

Nurses Performance Regarding Invasive Procedures in Intensive Care Unit

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Abstract

Background: Several medical procedures are performed daily in the intensive care unit (ICU). It is evident that complications still occur frequently and are potentially life-threatening. The most common support and monitoring devices used in the ICU include, intravenous catheter, nasogastric tube, endotracheal tube, central venous catheter, hemodialysis double-lumen catheter and chest tube. **Aim:** This study aimed to assess nurses performance regarding invasive procedures **Design** A descriptive explorative design was utilized for the conduction of this study. **Setting** The study was carried out at intensive care units at El-Matrya teaching hospital. **Study subject:** A convenience sample of all available nurses(30)nurses working at the previous mentioned setting **Tools:** I – nurses' self – administrated questionnaire form which consisted of nurse's demographic characteristics' and nurses' knowledge **II** nurses' practice observational checklist regarding invasive procedures. **Results:** revealed that 63.3% of the studied nurse's had satisfactory total level of knowledge, while 53.3 %had satisfactory level of practice regarding invasive procedures. **Conclusion:** around two third of the studied nurses had satisfactory knowledge and around half of studied nurses had satisfactory practice with invasive procedures. **Recommendations::** improved nurses theoretical knowledge, clinical practice and continuous evaluation of nurses knowledge and practice regarding invasive procedures at intensive care unit

Keywords: Intensive Care Unit, Invasive procedures, Nurses' performance.

Introduction:

Several medical procedures are performed daily in the intensive care unit (ICU). It is evident that complications still occur frequently and are potentially life-threatening. The most common support and monitoring devices used in the ICU include intravenous catheter, nasogastric tube, endotracheal tube, central venous catheter, hemodialysis double-lumen catheter and chest tube. Procedure complications involving critically ill patients are common and often potentially life-threatening. Decreasing the frequency of procedure-related complications is an important and direct way to improve quality of care. Understanding their incidence, causes, risk factors, diagnosis, management, and prevention are helpful in damage control, and large-volume extravasation may result in severe damage, extensive tissue

necrosis, severe skin, and subcutaneous ulceration **Pronovost, et al., 2021).**

Procedures can be divided into two categories-invasive procedures and non-invasive procedures. An invasive procedure is defined as a medical procedure which breaks the skin in some way. Non-invasive procedures are also quite common, these are defined as any medical procedure which does not break the skin. Risks and complications of minimally invasive procedures are the same as for any other surgical operation and include; Bleeding, infection, adhesions, internal organ injury, blood vessel injury, vein or lung blood clotting, breathing problems and death. There may be an increased risk of hypothermia and peritoneal trauma due to increased exposure to cold, and dry gases during insufflation **(Dorland, 2018).**

Medical procedures have the potential to cause complications. This is particularly so where medical device is inserted into the body-either through the skin into the blood stream or a body cavity, or into the gastrointestinal tract. The complications may arise at the time of the insertion, or may develop after the device has been in place for some time (Carlos, 2019)

There are numerous types and brands of catheters, each carrying different risks. But common risks associated with malpractice of catheters include; catheter perforation injuries, which is a common injury when catheters are used in coronary procedures. When the procedure is not handled properly, coronary walls and valves can become perforated, resulting in serious complications that are potentially fatal. Strokes and heart attacks; when catheter is not inserted properly, extreme pain and discomfort and infection when improperly cleaned and sterilized (Perry & Potter, 2021).

Intubation refers to the insertion of an endotracheal tube into the trachea through either the mouth or nose. Intubation is performed to establish an airway, assist in secretion removal, protect the airway from aspiration in patients with a depressed cough and gag and provide mechanical ventilation (Moseley, 2016)

Tracheal suction involves the removal of secretions from the trachea or bronchi by means of catheter inserted through the mouth or nose or tracheal stoma. A tracheostomy tube, or an endotracheal tube besides removing secretions. Tracheal suctioning stimulates the cough reflex (Perry & Potter, 2016).

Nurses are becoming increasingly responsible for management and care of patients after invasive procedures and its complications. Knowledge and uses of evidence based practice are essential to

ensure best practice and patients outcomes. Nurses are the health care team members who have direct responsibility to care of patients under any invasive procedure (Burns, 2017).

