

# Effect of Applying Program Based Learning on Nurse's Performance and Self-efficacy Regarding Arterial Blood Puncture

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**Abstract Background:** Arterial blood puncture is one of the most complex parts of nursing practice. **Purpose:** Evaluate effect of applying program based learning on nurse's performance and self-efficacy regarding arterial blood puncture. **Method:** Quasi experimental research design has been utilized in this study. This study was conducted at four hospitals affiliated to ministry of health. A convenient sample of 70 nurses was included. Three tools were utilized for collecting data; first tool was a questionnaire to assess nurses' knowledge regarding arterial blood puncture. Second tool was observational checklist of arterial blood puncture procedure. The last one was arterial blood puncture self-efficacy scale. **Results:** the study results revealed improvement in nurses' knowledge and practice regarding arterial blood puncture after applying the program based learning. A significant difference was founded between levels of nurses' self-efficacy about arterial puncture after program implementation with p-value of 0.000. While, hospitals where nurses working are associated significantly with total self-efficacy of nurses regarding arterial blood puncture. **Conclusion:** the current study concluded that the program based learning about arterial puncture improves nurses' knowledge, practice and self-efficacy. Additionally, regular training program regarding arterial blood puncture should be applied in hospitals. Conducting the same study in larger sample is recommended.

*Keywords:* Arterial blood puncture, nurse, performance, self-efficacy

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## 1. Introduction

Nurses are playing crucial role in early detection of patients at high risk for acid-base imbalance in critical care units. The nurse is involved in the medications administration, oxygen therapy and mechanical ventilation if indicated. In extreme circumstances in which therapeutic compensation is required, the nurse should be knowledgeable about potential risks of these therapy and able to monitor administration rates and therapeutic responses carefully [1].

Arterial blood gases are ordered frequently by emergency medicine, intensivist, anesthesiology and pulmonology physicians, but also might be needed in other clinical settings. There are many diseases that are evaluated using an ABG such as acute respiratory distress syndrome (ARDS), severe sepsis, septic shock, hypovolemic shock, diabetic ketoacidosis, renal tubular acidosis, acute respiratory failure, heart failure, cardiac arrest, bronchial asthma and metabolism disorder [2].

Arterial blood gases (ABG) is so important step of respiratory assessment in acutely ill patients and its

analysis has become one of the most common laboratory investigations in modern medicine. Therefore, arterial blood puncture is a regularly-performed invasive procedure in clinical settings. The puncture of the artery is always described as a very painful and challenging invasive procedure that is not exempt of risks. In fact, case report studies suggest that errors during the performance of arterial blood puncture for ABG analysis could cause serious complications as nerve injuries, acute compartment syndrome, thrombosis and pseudo aneurysm. Therefore, it is important that those healthcare professionals responsible for collecting arterial blood samples are adequately trained [3,4].

An arterial blood gases sampling (ABGs) is a simple 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 reasons behind performing this test are to identify the pH of the blood, the partial pressure of carbon dioxide, oxygen, and the level of bicarbonate [5,6].

The status of acid-base homeostasis may be monitored clinically through the serial measurement of arterial blood gases (ABGs) among the parameters reported are Ph, PaCo<sub>2</sub> and HCo<sub>3</sub>. These values may be used to determine the presence of type of acid base imbalances and evaluate the level of compensation. These disorders are not clinical diagnosis or diseases in themselves rather they are clinically syndromes, associated with a wide variety of diseases [7].

Self-efficacy is defined based on Bandura's theory as someone's beliefs in how the personal able to carry out specific tasks effectively [8]. When self-efficacy is highly perceived, individuals' motivation and cognitive resources are activated and the likelihood of attempting to perform a certain activity is greater than if self-efficacy is low [9,10,11]. In fact, low self-efficacy is always considered a barrier to effectively executing the tasks involved in the activity that must be carried out [12,13].

Self-efficacy as expressed by Bandura [9], is an individual's perception of one's ability to perform at various levels of tasks. Nursing teacher self-efficacy is founded in part on the confidence of the faculty member in being able to select, use, and modify appropriate teaching strategies. As new teaching strategies are being introduced in India, it is vital to ascertain the teacher self-efficacy of the Indian nursing faculty. According to Britton, K. L., [14] higher self-efficacy is achieved by understanding and experience which affect teaching behaviors and professional progress and is integral to increasing self-efficacy [15].

Moreover, nurses are responsible for drawing blood samples for ABG analysis in Spain and many countries Simundic, et al., [16] while, training in this invasive procedure is not always offered as a part of nursing programmers or as a continuous educational resource [16,17]. Furthermore, the patients have actively need more skillful professionals to carry out the procedure [18], may indicate a need for evaluation of nurses and nursing students' competence to perform arterial puncture before attempting the procedure in real patients without supervision.

