

# Educational Nursing Guideline: It's Effect on Preventing Central Venous Catheter Related Infection among Patients Receiving Total Parenteral Nutrition

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**Abstract** Infection of central venous catheter continues to be one of the most serious health problems among patients receiving total parenteral nutrition, and this infection remains a leading cause of morbidity and mortality among hospitalized patients. Therefore, reduction of central venous catheter infection may be achieved through providing appropriate education and training for all health team members specially nurses. **Aim of the study:** Evaluate effect of educational nursing guideline on preventing central venous catheter-related infection among patients receiving total parenteral nutrition. **Data Collection Tools: First Tool;** Self-administered Questionnaire that included two parts; Part one: Demographic characteristics of the nurses; Part two: Nurses' knowledge about central venous catheter infection preventive measures. **Second Tool:** Nurses' Practice Observational Checklist and **Third Tool:** Visual Infusion Phlebitis Score that was used to assess catheter-related infection. **Results:** The results of this study showed that, there was a highly statistically significant difference between both groups (study & control) regarding prevention of central venous catheter-related infection ( $P < 0.00$ ). **Conclusion:** Implementing educational nursing guideline for preventing central venous catheter-related infection among the patients who receive total parenteral nutrition showed a highly statistically significant positive effect on reducing the developed grade of phlebitis. **Recommendations:** This study recommended conducting the developed educational nursing guideline program for nurses to train them on central venous catheter, use proper procedures for the insertion, maintenance, and appropriate infection control measures to prevent central venous catheter-related infection.

**Keywords:** central venous catheter, educational, nursing guideline, associated infection, total parenteral nutrition

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## 1. Introduction

The central venous catheter (CVC) is an intravenous infusion device frequently used in intensive care units. It is placed intravenous into great vessel and it is indicated for administration of intravenous fluids, medication, blood products and total parenteral nutrition, and to monitor central venous pressure. Although the CVC facilitates patients' treatment, however, it is associated with a variety of complications such as infection, thrombosis, and embolism formation. The CVC infection is developed at least 2 full days following insertion of the central venous catheter. It is a common complication that is associated with increased cost of care, extended hospital stay and increased mortality rate [1].

Total parenteral nutrition (TPN) is used when gut fails to provide complete nutrition. Central venous catheter-related infection is a major complication of this therapy. This infection is defined as a laboratory-confirmed blood-

stream infection not related to an infection at another site that develops within 48 hours of a central venous line placement. This infection is known as the most costly, and most cases are preventable with proper aseptic techniques, surveillance, and management strategies [2].

Administered TPN via CVC has been identified as an independent risk factor for catheter-related infection [3,4]. Catheter-related infection is an important and still too common complication of TPN. The risk of infection can be reduced by adopting cost-effective, evidence-based interventions such as proper education and specific training of the health team members, an adequate hand washing policy, proper choices of the type of device and the site of insertion, use of maximal barrier protection during insertion, use of an antiseptic prior to insertion for disinfecting the exit site afterward, appropriate policies for the dressing of the exit site, routine changes of administration sets, and removal of central venous catheters as soon as they are no longer necessary [5].

In order to minimize the incidence of infection several literatures were published guidelines for dealing with

CVC. These guidelines focus on education and training; make the best use of sterile barrier precautions. Compliance with these guidelines is extremely important for reducing the incidence of infection and their associated healthcare costs, and to improve patient outcomes [6,7]. The Centers for Disease Control and Prevention has published CVC infection prevention guidelines that help to reduce the rate of infection and related complications. Major topics in these guidelines include education of healthcare providers, antisepsis, intravenous administration management, hand hygiene and dressing [5].

Several literatures have indicated that a lack of knowledge and skills among health team members in general and nurses in particular is considered as one of the main barriers to nursing practice. Nurses play important role in the maintenance and surveillance of CVC and the control of infections. However, proper procedures are not always applied by nurses. Nurses' knowledge regarding guidelines has significant impact for preventing intravenous catheter-related infection. Evidence-based researches reported that educational interventions greatly reduced infection rates in patients with CVC. Therefore, higher levels of nurses' knowledge and skills are strongly related with lower CVC infection rates [6]. Nurses always have the main responsibility for CVC care and prevent infection, as the nurses are assisting in the insertion procedure, dressing, flushing, blood sampling, and administration of fluid, medication, chemotherapy and other liquids that can be given through CVCs. Therefore, nurses form the first line in the reduction of CVC-related complications in general and infection in particular [8].

