Factors Affecting Central Venous Catheter's Dwell Time in Critically Ill Patients: Suggested Guideline

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Abstract

Background: Central venous catheter (CVC) is a hollow tube that provides reliable vascular access in critically ill patients. The dwell time of the catheter is ample, limited by presence of complications-related factors. Nursing care regarding central venous catheter is very important to prevent complications and increase the central venous catheter's dwell time. **Aim:** Assess the factors affecting central venous catheter's dwell time in critically ill patients with suggested guideline. **Design:** A descriptive exploratory design was utilized in this study. **Setting:** This study was conducted at the combined medical intensive care unit at Ain Shams University Hospital. **Study subjects:** A convenient sample of all nurses (32 nurses), all available physicians (22 physicians) working in the previous mentioned setting and all available patients connected with central venous catheter (84 patients). **Data collection tools:** Four tools were used for data collection; 1) Patient-related factors assessment questionnaire. 2) Nurse-related factors assessment tools containing knowledge assessment questionnaire and central venous catheter nursing care observational checklists. 3) Central venous catheter insertion observational checklist for physicians. 4) Environmental related-factors assessment tool. **Results:** more than one third of the studied patients had secondary education, more than two thirds of the studied nurse had unsatisfactory level of total knowledge regarding central venous catheter care, more than half of them had satisfactory level of total practice regarding its care and more than three quarters of the studied physicians had satisfactory level of practice regarding insertion of central venous catheter. **Conclusion**: The factors affecting central venous catheter's dwell time were patients' level of education, nurses' experience, their total knowledge and total practice and physicians' experience and practice. **Recommendations:** In-service training program must be developed based on need assessment for nurses in relation to care of central venous catheter.

Keywords: Central venous catheter**,** critically ill patients, dwell time, suggested guideline.

Introduction

Central venous catheter (CVC) is a catheter that is placed in the large venous vessels. It is commonly inserted for the care of critically ill patients; it is used as a diagnostic and interventional device for a number of indications as infusion of the medications and fluids. It is also an access for extracorporeal blood circuits, administration of blood products, plasma exchange and central venous pressure (CVP) measurement. It has been estimated that up to 200,000 CVCs are inserted in the United Kingdom annually and up to 15% of them are removed due to complications **(Smith & Nalon, 2013; Wong et al., 2018).**

Dwell time is defined as the number of days between the catheter insertion and removal when the catheter is usable and

functioning. This may be days, months or years. The dwell time of CVC depends on several factors, that include patient, nurse, physician and environmental factors. Patient related-factors include low immunity, old age, mental state of patient, medical diagnosis or disease and laboratory profile especially coagulation profile **(Greenberg et al., 2015; Mendelson et al., 2017).**

Nurses-related factors that may be related to care as dressing, following infection control measures, skin preparation, flushing and care after medication administration. Also, adequate supplies and training program provide safe environment for CVC insertion and care. There are also physician-related factors as using aseptic technique during insertion, fixation techniques, following confirmation line after insertion and types of described medications. **(Wildgruber et al., 2015; Calvache et al., 2016).**

These factors are affecting directly in occurrence of complications that decrease CVC's dwell time. The complications of CVC can be immediate or delayed in nature. Immediate complications occur at the time of catheter insertion include vascular, cardiac, pulmonary, and insertion complications. The physician should consider these complications when deciding on central venous access. The delayed complications included thrombosis and infection **(Patel, Petersen, Simpson, Feng & Hanson, 2019).**

Health care providers should be aware of the complications related to CVC insertion. The chance of complications can never be completely eliminated; their prevention should be a provider's ultimate goal from catheter insertion to the time planned to remove. So, the nurse should be aware of the importance to keep CVC's dwell time as long as possible. As, recognition the management of the complications early reduces morbidity and mortality and improves patient outcomes **(Wong et al., 2016).**

Significant of the study

Significant morbidity and mortality can result from CVC-related complications. These complications cause a significant healthcare burden in cost, hospital stay, and patient quality of life. Most complications still center around vascular injury, infection, and displacement. The mortality of CVC-associated infection alone represents 12% of all infections in intensive care unit. Advances in access technique, and medical devices have reduced and altered the types of complications encountered in clinical practice **(Frykholm, et al., 2014; Kornbau, Lee, Hughes & Firstenberg, 2015).**

According to what was reported by the infection control committee at the combined medical intensive care unit, the rate of CVC infection during 2017-2018 was 16% of the total ICU infection. Also, most of the physicians working at the study setting reported that, nearly quarter of the CVCs connected to critically ill patients are removed after short time due to other complications which are related to many factors as the patients, physicians, nurses and environment.