Significance of the study:

Five millions central venous catheters inserted each year. Catheter related blood stream infection occurs with 3-5% of catheters and affect more than 250,000 patients per year in U.S. Prolong hospitalization by 7days and mortality 5-35% (Pérez-Zárate et al., 2015). Approximately 44% of all the patients admitted to the ICUs in Egypt underwent Central Venous Catheter (CVC) insertion. The overall incidence density rate of CLA-BSI was 6 cases per 1000 central line-days. The central line utilization rate was 0.94 per 1000 patient-days. The mortality rate among cases with CLA-BSI was 16.8% (95% CI: 13.6% – 20.4%) during the study period (Rasslan, Seliem, Ghazi, et al., 2016).

The data was achieved by this study will highlighting the nursing management for patients undergoing invasive procedures. Lack of nurses' knowledge and practice was increased the risk of error, frequency of complications and health care costs, for that reasons this study was conducted, a high- quality performance of the nurses at I.C.U was important to reduce the complication, morbidity and mortality.

Aim of the Study:

This study aimed to assess the nurses' performance regarding invasive procedures at intensive care unit through the following;

- Assess the level of nurse's knowledge regarding invasive procedures at intensive care unit.

- Assess nurse's practice regarding invasive procedures at intensive care unit.
- Assess nurse's malpractice regarding of invasive procedures at intensive care unit.

Research questions:

To achieve the purpose of this study the following questions were answered:

- What is the level of nurse's knowledge regarding invasive procedures at intensive care unit?
- What is the nurse's practice regarding invasive procedures at intensive care unit?
- What is the nurse's malpractice regarding invasive procedures at intensive care unit?

Operational definition

- Invasive procedure; a procedure in which the body is penetrated or entered by a tube or a needle.
- Malpractice of invasive procedures; refers to negligence or misconduct and the failure to meet a standard of care when patient is injured or damaged due to error

Subject and Methods

This study was portrayed under the four main designs as follows:

- I- Technical design
- II- Operational design
- III- Administrative design
- IV- Statistical design

I- Technical design:

The technical design includes research design, setting, subject and tools for data collection.

Research design:

An descriptive exploratory, design was used to achieve the aim of this study

Setting:

This study was conducted in the intensive care units at El-Matarya Teaching Hospital, affiliated to ministry of health. The setting consisted of three intensive care units, cardiac intensive care unit (CICU) contained 9 beds, intensive care unit (ICU) contained 10 beds and neuro intensive care unit (NICU) contained 11beds. Investigator selected this setting because of the increasing flow rate of patients as indicated from the statistical records mentioned in the significance of this study.

Subjects:

Convenience sample of all available nurses (30) who working at intensive care units at El-Matarya Teaching Hospital, of both genders.

Tools of data collection:

Data collection was obtained by using the following three tools:

Tool I: nurses self-administered questionnaire:

This tool was developed by the investigator in Arabic language to assess nurses' knowledge about nurses performance regarding invasive procedures in intensive care units based on review of relevant and recent literatures guided by (Linton, et al., 2017; Pamela, et al., 2018; Perry & Potter, 2021).

It was consisting of the following two parts:

Part 1: It was concerned with demographic characteristics of nurses under study include: age, gender, qualifications, years of experiences, years of experience in invasive procedures in intensive care unit, and previous attendance of training courses regarding invasive procedures in intensive care unit.

Part 2: This part was concerned with assessment of nurses' knowledge

regarding invasive procedures in intensive care unit, it consisted of (38) questions; were multiple choice questionnaire. The items of knowledge include the following topics; general information about invasive procedures (5 items), complications of invasive procedures (4 items), and role of nurse during invasive procedures (29 items)

❖ Scoring system:

Nurses' Level of knowledge consisted of (38) questions in the form of multiple choice (MCQ). Zero mark was given for each incorrect answer and (1) mark was given for each correct answer. The total score of questionnaire was (38) marks which evaluated as the following:

- Satisfied level of knowledge > 70 % (≥ 27 marks)
- Unsatisfied score for knowledge < 70 % (≤ 27 marks)

Tool II: Nurses' practice regarding three invasive procedure observational checklist

It was concerned with assessment of nurses' practice regarding invasive procedures in intensive care unit. It was adapted from **Hartman, et al, (2016); Turner, et al. (2020); Nettina, (2020)**. Each procedure divided into three domains pre procedure, during procedure and post procedure. It comprised the following procedures including; patient airway suctioning of equipment & patient preparation (17 steps), airway suctioning procedure (13 steps), oral suctioning (10 steps), nasotracheal suction (12 steps), tracheal / tracheostomy suctioning (2steps), endotracheal tube suctioning (28 steps), airway suctioning document (13 steps), airway suctioning evaluate (4 steps).

