Impact of a Structured Teaching Program for Prevention of Ventilator Associated Pneumonia on Knowledge and Practices of Intensive Care Nurses at Central Quwesna Hospital, Egypt

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Abstract

Background: Ventilator-associated pneumonia (VAP) is considered a serious health hazard among ventilated patients. The frequency of VAP in the ICUs is high and its negative impact on patient outcomes and resource utilization is huge.

Aim of the Study: This study was carried out in order to examine the effect of a structured teaching program for prevention of ventilator-associated pneumonia on knowledge and practices of intensive care nurses at Central Quwesna Hospital, in Egypt.

Design: A quasi-experimental research design was utilized.

Setting: This study was conducted at the Central Quwesna Hospital in the intensive care unit.

Subjects: Purposive sample consisted of all nurses, (30 nurses) who provide care for patients admitted to the intensive care unit in the previously mentioned hospital.

Tools: Pre/posttest interview questionnaire sheet: It was designed to test nurse's knowledge about prevention of ventilator associated pneumonia, an observational checklist (pre/posttest), and teaching program for prevention of VAP.

Results: The study findings revealed that, 30% of respondents were in the age group of 21-25 years followed by 36.7% in the age group of 26-30 years and 33.3% in the age group of above 30 years with a mean age of 32.3 years. Also, in relation to gender, 76.7% of nurses were found to be females. Concerning total clinical experience 43.3% of the nurses had 1-5 years of clinical experience, 30% had 6-10 years of clinical experience and 26.7% had above 10 years of clinical experience. With respect to professional educational qualification, it was observed that 23.3% of the respondents were having bachelor degree in nursing and 76.7% of respondents had technical institute degree in Nursing. As well, it was cleared that none of the nurses in the study sample had satisfactory total knowledge score at the pre-program implementation, however, the score of total practice increased immediately after the program, and continued to be higher at the first follow-up phase. Moreover, a strong positive correlation was found between age, experience, knowledge, and practices of study subjects. As well, knowledge and practices were positively correlated. In addition, sex, education, and years of experience as sociodemographic variables were having an impact on knowledge, and practices regarding prevention of VAP among study subjects.

Conclusion: The current study shows that nurses were having unsatisfactory total knowledge and practice at the pre-program implementation, however, the score of total knowledge increased immediately after the program, and continued to be higher at the first follow-up phase. Moreover, a strong positive correlation was found between age, experience, knowledge, and practices of study subjects. As well, knowledge and practices were positively correlated. In addition, sex, education, and years of experience as sociodemographic variables were having an impact on knowledge, and practices regarding prevention of VAP among study subjects.

Recommendations: The current study recommended developing manuals, information booklets and self-instruction module in areas of prevention of VAP.

Key Words: Structured teaching program – Ventilator associated pneumonia – Knowledge – Practices – Intensive care nurses.

Introduction

VENTILATOR-Associated pneumonia (VAP) is defined as nosocomial pneumonia in mechanically ventilated patients, which develops more than 48h after initiation of mechanical ventilation (MV). VAP is divided into early onset VAP that occurs within 5 days of mechanical ventilation and late onset VAP that develops five or more days after initiation of mechanical ventilation [1]. It is characterized by a new or a progressive pulmonary infiltrate, fever, leukocytosis and purulent trachea-
bronchial secretions [2]. It carries a high mortality rate ranging 6%-68% and may be as high as 74% in high risk populations, indicating a serious health hazard among ventilated patients [3,4].

VAP arises when there is bacterial invasion of the pulmonary parenchyma in a patient receiving mechanical ventilation. Inoculation of the formerly sterile lower respiratory tract typically arises from aspiration of secretions, colonization of the alimentary tract, or use of contaminated equipment or medications. Risk factors for VAP include prolonged intubation, enteral feeding, witnessed aspiration, paralytic agents, underlying illness and extremes of age [5]. Intubation and mechanical ventilation both increase the risk of bacterial pulmonary infection because the invasive endotracheal tube allows direct entry of bacteria into the lower respiratory tract since the tube is located in the trachea. Bacterial colonization in the respiratory tract is further facilitated by the absence of the cough reflex and excessive mucus secretion in the mechanically ventilated patients. Prolonged ventilation increases the risk of VAP, increases hospital stay which dramatically increases mortality rates [6].

