

Nurses' Compliance with Safety Measures of Arterial Line

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Abstract

Background: arterial lines are used to obtain precise measurement and provide continuous blood pressure monitoring of critically ill patients. Critical care nurses are the primary responsible clinician for maintaining the safety and effectiveness of arterial lines. **Aim:** Assess nurses' compliance with safety measures of arterial line. **Research Design** A descriptive exploratory design was utilized to meet the aim of this study and to answer the research question. **Setting:** This study was conducted in three ICU units at Academy of Heart which affiliated to Ain shams University Hospitals. **Tools:** Two tools used Nurses' Self-administered questionnaire, and Practice compliance-related safety measures observational checklist. **Results:** revealed that, 75.0% of the studied nurses aged 18-30 years with mean age (28.83 ± 7.459) years, 80.4% hadn't training in safety measures in arterial line, and 80.3% had unsatisfactory total level of knowledge & incompetent total level of practice. Moreover, 76.3% of studied nurses reported that total factors affect their compliance with safety measure in arterial catheter. Additionally, there was a statistically significant correlation between studied nurses' total knowledge about safety measures in arterial line and their total compliance and factors affecting their compliance. **Conclusion:** A majority of the study nurses had an unsatisfactory level of knowledge & incompetent level of practice in following arterial line safety measures. Additionally, a substantial number of the study nurses recognize that certain factors impact their ability to comply with safety measures of arterial line. **Recommendations:** Replication of the current study on large sample and different hospitals settings to generalize the results.

Keywords: Arterial lines, compliance, safety measures& ICU, CUU, Nurses.

Introduction

Arterial lines are indispensable tools in perioperative and critical care environment, serving a multitude of essential functions to measure hemodynamic variables like blood pressure and cardiac output, as well as to regularly obtain blood gas values and other measurements from plasma. Also, inserted for measurements that cannot be obtained from other sources, such as arterial in pharmacokinetic-pharmacodynamics modeling studies. Overall, arterial lines are essential tools, providing indispensable data and aiding in the effective management of critically ill patients (*Strathman, 2022*).

Complications associated with arterial cannulation include transient obstruction, thrombosis, ischemia, hematoma development, and local and catheter-related infections that can lead to sepsis. Rare but more serious issues include nerve damage, severe ischemia that may require surgical amputation and radial arterial lines failing due to skin degeneration. Critical care can significantly reduce occurrence of complications associated with arterial

cannulation by putting these preventive measures into practice, which will enhance patient outcomes and safety (*Mooshian et al., 2019*).

According to *Sing et al. (2021)* suggest that the most effective safety measures for arterial line placement include ultrasound guidance, sterile technique, site selection, and placement by trained staff. Safe Insertion of Arterial Catheters (SIA) protocol is the first ultrasound-guided arterial insertion bundle, providing a high-level, evidence-based approach to peripheral arterial catheter (PAC) placement.

Nurses are essential in maintaining patient safety and minimizing complications. Certified nurses are permitted to perform or assist in cannulation for patients who require arterial line from initiating cannulation to catheter removal (*Imbriaco et al., 2022*).

Nurse's compliance defined as the act or process of doing what has been asked or ordered to do the act or process of complying also, compliance is considered acting according to certain accepted standards so, the staff should work diligently to do the best nurses can care

for the patients to improve the quality of care. However, various factors can impact nurses' compliance with these measures. Understanding these factors is essential for healthcare providers to develop effective strategies that promote a culture of safety and ultimately enhance overall patient care (*Mohamed et al., 2021*).

Many non-human factors like materials, equipment availability and manager lack of commitment and human factors like knowledge and experience can affect or govern nurses' compliance with arterial line safety measures. Therefore, to increase compliance with arterial line safety measures and to eliminate the factors which have a negative influence on nurse 'compliance, there should be critical behavioral changes in nursing practice. Those behavioral changes can involve the combination of education, motivation, and organizational changes (*Al-Faouri et al., 2021*).

Significant of study

Reported arterial catheter use in United States ICU is 49.2% for patients undergoing mechanical ventilation and 51.7% for patients requiring vasopressors with the instance of occlusion complications that ranged from 1.5% to 35%, with a global incidence of reported arterial catheter failure or dislodgement between 4% and 25% (*Imbriaco et al., 2022*).