Aim of the study

The aim of the study was to assess the factors affecting central venous catheter's dwell time in critically ill patient with suggested guidelines as the following:

1. Assessing patient-related factors.

2. Assessing nurses-related factors.

3. Assessing physician-related factors.

4. Assessing environmental-related factors.

5. Developing guideline based on needs assessment for increasing central venous catheter dwell time.

Research question:

The current study answered the following question:

What are the factors affecting central venous catheter's dwell time?

Subjects and Methods

Research Design

The study was conducted through using a descriptive exploratory design which is a scientific method that involves observing and describing the behavior of a subject without influencing it by any way.

Setting:

This study was conducted at Combined Medical Intensive Care Unit of Ain Shams University Hospital affiliated to Ain Shams University.

Subjects:

The present study consisted of three groups of subjects.

• A convenient sample of all available nurses working in the previous mentioned setting (32 nurses), all available physicians working in the previous mentioned setting (22 physicians) and all available patients connected with CVC in the previous mentioned setting (84 patients) with different age, education and medical diagnoses. The sample size was determined according to the total number of patients who was connected with CVC during the year 2017 in the previous mentioned setting (840 patients); using the epi-info.

Tools of data collection

Data was collected using the following tools:

I. Patient-related factors assessment questionnaire

It was designed by the researcher to assess patients'-related factors that affected CVC dwell time after reviewing the related literature **(Hajeri, 2017; Weerdt et al., 2017).** It includes two parts as the following:

Part 1: It was written in Arabic language and concerned with the assessment of the demographic characteristics of patients under the study such as patient`s age, gender, marital status and educational level.

Part 2: It was written in English language and concerned with assessment of patients' clinical data such as present medical diagnosis, past medical history, recent surgery less than one month, body mass index and laboratory investigations that affect dwell time of central venous catheter.

II. Nurse-related factors assessment tools

1) Self- administered nurses' knowledge assessment questionnaire regarding central venous catheter care.

This tool was developed by the researcher in Arabic language after reviewing the recent related literatures **(Saber, 2016; Wong et al., 2016; Shan, Schwartz, Luna & Cullen, 2016)**. It included two parts to assess nurses-related factors that affect CVC dwell time as the following:

A) Nurses' demographic characteristic:

It included the demographic characteristics of nurses such as nurse`s age, gender, qualifications, years of experience and number of attended training courses about CVC related protocols and guidelines.

B) Nurses' knowledge regarding CVC:

It concerned with the assessment of nurses' knowledge regarding CVC care. It was divided into six parts as the following:

- **Part 1**: It was concerned with assessment of nurses` basic knowledge about CVC (from question 1 to 4).

- **Part 2**: It was concerned with nurse` knowledge regarding insertion procedure and infection control measures (from question 5 to 12).

- **Part3**: It was concerned with nurses` knowledge regarding central venous pressure (CVP) (from question 13 to 16).

- **Part 4**: It was concerned with nurses` knowledge regarding care of CVC dressing, maintenance and post insertion (from question 17 to 21).

- **Part 5**: It was concerned with nurses` knowledge regarding administration of fluids through CVC (from question 21 to 23).

- **Part 6**: It was concerned with nurses` knowledge regarding factors affecting dwell time of CVC (from question 24 to 26).

Scoring system

The score for the correct answer of each question took grade 1 and incorrect answer took 0. The total score of the steps was 26 grades. If the score equal or more than 90% (>24grades) it was considered satisfactory knowledge, and it was considered unsatisfactory if the score less than 90% (<24grades). The question that wasn`t answered took zero.