VAP is one of the most common infections acquired by adults and children in ICU, Society for Healthcare Epidemiology of America/Infectious Diseases Society of America report 10%-20% of patients undergoing ventilation in America developed VAP [7]. The frequency of VAP in the ICUs is high and VAP's negative impact on patient outcomes and resource utilization is huge [6]. The hospital-wide prevalence of VAP was 1.7% and 2.9% in studies conducted in Algeria and in Senegal, respectively [8,9].

Even though VAP is a serious problem in developed countries the lowest incidences in developing countries may be contributed by inadequate knowledge and awareness about the problem which can cause the disease not to be well addressed. Strategies have been created in an attempt to find a solution to the problem of VAP in the world; these strategies incorporate a number of evidence-based strategies proved in the literature to decrease VAP and increase positive patient’s outcomes. There are 21 strategies for prevention of VAP and these are divided into 10 physical strategies, three positional strategies and eight pharmacological strategies [10,11].

The physical strategies for prevention of VAP include: Route of endotracheal intubation, systematic search for maxillary sinusitis, frequency of ventilator circuit changes, airway humidification: type of humidifier, frequency of humidifier changes, endotracheal suctioning system: Closed vs. open endotracheal suctioning system: Frequency of change, subglottic secretion drainage, timing of tracheostomy and use of bacterial filters [10,11].

The positional strategies include: Kinetic bed therapy, semi recumbent positioning and prone positioning. The pharmacological strategies are: Prophylactic aerosolized antibiotics, prophylactic topical antibiotics, prophyactic intravenous antibiotics, prophylactic topical/topical plus intravenous antibiotics, oral decontamination with chlorhexidine, oral decontamination with povidone-iodine, oral decontamination with iseganan and prevention of maxillary sinusitis [2].

The guidelines, which incorporate all the above strategies, were created by a multidisciplinary panel composed of intensivists, infectious disease specialists, intensive care nurses, an infection control nurse, an intensive care unit (ICU) pharmacist and respiratory therapist as well as a representative from the Canadian Patient Safety Institute. ICU nurses are in the best position to put the above strategies into practice as they are at the patient’s bedside 24 hours a day and therefore they play an important role in the prevention of VAP [2].

The Institute for Healthcare Improvement (IHI) developed the concept of “bundles” to help healthcare providers more reliably deliver the best possible care for patients undergoing particular treatments with inherent risks. Ventilator bundles are considered as a “package” of EBGs, designed to help reduce VAP and promote adherence to evidence-based protocols and guidelines in order to improve clinical outcomes. These include combinations of sedation vacation and use of weaning protocols, elevation of the head of the bed (HOB) between 30° and 45°, daily oral care with chlorhexidine, adequate hand hygiene, and ulcer and deep vein thrombosis prophylaxis [12,13].

Nevertheless, nurses need to have an awareness of the problem as well as knowledge on its prevention strategies to adhere to such practices. Skilled and knowledgeable nurses are extremely important and needed to make appropriate decisions in patient care and minimize risks to patients. ICU nurses knowledge should bring confidence to make appropriate decisions and prevent poor outcomes in the recovery of mechanically ventilated patients [14].
Significance of the study:

Research priorities reflect worldwide healthcare concerns and objectives related to patients’ safety and infection control [15,16].

In Egypt, it has been observed that, the VAP is a tremendous problem and its incidence is in continuous increasing representing a significant cause of increasing morbidity and mortality. This observation was supported through studies concerned with incidence of VAP in three Universities; Alexandria (four studies), Ain Shams (three studies) and Mansoura (one study). Incidence of VAP ranged from 16% to 75%, with the lowest ratio in Alexandria and the highest one in Ain Shams University [1].

