Effect of Educational Program on Improving Nurses' Performance Regarding Arterial Blood Gases Sampling for Critically Ill Children

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Abstract: Back ground: Arterial blood gases sampling is a valuable tool in the assessment of multitude of illness and injuries. It represents the criterion stander for determining a ventilated and non- ventilated children's acid base status. *Aim of the study* was to evaluate the effect of educational program on improving nurses' performance regarding arterial blood gases sampling for critically ill children. *Setting:* The study was conducted at pediatric intensive care units in Benha University hospital and Benha Specialized pediatric hospital. *Design:* A quasi experimental design was utilized for conducting the current study. *Sample:* A convenient sample of (50) nurses working at the above mentioned settings were recruited for this study regardless of their personal characteristics. *Tools:* Two tools were used for data collection, a structured questionnaire sheet to assess nurses' knowledge about arterial blood gases sampling and an observational checklist to assess nurses ' practice regarding arterial blood gases sampling. *Results:* There was a highly statistical significant differences in nurses' knowledge and practice regarding arterial blood gases sampling before and after program implementation. *Conclusion:* Based on the results of the present study, it can be concluded that, the research hypothesis is accepted, while it was found that the educational program is highly effective method to improve the nurses' knowledge and practice regarding arterial blood gases sampling. *Recommendation:* The study recommended that, the continuous training and evaluating should be provided to all nurses involved in arterial blood gases sampling in order to update their knowledge and ensure competent practice.

Key wards: Educational program, nurses' performance, arterial blood gases sampling and critically ill children.

INTRODUCTION

A child with critical ill condition is a someone whose age is under 18 years old, and with a life that requires a continuous care for being more subject to illness or injury than the others. As a result of this condition, the child may suffer from respiratory, cardiac, neurological, gastrointestinal, metabolic, renal, and hematological complications. **(Al-jboor et al., 2016).**

Arterial blood gases sampling is a common laboratory test used in intensive care units in order to observe children with acute respiratory failure. It is also used to determine the amount of oxygen therapy needed for children who suffer from chronic obstructive pulmonary disease. On the other hand, it helps in the assessment of children's gas exchange, oxygenation status and acid base balance. However, the test doesn't give a diagnosis and shouldn't be used as a screening test. It is imperative that the results are considered in the context of the child's symptoms. **(Davis et al., 2013)**.

An arterial blood gases sampling (ABGs) is simply a blood test which is performed through puncturing an artery with a thin needle and heparinized syringe. Those who performed this test usually draw a small amount of blood (approximately, 1ml) from the radial artery at the wrist, or the femoral artery in the groin or other sites can be used as well. Moreover, the blood can also be drawn from an arterial catheter. The reason behind performing this test is used to identify the pH of the blood, the partial pressure of carbon dioxide and oxygen, and the level of bicarbonate. **(Leach, 2017)** .

Although the collection of arterial blood sampling may not seem difficult for nurses, it is still something painful and scary for many children. Therefore, nurses should be aware of the suitable methods during performing this technique, taking in consideration the probable complications and the essential precautions. It is noteworthy that the specimens of arterial blood gases sampling is highly sensitive to pre analytic effects. It can be affected by inappropriate assessment of children, test requisition, the way of collecting or transporting the specimen, and the result of the test. **(Padilla etal., 2017).**

Many lives-saving diagnostic tests which performed in intensive care unit are very important tools in observing any deviations from normal functions as arterial blood gases sampling in which nurses must demonstrate competency to guarantee the safe care for the child. Most clinical interventions for critically ill children require well-trained nurses that possess the enough experience about the safety and preservation of the procedures and treatments which are the main core of a successful nursing care. Also, nurses should pay more attention to bedside observation in order to monitor and find out any problem instantly so that they can be rapidly assessed and treated. **(Ratini, 2017).**

Nurses who care for children in critical care settings require sufficient knowledge which will have a positive impact on both their actions and clinical experience as well as nursing

care. They should understand the unique physiological, psychological, and emotional problems that arise in critically ill children so as to achieve the balance between the scientific, technical, and humane elements of nursing care.**(Babu et al., 2014).**

In health care area, scientific and technological advances lead to the obsolescence of knowledge and professional skills in a remarkably short period of time. Thus, a comprehensive basic professional preparation is no longer sufficient for a whole life of practice. Moreover, given the emphasis on evidence-based practice, members of nursing staff are in a dire need to update their knowledge and professional skills. Therefore, continuing education has increasingly become important to fulfill a high-quality nursing practice.**(Goldsworthy, 2016).**

Particularly, nurses who work in PICU should receive intensive educationaland clinical interventionprogramscarried out by the department in order to assess their core competencies on a regular basis. These programsarebasically designed basing on the patient population and the requirements of a given unit.As well as, it is essential forstaff nurses to develop these programs under their closed supervisionto help the pediatric intensive care nurse to acquire more knowledge and skills in dealing with critically ill children.**(Fineout& Mazurek , 2015) .**

