Infection Control Measures for Patient with Central Line: Nurses' Performance

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Abstract

Background: Central venous catheters (CVCs) are vascular infusion tools utilized for studying hemodynamic variables, dialysis, administration of medication, and nutrition. Catheter related blood stream infection (CRBSI) is a complication of central venous catheter (CVC) use. Central venous catheter-related infection (CVC-RI) is considered a common cause of increased morbidity, mortality, and medical care costs in intensive care units (ICUs). Aim of the study: to assess nurses’ performance regarding infection control measures for patient with central line in critical care unit. Research design: A descriptive exploratory design was utilized. Subjects: Purposive sample of critical care nurses working in the ICU, at El-Fayoum University Hospital, 40 nurses from both genders, with different ages, educational levels and years of experience were selected for this study. Tool: Data were obtained through three main tools; Nurses' Self-administered questionnaire, Nurses' observational checklist and Nurses' attitudes questionnaire tool. Results: this study revealed that about more than two thirds of studied nurses had unsatisfactory knowledge and practice regarding infection control measures related to central line. Also, about (77.5%) of them had negative attitude regarding infection control measures for patient with central line. There were statistically significance correlation between nurses' level of knowledge, practice and their attitude. there were statistical significant relations between nurses' performance and their socio-demographic characteristics as regards age, education and experience. Conclusion: Nurses had unsatisfactory level of knowledge, practice and negative attitude regarding infection control measures related to central line. Knowledge, practice & attitude were found to differ significantly in relation to socio-demographic data. Recommendation: Designing nurses’ infection control program to improve their knowledge and practice regarding infection control measures related to central line. The study should be replicated on large sample & in different hospitals setting in order to generalize the results.

Key words: Infection control, central line, nurses’ performance...

Introduction

Central venous catheters are widely used in critically ill patients and particularly in the critical care units. CVCs are usually inserted into deep veins such as the subclavian, jugular, or femoral veins, and then advanced into the vena cava. Central venous catheters (CVCs) are vascular infusion tools utilized for checking hemodynamic changing, administration of medication, total parenteral nutrition
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Although CVCs provide reliable vascular access, there are associated risks with their use. The complications of central venous cannulation are many and can occur at any time during infusion therapy. Complications from CVCs insertion include arterial puncture, pneumothorax, hematoma, cardiac arrhythmias and venous perforation. Other complications include phlebitis, thrombus formation, air embolism, nerve injury and finally catheter-related bloodstream infection. (Wikipedia, 2016).

There are four recognized routes for contamination of central catheters: 1) migration of skin organisms such as (gram-positive bacteria) at the insertion site into the cutaneous catheter tract and along the surface of the catheter with colonization of the catheter tip; this is the most common route of infection for short-term catheters; 2) direct contamination of the catheter or catheter hub by Guidelines for the Prevention of Intravascular Catheter-Related Infections contact with hands or contaminated fluids or devices; 3) less commonly, catheters might become hematogenously seeded from another focus of infection; and 4) rarely, infusate contamination might lead to CRBSI (Mermel, Allon & Bouza, 2010).

The introduction of catheter care protocol may involve strict adherence to guidelines for use of aseptic conditions during CVCs placement, exit-site care, dressing management, catheter flushing, and applying the appropriate clamping technique with disconnection. The researchers concluded that the introduction of and adherence to a strict aseptic catheter care protocol may lead to sustained reduction in the incidence of CRBSI which positively influence patient outcome (Infusion Nurses Society, 2011).

According to the Agency for Health care Research and Quality and the Center for Disease Control (CDC), they recommend the following quality measures for prevention of central line infection including: hand hygiene, maximal sterile barrier precautions, Chlorhexidine skin antisepsis, appropriate insertion site selection and Prompt removal of unnecessary catheters (Centers for Disease Control and Prevention, 2014).

Aim of the Study:

This study aims to assess nurses' performance regarding infection control measures for patient with central line through the followings:

1) Assess the level of nurses’ knowledge regarding infection control measures for patient with central line in critical care department.

2) Assess the level of nurses’ practice regarding infection control measures for patient with central line in critical care department.