2) Central venous catheter nursing care observational checklists.

These observational checklists were designed by the researcher and written in English language after reviewing the related literatures **(Bove, Joseph & John, 2017; Centre for Diseases Control and prevention (CDC), 2018; World Health Organization (WHO), 2018).** It used to assess nurses' practice regarding care of CVC. It contained 4 parts as the following:

- **Part 1:** It illustrated the nursing care regarding insertion of CVC (33 steps).

- **Part 2:** It illustrated the nursing care regarding measurement of CVP (15 steps).

- **Part 3:** It illustrated the nursing care regarding dressing of CVC (21 steps).

- **Part 4:** It illustrated the nursing care regarding administration of drugs via CVC (22 steps).

Scoring system

The responses for each step in the checklists were "done correctly" was given "One" grade, while "done incorrectly" or "not done" were given "Zero". The total score of the steps were 91 grades; each correct step took one grade and the step that wasn't done, done incorrectly or not applicable took zero. If the score equal or more than 90% (> 82 grades), it was considered satisfactory level of nurses` practice, and it was considered unsatisfactory level of nurses` practice if the score less than 90%(<82 grades).

III . Physician-related factors assessment tool

It was designed by researcher and written in English language after reviewing the related literatures **(Mustafa, 2013; Centre for Diseases Control and prevention (CDC), 2018; Elhanfy, 2018; Hadaway, 2019).** This tool was consisted of three parts as follows:

- **Part1:** It included the demographic characteristics of the physician included in the study such as (physician`s age, gender, qualification, and years of experiences).

- **Part 2:** Central venous catheter insertion observational checklist for physician that concerned with assessing physician's practice regarding insertion of CVC.

This tool was adapted from **(Centre for Diseases Control and prevention (CDC),**

2018; Soffler,Hayes & Smith, 2018) and modified by the researcher. It illustrated the physician` practice regarding insertion CVC.

Scoring system

The score was 40 grades; each right step took one grade. If the score equal or more than 90% (>36grades) it was considered satisfactory level of physician` performance, and it was considered unsatisfactory level if the score less than 90% (<36 grades).

• **Part 3:** Data related catheter assessment. This tool was developed by the researcher after reviewing the related literatures.

It was concerned with assessing clinical data regarding CVC and its dwell time.

IV. Environmental related-factors assessment tool

This tool was designed by the researcher after reviewing the related literatures: **(Mustafa, 2013; Yacopetti, Davidson, Blacka & Spencer, 2013; Centre for Diseases Control and prevention (CDC), 2016; Mahmoud, 2017; Manchanda, Suman & Singh, 2018; Egyptian Society of Infection Control (ESIC), 2018).**

It was written in English language. It was carried out once to assess the environmental factors that affect CVC dwell time and it included:

• Human resources and structure: It composed of 6 items

• Antibiotic policy: It composed of 2 items.

• Training program: It was concerned with assessment of availability of training program for new staff and the periodic of the training program. It composed of 4 items.

• Infection control system: It composed of 8 items.

• Sterilization and care of equipment: It was composed of 4 items.

• Documentation system: It was composed of 3 items.

Scoring system

The total of the items was score 27 grades. The present item took "One" grade and not present took "Zero". If the score equal or more than 90% (>25grades) it was considered safe environment for CVC insertion and its care. It was considered unsafe environment for CVC insertion and its care if the score less than 90% (<25grades).

Ethical consideration:

The researcher clarified the objective and aim of study to the subjects included in the research study. A written approval was obtained from the Scientific Ethics Research Committee of the Faculty of Nursing, Ain Shams University**.** The study subjects' consent to participate in the study was obtained. All data was confidential and used only for their benefit and for research purpose. A master list of participant names was separated from data collections.

Operational design:

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

1. Preparatory phase:

Preparatory phase included reviewing the recent related literatures of various aspects of the study using books, periodicals and internet…etc. In order to develop the data collection tools.