The role of nurses in health care delivery is vital. Henceforth, it is their responsibility to enjoy a better understanding of the various procedures that performed for the children. The critical care nurse takes part in the stimulating process of healing, judging, taking decisions and actions. Such decisions are derived from an accurate recognition of the health and life saving procedures. The knowledge base is constantly updated via new clinical and educational experiences which promote the professional practice of critical care nurses.**(Shined & Anjum,2014).**

Nursing profession is worthy accounted for improving the competence and performance of nurses. This has been regarded the birth of the language of outcome. Outcome is mechanism to evaluate quality, improve effectiveness and link practices to profession and accountability. During the clinical experiences in PICU the researcher found that the majority of critically ill children's ventilation is being monitored by ABG interpretation. Though the nurses take an active role in collecting of ABGs and this requires skillful puncture by competent nurses which can prevent fatal complication in these children. By careful puncture the nurse is able to manage adverse outcomes before they arise. Hence, the researcher found urgent to conduct educational program for nurses about ABGs to enhance theirknowledge and practices that could help to achieve positive outcomes.

Aim of the study:

The aim of the present study was to evaluate the effect of educational program on improving nurses' performance regarding arterial blood gases sampling for critically ill children, through the following objectives:
1. Assessing nurses' knowledge about arterial blood gases sampling.
2. Assessing nurses' practice about arterial blood gases sampling.
3. Designing and implementing the educational program about arterial blood gases sampling based on the nurse's actual needs.
4. Evaluating the effect of the educational program on the nurses' knowledge & practice.

Research Hypothesis:
– The level of nurses' knowledge scores about arterial blood gases sampling will increase significantly after implementation of educational program.
– The level of nurses' practice scores about arterial blood gases sampling will improve significantly after implementation of educational program.
– There are a significant relationship between nurses' knowledge, practice, and personal characteristics.

Subjects and Method:
The study was conducted according to the following:
I. Technical design .
II. Operational design .
III. Administrative design .
IV. Statistical design .

Technical design:
The technical design of the study includes: the research designs, setting and subject as well as tools of data collection.

Research design:
A quasi experimental design was utilized to achieve the aim of the study.

Setting:
This study was conducted in pediatric intensive care units at Benha University hospital and Benha specialized pediatric hospital affiliated to ministry of health & population. Each pediatric intensive care unit in both hospitals is constructed from two rooms with bed capacity 16 beds.

Subjects:
A convenient sample of (50) nurses working at the above mentioned settings were recruited for this study regardless of their personal characteristics. They were selected based on their availability during the data collection time as well as their willingness to participate in the study.

Tools for data collection:

Tool I: A Structured Questionnaire Sheet:
It was developed by the researcher in the light of relevant literatures **as Stout and Foley, (2013); Hinkle and Cheever, (2014); Shelledy and Peters, (2016);**to assess nurses' knowledge regarding arterial blood gases sampling. It was written in a simple Arabic language and composed of three parts:

part (1): Personal data of the studied nurses such as ; age, gender, level of education, years of experience and attendance of any previous training courses related to arterial blood gases sampling

part (2): Personal data of the studied children such as ; age, gender, weight and diagnosis

part (3): concerned with nurses' knowledge about arterial blood gases sampling: It included(21) close ended questions in the form of multiple choice and true & false questions related to definition(1), indication(1), selection of site(1), contraindications(1), complications(1) and techniques of arterial blood gases sampling (16).

Scoring system of nurses' knowledge:

Nurses' knowledge were evaluated upon completion of the questionnaire sheet as the studied nurses' knowledge was checked with a model key answer and accordingly the correct answer was given one degree and zero for incorrect or don't know answers. The total scores were ranged from (0 – 21).Those who obtained a scores less than 80 % was considered as having an unsatisfactory level of knowledge while those who obtained a scores more than or equal to 80% was considered as having a satisfactory level of knowledge.

Tool (II): Nurses'Practice Observation Checklist:

It was designed by the researcher based on**Bowden and Greenberge, (2016)** to assess nurses' practice regarding arterial blood gases sampling (ABGs). It involved the procedures of arterial blood gases sampling from radial and femoral arteries. Withdrawal of ABGs from the radial artery included (38 steps) divided as pre sampling withdrawal (1 - 9), during(10- 25 steps) and after(26 to 38 steps). While, withdrawal from the femoral artery included (37 steps) categorized as pre sampling withdrawal (1-9), during (10 - 24 steps) and after (25 – 37 steps).

Scoring system of nurses' practice:

All practice variable were weighted according to care provided, one score was given for done and a zero for not done. Total scores were ranged from (0 - 75). Scores less than 85% was considered incompetent practice while scores greater or equal to 85% was considered competent practice.