In Egypt, studies of Shalaby [17] in Neonatal and Pediatric ICU at Tanta University, and Seweilam [18] in Mansoura University, concluded that nasal endotracheal tubes, re-intubation, prior antibiotic use, and contaminated ICU devices prior antibiotic use, duration of mechanical ventilation, reintubation, use of antacids and H2 blockers, corticosteroids use, coma long duration of pediatric ICU admission (more than 17 days) and long duration of mechanical ventilation (more than 12 days) are the most common risk factors of VAP.

Since VAP is a critical issue in Egyptian ICUs, and there were little studies handling this important infection, with seldom little studies handling teaching programs for prevention of VAP for intensive care unit nurses, this study was carried out in order to examine the effect of a structured teaching program for prevention of ventilator associated pneumonia on knowledge and practices of intensive care nurses at Central Quwesna Hospital in Egypt.

This study provides baseline information on ICU nurses’ knowledge level and practice on prevention of VAP. It will provide strong body of scientific knowledge and ensure the highest standards of nursing care practice, through adherence to the evidence based guidelines for prevention of ventilator-associated pneumonia, ultimately improving patients’ outcomes. Improved outcomes will shorten patient’s ICU length of stay, hospitalization as well as benefit the patient financially with decreased hospital costs. Hospitals also gain benefits as they are continually faced with the challenge of providing cost effective services to patients and communities.

It is hoped that this effort might help nurses in assessment, planning, implementation and evaluation of such patients. In addition, it might generate an attention and motivation for further researches into this area.

Aim of the study:

This study was carried out in order to examine the effect of a structured teaching program for prevention of ventilator associated pneumonia on knowledge and practices of intensive care nurses at Central Quwesna Hospital, in Egypt.

Research hypotheses:

- The post mean knowledge scores regarding prevention of ventilator associated pneumonia of nurses will be higher than their pre intervention mean knowledge scores.
- The post mean practice scores regarding prevention of ventilator associated pneumonia of nurses will be higher than their pre intervention mean practice scores.
- There will be an association between age, level of education, years of experience, knowledge scores, and practice scores of intensive care nurses regarding prevention of VAP.


**Subjects and Methods**

**Study variables:**

The independent variable in this study was the structured teaching program for prevention of ventilator associated pneumonia provided for the nurses working at the intensive care unit, while the dependent variables were their knowledge and practices.

**Design:** A quasi-experimental research design was utilized. One group pre test post test design is used to assess the effectiveness of structured teaching programme on VAP among staff nurses at the intensive care unit.

**Setting:** This study was conducted at the Intensive Care Unit at the Central Quwesna Hospital which introduces health services for Quwesna city and 48 surrounding villages.

**Subjects:** A purposive sample consisted of all nurses, (30 nurses) who provide care for patients admitted to the intensive care unit in the previously mentioned hospital.

**Inclusion criteria:**

The study includes, nurses working in the intensive care unit regardless their educational level.

**Exclusion criteria:**

- Nurses who had already attended formal teaching programme on VAP.
- Nurses who are not willing to participate in the study.

**Tools:**

Three structured tools were used to collect data pertinent to the study. They were developed and tested by the researcher, then reviewed by a jury of six medical and nursing experts. Their opinions were elicited regarding to the tools format layout, consistency, scoring system. These tools are:

1- **Pre/posttest interview questionnaire sheet:**

   It was designed by the researcher guided by (Centers for Disease Control and Prevention) [20] to test nurse’s knowledge about prevention of ventilator-associated pneumonia; it consists of two main parts:

   **Part one:** Covers socio-demographic data such as age, sex, level of education, and years of experience.

   **Part two:** It includes 40 multiple-choice questions on knowledge about prevention of VAP.

   *It covers the following sections:*

   - **Section-A:** Consisted of six questions (15%) regarding general information about VAP (definition, clinical manifestations, and risk factors).
   - **Section-B:** Consists of three questions (7.5%) on anatomy of the lungs.
   - **Section-C:** Consists of five questions (12.5%) regarding mechanical ventilation (definition, and ventilator modes).
   - **Section-D:** Consists of six questions (15%) regarding diagnosis and treatment of VAP.
   - **Section-E:** Consists of twenty questions (50%) regarding prevention of VAP (physical strategies, which include: Route of endotracheal intubation, systematic search for maxillary sinusitis, frequency of ventilator circuit changes, type of humidifier, frequency of humidifier changes, endotracheal suctioning system, frequency of change, subglottic secretion drainage, timing of tracheostomy and use of bacterial filters, positional strategies: Kinetic bed therapy, semi recumbent positioning and prone positioning and pharmacological strategies).

