide workshops, lecture, and nursing skills lab which emphasize on the

evidence-based practices about new approaches and devices as VAC therapy device and how operationalized it in surgical unit and critical settings within the hospitals. This will bridge the gap between theory and practice in new wound care technology as well as it will prevent functional combustion among those nurses.

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