Central line insertion, before insertion (17 steps), during insertion (13 steps), after insertion (18 steps).

Caring of patients on endotracheal tube, Assess of respiratory Status (5steps),

pre procedure (18 steps), post procedure (4). Endotracheal tube caring, pre nursing care (1 step), nursing care (21 steps), post nursing care (2 steps) and promoting optimal communication with patient (10 steps).

❖ Scoring system:

Each step that was not done or incorrectly done scored zero, while one grade was given for correctly done classified as the following according to statistical report:

Total score of patient airway suctioning (99) grades:

Level of practice > 70% (70 grade) was considered satisfactory.

Level of practice < 70% (70 grade) was considered unsatisfactory.

Total score of Central line insertion (48) grades:

Level of practice > 70% (33 grade) was considered satisfactory.

Level of practice < 70% (33 grade) was considered unsatisfactory.

Total score of Caring of patients on endotracheal tube (61) grades:

Level of practice > 70% (42 grade) was considered satisfactory.

Level of practice < 70% (42 grade) was considered unsatisfactory.

II-Operational design:

It included preparatory phase, content validity and reliability, pilot study and field work.

The preparatory phase:

It included reviewing of related literatures and theoretical knowledge of the various aspects of the study using books, articles, internet, periodicals and magazines to develop tools for data collection.

Content validity and reliability:

Content validity was ascertained by a group of experts (7). The (7) experts consist of (4) professor of medical – surgical nursing, (2) assist professor of

critical care nursing and (1) professor of cardio-theoretic-Ain-Shams University. Their opinion was elicited regarding the format, layout, consistency, accuracy and relevance of the tools. While validity of tools is respectively, this indicated high total internal consistency of the used tool.

Reliability This tables show Alpha Cronbach's test which used to measure the internal consistency (Reliability of the used tool or instrument) the reliability score of tool was 0.768 for Knowledge, 0.896 for patient airway suction, 0.854 for center line insertion and 0.874 for caring of patient on endotracheal tube, where the minimum reliability coefficient we need is 60%, so is the reliability coefficient for all questions....

Pilot study:

Pilot study was carried out before the actual data collection. The study was done on 10% of the nurses who working at intensive care unit to test the applicability, clarity, and efficiency of the tools items and the time required for fill in. The results of subjects of the pilot study were excluded from the study sample and necessary modifications were done.

The ethical research consideration in this study included the following:

The research approval was obtained from ethical committee of faculty of nursing - Ain Shams University before starting the study.

The investigator was clarified objectives of the study to nurses included in the study.

- The investigator assure of maintaining anonymity and confidentiality of subjects' data.
- Nurses were informed that they are allowed to choose to participate or not in the study and that they have the right to withdraw from the study at any time.

- An verbal consent was taken from the nurses who choose to participate in the study..

III- Administrative design:

An official approval was taken from director of National institute of Urology and Nephrology and director of El-Matrya Teaching Hospital after explaining the aim of the study.

Field work:

1. Data collection started and was completed within 6 months from August 2019 to January 2020.
2. The purpose of the study was simply explained to the nurses who agreed to participate in the study prior to any data collection.
3. The selected setting was visited by the researcher four days per week from Sunday to Wednesday during morning and afternoon shifts.
4. The investigator observed the practice for each nurse 3times, using observation check list (tool 11) during them work with the patients.
5. The nurses' self-administered knowledge questionnaire was filled in by the nurses included in the study, during their shifts. It took about 30 min to 45 min be fulfilled by each one.

IV- Statistical design:

The obtained data was organized, tabulated, analyzed, represented in tables and graphs required means and slandered deviation as well as percentage, suitable statistical testes was used to test the significance of result obtained, recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

Results:

Table (1): shows that the mean age of the studied nurses was 24.60, regarding gender 76.7% of them were females, regarding academic qualification 70% of them were graduate from nursing institute, regarding years of intensive care experience 53.3% of them were from 5-10 years.