   **Scoring system:**

   Each correct answer was given one score, and “zero” for wrong answers with overall scores of forty. Less than 85% is considered as having an unsatisfactory knowledge level.

2- **An observational checklist (pre/posttest):**

   An observational checklist developed by Said [21] and modified by the researcher guided by (Centers for Disease Control and Prevention [20], Tablan, Anderson and Besser, Bridges, Hajjeh [22]) to observe nurses’ practice as performed during the care of patients on mechanical ventilator, it includes 42 items and covers the following sections:

   - **Section-A:** Consisted of (10 items) regarding infection control measures and hand washing.
   - **Section-B:** Consisted of (14 items) regarding endotracheal suctioning.
   - **Section-C:** Consisted of (18 items) regarding oral care.

   Each statement has responses of complete action, incomplete action, and incorrect action.

   **Scoring system:**

   Two scores were given for each correct complete action, and one score for the correct incomplete action, and zero for the incorrect action, with total scores of 42. Less than (85%) is considered an unsatisfactory practice level.
3- Teaching program for prevention of ventilator associated pneumonia:

General objectives: Upon completion of this teaching program, the nurse will gain knowledge and practice regarding VAP prevention.

Specific objectives: Upon completion of this teaching program, the nurse will be able to:
- Define VAP.
- Describe clinical manifestations of VAP.
- List several contributing risk factors leading to VAP.
- Describe lung anatomy.
- Define mechanical ventilation.
- List ventilator modes.
- Describe major VAP prevention strategies.
- Demonstrate hand washing properly.
- Demonstrate endotracheal suctioning properly.
- Demonstrate oral care properly.

Contents:

Theoretical contents: 3 topics introduced: 1- General information about VAP, anatomy of the lungs, clinical manifestations of VAP, diagnosis and treatment of VAP. 2- Mechanical ventilation, definition, ventilator modes and nursing care. 3- Prevention strategies of VAP (physical strategies, positional strategies, and pharmacologic strategies).

Timing: Introduced through two weeks (3 sessions/week for each group) 20 minutes for each session so the theoretical contents given in 120 minutes through 6 sessions.

The practical contents: 3 topics introduced: 1- Hand washing. 2- Endotracheal suctioning. 3- Oral care.

Timing: Introduced through two weeks (3 sessions/week for each group) half hour per each session, so, the practical contents given in 180 minutes through 6 sessions.

Date: The program begins at 1-7-2013 and ends at 31-7-2013.

Teaching methods: Lecture, small group discussion, demonstration, and re-demonstration.

Audiovisual aids: Power point slides, illustrated charts, booklet.

Evaluation: Formative (quizzes and asking questions) and summative (post test).

Reliability: Of all items of the interview questionnaire sheet and the observation checklist was done using test-retest that revealed that, all items were significant and has a correlation coefficient above the significance level ($r=0.75$ & .70 for each respectively). A pilot study was carried out before starting data collection on (10%) of the sample (3 nurses), to evaluate the tentative developed tools for clarity and applicability, as well to estimate the time needed for data collection. Needed modifications were carried out and the three nurses were excluded from the actual study.

Protection of the human rights: Written consent were taken from each subject to participate in the study. Each subject was informed about the purpose, and the nature of the study. The subjects were informed that their participation is totally voluntarily and confidentiality and anonymity of the subjects were assured.

Method:

An official letters were issued to the director of the hospital and to the head of the intensive care unit. Nurses were approached individually to delineate the purpose and the nature of the study and to obtain their written consents for participation in addition to the time planning for conduction of the training sessions. They were cooperative and keen about learning some new issues. Data collected throughout a period from June to September 2013.