In health care field, scientific and advanced technology could 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 [19].

### 1.1. Significance of the Study

Arterial blood puncture is one of the most common performed procedures in health care settings. Therefore, reviewing literature related to complications of arterial blood puncture is inquiry. This procedure sometimes could be fetal while it is normally without complications; Complications that can arise from arterial blood puncture might be haematoma formation, nerve damage, pain, haemaconcentration, extravasation, iatrogenic anaemia, petechiae, allergies, fear and phobia, infection, syncope

and fainting, excessive bleeding, edema and thrombus. On the other hand, ABG analysis is a diagnostic tool that allows the objectives evaluation of a patient's oxygenation. Ventilation and acid-base balance, the results from an ABG will indicate how well a patient's respiratory system is working. However, ABG can offer more than just knowledge about respiratory system they also indicate how well a patient's kidney and other human body organs are functioning.

### 1.2. Study Aim

Evaluate effect of applying program based learning on nurse's performance and self-efficacy regarding arterial blood puncture.

### 1.3. Study Objectives

1. Assess nurses' knowledge regarding arterial blood puncture in intensive care units.
2. Determine nurses' practice about arterial blood puncture in intensive care units.
3. Identify arterial blood puncture self-efficacy of nurses in intensive care units.
4. Design a program based learning for nurses regarding knowledge, practice and self-efficacy regarding arterial blood puncture.
5. Implement the program based learning for nurses regarding arterial blood puncture.
6. Evaluate nurses' performance and self-efficacy regarding arterial blood puncture.

### 1.4. Research Question

1. Is there relationship between nurses' knowledge regarding arterial blood puncture and their socio-demographic characteristics?
2. What are the factors associated with nurses' practice regarding arterial blood puncture?
3. What are the factors associated with nurses self-efficacy regarding arterial blood puncture?

## 2. Design

Quasi experimental research design was utilized in the current study.

### 2.1. Sample

A convenient sample of 70 nurses was included in the present study.

### 2.2. Setting of the Study

This study was conducted at four hospitals affiliated to ministry of health named Port Said general hospital, Elzohor, Elnaser and Port Fouad hospitals.

### 2.3. Study Tools

Three tools were utilized for collecting study data, first tool was nurses' knowledge questionnaire that developed

by [7] and modified by the researcher based on reviewing relevant related literature to assess nurses' knowledge regarding arterial blood sample. This questionnaire include 50 multiple choice questions about arterial blood gases indications, preparation of arterial blood sample, complications and preventive measures that should followed by the nurse. Additionally, nurse's socio-demographic characteristics as Age, level of education, and years of experience were assessed.

### 2.3.1. Scoring System of Nurses Knowledge Questionnaire

Each question answered right scored with two and any question answered false or not answered scored with zero. The total score of all questions ranged from zero to 100 and it was classified as satisfactory level when it was  $\geq 75\%$  and unsatisfied when it was  $< 75\%$ .

Second tool was observational checklist regarding arterial blood sample procedure that was developed by [7,20] and modified by the researchers based on the field of work and relevant related literature [21,22,23].

### 2.3.2. Scoring System of Nurses Practice Checklist

Each procedure step done scored with two and each step not done scored with zero the total score of all steps ranged from zero to 106 and it was classified as satisfactory level when it was  $\geq 75\%$  and unsatisfied when it was  $< 75\%$ .

Third tool was used for data collection named arterial puncture self-efficacy likert scale that adapted by the researchers from [20].

### 2.3.3. Scoring System of Nurses' Self-efficacy Scale

All items in the arterial puncture self-efficacy scale were scored on a four points Likert Rating Scale whereas 1 mean not relevant, 2 mean somewhat relevant, 3 mean quite relevant and 4 mean highly relevant. The total score of all items was ranged from 22 to 88 grades and the total score of the tool was classified as satisfactory level when it was  $\geq 75\%$  and unsatisfied when it was  $< 75\%$ .

## 2.4. Content Validity

Validity was used for the modified tools to assure that it cover the objectives. This phase developed by a Jury of seven experts from nursing staff; two assistant professor of medical surgical nursing Faculty of nursing, Mansoura University and five lecturers of Medical-Surgical Nursing at Faculty of Nursing, Port Said University.

## 2.5. Pilot Study

A pilot study was carried out on 10% of the study sample with the selected criteria to test the applicability of the tools, arrangement of items, and to estimate the time needed for each tool. Nurses whom included in the pilot study were excluded from the study sample.