For patients who are critically ill, arterial catheterization and monitoring are frequently the standard of care. The procedure is commonly used in operating rooms, as well as medical and surgical intensive care units. Several anatomical locations can be used for arterial catheterization; each has advantages and disadvantages. Practitioners must, however, be aware of procedural indications and contraindications, ensure that staff and equipment are ready, and have advanced insertion technique knowledge. Arterial catheterization can have difficulties, just like any invasive procedure, therefore staff members need to be prepared to step in quickly to keep the patient safe (*Sun et al., 2024*).

Aim of the Study

The study aims to assess nurses' compliance with safety measures of arterial line.

Research Questions

1.What is nurses' knowledge with arterial line safety measures?

2.What is the level of nurses' compliance with arterial line safety measures?

3.What factors affecting nurses' compliance with arterial line safety measures?

Subjects and Methods

Study design:

A descriptive exploratory design was utilized.

Study setting:

This study was conducted in three ICU units the open-heart intensive care unit, chest intensive care unit and cardiac care unit (CCU) at Academy of Heart which affiliated to Ain shams University Hospitals, Cairo governorate, Egypt.

Study subjects:

The study included a convenience sample of all the available nurses (76) working in the previously selected ICUs, who were involved in providing direct patients care and accepted to take part in this study.

Tools of data collection:

Two tools were used to achieve the aim of this study included:

Tool I: Nurses' Self-administered questionnaire:

Part I: it was concerned with demographic characteristics of the nurses under study and consisted of 6 open end questions that includes age, gender, Job description, educational level, years of experience, attendance of training courses about safety measures.

Part II: Nurses' knowledge assessment questionnaire: it was developed by the investigator after reviewing related literatures (*Blackburn & Walton, 2016; Loukas, Tubbs & Feldman, 2016; Ogle, 2021; Hanrahan et al., 2022*) to assess nurses' level of knowledge regarding arterial line safety measures in intensive care units. The questionnaire consisted of 53 questions distributed into five sections as follows: **Section1:** Nurses' knowledge regarding arterial line and sites of arterial line placement (7 MCQ questions), **Section 2:** Nurses' knowledge regarding indications and contraindications of arterial line placement and Allen' test (6 MCQ questions), **Section 3:** Nurses' knowledge regarding complications of arterial line placement (7 true /false questions), **Section 4:** Nurses' knowledge regarding removal of arterial line (5 true /false questions) and **Section 5:** Nurses' knowledge

regarding safety measures toward arterial line pre, during & post insertion (28 true/false questions).

Scoring system

The scoring system for this part was as follows: One grade was given for the correct answer and zero for the incorrect answer, with total mark = 53. **The total level of nurses' knowledge score was categorized as follows:** $\geq 80\%$ was considered satisfactory it equal 32 grade and $80\% >$ was considered unsatisfactory it equal < 32 grade

Part III: Factors affecting nurses' Compliance: it was developed by the investigator based on related literatures (*Luo et al., 2010; Njovu, 2016; Suliman, 2018; AL-Gabri et al., 2020*) to assess factors affecting nurses' compliance regarding safety measures of arterial line. This part was divided into two sections including 39 questions as the follows: **Section1:** Human factors included Personal factors (10 items), Social factors (6 items) and psychological factors (6 items) and **Section2:** Non-human factors included: Hospital factors (11 items), Availability of tools and capabilities necessary to implement safety measures for arterial line (6 items).

Scoring system

Each item was scored as (1) for affected factor and (0) for not affected factor, negative questions scored as (0) for affected factor and (1) for not affected factor. The total score was calculated as: $\geq 80\%$ had effect on nurses' compliance equal 32-39 grade and $< 80\%$ had no effect on nurses' compliance equal 0-31 grades.

Tool II: Practice compliance-related safety measures observational checklist:

This tool was developed by the investigator based on reviewing of related literature (*Multak, 2015; Marino, 2019; British Association of Critical Care Nurses (BACCN), 2022*). It was used to assess nurses' compliance toward safety measures of arterial line and consist of (Nurses' care compliance for arterial cannula and Nurses interpretation compliance for arterial cannula). It consisted of 179 steps distributed as follows: care of arterial line observational checklist (22 steps), Changing the arterial line dressing observational checklist (33 steps), Assisting with insertion of the arterial catheter observational checklist (42 steps), Troubleshooting an Over damped Waveform

observational checklist (19 steps), Troubleshooting an Under damped Waveform observational checklist (12 steps), Drawing arterial blood sampling via arterial line observational checklist (24 steps) and Removal of arterial line observational checklist (27 steps)

Scoring system

For the scoring, each step done right got 1 point and no points for mistakes or not following the steps. The highest score possible was 179 points. The total level of nurses' compliance was categorized as follows: $\geq 85\%$ was considered competent = ≥ 153 grades and $< 85\%$ was considered incompetent < 153 grades actions.