2. Validity and reliability of the study tools:

Testing validity was ascertained by a group of 5 experts in Medical Surgical Nursing specialist to determine whether the tools measure what supposed to measure. The experts reviewed the tools for clarity, relevance, applicability, comprehensiveness, simplicity and minor modifications were done. While, reliability of the study tools was done by Alpha Cronbach test. The questionnaire and checklists reliability were confirmed by Cronbach's alpha coefficient (alpha = 0.791 for nurses' knowledge questionnaire & alpha = 0.854 for observation checklists) and (alpha = 0.851 for physicians' observational checklist).

3.Pilot study:

A pilot study was conducted on 10 % of total number of subjects to investigate and ensure the feasibility, and applicability of the study also the clarity and time needed for the tools filling out. Nine patients with nine connected central venous catheter, four nurses and three physicians were conducted as a pilot study. These samples were included in the total sample.

4. Field work:

The purpose of the study was explained and the oral consent from those who accepted to participate in the study and the family consent was obtained for unconscious patients. They are reassured that information collected would be treated confidentiality, and was used only for the purpose of research. Only code numbers were used to mark sheets. The researcher visited the selected setting three days per week for at least 7 hours per day, at morning and afternoon shifts. Firstly, the researcher assessed patients' demographic characteristics and clinical data using patient related-factors assessment questionnaire. The nurse's knowledge assessment questionnaire was filled out by the nurse. And the average number of nurse who answered questionnaire was one or two nurse per day. Nurses were observed during CVC related procedures during care through their shifts for approximately 10 minutes for each procedure as total 40 minutes for all nursing procedures.

They were informed with observation during the procedures. Physician was observed during CVC insertion for 30 minutes and they were informed with observation during the procedures. Necessary assessment related catheter and patients were obtained from patient` file. Organizational assessment sheet was used to assess the application of infection control in medical intensive care unit and was carried out once. Obtained data were converted into numerical data.

A suggested guideline for increasing central venous catheter's dwell time in critically ill patients was developed by researcher based on needs assessment included:

- Suggested guideline related to nurses caring of patients connected with CVC during CVC insertion and its care.
- Suggested guideline related to physician inserting CVC.
- Suggested guideline related to the environment.

Administrative design:

An approval was issued from the Faculty of Nursing Ain Shams University to carry out this study and obtained to the director of Ain Shams University Hospitals at which the study was conducted, explaining the purpose of the study and requesting the permission for data collection.

Statistical design:

The recorded data were coded and analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics were done using mean and standard deviation (SD) for the quantitative and frequency and percentage for the qualitative data. Inferential statistics were done using the appropriate statistical test.

The following tests were used:

Chi-square (x^2) test of significance was used in order to compare proportions between qualitative parameters.

• Pearson's correlation coefficient (r) test was used to assess the degree of association between two sets of variables.

Results

Table 1 reveals that, 35.7% of the studied patients' age ranged from 35 to less than 50 years old. In relation to gender, it was found that, 54.8% of the patients were females. In relation to marital status, it was found that, 64.3% of the patients were married. Regarding educational level, it was found that, 38.1% of them had a secondary education.

Table 2 reveals that, 59.4% of the studied nurses' age ranged from 25 to less than 35years old, 62.5% of them were females, 53.1% of them studied in nursing institute. Regarding years of experience, it is clear that, 56.2% of them had from 5 to less than 10 years of experience and 62.5% of them had no previous training courses regarding CVC care.

In relation to the nurses' level of total knowledge regarding CVC care; figure 1 shows that, 71.9% of the studied nurses had unsatisfactory level of total knowledge.

Concerning nurses' level of total practice regarding central venous catheter care, figure 2 shows that, 56.3% of the studied nurses had satisfactory level of total practice regarding CVC care.

Table 3 shows that, 59.1% of the studied physicians' age ranged from 25 to less than 30 years old and 54.5% of them were males. Regarding the educational level, the same table revealed that, 59.1% of them had bachelor degree in medicine. While, 45.4% of them had from 1 to less than 5 years of experience and 90.9% of them had received previous training courses regarding CVC insertion.

Figure 3 reveals that, 77.3% of physicians under study had satisfactory level of total practice regarding insertion of CVC.