### 1.1. Significance of the Study

Central venous catheter-related infection have been associated with increased length of hospital stay, mortality, and healthcare costs, especially in intensive care units [9]. Mortality attributable to CVC-related infection has been estimated to be as high as 35%, and length of hospital stay is consistently increased among infected patients. Total parenteral nutrition increases the risk of infection, and it has been identified as an independent risk factor for central venous catheter-related infection [3]. In order to improve patient outcomes and reduce healthcare costs, there is considerable interest in reducing the incidence of this infection. Although there is no consensus on the optimal approach to achieve this, several recent research studies indicate that educating healthcare providers to prevent these infections can decrease infection rates [10]. For that reason, the current study aimed to evaluate the effect of educational nursing guideline on preventing central venous-related infection among patients receiving TPN.

### 1.2. Aim of the Study is

Evaluate effect of educational nursing guideline on preventing central venous catheter-related infection through:

- 1) Assessing nurses' knowledge and practices before providing educational guideline.

- 2) Assessing patients if there is development of infection in CVC before and after providing educational guideline.
- 3) Developing educational guideline-based on assessment of the needs.
- 4) Evaluating effect of educational guideline on nurses' knowledge, practices and patients' CVC related infection.

### 1.3. Research Hypothesis

The research hypothesis was formulated to achieve the following outcome; implementing educational nursing guideline would have a positive effect on preventing of CVC infection among patients receiving total parenteral nutrition.

## 2. Methods

### 2.1. Research Design

The current study used a quasi-experimental study design, this designed was utilized because it is the most relevant design to assess the cause and effect and assess relation between independent and dependent variables.

### 2.2. Setting of the Study

This study was conducted at five intensive care units; in one of the governmental hospitals in Cairo. The number of beds in each unit ranged between 12 and 16 beds. The investigators selected this setting as the flow of patients who were connected with CVC and received TPN was adequate to recruit a study sample. The study started at the beginning of March 2021 to beginning of December 2021.

### 2.3. Sample of the Study

To select the sample of this study, the investigators used the Epi info, version 6, to obtain the required sample, with taking into consideration that this study was an intervention study, and the investigators found that the accurate sample size for 93% confident level, 80% power and the sample size could be 86 and the investigators took 80 patients who met the inclusion and exclusion criteria. The subjects for the control group were 40 and for the study group, subjects were the other 40. In addition, the patients recruited from different ICUs, who were connected with CVC and receiving TPN were included in the study. In this study, the investigators utilized a purposeful sampling technique, and the total number of nurses was, 40.

### 2.4. Inclusion and Exclusion Criteria

All adult patients, both gender, who are connected with CVC and receiving TPN and had no any pathological condition that could be a predisposing factor for developing infection were recruited for the study sample. Concerning nurses the inclusion criteria were as follows; nurses with different educational levels, both

gender, had at least one year experience in her/his unit. Regarding exclusion criteria for nurses were as follows; nurses who attended any training course about infection prevention related to CVC were excluded from the study.

## 2.5. Data Collection Tools

Data were collected by using three tools; **First Tool; Self-administered Questionnaire** that was developed by the investigators. The questionnaire included two parts: **Part one:** it dealt with nurse's demographic characteristics such as; age, gender, educational level, years of experience, and work place. **Part two:** Adopted from [11], it was used to assess nurse's knowledge about CVC infection preventive measures, and it contains 10 multiple questions about knowledge regarding CVC care, maintenance, factors leading to CVC infection, signs and symptoms of CVC infection, complications resulted from CVC generally and specifically in relation to administering TPN.

**Scoring system** of this tool was done as follows: Each question had only one correct answer that was scored "1", while the wrong answer was scored "0". Summation and percentage of the score of the correct answers were calculated for each item, for all participants, and if the participants got 75% and above she/he was considered had adequate level of knowledge, and if less than 75% she/he was considered as having inadequate level of knowledge.