Operational design:

The operational design included: preparatory phase, content validity, reliability of the tool, pilot study and field work.

Preparatory phase:

This phase include the following; reviewing the available literatures and different studies related to arterial blood gases sampling, and theoretical knowledge of its various aspects of the study, using textbooks, evidence based articles, internet, periodicals and magazines in order to collect tools of the study . This period extended from (The beginning of March 2017 to the end of May 2017).

Tools Validity:

The two developed Tools validity were revised by a panel of (3) experts in the field of pediatric and critical care and emergency nursing from faculty of nursing, Benha and Cairo universityfor ensuring content validity.Based on the experts' opinion responses, the researcher developed the final validated form of the tools. This phase took one month from (the beginning of June 2017 to the end of June 2017) .

Reliability of Tool:

Internal consistency reliability of all items of the tools was assessed using Cronbach's alpha coefficient**.** It was (0.79) for a structured questionnaire sheet and 0.83 for observation checklist by **(Youssef etal., 2013).**

Ethical considerations:

The researcher clarified aim of the study to studied nurses, and written approval was prerequisite to participate in the study. Nurses assured that all information obtained were confidential and used only for the purpose of the study. Additionally, all of the nurses have the freedom to withdraw from the study at any time without given any reason.

Pilot Study:

A Pilot study was conducted on 10 % of nurses (5 nurses) to test the applicability, clarity, feasibility of the study tools, sequence of questions to maintain consistency and time needed. Accordingly, no modification were done.Subjects who shared in the pilot study were included in the sample. This phase took one month from (beginning of July 2017 to the end of July 2017).

Field Work

Assessment phase:

The process of data collection was carried out from (the beginning of August to the end of August 2017). The researcher visited the pediatric intensive care units at the previously mentioned settings by rotationfour days weekly (Saturday, Sunday, Monday and Wednesday) morning & afternoon shifts to collect baseline data. Average of 3-4 nurses were interviewed per/day. At the beginning of the interview, the researcher greeted nurses in PICUs, explained the aim of the study and take their written approval to participate in the study prior to data collection, then the researcher assessed the nurses' performance level (knowledge & practice) regarding arterial blood gases sampling by using a structured questionnaire sheet and observational checklist (pre educational program implementation) as following:

Firstly, the questionnaire sheets were distributed to all nurses individually to assess their knowledge regarding arterial blood gases sampling in the presence of the researcher to clarify and answer any question. The average time needed 10-15 minutes.

Secondary, the researcher observed nurses' practice regarding withdrawal of arterial blood gases sampling from radial and femoral arteries during their shifts by using the observational checklist. Each nurse was evaluated 3 times and the mean was calculated. The average time needed for completion of each directobservation was between 15-20 minutes.This period of pre-test (knowledge and practice) took fourweeks.

Program construction:

The educational program for nurses was designed by the researcher according to the nurses' needs regarding arterial blood gases sampling. It was constructed, revised and modified from the related literatures to improve the nurses' knowledge and practice regarding arterial blood gases sampling. The contents were prepared in simple Arabic language. This was taken period of time from (the beginning of September till the end of October 2017).

Statement of objectives:

The general objectives of the program were to improve nurses' performance regarding arterial blood gases sampling for critically ill children.

Implementation of the program:

The implementation phase was achieved through sessions at a period of four month beginning from (November 2017 till the end of February 2018). Each session started by a summary of the previously session and the objectives of the new one; taking into consideration using of simple Arabic language that suits the nurses' educational level. Motivation and reinforcement during session were used in order to enhance sharing in this study.

The researcher was available at the PICUs at the previously mentioned hospitals 4 days per week (Saturday, Sunday, Monday and Wednesday). The total numbers of sessions were 10, (4 for knowledge and 6 for practice).The sessions have lasted for 156 hours (48 for theory – 108 h for practice). The theoretical sessions were started from 11:00AM to 12.00PM .The nurses were divided into 12 groups. Each group contains 4-5 nurses. The theoretical part of the program focused on knowledge about definition of ABGs, indication, sites for withdrawal of sample, precaution, contraindications, complications and techniques of arterial blood gases sampling. Each nurse was supplemented with booklet. The researcher continued to reinforce the gained information, answered any raised questions and gave feedback.

The practical sessions were started on the same 4 days from 12.30 AM to 2.00 PM. The practical parts cover the procedures related to withdrawal of arterial blood gases sampling from radial and femoral arteries. Teaching methods were lecture, group discussion, demonstration and redemonstration, brain storming, media utilized were handout and real materials to help proper understanding of the content by nurses.

Evaluation phase:

After implementation the educational program, the post-tests were administered to assess nurses' performance (knowledge & practice) by using the same tools of the pre-test. This helped to evaluate the effect of implemented program. This was done immediately after the intervention.