Table 4 shows that, there were highly statistically significant positive correlations between CVC's dwell time and the nurses' years of experience ($p<0.001$), level of total knowledge ($p<0.001$) and total score of practice ($p<0.001$). While there was no statistical significant correlation between CVC dwell time and nurses' age (p 0.481).

Table 5 shows that, there were highly statistically significant positive correlations between CVC's dwell time and physicians' years of experience ($p<0.001**$) and level of total practice ($p<0.001**$).

Table 1: Frequency & percentage distributions of demographic characteristics of the studied patients (n=84).

Variables	No.	%
Age group		
• 18-< 20 years	2	2.4
• 20-< 35 years	18	21.4
• 35-< 50 years	30	35.7
• 50-< 65 years	16	19.1
• 65>-80 years	18	21.4
Mean±SD	48.45±18.90	
Gender		
• Male	38	45.2
• Female	46	54.8
Marital status		
• Single	20	23.8
• Married	54	64.3
• Divorced/ widowed	10	11.9
Educational level		
• Illiterate	16	19.1
• Read& write	28	33.3
• Secondary education	32	38.1
• University education	8	9.5

Table 2: Frequency & percentage distributions of demographic characteristics among the studied nurses (n=32).

Variables	No.	%
Age group		
• 18<25 years	4	12.5
• 26<35 years	19	59.4
• 36<45 years	8	25
• >- 45years	1	3.1
Mean±SD	33.63±6.39	
Gender		
• Male	12	37.5
• Female	20	62.5
Education		
• Nursing school	8	25
• Nursing institute	17	53.1
• Bachelor degree	7	21.9
Years of experience		
• <5 years	7	21.9
• 5-10years	18	56.2
• >10 years	7	21.9
Mean±SD	8.16±3.18	
Training courses		
• Yes	12	37.5
• No	20	62.5

Nurses، level of total knowledge regarding CVC care

28.1%

71.9%

■ Satisfactory
■ Unsatisfactory
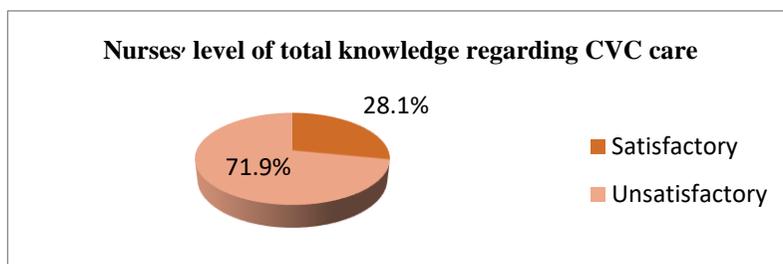
Figure 1: Percentage distribution of nurses' level of knowledge regarding CVC care (n=32).

Nurses، level of total practice regarding CVC care

56.3

43.7

■ Satisfactory
■ Unsatisfactory
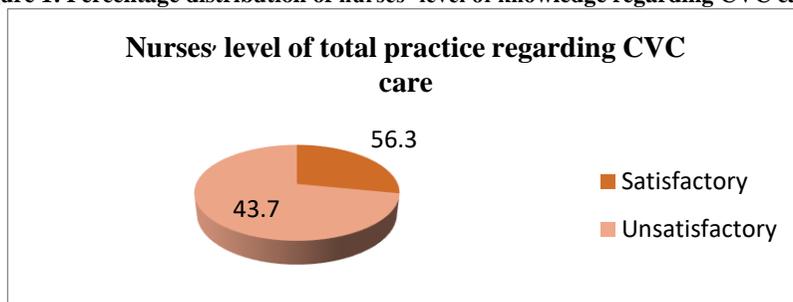
Figure 2: Percentage distribution of nurses' level of total practice regarding central venous catheter related procedures (n=32).

Table 3: Frequency & percentage distributions of demographic characteristics among the studied physicians (n=22).