Figure (1): shows that, according to training courses 63.3% of nurses had attended training courses, while 36.7% was not attended any training courses.

Table (2): revealed nurses total and subtotal knowledge regarding invasive procedures in intensive care unit, it was clear that 50% of studied nurses had satisfactory knowledge about general information on invasive procedures, 56.7% of them had satisfactory knowledge about complications of invasive procedures and 83.3% of them had satisfactory knowledge about nurses' role in invasive procedures, *endotracheal tube and suction*, while 66.7% of them had satisfactory knowledge about central venous catheterization. While 63.3% of studied nurses had total satisfactory knowledge regarding invasive procedures in intensive care unit.

Table (3): illustrated the studied nurses' total and subtotal practice level regarding invasive procedures in intensive care unit, it was found that 53.3% of them had satisfactory total level of practice regarding invasive procedures in intensive care unit, while 46.7% of them had unsatisfactory of practice about total level of practice regarding invasive procedures in intensive care unit

Figure (3): showed that 53.3% of studied nurses had total satisfactory level of practice regarding invasive procedures in intensive care unit and 46.7% of them had total unsatisfactory level of practice regarding the same issue.

Table (4): presented that, there were highly statistically significant relation between level of knowledge of the nursing and their Years of intensive care experience at (p -value <0.001). Also, there were statistically significant relation with their academic qualification and training course ($P<0.05$). While there were no significant relations between knowledge and age and gender at ($P>0.05$).

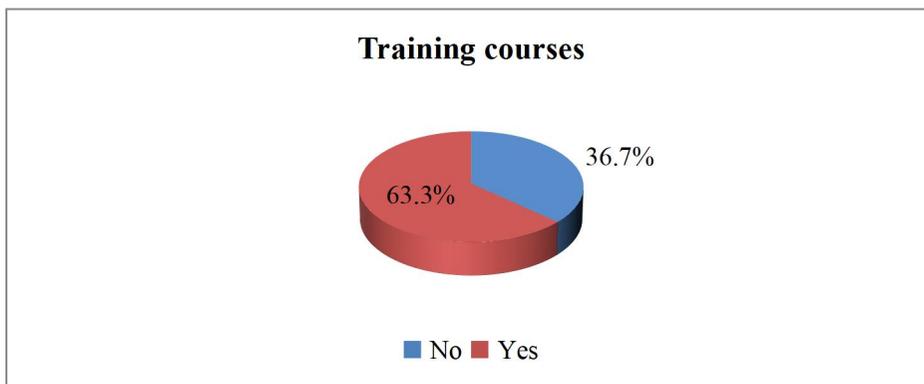
Table (5): presented that, there were highly statistically significant relation between level of practice of the nursing and their Years of intensive care experience and training courses at (p -value <0.001). Also, there were statistically significant relation with their academic qualification ($P<0.05$). While there were no significant relation between practice and age and gender at ($P>0.05$).

Table (6): presented that, there were statistically significant relation between level of knowledge about invasive procedure in intensive care unit and their Level of practice regarding invasive procedures ($P<0.05$).

Table (7): presented that, table shows that there was a positive correlation between the total score of knowledge and practice about invasive procedures in intensive care unit.

Part I: Demographic data of the studied nurses**Table (1):** Number and percentage distribution of studied nurses according to their demographic data (n=30).