Administrative design:

For conduction of the study an official letter was issued from the Dean of faculty of nursing, Benha University to the administrator of the study setting. A clear explanation was given about the nature, importance and expected outcomes of the study. Then, it was possible to carry out the study with minimal resistance.

Statistical design:

The collected data were organized, categorized, tabulated and analyzed using SPSS advanced statistics version 20. Numerical Data were expressed as mean and standard deviation as appropriate. Qualitative data were expressed as frequency and percentage. Chi-square test was used to examine the relation between qualitative variables. For quantitative data, comparison between two groups was done using non parametric t-test. One way analysis of variance test (ANOVA) was used to analyze the difference between three or more continuous variables. Reliability of the interviewing questionnaire was done using Cronbach's Alpha. Significances were considered at p-value < 0.05,<0.01 and <0.001.

RESULT:

Table (1): Percentage Distribution of TheStudied Nurses According to Their Personal Characteristics (N=50).

General characteristics	No	%
Setting		
▪ Benha university hospital	25	50.0
▪ Benha specialized pediatric hospital	25	50.0
Age in years		
▪ 20>30	39	78.0
▪ 30> 40	11	22.0
Mean ±SD	**24.76±6.89**	
Gender		
▪ Male	1	2.0
▪ Female	49	98.0
Educational qualification		
▪ Secondary nursing education	12	24.0
▪ Technical nursing education	31	62.0
▪ Bachelor of nursing	7	14.0
Years of experience		
▪ Less than one year	2	4.0
▪ 1-5 yrs	30	60.0
▪ 6-10 yrs	5	10.0
▪ 11-15 yrs	13	26.0
Mean ±SD	**6.48±3.24**	
Previous training courses regarding ABGS		
▪ Yes	0	0.0
▪ No	50	100.0

It apparent from table (1) that, the mean age of the studied nurses are 24.76±6.89 and most of them (98.0%) are female. In relation to nurses' education, 62.0% of them graduated from technical Institute of nursing. As regard years of experience, this table illustrates that more than half (60%) of nurses have 1-5 years of experience with mean years of experience of (6.48±3.24 years). Moreover, all of them (100%) have not received any previous training courses regarding arterial blood gases sampling.

Table (2): Percentage Distribution of the Studied Children According to Their Personal Characteristics (N=150).

General characteristics	No	%
Age in years		
▪ <3years	68	45.3
▪ 3-< 6years	44	29.3
▪ 6-9 years	38	25.4
Mean ±SD	3.87±2.13	
Gender		
▪ Male	60	40.0
▪ Female	90	60.0
Weight in kilograms		
▪ 10-12 kg	75.0	50.0
▪ 13-21 kg	40	26.7
▪ 22-30 kg	35	23.3

Table 2 shows that, the mean age of children are 3.87±2.13years and60.0% of them are female. In addition, half (50%) of studied children weight are ranged from 4 to 12 kilograms.

Figure (1): Percentage Distribution of The Studied Nurses ' Total Knowledge Scores Regarding Arterial Blood Gases Sampling(N=50).
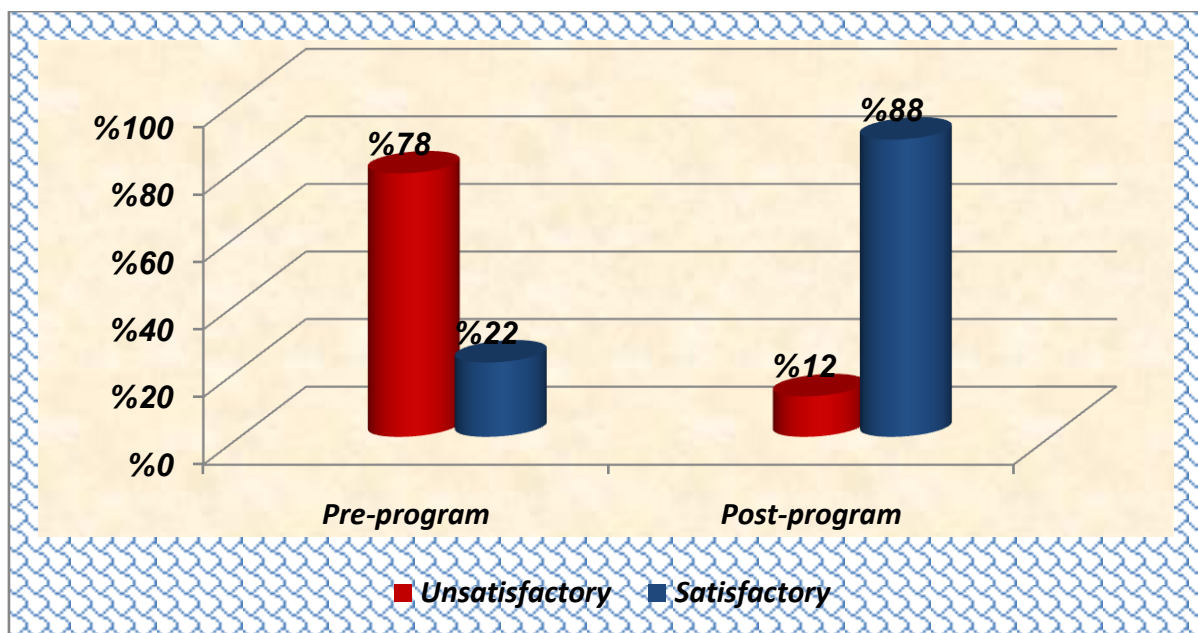