3) Assess the level of nurses’ attitude regarding infection control measures for patient with central line in critical care department.

Research Questions:

-What is the level of nurses’ knowledge toward infection control measures for patient with central line in the critical care department?

-What is the level of nurses’ practice toward infection control measures for patient with central line in the critical care department?

-What is the level of nurses’ attitude toward infection control measures for patient
with central line in the critical care department?

**Subjects and Methods:**

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

1. Technical design.
2. Operational design.
3. Administrative design.
4. Statistical design.

1) The technical design:

- Includes research design, setting, subject and tools for data collection.

**A) Research design:**

Descriptive exploratory research design was used in this study.

**B) Setting:**

This study was carried out at the critical care unit (ICU & Emergency) at El-Fayoum University hospital.

**C) Subjects:**

Purposive sample of critical care nurses (40 nurse) in the ICU & Emergency unit who are providing direct care for critically ill patients in the previous study settings.

- **Inclusion and Exclusion criteria:**

  The inclusion criteria of the current study include nurses who not receiving training or infection control courses, while the exclusion criteria include nurses who had an experience in ICU less than 1 year.

**D) Tools for data Collection:**

Three tools were developed by the investigator after reviewing the relevant literatures.

*1- Nurses' Self-administered questionnaire:*

It was developed by the investigator in Arabic language based on review of relevant recent literature. This questionnaire administered to the nurses to assess nurses' level of knowledge regarding infection control measures for patient with central line, and it was divided into two parts:

**Part (1): Nurses' Demographic Data:**

It was developed by the investigator to collect data about nurses’ age, gender, the level of education and years of experience in critical care units (ICU, Emergency).

**Part (2): Nurses' Knowledge:**

This tool adapted from Grove, Burns, & Gray, (2013), and it was modified by the investigator after reviewing the relevant literature, to assess nurses' knowledge regarding infection control measures for patient with central line. It is consisted of 36 questions (multiple choice & true and false). It is divided into 6 main headings related to infection control measures for patient with central line as following; sites of central venous catheter insertion and its complication, sources of catheter related infection, guidelines for changing dressing, lines replacement and flushing, types of antiseptic solution and nursing role for central venous catheter.

**Scoring of nurses’ knowledge:** Each correct answer got one score and the incorrect one got zero mark; the total scores were 36 marks. The level of knowledge score converted into a percentage, and overall adequacy of knowledge graded according to the following criteria: If the score was ≥75% it was considered a satisfactory level of knowledge. If the score was <75% it was considered un-satisfactory level of knowledge.
2-Nurses’ observational checklist:

This tool adapted from The Joint Commission, (2013) and it was modified by the investigator after reviewing the relevant literature, to assess nurses’ practice regarding infection control measures for patient with central line. The nurses’ practice was consisted of three stages of central line care as the following:

First stage (before CVC use): it included infection control measures before insertion of central line catheter (12 items), during the insertion (8 items) and post insertion procedure (3 items).

Second stage (During CVC use): it included daily maintenance care for CVC such as dressing change (14 items) and accessing lines (5 items).

Third stage (After CVC use): it included infection control measures before removal procedure (8 items), also included control measures during removal procedure (9 items) and control measures post removal of CVC (3 items).

Scoring of nurses’ practice: The score of each item was allotted “done correctly” which got one grade, and” done incorrectly” or “not done” which got zero. If the score was ≥90% the level of nurses’ practice considered competent. If the score was<90% it was considered incompetent.

3) Nurses’ attitudes Likert Scale:

This tool adapted from Bianco, Coscarelli, Nobile, Pavia, (2013). It was modified by the investigator after reviewing the relevant literature, to assess nurses’ attitudes toward infection control measures for patient with central line. It included statements that reflect nurses’ feelings and reactions toward infection control measures for patient with central line. Nurses’ responses were measured by (agree, uncertain and disagrees).

Scoring of nurses’ attitude: It was scored on two part Likert Scale. The score of each item allotted “positive” which got one grade, “negative” which got zero. If the score was ≥60% it was considered positive attitude. If the score was<60% it was considered negative attitude.

2. Operational Design:

The operational design includes preparatory phase, content validity, tool reliability, pilot study and field work.