Preparatory phase:

This phase included reviewing of more recent relevant national and international related literature review and theoretical knowledge of various aspect of the study using books, articles, internets periodicals and magazines to develop the tools for data collection after translation into Arabic and back translation into English.

Tool Validation

Validity of the developed tools was tested by using face and content validity. Validity was tested through a jury of 7 experts from critical and medical surgical nursing staff, Ain shams university (7 professors). The experts reviewed the tools for clarity, relevance, comprehensiveness, and simplicity; minor modifications were done.

Tool reliability:

Testing reliability of the developed tools was done by alpha Cronbach test, was used to examine whether the questionnaire had an internal consistency. The tools had an internal consistency. Alpha tests reached 0.82 for nurses' knowledge assessment questionnaire, 0.95 related Factors affecting nurses' Compliance questionnaire and 0.97 related practice compliance-related safety measures observational checklist.

Pilot study:

Pilot study was conducted on 10% the studied nurses (8 nurses) working in the previous mentioned setting to test the applicability of the study tools, clarity of the included questions as well as estimation of the average time needed to complete all questions. The results obtained were studied and analyzed; accordingly, modifications were done for the

final development of the study tools. Nurses selected for the pilot study were included in the study.

Administrative Design:

An official letter was issued from the faculty of nursing Ain Shams University to the director of academy of heart hospital and the director of ICU open heart Unit at which the study was conducted, explaining the purpose of the study, and requesting the permission for data collection from the study group.

Ethical considerations:

The ethical research consideration in the study included the following:

- The research approval was obtained from the ethical committee of faculty of nursing before initiating the study work.
- The investigator clarified the objectives and aim of the study to the nurses included in the study.
- Nurses written consents to participate in the study were obtained.
- The investigator assured maintaining anonymity and confidentiality of subjects` data.
- Nurses were informed that they allowed choosing to participate or withdraw from the study at any time.

Fieldwork:

1. Data collection took 4 months start from the beginning of March 2023 until the end of June 2023. The investigator interviewing with (1-2) nurses in the previous mentioned setting to explain the aim of the Study and effect of the study on their performance as well as patient's quality care and take Their approval to participate in the study Prior to any data Collection.

2. The data were collected by the investigator through 3 day / week (Sunday, Tuesday & Wednesday) during the morning and afternoon shifts, each nurse was interviewed individually by the investigator.

3. Assessing nurse's knowledge, compliance and factors affecting compliance regarding safety measures of arterial line by using the study tools as follow:

- 1st The self-administered questionnaire tool was filled by the nurses. It took about 30:45 minutes for every nurse fulfilled.
- 2nd The observational checklist was used by the investigator to assess nurse's compliance regarding safety measures of

arterial line. It took about 30:45 minutes for every nurse to fulfill by the investigator while nurses caring for the patients with arterial lines.

Statistical Design:

The data were collected, coded, and entered a suitable excel sheet. Data were transferred into Statistical Package for Social Science (SPSS) version 22. Quantitative data were presented as mean, standard deviation; comparison was done using X2 test. Qualitative data were presented as percentages. The observed differences and association were considered as follows: Non-significant at $P > 0.05$, Significant at $P \leq 0.05$ and highly significant at $P < 0.001$.

Results:

Table (1): Shows that, 75.0% of the studied nurses age ranged between 18 <30 years old with Mean \pm SD =28.83 \pm 7.459, 59.2% of them were females. Regarding to job description 56.6% of the studied nurses were staff nurses, whenever 42.1% of them have < 5 years of experience with Mean \pm SD =8.105 \pm 4.583 and the majority of them (80.3%) didn't have training courses about safety measures in arterial line.

Table (2): reveals that, 35.5 % of studied nurses had Satisfactory total knowledge regarding Safety measure after arterial line insertion whenever, 88.2% ,86.8% ,84.2% & 76.3% of nurses had unsatisfactory total knowledge regarding arterial line and sites of insertion, complication of arterial line, removal of arterial line and safety measure before arterial line insertion respectively.