Procedures:

- After preparation of the study tools and the educational materials including a simple illustrated Arabic booklet.
- The investigator utilized structured interview and observation in order to fill out the study tools.
- Questionnaire sheet was filled in individually and completed by the studied nurses while they were on duty.
- An observation checklist was filled in and completed by the researcher while she observed nurses while they were working.
- Pre-test was done to determine baseline data for nurses’ knowledge and practices.
- Beginning of training included classification of the studied nurses into groups, then orientation of the nurses about program objectives, contents, schedule, and expected outcomes.
- For theoretical contents: Based on nurses number (30) and their roster, 10 nurses for each shift, nurses were divided into (9) small groups; (6
small groups, 3 nurses each, and (3 small groups, 4 nurses each), then teaching sessions were sched-
uled in accordance to their work involvement, short interactive teaching sessions of lectures and
and group discussions and pictures supported by audiovisual aids were conducted for each group.
Each session lasted (20) minutes. The number of
sessions for each group were six sessions which
were covered on two weeks. Continuous feedback
and communication were assured to clear any
misconception or misunderstanding, as well, to
reinforce learning.

- For the practical part, demonstration and re-
demonstrations utilized on top of using an audio-
visual aids. The practical sessions were six for
each group. Each session was lasted for 30 min-
utes, which were covered on 2 weeks.

- The researcher was available for 3 days/week at
the intensive care unit at the three shifts for 90
minutes for each shift (she was available for 3
groups/shift, 30 minutes/each group).

- Nurses were evaluated 3 times after the pre-
assessment. The first assessment was immediately
after implementation of the structured teaching
program. The second was on the 2 nd week and
the last assessment was after 3 weeks from the
immediate posttest.

Statistical analysis:

Data was presented using SPSS program in
numbers, percentages, mean and standard deviation
(SD), t-test, Pearson correlation analysis were used
for assessment of the inter-relationships among
quantitative variables, and one-way anova. Statis-
tical significance was considered at p-value <0.05.

Results

Table (1) shows that 30% of respondents were
in the age group of 21 ≤25 years followed by 36.7%
in the age group of 26-30 years and 33.3% in the
age group of above 30 years with a mean age of
(32.32) years. Also, in relation to gender, (76.7%) of
nurses were found to be females as compared to
(23.3%) males in the study group. Concerning
total clinical experience (43.3%) of the nurses had
1 and up to 6 years of clinical experience, (30%)
had more than 6 years and up to 10 years of clinical
experience and (26.7%) had above 10 years of
clinical experience. With respect to professional
educational qualification, it was observed that
(23.3%) of the respondents were having bachelor
degree in nursing and 76.7% of respondents were
with technical institute degree in nursing.

Table (2) describes the differences, mean and
standard deviation of subtotal knowledge scores
among nurses throughout the study phases, it shows
that (90%) of the nurses in the study sample had
unsatisfactory knowledge at the pre-program im-
plementation, however, the scores of subtotal
knowledge increased immediately after the pro-
gram, and continued to be higher at the first and
subsequent follow-up phases (statistically signifi-
cant, p<0.001).

Table (3) shows that none of the nurses in the
study sample had satisfactory total knowledge at
the pre-program implementation, however, the
score of total knowledge increased immediately
after the program, and continued to be higher at
the first and subsequent follow-up phases (statisti-
cally significant, p<0.001).

Table (4) as evident from this table, that (86%),
(90%), and (93%) of the nurses in the study sample
had unsatisfactory practice regarding hand washing,
endotracheal suctioning, and oral hygiene respec-
tively at the pre-program implementation, however,
the score of subtotal practice increased immediately
after the program, and continued to be higher at
the first and subsequent follow-up phases (statisti-
cally significant, p<0.001).

Table (5) shows that none of the nurses in the
studied sample had adequate practice at the pre-
program phase, however, the score of total practice
increased immediately after the program, and con-
continued to be higher at the first and subsequent follow-up phases (statistically significant, \( p<0.001 \)).