Figure (1)illustrates that more than three quarter (78%) of nurses have unsatisfactory level of knowledge at the pre-program phase and the majority (88%) of them have satisfactory level of knowledgeat the post program phase.

Table (3):Percentage Distribution of The Studied Nurses'Total Practice Scores Regarding Radial Arterial Blood Gases Sampling Throughout The Program Phases (N=50).

Practice	Pre - Program n =50				Post- Program n= 50				Chi square test	P value
	Incompetent		Competent		Incompetent		Competent			
	No	%	No	%	No	%	No	%		
Radial arterial										
▪ Pre-	37	74.0%	13	26.0%	7	14.0%	43	86.0%	36.52	<0.001**
▪ During	35	70.0%	15	30.0%	10	20.0%	40	80.0%	25.25	<0.001**
▪ After	34	68.0%	16	32.0%	3	6.0%	47	94.0%	41.22	<0.001**
Total radial	41	82.0%	9	18.0%	6	12.0%	44	88.0%	49.17	<0.001**

** Highly statistically significant at p value < 0.001.

It is clear from table (3) that the majority (82.0%) of nurses have incompetent practice at the pre- program phase. On the otherhand,themajorities (88.0%) of them have competent practice at the post program phase.

Table (4): Percentage Distribution of The Studied Nurses' Total Practice Scores Regarding Femoral Arterial Blood Gases Sampling Throughout The Program Phases (N =50).

Practice	Pre-program n =50				Post-program n= 50				Chi square test	P value
	Incompetent		Competent		Incompetent		Competent			
	No	%	No	%	No	%	No	%		
Femoral arterial										
▪ Pre-	22	44.0%	28	56.0%	2	4.0%	48	96.0%	21.93	<0.001**
▪ During	34	68.0%	16	32.0%	2	4.0%	48	96.0%	44.44	<0.001**
▪ After	33	66.0%	17	34.0%	2	4.0%	48	96.0%	42.24	<0.001**
▪ **Total femoral**	35	70.0%	15	30.0%	2	4.0%	48	96.0%	46.71	<0.001**

** Highly statistically significant at p value < 0.001.

As can be seen from table (4) that more than two third (70.0%) of nurses have incompetent practice at the pre- program phase. On the other hand,most (96.0%) of them have competent practice at the post program phase.

Figure (2): Percentage Distribution of The Studied Nurses' Total Practice Scores RegardingArterial Blood Gases Sampling Throughout The Program Phases(N=50).
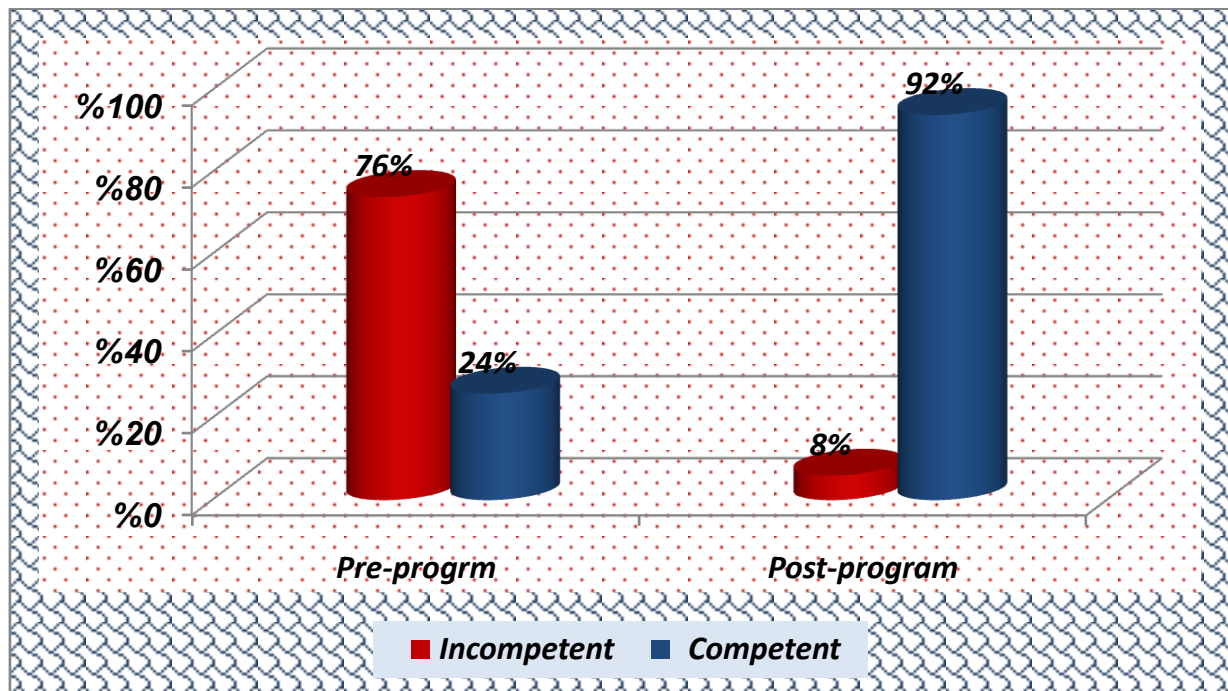
As shown from figure (2) that more than threequarters (76%) of nurses have incompetent practice level at pre-program phase and the vast majority (92%) of them have competent level at the post program phase.