Figure (1): reveals that, 19.7 % of the studied nurses have a satisfactory total level of knowledge, while 80.3 % of them have unsatisfactory total level of knowledge regarding arterial line safety measures.

Table (3): reveals that, 48.7% of studied nurses had competent total practices regarding drawing the arterial blood sampling via arterial line Whenever, 80.3%, 72.4%, 68.4% & 60.5% of nurses had incompetent total practices regarding routine assessment and care of arterial line, assisting with insertion of an arterial catheter, removal of arterial line and changing the arterial line dressing respectively.

Figure (2): Figure 2 reveals that, 19.7 % of the studied nurses have competent total level of practices regarding nurses' compliance to

safety measures whenever, 80.3 of them have incompetent total level of practices.

Table (4): indicates that, 80.3 %, 75.0 % & 80.3% respectively, studied nurses reported that the hospital organizational factors, equipment and supplies and psychological factors affect their compliance with safety measures of arterial line.

Figure (3) reveals that, 76.3% of studied nurses reported that total factors affect nurses' compliance to safety measure in arterial catheter whenever, 23.7% of studied nurses reported that, total hospital factors not affect their compliance to safety measure in arterial catheter.

Table (5) demonstrates that, there is statistically significant relation between studied nurses' total knowledge and their demographic characteristics at p.value <0.001 except for their gender there is statistically significant relation at p. value <0.05.

Table (6) illustrates that, there is statistically significant relation between studied nurses' total practices and their demographic characteristics at p.value <0.001 except for their gender there is no statistically significant relation at p.value >0.05.

Table (7) illustrates that, there is no statistically significant relation between studied nurses' total factors affecting nurses' compliance to safety measures and their demographic characteristics at p.value >0.05 except for their training courses, there is statistically significant relation at p.value <0.05.

Table (8) illustrates that, there statistically significant Correlation between studied nurses' total knowledge about safety measures in arterial line and their total compliance and factors affecting their compliance at p.value <0.001.

Table (1): Frequency and Distribution of the studied nurses regarding to their demographic data (n=76).

Demographic data	No.	%
Age/ years		
18 <30	57	75.0
31 <40	11	14.5
41 <50	5	6.63
≥50	3	3.9
Mean± SD	28.83±7.459	
Gender		
Male	31	40.8
Female	45	59.2
Job description		
Staff nurse	43	56.6
Nursing specialist	31	40.8
Nursing Supervisor	2	2.6
Nursing Qualification		
Diploma of nursing	45	59.2
Nursing bachelor	27	35.5
Master's degree of nursing	3	3.9
Doctorate degree of nursing	1	1.3
Experience years		
<5	32	42.1
5<10	25	32.9
10<15	14	18.4
≥15	5	6.6
Mean± SD	8.105± 4.583	
Training courses about safety measures in arterial line		
Yes	15	19.7
No	61	80.3

Table (2): Frequency and distribution of studied nurses regarding their total knowledge items (n=76).

Total nurses' knowledge regarding	Total nurses' knowledge			
	Satisfactory		Unsatisfactory	
	No	%	No	%
Arterial line and sites of insertion	9	11.8	67	88.2
Indications and contraindications of arterial catheterization and the Allen test	24	31.6	52	68.4
Complication of arterial line	10	13.2	66	86.8
Removal of arterial line	12	15.8	64	84.2
Safety measure before arterial line insertion	18	23.7	58	76.3
Safety measure during arterial line insertion	18	23.7	58	76.3
Safety measure after arterial line insertion	27	35.5	49	64.5
Total	15	19.7	61	80.3

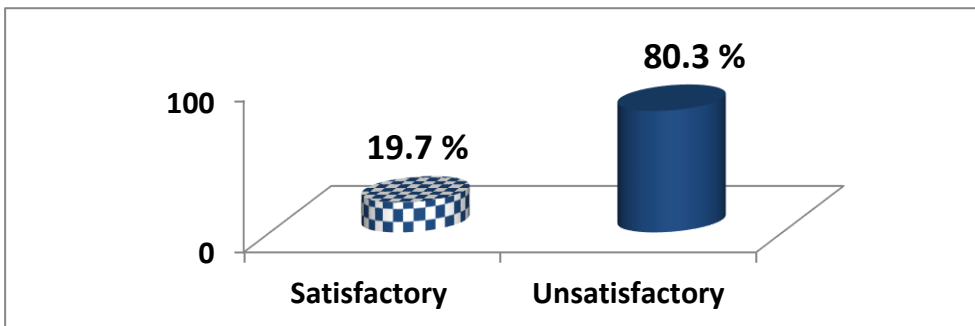


Figure (1): Frequency and percentage distribution of studied nurses regarding their total knowledge level about arterial line safety measures (n=76).