Items	No.	%
Age		
• 25< 30 years	13	59
• 30<40 years	7	31.9
• 40< 65 years	2	9.1
Mean±SD	33.85±13.2	
Gender		
• Male	12	54.5
• Female	10	45.5
Education		
• Bachelor degree	13	59.1
• Master degree	5	22.7
• Doctoratedegree	4	18.2
Specialty		
• Intensivist	6	27.3
• Anestheologist	6	27.3
• General practitioner	10	45.4
Years of experience		
• <1 year	2	9.1
• 1<5 years	10	45.4
• 5<10years	6	27.3
• >-10years	4	18.2
Mean±SD	5.61±1.63	
Training courses		
• Yes	20	90.9
• No	2	9.1

Physicians' level of total practice regarding CVC insertion

22.7%

77.3%

■ Satisfactory
■ Unsatisfactory
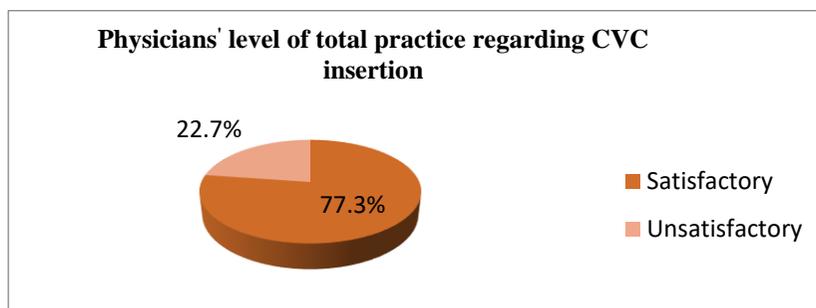
Figure 3: Percentage distribution of physicians` level of total practice regarding insertion of CVC (n=22).

Table 4: Correlation between central venous catheter dwell time and nurses related factors

Nurses related-factors	Central venous catheter dwell time	
	R	p-value
Age (years)	0.188	0.481
Years of experience	0.517	<0.001**
Total score of knowledge	0.414	<0.001**
Total score of practice	0.587	<0.001**

r: correlation coefficient p-value >0.001 Non-S**p-value <0.001 HS

Table 5: Correlation between central venous catheter dwell time and central venous catheter dwell time with physician related factors

Physician –related factors	Central venous catheter dwell time	
	R	p-value
Years of experience	0.563	<0.001**
Total score of practice	0.397	<0.001**

r: correlation coefficient**p-value <0.001 HS

Discussion

Regarding the demographic characteristics of the patients in the present study revealed that, the mean age of the patients included in the current study was 48.45±18.90 years old. It may be due to the proportion of patients with comorbidities increases with age. Aging is a complex process that includes a physiological and cognitive changes, making the patient more prone to acute critical illness, medical diseases and decreasing immunity.

This result goes in the same line with **Pasalioglu and Kaya, (2014)** in their study

"Catheter indwell time and phlebitis development during peripheral intravenous catheter administration" who reported that, the mean patient age was 53.75±15.54 years old.

The current study showed that more than half of the patients were females. It may be due to in our community females' percentage more than male also, the current study setting was combined for cardiovascular, diabetes mellitus (DM) and other diagnosis This result is inconsistent with **Haider, Aziz and Ahmed, (2016**) in their study aimed to determine the frequency of overall mechanical complications associated with insertion of central venous catheters in adult patients reporting to hospital. In which they reported

that more than two thirds of the participant patients were male.

The present study revealed that, more than half of the patients were married and more than one third of the patients' education was secondary education. This result in the same line with **Ali, (2014)** in a study entitled "Effect of educational nursing intervention on knowledge and practice of patients with implantable port catheter and undergoing chemotherapy**"** who stated that more than two thirds of the studied patients were married and 34% of the studied patients had secondary level of education.

Regarding the demographic characteristics of the nurses, less than two thirds of the nurses their age ranged from 25 to 35 years old and the mean age of the nurses included in the study was (33.63+6.39), it may be due to nurses worked in our community after graduation directly. Young nurses respond to challenge and being more aware to the medical care of such group of patients. This result is consistent with **Deshmukh and Shinde, (2014),** in a study entitled "The impact of structured education on knowledge and practice regarding venous access device care among nurses" at India and reported that, two thirds of nurses their age ranged from 21 to 30 years old.