Table (5): Relation Between Studied Nurses' Total Knowledge Scores and Personnel Characteristics Throughout The Program Phases (N =50).

General characteristics	Knowledge pre-program Mean±SD	Statistical tests		P value	Knowledge post-program Mean±SD	F test	Independent t test	P value
		F test	Independent t test					
Working setting								
▪ BenhaUniversity hospital	7.0400±2.57358		0.414	>0.05	13.1600±2.57682		2.00	<0.05*
▪ Benha specialized pediatric hospital	7.4000±3.50000				14.3600±1.52425			
Age in years								
▪ 20-<30	6.7949±3.13872		2.32	<0.05*	13.7179±2.30501		0.296	>0.05
▪ 30-40	8.7273±2.19504				13.9091±1.75810			
Gender								
▪ Male	7.0000±2.61861		0.251	>0.05	13.8750±2.23207		0.519	>0.05
▪ Female	7.2619±3.14728				13.7381±2.19822			

Educational qualification							
▪ Secondary nursing education	7.5833±2.96827	0.364		>0.05	13.6667±1.82574	0.566	<0.05*
▪ Technical nursing education	6.9355±3.03244				13.9677±2.12107		
▪ Bachelor of nursing	7.8571±3.53217				13.0000±3.05505		
Years of experience							
▪ Less than one year	7.5000±3.53553	1.49		>0.05	13.0000±2.82843	0.927	<0.05*
▪ 1-5	6.5000±3.14862				14.0667±2.19613		
▪ 6-10	8.4000±2.07364				12.4000±3.04959		
▪ 11-15	*8.3846±2.84425				13.6923±1.70219		

*statistically significant at p value <0.05

It is apparent from table (5) that there is a statistically significant relation between studied nurses' total knowledge scores and age (P<0.05*) at the pre- program phase. Moreover, there area statistically significant relation between working setting, educational qualification, years of experience and studied nurses' total knowledge scores(P<0.05*)at the post program phase.

Table (6): Relation Between Studied Nurses' Total Practice Scores and Personnel Characteristics Throughout The Program Phases (N =50).

General characteristics	Practice pre-program Mean±SD	Statistical tests		P value	Practice post-program Mean±SD	F test	Independen t t test	P value
		F test	Independen t t test					
Working setting								
▪ Benha university hospital	35.6800±8.73556	3.27		<0.001**	66.0800±2.56450	3.36		<0.001**
▪ Benha specialized pediatric hospital	43.6400±15.19287				68.6800±2.88271			
Age in years								
▪ 20-<30	40.3590±12.48470	0.654		>0.05	67.6154±2.84342	0.924		>0.05
▪ 30-40	37.1818±14.67527				66.5455±3.53167			
Gender								
▪ Male	42.5000±13.08216	0.671		>0.05	68.3750±3.46152	0.908		>0.05
▪ Female	39.1190±12.96186				67.1905±2.91538			
Educational qualification								
▪ Secondary nursing education	30.7500±7.35002	32.20		<0.001**	65.0833±3.02890	20.19		<0.001**
▪ Technical nursing education	37.9355±9.68482				67.2581±2.09711			
▪ Bachelor of nursing	62.5714±2.43975				71.8571±.89974			
Years of experience								
▪ Less than one year	20.5000±.70711	10.10		<0.001**	60.5000±.70711	9.80		<0.001**
▪ 1-5	36.2667±8.43610				66.9667±2.18905			
▪ 6-10	35.0000±6.85565				66.6600±2.19089			
▪ 11-15	52.2308±14.91171				69.6923±3.03822			

**Highly statistically significant at p value < 0.001

It is evident from table (6) that there are a highlystatistically significant relation between working setting, educational qualification, years of experience and studied nurses' practice scores in both pre and post program phases ((p<0.001**& P<0.001**) respectively.