Table (6) this table shows that a strong positive correlation was found between age, experience, knowledge, and practices of nurses at intensive care unit. As well, knowledge and practices were positively correlated.

Table (7) illustrates that sex as a variable has an effect on knowledge, and practices regarding prevention of ventilator associated pneumonia at intensive care unit among nurses, with a high tendency of female subjects to have higher mean scores.

Table (8) it is clear that, post intervention, education as one of the categorical variables was found to have an effect on knowledge, and practice regarding prevention of ventilator associated pneumonia at intensive care unit among nurses, with a high tendency of who had bachelor degree to have higher mean scores.

Table (9) illustrates that, the more experienced nurses had more knowledge and practice scores.

### Table (2): Differences, mean and standard deviation of subtotal knowledge scores among nurses throughout the study phases (Total \( n=30 \)).

<table>
<thead>
<tr>
<th>Knowledge items</th>
<th>Pre</th>
<th>1st assess</th>
<th>2nd assess</th>
<th>3rd assess</th>
<th>( F )-p values</th>
</tr>
</thead>
<tbody>
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<td>General Information on VAP (6):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Satisfactory (85%+)</td>
<td>3</td>
<td>10.00</td>
<td>26</td>
<td>86.66</td>
<td>25</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>27</td>
<td>90.00</td>
<td>4</td>
<td>13.34</td>
<td>5</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>2.50 ± 1.1</td>
<td>5.65 ± 2.6</td>
<td>5.33 ± 2.4</td>
<td>5.60 ± 2.5</td>
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<td>Anatomy of lungs (3):</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfactory (85%+)</td>
<td>5</td>
<td>16.33</td>
<td>27</td>
<td>90.00</td>
<td>26</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>25</td>
<td>83.33</td>
<td>3</td>
<td>10.00</td>
<td>4</td>
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<tr>
<td>Mean±SD</td>
<td>1.08 ± 1.0</td>
<td>2.80 ± 1.9</td>
<td>2.77 ± 1.8</td>
<td>2.79 ± 1.8</td>
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<td>Mechanical Ventilation (5):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfactory (85%+)</td>
<td>6</td>
<td>20.00</td>
<td>26</td>
<td>86.66</td>
<td>25</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>24</td>
<td>80.00</td>
<td>4</td>
<td>13.34</td>
<td>5</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>1.94 ± 1.2</td>
<td>4.66 ± 2.5</td>
<td>4.59 ± 2.4</td>
<td>4.63 ± 2.5</td>
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<tr>
<td>Diagnosis and Treatment (6):</td>
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<td></td>
<td></td>
<td></td>
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<td>Satisfactory (85%+)</td>
<td>2</td>
<td>6.66</td>
<td>26</td>
<td>86.66</td>
<td>25</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>28</td>
<td>93.33</td>
<td>4</td>
<td>13.34</td>
<td>5</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>1.90 ± 1.6</td>
<td>5.56 ± 2.6</td>
<td>5.44 ± 2.5</td>
<td>5.57 ± 2.6</td>
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<td>Prevention of VAP (20):</td>
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<tr>
<td>Satisfactory (85%+)</td>
<td>3</td>
<td>10</td>
<td>27</td>
<td>90.00</td>
<td>26</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>27</td>
<td>90.00</td>
<td>3</td>
<td>10.00</td>
<td>4</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>12.42 ± 5.9</td>
<td>18.75 ± 8.3</td>
<td>17.99 ± 7.6</td>
<td>18.80 ± 8.4</td>
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</table>

### Table (3): Differences, mean and standard deviation of total knowledge scores among nurses throughout the study phases (Total \( n=30 \)).