Table (3): Frequency and distribution of studied nurses regarding their total compliance items (n=76).

Total nurses' compliance regarding	Total nurses' practices			
	Competent		Incompetent	
	No	%	No	%
Routine assessment and care of arterial line	15	19.7	61	80.3
Changing the arterial line dressing	30	39.5	46	60.5
Assisting with insertion of an Arterial Catheter	21	27.6	55	72.4
Troubleshooting an Overdamped Waveform	24	31.6	52	68.4
Troubleshooting an Underdamped Waveform	30	39.5	46	60.5
Drawing arterial blood sampling via arterial line	37	48.7	39	51.3
Removal of arterial line	24	31.6	52	68.4
Total	15	19.7	61	80.3

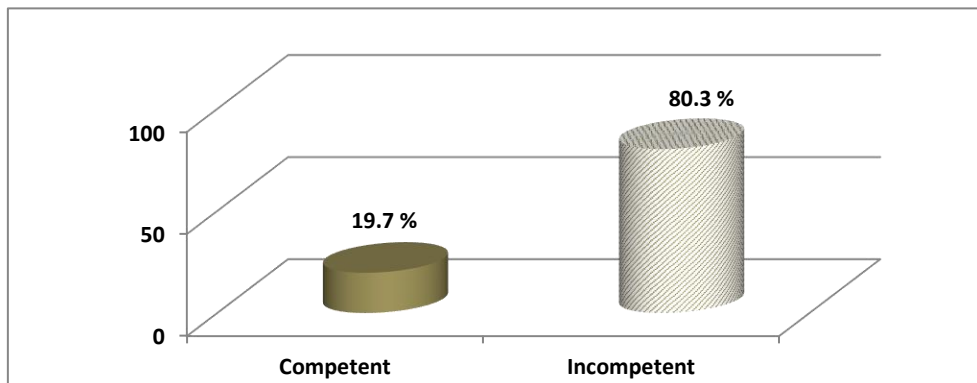


Figure (2): Frequency and percentage distribution of studied nurses regarding their total practice level about safety measures in arterial line catheterization (n=76).

Table (4): frequency and frequency distribution of studied nurses regarding total factors items (n=76).

Total factors affecting nurses' compliance related to	Total factors			
	Affected		Not affected	
	No	%	No	%
Organizational factors	61	80.3	15	19.7
Equipment and supplies	57	75.0	19	25.0
Human factors	56	73.7	20	26.3
Social factors	55	72.4	21	27.6
Psychological factors	61	80.3	15	19.7
Total	58	76.3	18	23.7

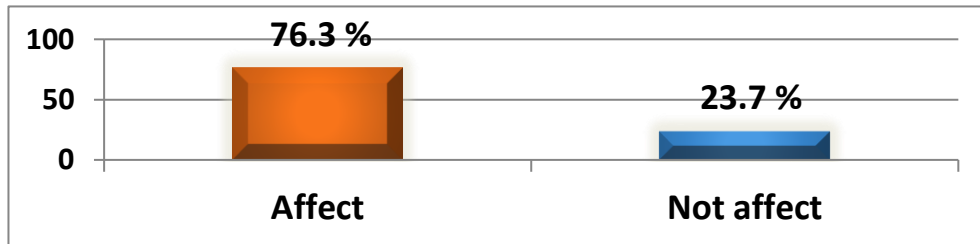


Figure (3): Frequency and Percentage distribution of the hospital factors that affect nurses' compliance to safety measure in arterial catheter (n= 76).