It is obvious from table (7) that there is a statistical significant positive correlation between studied nurses' total knowledge scores and total practice scores at the post program phase (r=.588, p < 0.001**).

Table (7): Correlation Between Studied Nurses' Total Knowledge Scores and Total Practice Scores at The Post Program Phase.

Variables	Total Knowledge scores	
	r	P value
Total Practice scores	.588	0.001**

** correlation is significant at the 0.01 level (1-tailed).

DISCUSSION

Arterial Blood Gases sampling (ABGs) measurement is a valuable way for assessing the need of respiratory therapy. ABGs studies aid in assessing the ability of the lungs to provide adequate oxygen and remove carbon dioxide and the ability of the kidneys to reabsorb or excrete bicarbonate ions to maintain normal body PH. Furthmore, it evaluates the serum electrolytes sodium and potassium.**(Dugle & Lengel, 2017)**.

Arterial blood gases sampling has become an integral part of nurse's role when caring for the critically ill children. With the appropriate training a nurse can learn the clinical skills required to obtain an ABGs sample for recognizing any abnormalities and take corrective action.**(Kaufman,2015).**

The present study aimed to evaluate the effect of educational program on improving nurses' performance regarding arterial blood gases sampling for critically ill children.

As regards to nurses' characteristics, findings of the present study revealed that the majority of studied nurses were females. This could be due to the fact that the profession of nursing in Egypt was mostly feminine. Additionally, male nurse prefer to travel abroad or working in private hospitals and leave governmental hospitals for female nurses specially at morning and afternoon shifts because of its low salary and this was the time selected by researcher to collect required data, This finding was in the same context with **Padma etal., (2017)**, who conducted a study to assess the knowledge regarding arterial blood gases sampling among staff nurses in selectedhospital in India and found that, the majority of staff nurses were female.

Regarding qualification level of the studied nurses, the present study revealed that, two third of the studied nurses had technical nursing education. This result might be related to that the technical institute of nursing provide the community with large number of nurses.This finding was in agreement with **Zhang and Shan, (2017)** who carried out a study to compare the blood collecting from radial andfemoral artery among nurses having different length of service and found that, two third of the studied nurses had technical nursing education. On the other hand the present finding was inconsistent with **Safwat and khorais, (2018)**who conducted a study to assess the effectiveness of a computer- based learning module on arterial blood gases sampling among staff nurses in critical care units affiliated to Ain shams University Hospital, Egypt and found that, two third of the studied subjects were having bachelor degree and the rest were diploma.

Moreover, all the studied nurses reported that, they didn't'receiveany previous training courses regarding arterial blood gases sampling. This reflected the unsatisfactory level of nurse's knowledge at the pre- program phase. This finding was supported with **Padilla etal., (2017**) who assess the effect of simulation- based workshop on nursing students' competence in arterial puncture in London and found that the majority of nurses didn't' receive any form of training regarding arterial puncture. On the contrary, **Thorat etal., (2017**) who conducted a study to assess the effectiveness of structured teaching program on knowledge regarding arterial

blood gases sampling among staff nurses in India and showed that, more than two third of the staff nurses have participated in arterial blood gases program.

The current study has highlighted the overall unsatisfactory nurses' knowledge at the pre- program phase. This could be due to the fact that nurses didn't received any training courses regarding ABGs and overload by increased number of patients for each nurse as well as this topic was not integrated in the nursing education curricula for nursing student. This finding was congruent with **Subin, (2017)** who carried out a study toassess the effect of video- assisted teaching on knowledge regarding ABGs among staff nurses of Bhopal in India and found that the majority of staff nurses had inadequate knowledge regarding ABGs at the pre - test phase.

After implementation of the program, there was a significant improvement in the total scores of nurses who achieve satisfactory level of knowledge. This improvement indicated that, the program was a successful method to increase nurses' knowledge. This finding was consistent with **Hemavathy etal., (2016)** who conducted a study to assess the effectiveness of structured teaching program regarding ABGs among the staff nurses at selected hospital ,Chennai, India and revealed that the majority of studied nurses had adequate knowledge at the post test phase.Similarly, this result was in harmony with the study done by **Thulasimani, (2010)** who assess the effectiveness of structured teaching program on knowledge regarding arterial blood gases sampling among the staff nurses who are working in ICU of Vinayaka mission hospital at Salem in India and showed that**,**all of staff nurses had adequate knowledge regarding ABGsafter structured teaching program implementation.In this respect, this findingwas in the same context with**Schneiderman etal.,(2012)** who conducted a study to demonstrate the effectiveness of an online, computer- based learning module for arterial blood gases sampling in Northern Illinois in USA and found that the educational program was significantly effective for increasing the knowledge regarding ABGs and emphasized that continuing nursing education is the key to update the knowledge of the nursing personnel which will help to provide comprehensive nursing care.