• The preparatory Phase:

It included reviewing of related literature and theoretical knowledge of various aspects of the study using books, articles, internet periodicals and magazines.

• Tool validity and reliability:

Content validity was conducted to determine whether the tool covers the aim of the study or not. It was ascertained by a jury of 9 expertises who review the tool for clarity, relevance, accuracy and comprehensiveness.

B) Tool reliability:

Reliability of the developed tool was tested to determine the extent to which the questionnaire items are related to each other. The Cronbach’s alpha model which is a model of internal consistency was used in the analysis (value throughout the assessment are 0.81, 0.70 and 0.88. statistical equation of Cronbach’s alpha reliability coefficient normally ranges between 0 and 1, higher value (more than 0.7) denote acceptable reliability.
- Pilot Study:

A pilot study was carried out on 10% (4 nurses) of the sample to test applicability and clarity of the tools. Modifications were done according to the results of pilot study. Nurses in the pilot study were excluded from the study group.

- Field Work:

- A written informed consent was obtained from each participant prior to data collection after explaining the aim of the study.

- Purpose of the study was simply explained to the nurses who agreed to participate in the study prior to any data collection.

- Data collection started and completed within six months from November (2016) until the end of April (2017).

- Data collection was done 2 day/week by the investigator in the morning and afternoon shifts.

- The self-administered questionnaire sheet was distributed to the nurses after providing the care to the patient in their workplace; each questionnaire took 30 to 45 minutes to fill it.

- The observational checklist tools were completed by the investigator throughout three stages:

- **First stage**: observational checklist during central venous catheter insertion were filled.

- **Second stage**: observational checklist during care for CVC such as dressing change or accessory lines replacement were filled.

- **Third stage**: observational checklist during CVC removal were filled.

3. Administrative Design:

Approval to carry out this study was obtained from the director of El-Fayoum University’s Hospital.

4. Statistical Design:

The collected data were organized, categorized, tabulated, and statistically analyzed using the statistical package for social science (SPSS) version (20) to assess nurses’ level of knowledge, practice and attitude regarding infection control measures for patient with central line at intensive care unit. Data were presented in tables and graphs. The statistical analysis included; percentage (%), the arithmetic mean (\( \bar{X} \)), standard deviation (SD), chi-square (\( X^2 \)), and Pearson correlation (r).
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Results

Part (I):

Table (1): Frequency distribution of studied nurses as regards their demographic characteristics (N=40).

<table>
<thead>
<tr>
<th>Items</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-&lt;30</td>
<td>27</td>
<td>67.5</td>
</tr>
<tr>
<td>30-&lt;40</td>
<td>9</td>
<td>22.5</td>
</tr>
<tr>
<td>+40</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td><strong>Mean±SD</strong></td>
<td></td>
<td>32.47±3.68</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>19</td>
<td>47.5</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>52.5</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diploma</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Technical</td>
<td>11</td>
<td>27.5</td>
</tr>
<tr>
<td>Bachelor's degree</td>
<td>24</td>
<td>60.0</td>
</tr>
<tr>
<td>Master's degree</td>
<td>4</td>
<td>10.0</td>
</tr>
<tr>
<td><strong>Experience(years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-&lt;5</td>
<td>35</td>
<td>87.5</td>
</tr>
<tr>
<td>5≥10</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>Mean±SD</strong></td>
<td></td>
<td>8.62±2.09</td>
</tr>
</tbody>
</table>

This table illustrated that, 52.5% of the studied nurses were females, 67.5% of them their age ranged between 20≤30 years with a mean age of 32.47±3.68, as regarding the educational level, it was found that 60% of them have a Bachelor degree in nursing science and 10% of them have master degree of nursing science. Furthermore, it was found that 87.5% of them have an experience between 1≤5 yrs.

Part (II):

Table (2): Frequency distribution of the studied nurses according to their knowledge as regards infection control measures for patient with central line (N=40).