## 2.6. Data Collection

Data were collected two times using the previous mentioned study tools as possible time for Nurses. First

time to assess baseline data of nurses' knowledge, practice and self-efficacy regarding arterial blood puncture before implementing the program based learning. Second time after implementing the program based learning on nurse's performance and self-efficacy regarding arterial blood puncture to evaluate the effect of the educational program on nurses' performance and self-efficacy.

## 2.7. Field Work

The actual fieldwork of data collection was carried out over the period from the beginning February of 2019 up to the end of July 2019 for data collection. Before data collection the process and purpose of the study were explained to the nurses. The study was carried out through the following three phases:-

### 2.7.1. Pre-intervention Phase

After the finalization of study tools and tested its applicability through the pilot study, each studied nurse was interviewed individually to collect their knowledge about arterial blood puncture and observed during applying arterial blood puncture in their working wards as a pre-test, before developing and implementing the program based learning about nurse's performance and self-efficacy regarding arterial blood puncture. Data were collected by using the study tools that mentioned previously.

### 2.7.2. Implementation Phase

Based on the data collected from various sources during the assessment phase, and with the help of the literature review from PubMed, Cochrane library, and textbooks the researcher was designed a training program responding to the needs identified from baseline data of the nurses. These needs were translated into a general objective; the general objectives were broken down into specific objectives, which were set in sequential order. The researchers was designed and provided an program based learning about nurse's performance and self-efficacy regarding arterial blood puncture. The educational program includes objectives of nurses practice which represent steps of arterial blood puncture. In addition to objectives about knowledge related arterial blood puncture procedure. The program conducted using video and demonstration for practice related to arterial blood puncture procedure however booklets and interactive lectures was used for knowledge and self-efficacy. The educational program was applied for participated nurses in seven small groups each group include ten nurses. The program covered two sessions for each group, one for knowledge and self-efficacy and one for practice regarding arterial blood puncture. The program education was held twice-weekly at Saturday and Monday each session take an hour in the morning shift from 9 to 10 AM.

### 2.7.3. Evaluation Phase

The program outcome was evaluated for nurses immediately and three months after implementation of the program. While the statistical analysis was compare only between nurses baseline data after the program implementation and three months later to get more

accurate magnitude about effect of the program based learning on the nurse's performance and self-efficacy regarding arterial blood puncture.

### 2.8. Ethical Considerations

An approval was obtained from directors of hospitals included in this study after a comprehensive explanation of study aim, benefits and methods. Additionally, before data collection, oral consent was taken from each nurse after explaining the study aim and process

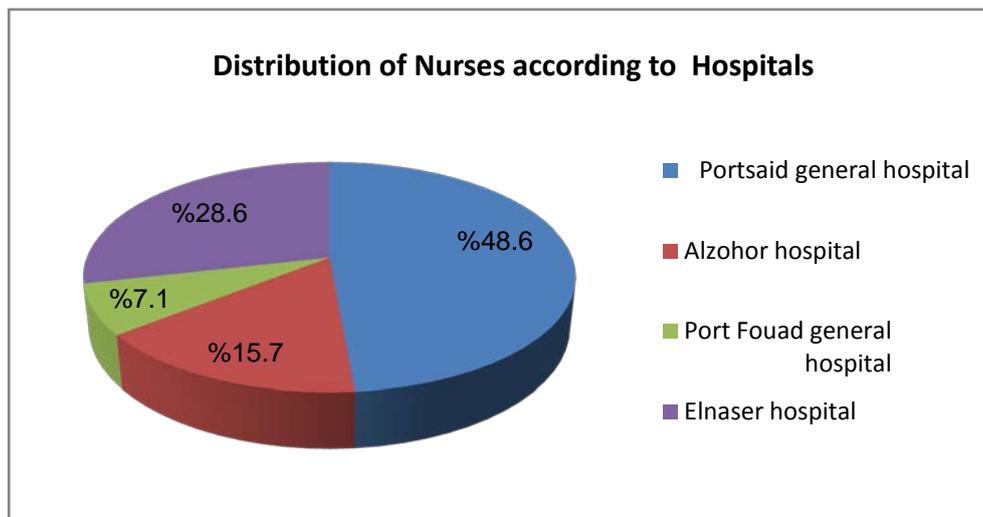
### 3. Results

The current study revealed that the majority of studied nurses were female (97.1%) and most of them (72.9%) were in age group from 20 to less than 30 years. Regarding education (48.6%) graduated from technical institute of nursing followed by (31.4%) graduated from Secondary technical School of nursing (see Table 1). Moreover, the highest percent of studied nurses works at Port Said general hospital (48.6%) while lowest percent from Port Fouad general hospital (7.1%). Figure 2