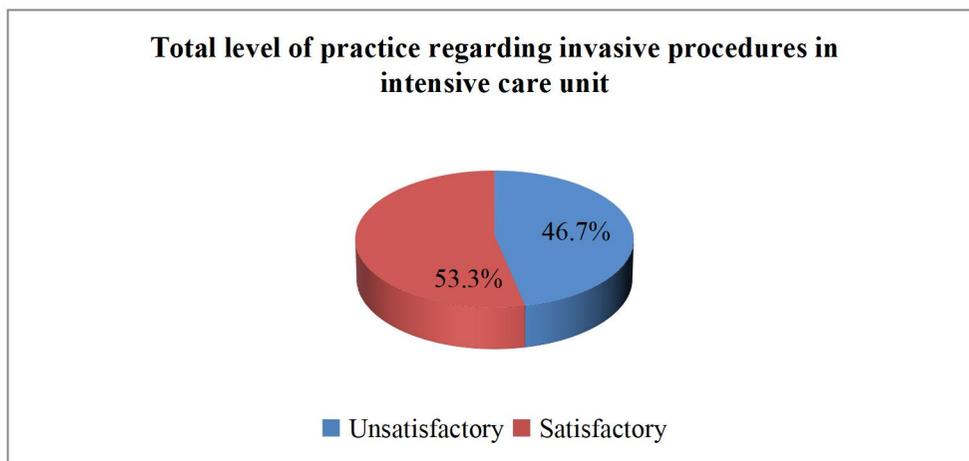
Demographic data	No.	%
Age:		
20-25 years	18	60.0
25-<30 years	12	40.0
Mean±SD		24.60±4.18
Gender:		
Male	7	23.3
Female	23	76.7
Academic Qualification		
Nursing Institute	21	70.0
Bachelor of Nursing.	9	30.0
Years of intensive care experience		
<5 years	14	46.7
5-10 years	16	53.3
Mean±SD		5.67±0.96

**Figure (1):** Percentage distribution of studied nurses according to their training courses.**Table (2):** Nurses' total and subtotal knowledge regarding invasive procedures in intensive care unit (n=30).

Total knowledge about invasive procedures in intensive care unit	Satisfactory		Unsatisfactory		Mean	±SD
	No.	%	No.	%		
General information about invasive procedures	15	50.0	15	50.0	69.4	25.2
Complications of invasive procedures	17	56.7	13	43.3	76.7	23.4
Nurses' role regarding invasive procedures.	25	83.3	5	16.7	60.5	11.8
- Endotracheal tube	25	83.3	5	16.7	54.0	14.8
- SUCTION	25	83.3	5	16.7	59.4	13.4
- Central venous catheterization	20	66.7	10	33.3	71.4	16.8
Total Knowledge	19	63.3	11	36.7	63.2	12.3

Table (3): Number and percentage distribution of nursing according to their total level of practice regarding invasive procedures in intensive care unit (n=30).

Practice regarding invasive procedures	Satisfactory		Unsatisfactory		Mean	±SD
	No.	%	No.	%		
Patient Airway Suctioning	4	13.3	26	86.7	64.4	6.9
Total practice about Central line insertion and maintenance	27	90.0	3	10.0	88.3	5.7
Total practice about caring of patients on endotracheal tube	14	46.7	16	53.3	70.3	8.0
Total level of practice regarding invasive procedures in intensive care unit	16	53.3	14	46.7	223.0	20.6

**Figure (3):** Percentage distribution of nursing according to their total level of practice regarding invasive procedures in intensive care unit.**Table (4):** Relation between level of knowledge about invasive procedure in intensive care unit and their demographic data (n=30).

demographic data	Total knowledge about invasive procedure in intensive care unit				Chi-square test	
	Satisfactory (n=11)		Unsatisfactory (n=19)		x ²	p-value
	No.	%	No.	%		
Age (years)						
20-25 years	7	63.6	11	57.9	0.00	
25-<30 years	4	36.4	8	42.1	6	0.938
Gender						
Male	5	45.5	2	10.5	2.99	
Female	6	54.5	17	89.5	9	0.083
Academic Qualification						
Nursing Institute	4	36.4	17	89.5	6.99	
Bachelor of Nursing.	7	63.6	2	10.5	8	0.008*
Years of intensive care experience						
<5 years	1	9.1	13	68.4	9.61	<0.001*
5-10 years	10	90.9	6	31.6	3	*
Training courses on invasive procedures in intensive care units						
No	1	9.1	10	52.6	3.96	
Yes	10	90.9	9	47.4	7	0.046*

Chi-square test; p-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS

Table (5): Relation between level of practice regarding invasive procedures in intensive care unit and their demographic data (n=30).