Table (5): Relationship between demographic characteristics and total knowledge level among studied nurses

	Nurses' knowledge				X ²	p-value
	Unsatisfactory (n=60)		Satisfactory (n=16)			
	No	%	No	%		
Age/ years						
18 <30	53	88.3	4	25.0	38.307	0.000**
31 <40	7	11.7	4	25.0		
41 <50	0	0.0	5	31.3		
≥50	0	0.0	3	18.8		
Gender						
Male	35	58.3	10	62.5	0.091	0.498
Female	25	41.7	6	37.5		
Job description						
Staff nurse	43	71.7	0	0.0	29.808	0.000**
Nursing specialist	17	28.3	14	87.5		
Nursing Supervisor	0	0.0	2	12.5		
Nursing Qualification						
Diploma of nursing	45	75.0	0	0.0	31.432	0.000**
Nursing bachelor	14	23.3	13	81.3		
Master's degree of nursing	1	1.7	2	12.5		
Doctorate degree of nursing	0	0.0	1	6.3		
Experience years						
<5	30	50.0	2	12.5	32.590	0.000**
5<10	23	38.3	2	12.5		
10<15	7	11.7	7	43.8		
≥15	0	0.0	5	31.3		
Training courses about safety measures in arterial line						
Yes	3	5.0	12	75.0	39.071	0.000**
No	57	95.0	4	25.0		

*Significant relation at p. value <0.05. ** Statistically significant at p.value <0.001

Table (6): Relationship between demographic characteristics and total practices level among studied nurses

	Nurses practice				X ²	p-value
	Incompetent (n=61)		competent (n=15)			
	No	%	No	%		
Age/ years						
18 <30	54	8.5	3	20.0	41.991	0.000**
31 <40	7	11.5	4	26.7		
41 <50	0	0.0	5	33.3		
≥50	0	0.0	3	20.0		
Gender						
Male	36	59.0	9	60.0	0.005	0.592
Female	25	41.0	6	40.0		
Job description						
Staff nurse	43	70.5	0	0.0	28.350	0.000**
Nursing specialist	18	29.5	13	86.7		
Nursing Supervisor	0	0.0	2	13.3		
Nursing Qualification						
Diploma of nursing	45	73.8	0	0.0	29.708	0.000**
Nursing bachelor	15	24.6	12	80.0		
Master degree of nursing	1	1.6	2	13.3		
Doctorate degree of nursing	0	0.0	1	6.7		
Experience years						
<5	30	49.2	2	13.3	36.010	0.000**
5<10	24	39.3	1	6.7		
10<15	7	11.5	7	46.7		
≥15	0	0.0	5	33.3		
Training courses about safety measures in arterial line						
Yes	3	4.9	12	80.0	42.843	0.000**
No	58	95.1	3	20.0		

Significant relation at p.value >0.05. ** Statistically significant at p.value <0.001

Table (7): Relationship between demographic characteristics and total factors affecting nurses' compliance to safety measures among studied nurses.

	Factors affecting compliance				X ²	p-value
	Not affected (n=18)		Affected (n=58)			
	No	%	No	%		
Age/ years						
18<30	17	94.4	40	69.0	4.968	0.174
31<40	1	5.6	10	17.2		
41<50	0	0.0	5	8.6		
≥50	0	0.0	3	5.2		
Gender						
Male	9	50.0	22	37.9	0.828	0.261
Female	9	50.0	36	62.1		
Job description						
Staff nurse	14	77.8	29	50.0	4.488	0.106
Nursing specialist	4	22.2	27	46.6		
Nursing Supervisor	0	0.0	2	3.4		
Nursing Qualification						
Diploma of nursing	15	83.3	30	51.7	6.740	0.081
Nursing bachelor	2	11.1	25	43.1		
Master degree of nursing	1	5.6	2	3.4		
Doctorate degree of nursing	0	0.0	1	1.7		
Experience years						
<5	12	66.7	20	34.5	7.238	0.065
5<10	5	27.8	20	34.5		
10<15	1	5.6	13	22.4		
≥15	0	0.0	5	8.6		
Training courses about safety measures in arterial line						
Yes	0	0.0	15	25.9	5.800	0.010*
No	18	100.0	43	74.1		

*Statistically significant at p.value <0.05. ** Statistically significant relation at p.value <0.001. No statistically significant relation at p.value >0.05

Table (8): Correlation between total nurses' compliance and their total knowledge and factors affecting their compliance' level.