**Second Tool: Nurses' Practice Observational Checklist:** Adopted from [12,13], it was used to assess nurses' practice-based on the adopted guideline for care and maintenance of CVC, it contains 8 items as follows: Education, training and staffing, central venous catheters recommendations, hand hygiene and aseptic technique, maximal sterile barrier precautions, skin preparation, catheter site dressing regimens, and patient cleansing.

**Scoring system** of this tool was done as follows: If the respondent performed the required step she/he would get "1" and if the respondent did not perform the required step she/he would get "0". Summation and percentage of the scores of the correct answers were calculated in each item for all participants, if the participants got 75% and above, this was considered as satisfactory level of practices, and if they got less than 75% this was considered unsatisfactory level of practices.

**Third Tool: Visual Infusion Phlebitis Score:** This tool adopted from [14], it consists of two parts; **Part one:** used to assess patient's demographic characteristics as; gender, age, type of TPN fluids, amount per 24 hours; **Part two:** was used for assessing the grade and severity of phlebitis through assessing presence of infection at the site of CVC.

**Scoring system** of this tool consists of 6 categories as follows; category "0" if CVC site appeared healthy, indicated no signs of phlebitis; category "1" if there was slight pain or redness appeared near the site, which that indicated that there was possibly first signs of phlebitis; category "2" if there was pain at the site of insertion and redness; category "3" if there was pain along path of CVC, redness around the site and swelling; category "4" if there was pain along path of CVC, redness around the site, swelling and palpable vein cord, and these indicated advanced stage of phlebitis or thrombophlebitis; and category "5" if there was pain along path of CVC, redness

around the site, swelling, palpable vein cord and pyrexia, and any incidence of phlebitis greater than grade 2 should be reported to the physician.

## 2.6. Validity and Reliability of Data Collection Tools

They are the main components to assess the quality of data collection tools. Validity was done to assess to which degree the tools measured what proposed to be measured. Meanwhile, the reliability was done to identify the accuracy of the obtained data in the research study, it was assessed by using Cronbach's alpha test, and its values were as follows; questionnaire = 0.89, observation checklist = 0.90, and phlebitis grading scale = 0.95.

With regard to this study, validity of the tools was tested by 3 Professors from Medical Surgical Nursing, as they ensured that the translated version was accurately reflecting its meaning, and the tools are assessing all components of the study that respond to the study hypothesis and achieve its aim.

## 2.7. Ethical Considerations

Approval was obtained from the hospital administration to conduct this study after explaining its aim, implementation plan, and the policy of maintaining the participants' rights and confidentiality throughout the study. Based on the hospital's administration that requested, the hospital name was kept. The investigators informed the participants that, they had the right to withdraw from the study at any time without giving any reason and without any harmful effect on them. In addition, the investigators informed them that, the data collection tools were anonymously designed. After all these clarifications, the investigators confirmed their approval to participate in the study. The investigators declared that there was no harmful effect on the study group participants.

## 2.8. Pilot Study

The pilot study was done on 10% of the study subjects; 4 nurses and 8 patients to assess the clarity, feasibility, and time needed to fill in the data collection tools and to deliver educational sessions. The necessary modifications were done according to the subjects' responses in the pilot study. The time needed for delivering the theoretical and practical sessions was 6 hours. The participants involved in the pilot study were excluded from the main study sample.

## 2.9. Procedure

The current study was carried out over 9 months through three phases as follows; **Phase 1:** it was called assessment phase (pre-educational phase) that included the following: 1). the investigators divided the patients randomly into two groups (study & control), each group 40 patients. 2). the investigators assessed the nurses in the selected study setting who were assigned into the patients in the control group for their knowledge and practices in relation to providing routine care for patients connected

with CVC and receiving TPN. Data collection was done as follows; the investigators distributed tool I among the nurses to assess their knowledge through self-administering questionnaire, and it took 20 minutes to be completed by them. Then, the investigators used tool II to assess nurses' practices while providing routine care for those patients, and it took 25 minutes to be completed. After that, the investigators used tool III to assess the presence of venous catheter-related infection for the patients in the control group which took 15 minutes to be filled in.