demographic data	Total Level of practice regarding invasive procedures in intensive care unit				Chi-square test	
	Satisfactory (n=16)		Unsatisfactory (n=14)		x ²	p-value
	No.	%	No.	%		
Age (years)						
20-25 years	12	75.0	6	42.9	2.01	0.156
25-<30 years	4	25.0	8	57.1	5	
Gender						
Male	4	25.0	3	21.4	0.04	0.84
Female	12	75.0	11	78.6	1	
Academic Qualification						
Nursing Institute	8	50.0	13	92.9	4.64	0.031*
Bachelor of Nursing.	8	50.0	1	7.1	9	
Years of intensive care experience						
<5 years	2	12.5	12	85.7	13.2	<0.001
5-10 years	14	87.5	2	14.3	74	**
Training courses on invasive procedures in intensive care units						
No	1	6.3	10	71.4	10.9	<0.001
Yes	15	93.8	4	28.6	97	**

Chi-square test; p-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS

Table (6): Relation between level of knowledge about invasive procedure in intensive care unit and their Level of practice regarding invasive procedures (n=30).

Total Level of practice	Total knowledge				Total		Chi-square test	
	Satisfactory		Unsatisfactory		No.	%	x ²	p-value
	No.	%	No.	%				
Unsatisfactory	1	9.1	13	68.4	14	46.7	7.613	0.006*
Satisfactory	10	90.9	6	31.6	16	53.3		
Total	11	100.0	19	100.0	30	100.0		

Chi-square test; *p-value <0.05 S

Table (7): Correlation between total score of knowledge and practice about invasive procedure in intensive care unit (n=30).

Practice	Total Knowledge Scale	
	r	p-value
Total score of Invasive Procedures	0.721	<0.001**
Total score of Central line insertion and maintenance	0.512	0.022*
Total score of caring of Patients on endotracheal tube	0.638	0.006*
Total score of practice regarding invasive procedures in intensive care unit	0.681	<0.001**

r-Pearson Correlation Coefficient; *p-value <0.05 significant

Discussion:

Intensive care units (ICUs) is a major component of the health care environment which becomes occupied by critically ill patients who are surrounded by monitors, ventilators, and other sophisticated technologies, large number of staff members, and involvement of consultants in multiple specialties generate

specific burdens for the patients, relatives, and workers (Adel, 2015).

Critically ill patients are characterized by the presence of actual and/or potential life-threatening problems, requiring continuous observation, intervention and an extraordinary dependence on health care providers and possibly technology (Ali, 2015).

The current study was carried out to assess nurses performance regarding invasive procedures in intensive care unit discussion of the findings of this study covered the main parts of the result.

Part I: Demographic data of the study nursing.

Part II: Nurses knowledge about invasive procedure in intensive care unit.

Part III: Nurses practice regarding invasive procedures in intensive care unit.

Nurses mal practice regarding invasive procedures in intensive care unit.

Part IV: Nurses mal practice regarding invasive procedures in intensive care unit

Part V: Relations and correlations between the studied variables.

Part I: Demographic data

Regarding the studied nurses' demographic characteristics the current study revealed that about two third of the nurse's age was 20-25 years this is because in emergency department need the young age nurses can be fast in the emergency situation. This finding was in agreement result of with *El Sayed and Refect, (2018)*.

Related to gender the present results showed that the more than three quarter of the study nurses were females. This is may be due to the greater fraction of the nurse in Egypt was female and my also related to the studying of nursing in Egypt were exclusive for female only till few years ago. This finding is in consistent with *Mohamed, et al., (2017)*, in a study titled "Assessment of the Nurses performance in providing care to patients undergoing Nasogastric tube" and reported that most of their study group were females.

Concerning level of academic qualification, the present study indicated that, less than three quarter of the studied nurses were technical institute nurses. This explains the lack of knowledge and practice

regarding invasive procedures. It could be related to that highly qualified nurses always perform administrative work. This study finding was supported by *Elauoty (2013)*, who found that most of the nurses were diploma nurses, and it is in contrast with *Hessaen (2011)*, who conducted a study titled "Assessment of nursing staff knowledge and practice regarding streptokinase administration for MI patients in CCU" who found that, most of nurses were bachelor degree nurses.

Regarding years of experience in intensive care unit, the current study showed that more than half of the studied nurses had experience up to five years to less than ten years. This finding might be due to that most of the nurses under study were recently graduated and work stress, severity of patient condition and occupational hazards that facing them in ICU, all of this prevent nurses from continuing work in the critical care unit. This finding was contradicted with *Mohamed, (2016)* in a study titled "Assessment of Nurses performance in Gastrointestinal Endoscopy Unit" and reported that more than two thirds of the study subjects years of experience in ICU ranged between 1-5 years.