On investigating nurses' practices regarding ABGs the present study revealed that the majority of nurses had incompetent practices in the pre-program phase. This could be attributed to that nurses felt that ABGs is the responsibility of doctors not the nurses, nurses didn't feel competent enough to perform ABGs and majority of them depend on random repetition and imitation during withdrawing ABGs samples. The result of the current study was compatible with what reported by **youssef etal., (2013)** who conducted a study to assess factor affecting validity of arterial blood gases results among critically ill patient at Cairo university hospital, in Egyptand found that majority of the studied subjects demonstrated an unsatisfactory practical level in relation to arterial blood gases samplingat the baseline assessment.

After the program there was a highly statistical significant improvement with the number of nurses who achieve

competent scores. One possible factor might explain this finding that the program enriches nurses' knowledge which in turn leads to improvement of their practice. This result matched with the result found by **Kaur and Charan,(2018)**who carried out a study in India to assess the effectiveness of structured teaching program on knowledge and practice regarding ABGs among ICU nurses and showed that the majority of nurses had competent level of practice in the post –test phase.As above mentioned, the present finding was in the same context with **Barnett and Kautz, (2013)** who conducted a study to assess the creative ways to teach arterial blood gases sampling: dimension of critical care nursing in United kingdom, London and found that using teaching approach to evaluate ABGs could enhance the ability of the nurse to perform ABGs **.**Additionally, the current study was in agreement with **Azad etal., (2009**) who conducted a study to compare the effect of two clinical teaching models on performance of nursing students in intensive care unit regarding arterial blood gases sample in Iran and found that there was a statistically significant difference sores of nurses' practice in both experimental and control groups regarding ABGs at the post - test phases, whereas the average score of nurses at experimental groups was significantly higher than control groups (p< 0.001). Moreover, at the end of clinical education many of experimental students reached to mastery level of performance.

In this regard, **Aygencel, (2014)** who carried out a study toassess knowledge and practice regarding arterial blood gases sampling in Ankara, Turkey, and emphasizedthat training has positive impact toward enhancing nurses' practice.

It was evident from the present study that, there was a significant relation between nurses' knowledge scores and age at the pre- program phases. This might be due to the fact that the older nurses had more experience and knowledge about ABGs than those the young one. This finding was supported with **Mathew etal., (2014)** who conducted a study to assess the effectiveness of structured teaching program regarding arterial blood gases sampling in terms of knowledge among nurses working in ICU in selected hospitals of India and found that there was a statistically significant relation between nurses' knowledge scores and age at the pre- program phase. On the other hand this result was opposite to that of **Zhang and Shan, (2017)** whofound that there was no significant relation whatsoever between nurses knowledge scores and age at the pre-program phase.

Apparently, the current study finding indicated that there was a statistically significant relation between years of experience and nurses' knowledge scores at the post-program phase. This finding might be related to the nurses who have more experience with ABGs sampling are more likely to have more favorable knowledge. The study finding was consistent with **Padmakumar, (2010)** in an published master thesis entitled, a study to evaluate the effectiveness of structured teaching program on specimen collection for arterial blood gas analysis in terms of knowledge and skills among staff nurses at selected private hospital at Bangalore and found that there was a statistically significant relation between years of experience and nurses' knowledge scores at the post-program phase **.**

Interestingly, the current study revealed that there was a highly statistically significant relation between years of experience and nurses' practices scores at the post-program phase. This finding may be interpreted in the light of increasing the years of experience may have enhanced the higher efficiency of the clinical practices among nurses. The finding of the current study was congruent with **Kaur and Charan, (2018)** who found that there was a statistically significant relation between years of experience, and nurses' practices scores at the post-program phase.

Finally, the present finding revealed that, there was a significant positive statistical correlation between nurses' knowledge and practices scores at the post- program phase. This result might be attributed to the more hours of ABGs sampling education could help the nurses to enhance their knowledge and improve their abilities to perform ABGs competent. This finding was on the same line with the study done by **Safwat and khorais, (2018)** who revealed that there was a significant positive correlation between nurses' knowledge and practices at the post program phases. (p<0.001).

CONCLUSION:

Based on the results of the present study, it can be concluded that, the research hypothesis is accepted, while it was found that the educational program is highly effective method to improve the nurses' knowledge and practice regarding arterial blood gases sampling.

RECOMMENDATION:

Based on the findings of the present study, the following recommendations can be suggested.
1. The educational guidelines regarding arterial blood gases sampling should be revised and available in pediatric intensive care units in Arabic language.
2. Continuous training and evaluating should be provided to all nurses' involved in arterial blood gases sampling for updatedtheir knowledge and ensure competent practice.
3. Further study can be replicated on other hospitals using a large sample size to generalize the finding.

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