This result goes also in the same line with **Aloush and Alsaraireh, (2018)** in a study titled "Nurses' compliance with central line associated bloodstream infection prevention guidelines" Faculty of Nursing, Al-albayt University, Mafraq, Jordan who reported that, the nurses participated in the study were a young adult with the mean of age 32.5 years.

According to nurses' gender, less than two thirds of nurses were females, this may due to the majority of nursing staff were females. This finding is consistent with **Ahmed, (2017) at** Ain Shams University in study entitled "infection control measures for patient with central line: nurse`s Performance" who reported that less than two thirds of the studied nurses were females.

The result of the current study revealed that, more than half (53.1%) of nurses studied in nursing institute. From researcher' point of view, this result may be related to having different types of nursing education in Egypt. However, variation increased patients' acuity level requires a highly qualified nurse to deal with critically ill patients. This result is inconsistent with **Mahmoud, (2017)** at Ain Shams University. In a study titled "Factors affecting nurses' performance toward central line associated blood stream infection" and reported that, one half of the studied nurses had nursing bachelor degree in nursing.

Regarding years of experience, the result found that less than two third of the nurses had 5-10 years of experience. This may due to majority of them had nursing institute degree with age 26 to 35 years. that is disagree with **Shrestha, (2013)** in a study titled "impact of educational intervention on nurses' Knowledge regarding care of the patients with central venous line" who found that, majority of nurse had less than ten years of experience.

According to training courses, it was found that less than two thirds of nurses did not have training courses regarding care of CVC. This may due to decreased nursing staff with increased work overload. They didn't have time to attend training courses .as well as the majority of them did not attend previous training courses regarding care of central line. This is congruent with **Mustafa (2013)** in a study titled "central venous catheter bundle care" and reported that, it is important for the nurses to receive appropriate training program in the management of vascular access.

Also, this result is consistent with **Woodrow (2015),** at United Kingdom who reported that, it is important that nurse receive appropriate training in the management of vascular access.

The finding is inconsistent with **Saber, (2016)** with a study titled "Non-tunneled Hemodialysis Catheter among Acute Renal Failure, Nurses' Knowledge and Practice at El-fayoum Insurance Hospital" at Cairo university

who reported that, no one of the studied sample had training course regarding care of catheter.

The total nurses' level of knowledge revealed that, more than two thirds (71.9%) of nurses had unsatisfactory level of knowledge regarding CVC care. It may be due to lack of training courses regarding care of central line, moderate educational level of the nurses in the current study and inadequate resources in the study setting affect in a direct way on their level of knowledge.

The finding agrees with **AbuRub, (2012)** in a study entitled "Assessment Nurses Knowledge and Practice Regarding Infection Control Measure for Patients with Vascular Access in Intensive Care Unit" who reported more than half of the nurses had unsatisfactory level of the knowledge.

This findings of the current study are inconsistency with **Aocna and Lisbeth, (2012)** in a study entitled "Central Line-Associated Bloodstream Infection Prevention in the Long Term Acute Care Setting" at Grand Valley State University.who found that the majority of the nurses had satisfactory level of knowledge regarding nursing care for central venous catheter.

The level of total nurses' practice revealed that, more than half of nurses (56.3%) had satisfactory level of practice regarding CVC care. This result is due to unavailability of chlorhexidine and transparent dressing in units that causing decrease total nurses' level of practice.

This result is consistent with **El Nemr, (2015)** in a study entitled "An interventional study to decrease central line related blood stream infection in intensive care units at Zagazig university hospital" at Zagazig university found that satisfactory practice related nurses' procedures although all nurses disinfect skin before catheter insertion with iodine.

The result also consistent with **Aloush and Alsaraireh, (2018)** in a study entitled "Nurses' compliance with central line associated blood stream infection prevention guidelines" who reported lack of supplies in their hospital, such as antibiotic impregnated central venous catheters affect CVC related procedure.