**Phase II:** it was called intervention phase, as the investigators after assessing the nurses' knowledge and practices regarding provision of routine care for the patients in the control group and based on the findings, they divided the nurses into 2 groups, each group 20 nurses for delivering the theoretical content and practical part related to the educational guideline. After agreement with the hospital administration, the theoretical content was delivered in two different days for each nursing group separately, and each session took 3 hours. In this session, the investigators explained to the nurses in each group the educational guideline for caring the patients connected with CVC and receiving TPN in the study group, and the theoretical content included CVC care, maintenance, complications of CVC, risk factors, and measures to prevent CVC-related infection. Concerning the practical sessions, the investigators divided the nurses into 4 groups, each group 10 nurses for explaining and demonstrating the practical guideline for them, and each practical session took one hour for each group, after that, the investigators agreed with the nurses if they need one more session they can meet them for another session. These theoretical and practical sessions were conducted over two weeks, first week for theoretical part, and the second week for practical part, and the 40 nurses were divided between the two investigators, and implementing of the educational guideline was done in both shifts morning and afternoon for those nurses, after taking permission from the head nurses of each unit to let them free during the scheduled sessions.

**Phase III:** it was called evaluation phase (post educational sessions), in this phase the investigators reassessed nurses' knowledge and practices by using tool I and II, in addition to using the tool III by the investigators to assess the effect of the educational nursing guideline on preventing CVC infection among patients receiving TPN, through assessing any presence of infection in the CVC and this was done for the patients in the study group. Accordingly, the investigators documented all findings for the study and control groups, before and after conducting the educational nursing guideline.

### 2.10. Statistical Analysis

Data were recorded into a database and analyzed with the statistical program Statistical Package for Social Science (SPSS), version 20.0. A quasi-experimental research design was performed by assessing the variables related to the total sample and the selected groups (study & control). The categorical variables were presented in frequencies, percentages, t-test, Fisher test, and standard

deviations (SD), as well as bar charts, a p-value of less than 0.05 was used to determine statistical significance.

## 3. Results

**Table 1. Frequency and Percentage Distribution of Demographic Characteristics of the Studied Nurses (n=40)**

| Items                                 | No. | %    |
|---------------------------------------|-----|------|
| <b>Gender</b>                         |     |      |
| Male                                  | 11  | 27.5 |
| Female                                | 29  | 72.5 |
| <b>Age (in years)</b>                 |     |      |
| 20 - < 23                             | 8   | 20   |
| 23 - < 26                             | 16  | 40   |
| 26- ≤ 29                              | 16  | 40   |
| $\bar{X} \pm SD 24.75 \pm 2.2$        |     |      |
| <b>Selected ICUs</b>                  |     |      |
| Emergency Room ICU                    | 6   | 15   |
| General ICU                           | 5   | 12.5 |
| Medical ICU                           | 12  | 30   |
| Surgical ICU                          | 11  | 27.5 |
| Neuro-surgery ICU                     | 6   | 15   |
| <b>Level of education</b>             |     |      |
| Diploma                               | 11  | 27.5 |
| Technical Institute                   | 29  | 72.5 |
| <b>Years of experience (in years)</b> |     |      |
| 1 - < 3                               | 5   | 12.5 |
| 3 - < 6                               | 19  | 40   |
| 6 - < 9                               | 13  | 32.5 |
| 9 - < 12                              | 3   | 7.5  |
| $\bar{X} \pm SD 5.05 \pm 2.09$        |     |      |

Table 1 shows that, 72.5% of the nurses in the studied subjects were females. Concerning their age, it ranged between 20 to 29 years or more, with a mean age of  $24.75 \pm 2.2$  years. With regard to their working department the same table shows that, 15%, 12.5%, 30%, 27.5%, and 15% of them were working in emergency room, general, medical, surgical, and neuro-surgery ICUs respectively. Regarding to their educational level, 27.5%, and 72.5% of them had diploma and technical institute of nursing respectively. Meanwhile, for 40%, and 32.5%, of them their years of experience ranged between; 3 to less than 6, and 6 to less than 9 respectively, with a mean of  $5.05 \pm 2.09$  years.