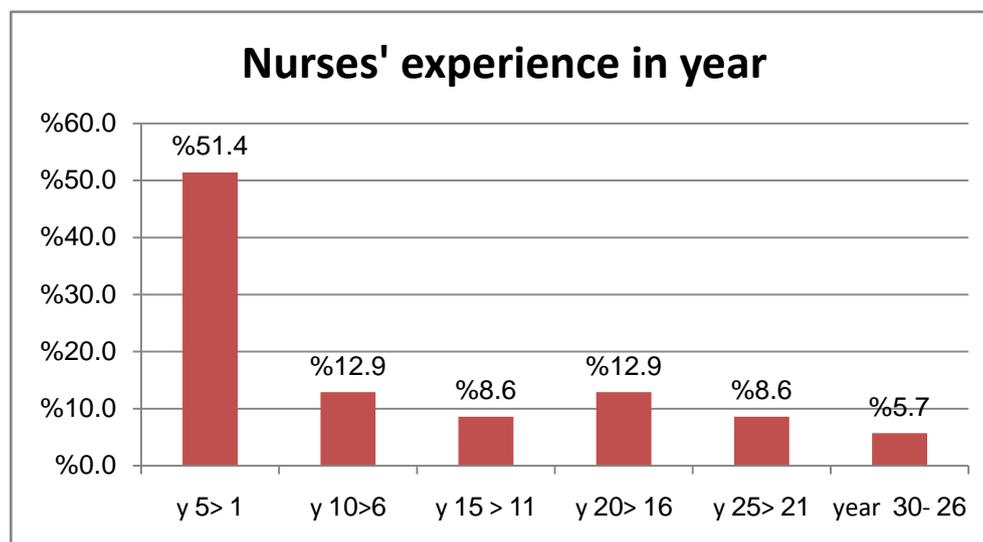
displays that more than half of studied nurses have experience years from 1 to less than 5 years (see Figure 1). On the other hand, the current study results showed a statistically significant difference between total nurses' Knowledge and practice regarding ABG pre and post program implementation with P-Value 0.000. Furthermore, the study results found a statistically significant difference between nurses' total self-efficacy pre and post program implementation with P-Value, 0.000.

**Table 1. Personal characteristics of the studied nurses (n=70)**

Personal characteristics	N	(%)
• Gender		
Male	2	(2.9%)
Female	68	(97.1%)
• Age		
20 < 30 years	51	(72.9%)
30 < 40 years	16	(22.9%)
40 – 50 years	3	(4.3%)
• Education		
Secondary technical School of Nursing	22	(31.4%)
Technical institute of nursing	34	(48.6%)
Bachelor	11	(15.7%)
Master	3	(4.3%)



**Figure 1.** Distribution of studied Nurses according to hospitals



**Figure 2.** Distrubution of studied Nurses according to their Experiences in Years

**Table 2. Factors associated with nurses' knowledge and practice regarding ABG**

Factors	Pre knowledge		Post knowledge		Pre practice		Post-Practice	
	F	P-value	F	P-value	F	P-value	F	P-value
Age	7.641	0.000*	0.790	0.458	3.304	0.001*	1.008	0.395
Gender	5.948	0.653	1.050	0.592	13.226	0.509	0.581	0.901
Level of education	20.831	0.000*	1.814	0.171	1.857	0.053*	0.533	0.661
Years of Experience	6.846	0.000*	0.881	0.419	1.849	0.54	0.726	0.540
Hospital	0.528	0.831	1.029	0.363	0.697	0.768	0.360	0.782

Significant level considered when P value  $\leq$  0.05, F, ANOVA.

**Table 3. Factors associated with nurses' self-efficacy regarding arterial puncture procedure**

Factors	Pre self-efficacy		Post self-efficacy	
	F	P-value	F	P-value
Age	1.571	0.193	0.534	0.660
Gender	2.445	0.655	1.144	0.767
Level of education	0.021	0.999	0.212	0.887
years of Experience	2.009	0.104	0.982	0.407
Hospital	4.921	0.002*	2.370	0.078

Significant level considered when P value  $\leq$  0.05, F, ANOVA.

However, the current results revealed a statistically significant difference between nurses' knowledge and practice related ABG preprogram implementation and their age with P-Value, 0.000 and 0.001 respectively, and level of education with P-Value 0.000 and 0.053, while there was statistically significant difference between nurses' knowledge and their years of experience (see Table 2). Additionally, the current results displays that the only statistically significant difference between nurses' self-efficacy pre-program based learning implementation and hospital with P-Value of 0.002 (see Table 3).