Scale	Total factors		Total knowledge	
		p- value	R	p- value
Total knowledge	0.288	0.012*	-	-
Total compliance	0.276	0.016*	0.960	0.000**

**Highly statistically significant at p. value <0.001

Discussion:

These days, arterial lines are a crucial part of caring for critically ill patients in ICU. In addition, arterial lines offer vital hemodynamic data that physicians can use to precisely treat patients during these crucial times. Because arterial lines are frequently the source of infections and other complications, nurses have a duty to ensure that arterial lines are maintained in order to maximize patient benefits and lower the risk of serious complications. Arterial cannulation should only

be carried out by clinicians with clearly established competencies along with associated knowledge and skills (*Katz et al., 2021*).

Regarding the demographic characteristics of studied nurses, the results of the current study illustrate that, almost three quarters of the studied nurses age ranged between 18 <30 years old with Mean \pm SD =28.83 \pm 7.459, from the investigator point of view this indicate that studied nurses were within the active- working age group and can tolerate nature of work in ICU. The result was in contrast with *Sobeih et al., (2018)* in study

entitled “Infection Control Measures for Patient with Central Line: Nurses' Performance” who revealed that more than two thirds of nurses aged from $20 \leq 30$ years old.

Regarding gender of studied nurses, the results of the present study revealed that, more than half of nurses were females, from the investigator point of view this could be since the profession of nursing in Egypt was mostly feminine, additionally male nurses prefer to travel abroad or working in private hospitals for high salary outcome. The study agreed with *Upreti & Mishra (2020)* in study entitled “Effectiveness of planned teaching programme on knowledge and practice regarding arterial blood gas analysis and its interpretation among staff nurses working in critical care quantitative research approach” who illustrated that the majority of nurses were female.

Regarding educational level of studied nurses, the current study results illustrated that, more than half of studied nurses had Diploma of nursing from the investigator point of view; this could be related to that the technical institutes of nursing provide the community with large number of nurses who work in all hospital units. The study was agreed with *Mohamed, (2018)* in study entitled “Intensive care unit nurses' performance regarding caring patients with head injury: an educational intervention” who illustrated that more than half of nurses had a technical nursing education.

Regarding years of experience of studied nurses, the present study results revealed that, less than half of nurses have < 5 years of experience with Mean \pm SD = 8.105 ± 4.583 , this could be due to almost three quarters of the studied nurses age ranged between $18 < 30$ years old. The study finding agreed with *Abd-Elbaky et al., (2018)* in study entitled "Impact of a simulated education program on nurses' performance of invasive procedure at intensive care units," who showed that, the majority of the studied nurses had less than five years of experience.

Regarding training courses, the current study results revealed that, the majority of nurses didn't have training courses about safety measures in arterial line. from the investigator point of view this could be due to shortage of staff, work load, lack of training courses about safety measures of arterial line and lack of time ICU, this result was matched with *Abo Seif et*

al., (2021) in study entitled “Effect of an educational program on nurses' knowledge regarding management of patients undergoing peripheral vascular access” who illustrated that, the majority of studied nurses had no any training courses.

Regarding to nurses' total knowledge regarding arterial line safety measures, the current study results revealed that, nearly the majority of nurses had unsatisfactory total level of knowledge regarding arterial line safety measures. This might be due to more than half of studied nurses had Diploma of nursing also, this may be due to the majority of nurses didn't have training courses about safety measures in arterial line. This finding of current study was congruent with *Ahmed et al., (2016)* in study entitled “Invasive hemodynamic monitoring at critical care units in Sudan: Assessment of nurses' performance” who illustrated that, total knowledge of nurses about Invasive hemodynamic monitoring was either fair or poor.

While, these results disagreed with *Upreti & Mishra (2020)* in study entitled “Effectiveness of planned teaching programme on knowledge and practice regarding arterial blood gas analysis and its interpretation among staff nurses working in critical care quantitative research approach” who found that, less than half of staff nurses were having average knowledge, more than one third good, minority excellent and minority poor regarding knowledge score of Arterial blood gas analysis and its interpretation in pre-test.

Concerning total nurses' compliance regarding arterial line safety measures of arterial line, the current study results revealed that, the majority of the studied nurses had incompetent total level of practices. This might be related to the unsatisfactory level of knowledge of the studied nurses, which affect negatively on their compliance to the safe practices. In addition, these results might be due to unavailability of procedures book for the nurses at ICU and lack of supplies equipment that used for application of safety measures of arterial line. This result was similar to *Yuan et al., (2022)* in study entitled “The practice of arterial catheters in ICUs and nurses' perceptions of infection prevention: A multicenter cross-sectional study” who revealed that, critical care nurses' practices partially

complied with guideline recommendations and most of them had unsatisfactory practices regarding arterial catheters.