Table 2 denotes that, 52.5% and 47.5% of the patients in the control and study groups were males and females respectively. Concerning their age, it ranged between 55 to 75 years or more in the control and study groups, with a mean age of  $65.8 \pm 4.74$  and  $65.3 \pm 3.8$  years respectively. With regard to type of TPN that was administered per 24 hours, the same table reveals that, 47.5%, and 65% of the subjects in the control and study groups received TPN in a form of proteins respectively, while, 37.5% and 35% of them in the control and study groups received TPN in a form of lipids and electrolytes respectively. Regarding to the amount of TPN fluids, the above table shows that, 55%, and 77.5% of the subjects in the control and the study groups received 1000 cc per 24 hours respectively.

**Table 2. Frequency and Percentage Distribution of Demographic Characteristics and Medical Data of the Studied Subjects (n=80)**

| Items   | Control group                  |      | Study group                   |      |
|---|--------------------------------|------|-------------------------------|------|
|   | No.                            | %    | No.                           | %    |
| <b>Gender</b>                                   |                                |      |                               |      |
| Male  | 21                             | 52.5 | 19                            | 47.5 |
| Female  | 19                             | 47.5 | 21                            | 52.5 |
| <b>Age (in years)</b>                           |                                |      |                               |      |
| 55 – < 60                                       | 3                              | 7.5  | 2                             | 5    |
| 60 – <65  | 13                             | 32.5 | 14                            | 35   |
| 65 – <70  | 14                             | 35   | 17                            | 42.5 |
| 70 – ≥ 75                                       | 10                             | 25   | 7                             | 17.5 |
|   | $\bar{x} \pm SD 65.8 \pm 4.74$ |      | $\bar{x} \pm SD 65.3 \pm 3.8$ |      |
| <b>Type of Administered IV Fluids/ 24 hours</b> |                                |      |                               |      |
| Amino acids                                     | 6                              | 15   | 0                             | 0    |
| Proteins  | 19                             | 47.5 | 26                            | 65   |
| lipids and electrolytes                         | 15                             | 37.5 | 14                            | 35   |
| <b>Amount of TPN fluids /24 hours</b>           |                                |      |                               |      |
| 150 cc.   | 1                              | 2.5  | 0                             | 0    |
| 500 cc.   | 5                              | 12.5 | 0                             | 0    |
| 1000 cc.  | 22                             | 55   | 31                            | 77.5 |
| 1500 cc.  | 12                             | 30   | 9                             | 22.5 |

**Table 3. Frequency and Percentage Distribution of Phlebitis Grading among the Patients in the Control and Study Groups**

| Characteristics of phlebitis grade  | Control group |      | Study group |    | Test of significance |       |
|---|---------------|------|-------------|----|----------------------|-------|
|   | No.           | %    | No.         | %  | F-test               | Sign. |
| <b>No signs of phlebitis</b><br>IV site appears healthy   | 6             | 15   | 6           | 15 | 3.660                | 0.00* |
| <b>First signs of phlebitis</b><br>Slight pain near IV site<br>Slight redness near IV site  | 1             | 2.5  | 20          | 50 |                      |       |
| <b>Early stage of phlebitis</b><br>Pain at IV site<br>Redness   | 4             | 10   | 8           | 20 |                      |       |
| <b>Medium stage of phlebitis</b><br>Pain along path of cannula<br>Redness around site<br>Swelling   | 9             | 22.5 | 6           | 15 |                      |       |
| <b>Advanced stage of phlebitis</b><br>Pain along path of cannula<br>Redness around site<br>Swelling<br>Palpable venous cord                   | 6             | 15   | 0           | 0  |                      |       |
| <b>Advanced stage of thrombophlebitis</b><br>Pain along path of cannula<br>Redness around site<br>Swelling<br>Palpable venous cord<br>Pyrexia | 14            | 35   | 0           | 0  |                      |       |

\*highly significant at  $p < 0.00$ .

Table 3 reveals that, 15% of the control and study groups did not develop any grades of phlebitis. As well, the same table reports that, there was a highly statistically significant difference between grades of phlebitis among the patients in the control and the study groups at  $p = 0.000$ .