## 4. Discussion

Arterial blood gases analysis is a crucial skill for nurses. The ability of nurses to perform accurate assessment of ABGs allows them to assist health care members in restoring a patient's acid-base balance [24]. Nurses familiar with normal ABG values can quickly spot abnormal results. Identifying acid-base imbalance problems early leads to improved patients care and can help to reduce morbidity and mortality [25].

Results of the current study found a statistically significant difference between total nurses' Knowledge and practice regarding ABG pre and post program based learning implementation. This result goes in the same line with Kaur, & Charan, [26] who reported that the majority of intensive care nurses had adequate knowledge and practice after implementation of the program based learning about arterial blood puncture.

On the other hand, the study of Sabaq, et al. [6] consistent with the current study results which stated that more than two thirds of nurses have inadequate level of practice in the pre- program phase while , most of them have adequate practice level after implementing the program based learning about arterial blood puncture. Additionally, the study by Marco, Castillo& Soler, [27] goes also in the same line with the current study which revealed that more than half of the nurses and the majority of student nurses understood the purpose of Allen's test with significant difference between pre and post applying

the program based learning regarding arterial blood puncture. This is congruent with the findings of other study conducted by Schneiderman, Corbridge & Zerwic, [28] which found that, nurses' knowledge improved significantly after viewing the computer-based learning module about arterial blood puncture. In this regards, the study conducted by Hemavathy et al. [20] found a statistically significant difference between level of knowledge regarding arterial blood gases analysis among staff nurses before and after applying the program based learning. Moreover, consistent with the study results by Sabaq et al., [6] which reported that more than three quarter of nurses have unsatisfactory level of knowledge at the pre-program phase and the majority of them have satisfactory knowledge after program implementation about arterial blood puncture.

Regarding factors associated with nurses' knowledge and practice the current study finding showed a statistically significant difference between nurses' knowledge and practice before and after applying the program based learning about arterial blood. Otherwise, nurses' age and level of education were associated significantly with their knowledge and practice regarding arterial blood puncture, while there was a statistically significant only between nurses' knowledge and their years of experience. In this aspect Hernández-Padilla et al. [29] stated that there is a statistically significant relation between studied nurses' total knowledge scores and age at the pre-program phase. Moreover, there is a statistically significant relation between working setting, educational qualification, years of experience and studied nurses' total knowledge scores at the post program phase. This result was disagree with Thulasimani, [7] who reported that none of the demographic variables were significantly associated with the level of nurses' knowledge in pretest and posttest of control group. However, the current study result was consistent with Sabaq et al., [6] that revealed a statistically significant relation between working settings, educational qualification, years of experience and studied nurses' total knowledge regarding arterial blood puncture. On the other hand, Kaur, and Charan, [26] reported that age, sex, professional qualifications, clinical experience,

and working settings are related significantly with nurses' practice.

In relation to Self-efficacy with arterial puncture procedure among studied nurses' pre and post program implementation the results of the current study demonstrated that there was a statistically significant difference between nurses' total self-efficacy pre and post program implementation. These results agree with Hernández-Padilla et al., [29] who emphasize that effectiveness 1.5-hour simulation-based workshop on student nurses' knowledge, skills, self-efficacy and overall competence regarding ABG. Goes in the same line, the study of Chee, Baldwin, Fealy & Rogan, [30] which found that more than half of studied nurse believed this extension of skill and scope of practice would enhance their confidence and autonomy sense. Otherwise, the present study results revealed that only hospital where the nurse's work was the only factor associated significantly with nurses' self-efficacy after applying the educational based learning regarding arterial blood puncture. From the researchers point of view, this result could be refer to that nurses self-efficacy and confidence affected by competent skills and adequate practice and other factors as age or gender are not the main factor that affect level of self-efficacy. Additionally, the lack of orientation about program in different hospitals of the new working nurses in the units, and lack of staff nurses' development program about arterial blood puncture could play a role in nurses' self-efficacy.

## 5. Conclusion

The current study concluded that the program based learning about arterial blood puncture improves nurses' knowledge and practice significantly and improve also nurses' self-efficacy significantly while, the hospital where nurses working was the only factor associated significantly with total self-efficacy of nurses with arterial puncture. Moreover nurses' age and education associated significantly with nurses' knowledge and practice. However, a year of experience was associated significantly only with nurses' knowledge.

## 6. Recommendations

Nurses training about arterial blood puncture should be conducted regularly. Further research about the same research topic should be applied on larger sample with including other factors that could affect the performance of nurses. Additionally, effect of the educational program about arterial blood puncture on patients' outcome is recommended.

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