<table>
<thead>
<tr>
<th>Items of knowledge</th>
<th>Unsatisfactory</th>
<th>Satisfactory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central venous catheter insertion</td>
<td>21 52.5</td>
<td>19 47.5</td>
</tr>
<tr>
<td>Infection associated with central venous catheters</td>
<td>33 82.5</td>
<td>7 17.5</td>
</tr>
<tr>
<td>Skin preparation</td>
<td>25 62.5</td>
<td>15 37.5</td>
</tr>
<tr>
<td>Catheter dressing</td>
<td>38 95</td>
<td>2 5</td>
</tr>
<tr>
<td>Lines replacement and flushing</td>
<td>35 87.5</td>
<td>5 12.5</td>
</tr>
<tr>
<td>Nursing care for central venous catheter</td>
<td>12 30</td>
<td>28 70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29 72.5</td>
<td>11 27.5</td>
</tr>
</tbody>
</table>
This table shows that, 95% of the studied nurses have unsatisfactory knowledge about catheter dressing, while 70% of them have adequate knowledge about nursing care for central venous catheter.

Table (3): Frequency distribution of the studied nurses according to their total practice toward infection control measures for patient with central line (N=40).

<table>
<thead>
<tr>
<th>Total practice level score</th>
<th>Incompetent</th>
<th>Competent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Insertion procedure</td>
<td>35</td>
<td>87.5</td>
</tr>
<tr>
<td>Daily maintenance procedures</td>
<td>34</td>
<td>85.0</td>
</tr>
<tr>
<td>Removal Procedure</td>
<td>36</td>
<td>90.0</td>
</tr>
<tr>
<td>Overall total practice level score</td>
<td>28</td>
<td>70.0</td>
</tr>
</tbody>
</table>

This table shows that 70% of the studied nurses have incompetent level of practice regarding infection control measures for patient with central line, while 30% of them have competent level of practice regarding infection control measures for patient with central line.

Table (4): Frequency distribution of the studied nurses’ attitude regarding infection control measures for patient with central line among nurses under study (n=40).

<table>
<thead>
<tr>
<th>Attitude Level</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>31</td>
<td>77.5</td>
</tr>
<tr>
<td>Positive</td>
<td>9</td>
<td>22.5</td>
</tr>
</tbody>
</table>

This table shows that, 77.5% of the studied nurses have Negative attitude regarding infection control measures for patient with central line, while 22.5% of them have positive attitude toward the same items.

Discussion

Part I:

Regarding the study nurse’s demographic characteristics, the results of the present study revealed that about more than two-thirds of the studied nurses had age less than thirty years. This explains that most of those nurses were newly graduated, young and tolerate the nature of the work. This finding is consistent with Deshmukh & Shinde, (2014) in a study titled “Impact of structured education on knowledge and practice regarding venous access device care among nurses” reported that more than two-thirds of the study subjects were in the age group of 21-30 years.

Regarding gender, the present study results showed that more than half of the study nurses were females.

This finding is inconsistent with Mohammed et al., (2015) in a study titled "Effect of Implementing Intravenous Infusion Therapy Protocol on Nurses’ Knowledge and Performance at Specialized Medical Hospital" found that all of the studied nurses were females.

Concerning educational level, the present study results indicated that, about two-thirds of the studied nurses had nursing
Bachelor degree. This might elaborate the current condition of nursing qualification as Bachelor nurses are working as administrator rather than practitioner. This finding is consistent with what was reported by Alkubati et al., (2015) in a study titled "Health care workers' knowledge and practices regarding the prevention of central venous catheter-related infection" reported that more than half of nurses held a Baccalaureate degree.

Regarding years of experience, the current study showed that the majority of the studied nurses had experience less than five years. This finding goes in the same line with what was reported by Shrestha, (2013) in a study titled "Impact of educational interventions on nurses' knowledge regarding care of the patient with central venous line" found that most of nurses were newly graduated and consequently had few years of experience.

Part II: Critical care nurses’ knowledge toward infection control measures for patient with central line:

Regarding total nurses' knowledge, the results of the current study indicated that about more than two-thirds of the studied nurses had unsatisfactory knowledge regarding infection control measures for patient with central line. This result is congruent with Akinwole, (2015) in a study titled "Central line-associated bloodstream infection (CLABSI) reduction in a long term acute care hospital” found that the majority of nurses had unsatisfactory knowledge regarding infection control measures for central line. This inadequacy of nurses’ knowledge might be due to lack of continuous educational programs.