Demographic characteristics of the physicians in the present study revealed that, the mean age of the physicians included in the present study was (33.85+13.2). This result is consistent with **Tsugawa, Newhouse, Zaslavsky, Blumenthal and Jena, (2017)** in a study aimed to assess the relation between physician age and patients' outcomes in which they reported that the mean age of the participant physician was (41+15) years old.

This study showed that less than half of the physicians had experience from one to less than five years. As well as the majority of them attended training courses regarding intensive care unit and central line care. This may be due to decrease experience years may be related to more than half of the physician are newly graduated.

This result is consistent with **Barsuk et al., (2016)** in their study aimed to compare attending physicians' simulated central venous catheter insertion performance to published competency standards at Chicago. They reported that the majority of the physicians had experienced less than 5 years and also had attended training program related to CVC care.

According to physicians' level of practice, the result of the current study revealed that, more than three quarters of the physician under the study had satisfactory level of practice. This may due to the majority of the physicians in the current study had attended training program prior to work in ICU. This finding goes in the same line with **Ista et al., (2016)** in their study titled "Effectiveness of insertion and maintenance bundles to prevent central line associated bloodstream infection in critically ill patients of all ages". They reported that, two thirds of physicians had satisfactory level of practice.

The mean of CVC's dwell time in the current study was 27.88±13 days, and majority of them were inserted in ICU. This result may be due to the policy of the current study setting is to insert CVC in ICU and remove it after one month from insertion even if there weren't complications. These all findings are correspondent with **Aloush and Alsaraireh, (2018)** who reported that, the dwell time of CVCs in their study were more than three weeks and all the CVCs inserted in ICU.

In relation to correlation between CVC's dwell time and nurses-related factors, the current study revealed that, there were positive statistically significant correlations between CVC's dwell time and nurses' level total of knowledge and practice. This may be due to the practice implemented by a nurse isn't performed contextually free. It is always supported by the knowledge acquired through basic and continuing education, experience. So, they have direct relation with each other. This result goes in the same line with **Mahmoud, (2017)** who reported that, nurses' low level of knowledge affected their level of practice toward care of the central line.

As regard correlation between CVC's dwell time and physician' level of practice and experience, this study revealed that, there were positive statistically significant correlation between CVC's dwell time and physician' level of practice and experience. The physician is responsible for complications associated with CVC insertion. So, increasing level of experience for the physician reduces risk of these complications and increase CVC dwell time.

This result is in the same line with **Amini, (2016)** in his study entitled "Evaluation the effectiveness of an educational intervention to decrease central line-associated bloodstream infections among hemodialysis patients" at

Iran who reported that physician' education and practice affected central line dwell time.

Conclusion

The result of this study concluded that:

The factors that affecting CVC's dwell time are; patient-related factors including patients' level of education, present medical diagnosis, past medical history, BMI, recent surgery and laboratory investigations. Also, the factors including nurse-related factors as nurses' level of educational, years of experience, attendance of training courses, their level of total knowledge and practice. As well also there are physician-related factors involving physicians' level of education, experience and level of total practice.

So, based on the previous factors the suggested guideline was developed.

Recommendations

Based on the result of the present study the following recommendations are suggested:

Recommendation related to patients

❖ Establish simplified and illustrated educational booklet for the conscious patients connected with CVC about basic information of CVC.

Recommendations related to nurses

❖ Establish periodical in-services program to improve nurses' knowledge regarding care of CVC.

❖ Develop procedure book for nurses regarding CVC related procedure in ICU as a guidance for all nurses.

Recommendation related to physicians

❖ All physicians should attend training courses regarding CVC insertion prior to work in ICU. As in the study setting, majority of the

physicians had attended training courses regarding CVC insertion.

Recommendation related to environment

❖ Developing CVC car that contain all necessary supplies for CVC insertion and procedures.

❖ Developing policy for the frequency of dressing change and frequency of skin cleansing ranged from 48 hours for adhesive tapes and 7 days for transparent dressing.

Recommendation related to research

❖ Future researches are recommended to examine factors affecting CVC's dwell time before and after using transparent dressing and chlorohexidine.

❖ The study should be replicated on larger probability samples in order to generalize the results.

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