The results of the present study showed that, about two thirds of nurses attended continuous training courses about invasive procedures. This results are not in agreement with *Couchman et al. (2017)* they mentioned that, the majority of ICU nurses had no intensive care training. Also, *Lavelle & Doweling (2011)* who showed that, two thirds of participants had no specialization or course in the area of ICU.

Part II: Nurses knowledge

Concerning nurses' Knowledge about invasive procedure in intensive care unit, the current study revealed that, one half of nurses under study had satisfactory level of knowledge about general information This finding was incongruent with, *Almaymuni et al., (2017)*, who

conducted a study titled "Knowledge and Perception on Surgical and Invasive Procedure Protocols: who reported that more than half of nurses got unsatisfactory level of knowledge about invasive procedures.

Concerning the studied nurses' knowledge regarding complications of invasive procedures, this study revealed that more than half of nurses under study had got a satisfactory level of knowledge regarding complications of invasive procedures. This might be due to high rate of the cases that necessary admitted to ICU and continuous training programmes and courses. This finding is in consistent with *Almaymuni et al., (2017)*, who reported that about two thirds of the study nurses had unsatisfactory knowledge regarding complications of invasive procedures.

Concerning knowledge regarding nurses role in invasive procedures, the present study revealed that more than three quarter of studied nurses got satisfactory knowledge level regarding nurses role in invasive procedures. This finding is in consistent with *Almaymuni et al., (2017)*, who reported that about two thirds of the study nurses had unsatisfactory knowledge regarding specific role of invasive procedures.

Concerning total level of knowledge regarding invasive procedures in intensive care unit, the present study revealed that around two thirds of studied nurses had satisfactory level of total knowledge. This might be due to that, high percent of nurses were attended training courses regarding invasive procedures, most of nurses had more than five years of experience with invasive procedures and high level of education.

This finding is in consistent with *Mohammad, (2016)*, who reported that most of nurses had unsatisfactory level of knowledge regarding invasive procedures. It is in the same line with, *Almaymuni et al., (2017)*, who conducted a study titled

"Knowledge and Perception on Surgical and Invasive procedures: and found that more than two thirds of studied nurses got unsatisfactory level of knowledge regarding invasive procedures.

Part III: Nurses practice

Concerning the nurses' total level of practices, findings of this study documented that more than half of the nurses under study have satisfactory total level of practice this is might be due to half of study nurses have training program that lead to improve their skills, this finding agree with *Taha & Ali, (2009)* who studied "Nurses' Practice Related to Invasive Procedures in Intensive Care Units" at Zagazig University Hospitals which reported that half of studied nurse have competent level of practice.

Concerning the nurses' total level of practices regarding patient airway suctioning, the present study revealed that majority of studied nurses have un satisfactory total level of practice, this study agree with *Afenigus et al., (2021)* who study Skill of suctioning adult patients with an artificial airway and associated factors among nurses working in intensive care units of Amhara region, public hospitals, Ethiopia.

Concerning the nurses' total level of practices regarding Central Line Insertion and Maintenance, this result showed that most of studied nurses got satisfactory total level of practice, this may be high rate of using central line at intensive care units and increase training courses for nurses, this study agree with, *Shah & Qasim, (2017)*, who study Practice of Nursing Care for Central Venou Catheter Among Icus Nurses in Private Tertiary Care Hospital Peshawar, "KP" and who found that three quarter of nurses got satisfactory total level of practice regarding the study.

Concerning the nurses' total level of practices regarding caring of patient on endotracheal tube, this study revealed that around half of studied nurses got

unsatisfactory total level of practice this study disagreement with *Colombage, (2020)* who study Knowledge and practices of nurses caring for patients with endotracheal tube admitted to intensive care units in National Hospital of Sri Lanka and found that around half of nurses got satisfactory total level of practice for this study.

Part IV: Nurses mal practice regarding invasive procedures in intensive care unit

Concerning the nurses' mal practices about invasive procedures, this study revealed that majority of studied nurses got unsatisfactory practice about patient airway suctioning this study agreement with *Majeed, (2017)* assessment of knowledge and practices of intensive care unit nurses about patient airway suctioning for adult patients in Baghdad, Iraq teaching hospitals and found that majority of nurses got unsatisfactory practice for this study.