Critical care nurses’ practice toward infection control measures for patient with central line:

As regards the total nurses’ practice, the present study showed that more than two-thirds of the studied nurses had incompetent level of practice regarding infection control measures for patient with central line. This is in line with Abdel Azim, (2013) in a study titled "Central Venous Catheter Bundle Care” found that total nurses’ practice regarding prevention of infection associated with central line was unsatisfactory. This could be attributed to inadequate in-service training program, lack of nursing staff number, lack of close supervision as well as lack of knowledge about risks & complications of catheter-related infection and nursing work overload.

Concerning infection control measures toward the insertion procedure, the current study revealed that more than two-thirds of studied nurses hadn’t perform hand washing before CVC insertion. Result in the current study is in line with Sean et al., (2014) in a study titled "Eliminating catheter-related bloodstream infections in the intensive care unit" reported that only one-fifth of nurses were washing their hands before catheter insertion. This result may be due to lack of knowledge about the importance of hand washing, lack of supervision and inadequate resources.

Also in the current study, it can be noticed that more than three-quarters of nurses didn’t wear sterile gloves, mask and sterile gown before insertion of CVC. Result in the current study is consistent with Rosenthal et al., (2010) in a study titled "International Nosocomial Infection Control Consortium (INICC) report " found that less than a half of nurses used maximal sterile barrier precautions during the insertion of CVCs. This finding may be due to nurses’ conception that only physicians are responsible for wearing maximal sterile barrier precautions and inserting CVCs.
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The present study clarified that about two-thirds of studied nurses didn’t drape patients in sterile fashion preceding catheter insertion. This result is consistent with Ider et al., (2012) in a study titled "Using a checklist to identify barriers to compliance with evidence-based guidelines for central line management” found that more than a half of nurses didn’t cover the whole body of the patient with a sterile drape during CVC insertion procedure. This result may be due to insufficient training, inadequate resources and lack of infection control guidelines application.

From the present study it was found that, all nurses performed skin sterilization before CVC insertion using povidone iodine not chlorhexidine. Result in the current study is consistent with El Nemr et al., (2015) in a study titled” An interventional study to decrease central venous catheter-related blood stream infection in intensive care units at Zagazig University Hospital” found that all nurses disinfect skin before catheter insertion with iodine. This result may be due to the fact that chlorhexidine not available at the study setting, so they may not be familiar with it.

Critical care nurses’ attitude toward infection control measures for patient with central line:

The current study showed that more than three quarter of studied nurses had negative total attitude score and more than one fifth of studied nurses had positive attitude total score. This result is not in agreement with Bianco et al., (2013) in a study titled "The reduction of risk in central line-associated bloodstream infections: Knowledge, attitudes, and evidence-based practices in health care workers”

Conclusion:

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

About more than two thirds of studied nurses had unsatisfactory knowledge and practice regarding infection control measures related to central venous catheters. Moreover, about more than three quarter had negative attitude. In addition, there was statistical significant relation between total knowledge, total practice, total attitude and their socio-demographic characteristics as regards: age, education and experience.

Recommendations:

Based on the results of the present study, the following recommendations are suggested:

- Nurses should add to their routine obligations the regular updates about the prevention and management of infection associated central venous catheter.
- Policies and guidelines related to infection control measures must be informed to the nurses in order to prevent complications.
- Importance of implementing an educational and training programs for nurses in critical care units about infection control for prevention of infection related to central line.
- Adequate supplies and facilities should be available in such critical unit.
- Orientation programs for all newly employed nurses in ICU, must be done.
- Periodical and continuous, evaluation of nurses’ performance should be done to improve quality of their performance.

For further researches:

- Replication of the present study on a large sample representing different hospital
settings in Egypt to figure out the main aspects of this problem and also in order to generalize the results.

References:

Abd-elazem, H., (2013): Central Venous Catheter Bundle Care, Master Thesis (unpublished), Faculty of Nursing, Ain Shams University. PP 50-120.