Table 4 shows that, there was a highly statistically significant difference in the total levels of nurses' knowledge before and after implementing educational nursing guideline about infection prevention among patients connected with CVC and receiving TPN at  $p = 0.000$ .

**Table 4. Frequency and Percentage Distribution of Nurses' Total Knowledge Levels Related to Prevention of Infection among Patients connected with CVC and Receiving TPN before and after Implementing Educational Guideline (n=40)**

| Knowledge level      | Before intervention |     | After intervention |      | Test of significance |       |
|----------------------|---------------------|-----|--------------------|------|----------------------|-------|
|                      | No.                 | %   | No.                | %    | t-test               | Sign. |
| Satisfactory level   | 0                   | 0   | 31                 | 77.5 | 11.56                | 0.00* |
| Unsatisfactory level | 40                  | 100 | 9                  | 22.5 |                      |       |

\* Highly statistically significant at P-value < 0.00.

**Table 5. Frequency and Percentage Distribution of Nurses' Total Practices in relation to Prevention of Infection among Patients Connected with CVC and Receiving TPN before and after Implementing Educational Nursing Guideline (n=40)**

| Practice levels  | Before intervention |    | After intervention |      | Test of significance |       |
|------------------|---------------------|----|--------------------|------|----------------------|-------|
|                  | No.                 | %  | No.                | %    | t-test               | Sign. |
| Adequate level   | 12                  | 30 | 37                 | 92.5 | 8.06                 | 0.00* |
| Inadequate level | 28                  | 70 | 3                  | 7.5  |                      |       |

\* Highly statistically significant at P-value < 0.000.

Table 5 shows that, there was a highly statistically significant difference in the total levels of nurses' practices before and after implementing educational nursing guideline for preventing CVC infection among patients receiving TPN at p = 0.00.

**Table 6. Relation between Total Levels of Nurses' Knowledge and Grades of Phlebitis among the Patients of the Study Group**

| Levels of knowledge | Phlebitis grading |    |                                    |    |                 |      |                  |    | X <sup>2</sup><br>P- Value | Sign.  |
|---------------------|-------------------|----|------------------------------------|----|-----------------|------|------------------|----|----------------------------|--------|
|                     | 0 grade           |    | 1 <sup>st</sup> signs of Phlebitis |    | Early Phlebitis |      | Medium Phlebitis |    |                            |        |
|                     | No.               | %  | No.                                | %  | No.             | %    | No.              | %  |                            |        |
| Satisfactory        | 2                 | 5  | 18                                 | 45 | 7               | 17.5 | 4                | 10 | 9.367                      | 0.025* |
| Unsatisfactory      | 4                 | 10 | 2                                  | 5  | 1               | 2.5  | 2                | 5  |                            |        |

\* Statistically significant at p < 0.05.

Table 6 reveals that, there was a statistically significant relation between the total levels of nurses' knowledge and grades of phlebitis among the patients in the study group at p < 0.05.

**Table 7. Relation between the Total Levels of Nurses' Practices and Grades of Phlebitis among the Patients in the Study Group**

| Levels of Practices | Phlebitis grading |    |                                    |      |                 |      |                  |      | X <sup>2</sup><br>P- Value | Sign.  |
|---------------------|-------------------|----|------------------------------------|------|-----------------|------|------------------|------|----------------------------|--------|
|                     | 0 grade           |    | 1 <sup>st</sup> signs of Phlebitis |      | Early Phlebitis |      | Medium Phlebitis |      |                            |        |
|                     | No.               | %  | No.                                | %    | No.             | %    | No.              | %    |                            |        |
| Adequate            | 6                 | 15 | 19                                 | 47.5 | 7               | 17.5 | 5                | 12.5 | 1.682                      | 0.641* |
| Inadequate          | 0                 | 0  | 1                                  | 2.5  | 1               | 2.5  | 1                | 2.5  |                            |        |

\* No significant relation P > 0.05.

Table 7 indicates that, there was no statistically significant relation between the total levels of nurses' practices and the grades of phlebitis among the patients in the study group at P > 0.05.