Concerning the nurses' mal practices about invasive procedures, this study revealed that most of studied nurses got satisfactory practice during center line insertion this study agreement with *Awad et al., (2019)* assessment of nurses' Knowledge and Practice Related to caring of Central Venous Line at Aldamam hospital found that more than half of nurses got satisfactory practice for this study.

Part V: Relations and correlations between the studied variables

The current study found that there were highly statistically significant relation between level of knowledge of the nursing and their years of intensive care experience at (p-value <0.001). Also, there were statistically significant relation with their academic qualification and training course (P<0.05). While, there were no significant relation with age and gender at (P>0.05). And this results agreement with *Hassan, (2019)* who found that there was, a statistically significant relation between training course and knowledge level, also

there was a highly statistically significant relation between knowledge level and education level and years of experience the group with five to ten years of experience has the highest proportion of satisfactory knowledge level, while there were no statistically significant relation between total knowledge level and both age and gender of the studied nurses. This finding similar to study of *Kirakli. (2011)* who mentioned that, there was statistically significant difference between the ICU trained nurses performing better than the non trained nurses.

The current study found that, there were highly statistically significant relation between level of practice of the nursing and their years of intensive care experience and training courses. Also, there were statistically significant relation with their academic qualification. While, there were no significant relation with age and gender. This result agreement with *Taha & Ali, (2009)* who studied (Impact of training program about invasive procedures on Nurses' Knowledge and Performance) who reported that there was a significant relation between nurses' knowledge and practice regarding invasive procedures with highly statistical significant differences.

Concerning the relation between nurses' total knowledge score and total practice score. Findings of the present study presented that, there was positive correlation and highly statistically between the total score of knowledge and practice about invasive procedure in intensive care unit, this finding agreement with *Taha & Ali, (2009)* who studied (Impact of training program about invasive procedures on Nurses' Knowledge and Performance). That who reported that there was a significant positive correlation between nurses' knowledge and practice.

Critical care nurses are highly knowledgeable and skilled health care professionals that work in a critical care unit in collaboration with members of the health care team to provide optimum

holistic care. The skills and knowledge of critical care nurses may be directed towards health promotion, prevention, crisis intervention, maintenance, rehabilitation restoration or palliation in care of critically ill patients. Critical care nurses maintain professional competence through on going education, research and skill development and strive to provide evidenced-based practice through promotion of research within their specialty areas (Byrne, 2015).

Conclusion:

Based on the study findings, it was concluded that around two third of the studied nurses at intensive care unit had satisfactory total level of knowledge, around half had satisfactory total level of practice regarding invasive procedures, concerning the nurses' mal practices about invasive procedures, this study revealed that majority of studied nurses got unsatisfactory practice about patient airway suctioning, most of study nurses' got satisfactory practice during center line insertion and around half studied nurses got unsatisfactory about caring of endotracheal tube.

It was concluded also that, there was statistical significant relation between the studied nurses level of knowledge and their academic qualifications, years of experience and training courses in emergency units, while there were no statistically significant relation between total knowledge level and both age and gender of the studied nurses and marital status. Also the current study found that there was statistical significant relation between the studied nurses' level of practice and their educational level, years of experience and training courses in emergency units.

Recommendations:

Education recommendations:

- Conduct orientation and periodic in-service training program for nurses in intensive care units regarding performance of invasive procedures for continuous update of their knowledge.

- Developing a simplified and comprehensive booklet including guidelines about nurses performance regarding invasive procedures in intensive care unit.

Practice recommendations:

- Application of the guidelines related to performance of invasive procedures in the emergency department and critical department as policy in the hospitals.
- Continuous evaluation of nurses' practice is essential to identify their needs about performance regarding invasive procedures in intensive care unit
- On-going and regular in-service educational and training programs to improve practices regarding invasive procedures in intensive care unit.

Research recommendations:

- Improved nurses theoretical knowledge, clinical performance and continuous evaluation of nurses knowledge and practice regarding invasive procedures at intensive care unit.
- The study should be replicated on large sample and different hospitals setting in order to generalize the result.

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