In addition, this finding was in congruence with *Reynolds et al., (2013)* in study entitled “A snapshot of guideline compliance reveals room for improvement: A survey of peripheral arterial catheter practices in Australian operating theatres” who showed that, the majority of studied subjects didn’t adhere with practical guidelines of peripheral arterial catheter.

Also, these results were agreed with *Morton, (2020)* in study entitled “Arterial line nursing care and arterial blood gas drawing Abstract” who observed that, the majority of participants had incompetent practices about arterial line as the overall nurses in the critical care step-down unit do not frequently care for patients with these invasive devices. As a result of this decreased prevalence, there was an observed and verbalized interest to strengthen arterial line care and skills.

Regarding total factors that affect nurses’ compliance with safety measures of arterial line, the finding of current study revealed that, more than three quarters of studied nurses demonstrated that total factors affect their compliance to safety measures. This result can be attributed to low educational levels (the majority of nurses did not have degrees) and lesser clinical experiences of participating nurses. This result was in harmony with *Kim & Lee, (2021)* in study entitled “Factors Influencing Emergency Department Nurses’ Compliance with Standard Precautions Using Multilevel Analysis” who revealed that, more than two thirds of participants reported a negative effect of organizational factors in addition, more than half of them affected by individual factors.

Regarding the relation between nurses’ total knowledge and their demographic characteristics, the finding of the present study illustrated that, there was statistically significant relation between studied nurses’ total knowledge and their educational level, years of experience and age. While there was no statistically significant relation between nurses’ total knowledge and their gender. This may be explained as, increases nurses age and high education level increase their years of experience and expose them to various

situations that increase their knowledge also, training courses lead to acquiring more knowledge and information which affect their compliance to safety measures. While there is no difference between knowledge among male and female.

The current study result was similar to *Ahmed & Kaf1, (2019)* in study entitled “Knowledge and Practice of the Critical Care Nurses on Vascular Access Devices Related Infection” who illustrated that, there was a statistical significance among the demographic data and mean level of knowledge scores. But there was no statistically significant relation between gender and the mean level of knowledge scores.

Regarding the relation between nurses’ total practices and their demographic characteristics, the finding of the present study illustrated that, there was highly statistically significant relation between studied nurses’ total practices and their age, educational level and years of experience. While there was no statistically significant relation between nurses’ total practices and their gender. From the investigator point of view, this might be due to old age nurse had a long period working in ICU and previous exposure to such procedure for several times so that increase their compliance moreover, high educational level and previous training course increase their chance for exposure to such practices and accordingly increase their compliance to safety measures.

The current study was similar to *Hassanein & Sobh (2021)* in study entitled “Effect of an educational program on nurses’ practice regarding management of patients undergoing peripheral vascular access” who illustrated that, there was a significant relation between demographic characteristics of the studied nurses and their practices such as age, qualifications, years of experience and previous training throughout educational program application.

Regarding correlation between total nurses’ compliance and their total knowledge and factors affecting their practices level, the result of current study illustrated that, there was statistically significant correlation between studied nurses’ total knowledge about safety measures in arterial line and their total practices and factors affecting their compliance.

From the investigator point of view, this might be related to that high level of knowledge results in acquiring more practice and skills and result in more nurses' compliance to safety measures.

The current study was supported to *Ahmed & Kafli, (2019)* who illustrated that, there was a significant relation between the nurses' mean level of knowledge and mean level of practice regarding vascular access devices related infection.

Conclusion

In the light of the current study findings, it can be concluded that:

A majority of the study nurses had unsatisfactory level of knowledge & incompetent level of practice in following arterial line safety measures. Additionally, a substantial number of the study nurses recognize that certain factors impact their ability to comply with safety measures of arterial line. And there was a significant correlation between studied nurses' total level of knowledge and compliance and factors affecting their compliance regarding safety measures of arterial line.

Recommendations:

Based on the current study finding the following recommendations were proposed:

1. Replication of the current study on large sample and different hospitals settings to generalize the results.

2. Strict applications of aseptic techniques and infection control precautions in order to prevent many of the complications associated with peripheral arterial lines.

3. Implementing an educational Training program for nurses to improve their compliance regarding arterial line safety measures.

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