**Table 8. Relations between Demographic and Medical Data of the Patients in the Study Group and Grades of Phlebitis**

| Item                    | Phlebitis grading |      |                                    |      |                 |    |                  |      | P- Value | Sign. |
|-------------------------|-------------------|------|------------------------------------|------|-----------------|----|------------------|------|----------|-------|
|                         | 0 grade           |      | 1 <sup>st</sup> signs of Phlebitis |      | Early Phlebitis |    | Medium Phlebitis |      |          |       |
|                         | No.               | %    | No.                                | %    | No.             | %  | No.              | %    |          |       |
| Gender                  |                   |      |                                    |      |                 |    |                  |      | 4.378    | 0.22  |
| Male                    | 5                 | 12.5 | 7                                  | 17.5 | 4               | 10 | 3                | 7.5  |          |       |
| Female                  | 1                 | 2.5  | 13                                 | 32.5 | 4               | 10 | 3                | 7.5  |          |       |
| Age (in years)          |                   |      |                                    |      |                 |    |                  |      | 53.75    | 0.05* |
| 55- <60                 | 1                 | 2.5  | 1                                  | 2.5  | 0               | 0  | 0                | 0    |          |       |
| 60- <65                 | 4                 | 10   | 10                                 | 25   | 0               | 0  | 0                | 0    |          |       |
| 65- <70                 | 1                 | 2.5  | 9                                  | 22.5 | 6               | 15 | 1                | 2.5  |          |       |
| 70- ≥ 75                | 0                 | 0    | 0                                  | 0    | 2               | 5  | 5                | 12.5 |          |       |
| Type of TPN             |                   |      |                                    |      |                 |    |                  |      | 0.586    | 0.90  |
| Lipids, electrolytes    | 4                 | 10   | 12                                 | 15   | 6               | 15 | 4                | 10   |          |       |
| Protein                 | 2                 | 5    | 8                                  | 20   | 2               | 5  | 2                | 5    |          |       |
| Amount of TPN /24 hours |                   |      |                                    |      |                 |    |                  |      | 6.260    | 0.10  |
| 1000 cc.                | 4                 | 10   | 13                                 | 32.5 | 8               | 20 | 6                | 15   |          |       |
| 1500 cc.                | 2                 | 5    | 7                                  | 17.5 | 0               | 0  | 0                | 0    |          |       |

\* Significant at P < 0.05.

Table 8 states that, there was a statistically significant relations between the age of the patients in the study group and their grades of phlebitis at  $p < 0.05$ .

## 4. Discussion

The CVC is the route of choice for TPN as its osmotic load is not well tolerated by peripheral veins [15]. Infections related to CVC are complications with a high prevalence and possible serious consequences. Administration of TPN is considered as one of the most common risk factors for developing CVC infection [16].

In this study, more than two thirds of the studied subjects' nurses were females. With regard to their age, it ranged between 20 and 29 years or more with mean age of  $24.75 \pm 2.2$  years. Concerning their work place, the present study results showed that the highest percentage representing less than one third of them was working in medical ICU, and less percentage of the rest of them were working in different ICUs. Meanwhile, less than three quarters of them had technical institute of nursing education. As regards to their years of experience, the mean of years of experience was  $5.05 \pm 2.09$  years.

In relation to the patients under the study, the current study results reported that, slightly more than half of the subjects in the control group were males, while less than half of the subjects in the study group were males. Meanwhile, the age of the subjects in the control and study groups ranged between 55 to 75 years or more, and the mean age of the subjects in the control group was  $65.8 \pm 4.74$  years, and for the subjects in the study group it was  $65.3 \pm 3.8$ .

Regarding types of TPN administered through CVC, this study results showed that, less than half of the subjects in the control group and almost two thirds of the subjects in the study group received proteins as TPN. Concerning the amount of TPN fluids administered per 24 hours, more than half of the subjects in the control group and more than three quarters of the subjects in the study group both received 1000 cc per 24 hours.

The present study findings revealed that, the minorities of the studied subjects in the study and control groups did not develop phlebitis at all. However, half of the patients in the study group developed only first signs of phlebitis and around one third of the patients in the control group developed advanced stage of thrombophlebitis. Additionally, this study results stated that, there was a highly statistically significant difference between both groups regarding the grades of phlebitis after implementing the educational nursing guideline which prevented CVC infection among patients who received TPN. This may be due to the effectiveness of educating nurses on how to control and how to manage the risk factors for developing CVC infection and let them more oriented by the preventive measures. This finding is supported by that of [17], who stated that educational guideline and quality of provided care had been shown to be effective to prevent development of complications related to CVC. As well, [18,19], highlighted that conducted educational sessions and presence of clear instructions for the nurses on their knowledge and practices in relation to CVC care are playing significant role in achieving positive outcomes and reducing CVC infection.

In the present study, the results showed that, there was a highly statistically significant difference between the total level of nurses' knowledge before and after implementing educational guideline to prevent CVC infection among patients receiving TPN. This may be due to that nurses became more aware by the appropriate knowledge and practices for caring patients connected with CVC which made them motivated to practice in correct way. Similarly, this finding is supported by those of earlier similar studies carried out by [20,21], as well with findings of a very recent study carried out by [22], who interestingly highly recommended involving educational guideline in the nursing curricula and providing continuous educational programs for nurses to help them in improving their knowledge which is reflecting positively on their practices.

In relation to nurses' practice regarding measures of preventing infection among patients receiving TPN, this study results showed that, before conducting the educational guideline for CVC infection prevention, less than one third of the studied nurses had adequate level of practices, while, most of them had adequate level of practices after conducting the educational guideline for CVC infection prevention. As well, it showed that, there was a highly statistically significant difference between levels of nurses' practices before and after implementing the educational guideline. This finding is attributed to that, educating nurses about proper steps of practicing CVC nursing care could encourage them to practice appropriately, as they consider this as motivation for them to perform the nursing care according to the standardized steps. This finding is in the same line with those of similar studies carried out by [10,23,24], which proved that the educational program for the nurses has apparent and significant effect on reducing of CVC infection rate.

In the current study, the results reported that, those nurses who had satisfactory knowledge and representing more than one third, their patients only developed first signs of phlebitis with statistically significant relation between their level of knowledge and grade of phlebitis among the patients in the study group. This may be attributed to that improvement of nurses' knowledge enhanced the provision of quality care that minimized the grades of phlebitis. This result is in the same line with that of [25], who clarified that appropriate obtained knowledge among nurses contributed and reduced the frequency and development of CVC infection.

This study finding indicated that, those nurses who had adequate level of practices more than one third of their patients developed only first signs of phlebitis with statistically insignificant relation between their levels of practices and grade of phlebitis among the patients in the study group. This may be attributed to that, after attending the training, the nurses were in need to retain these theoretical and practical contents in order to implement them by heart which will reflect positively on the outcome of nursing care and consequently prevents or minimizes complications of invasive procedures. According to several studies as those of [26,27,28], which proved that, the educational guideline improved nurses' knowledge and practices about CVC maintenance and prevention of complications, additionally, provision of continuous and regular training was crucial to maintain quality of nursing care.

Considering the relations between demographic and medical data of the study group of patients and grades of phlebitis, this study indicated that, there was a statistically significant relation between developing medium grades of phlebitis and age of the studied patients. This may be due to that the older patients had higher percentage rate of impaired immune system function which makes them at high risk for developing infection. This result is supported by that of [29], who reported that, advanced age and longer duration of connection with CVC were independent and significant risk factors for the development of CVC infection.

## 5. Conclusion

The results of this study clearly indicated that the educational nursing guideline had highly statistically significant effect on reducing CVC related infection among patients who received TPN.

## 6. Recommendations

This study recommended to conduct the developed educational nursing guideline program for nurses to train them on implementing proper procedures for patients connected with central venous catheter such as; providing care, maintenance, as well applying appropriate infection control measures to prevent central venous catheter-related infection. Furthermore, the educational program needs to be implemented on larger samples of the nurses and patients in order to be able to generalize the results, and this study recommended also the conduction of further studies to avoid the limitations of this study.

## 7. Limitations

The current study had some limitations such as; small number of the nurses and patients. As well, only nurses from the health team who were involved but it should include all the health team members, there was no available statistics in the selected setting about the incidence of patients who developed infection while connected with CVC and receiving TPN.

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