<table>
<thead>
<tr>
<th>Total Knowledge score (40)</th>
<th>Pre</th>
<th>1st assess</th>
<th>2nd assess</th>
<th>3rd assess</th>
<th>( F )-p values</th>
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<tr>
<td>Satisfactory (85%+)</td>
<td>0</td>
<td>0</td>
<td>26</td>
<td>86.66</td>
<td>25</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>30</td>
<td>100.00</td>
<td>4</td>
<td>13.34</td>
<td>5</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>19.84 ± 9.52</td>
<td>37.42 ± 11.46</td>
<td>36.12 ± 10.40</td>
<td>37.39 ± 11.91</td>
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</table>
Table (4): Differences, mean and standard deviation of subtotal practice scores among nurses throughout the study phases (Total n=30).

<table>
<thead>
<tr>
<th>Practice items</th>
<th>Pre</th>
<th>1st assess</th>
<th>2nd assess</th>
<th>3rd assess</th>
<th>F-p values</th>
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</thead>
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<tr>
<td></td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td></td>
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<tr>
<td>Hand washing (10):</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Satisfactory (85%+)</td>
<td>4 13.34</td>
<td>27 90.00</td>
<td>25 83.33</td>
<td>26 86.66</td>
<td>45.30***</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>26 86.66</td>
<td>3 10.00</td>
<td>5 16.33</td>
<td>4 13.34</td>
<td></td>
</tr>
<tr>
<td>Mean±SD</td>
<td>3.51 ±1.3</td>
<td>9.65 ±3.9</td>
<td>9.33 ±3.4</td>
<td>9.68 ±3.5</td>
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</tr>
<tr>
<td>Endotracheal suctioning (14):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfactory (85%+)</td>
<td>3 10.00</td>
<td>27 90.00</td>
<td>26 86.66</td>
<td>27 90.00</td>
<td>60.38***</td>
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<tr>
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<td>3 10.00</td>
<td>4 13.34</td>
<td>3 10.00</td>
<td></td>
</tr>
<tr>
<td>Mean±SD</td>
<td>2.08 ±1.5</td>
<td>12.80 ±8.9</td>
<td>12.77 ±8.8</td>
<td>12.97 ±8.9</td>
<td></td>
</tr>
<tr>
<td>Oral care (18):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfactory (85%+)</td>
<td>2 6.66</td>
<td>27 90.00</td>
<td>26 86.66</td>
<td>26 86.66</td>
<td>96.30***</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>28 93.33</td>
<td>3 10.00</td>
<td>4 13.34</td>
<td>4 13.34</td>
<td></td>
</tr>
<tr>
<td>Mean±SD</td>
<td>2.90 ±1.7</td>
<td>16.76 ±9.5</td>
<td>16.59 ±9.4</td>
<td>16.63 ±9.5</td>
<td></td>
</tr>
</tbody>
</table>

Table (5): Differences, mean and standard deviation of total practice scores among nurses throughout the study phases (Total n=30)

<table>
<thead>
<tr>
<th>Total practice score (42)</th>
<th>Pre</th>
<th>1st assess</th>
<th>2nd assess</th>
<th>3rd assess</th>
<th>F-p values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td>No. %</td>
<td></td>
</tr>
<tr>
<td>Satisfactory (85%+)</td>
<td>0 0</td>
<td>27 90.00</td>
<td>25 83.33</td>
<td>27 90.00</td>
<td>150.00***</td>
</tr>
<tr>
<td>Unsatisfactory &lt; (85%)</td>
<td>30 100.00</td>
<td>3 10.00</td>
<td>5 16.33</td>
<td>3 10.00</td>
<td></td>
</tr>
<tr>
<td>Mean±SD</td>
<td>8.49 ±9.02</td>
<td>39.21 ±10.06</td>
<td>38.69 ±10.00</td>
<td>39.28 ±10.91</td>
<td></td>
</tr>
</tbody>
</table>

Table (6): Correlation matrix of age, knowledge, practices and experience of nurses in the Intensive Care Unit (Total n=30).

<table>
<thead>
<tr>
<th>Item</th>
<th>Age</th>
<th>Experience</th>
<th>Knowledge</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience</td>
<td>.81 **</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>.70 **</td>
<td>.82 **</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Practice</td>
<td>.83 **</td>
<td>.87 **</td>
<td>.66*</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table (7): Comparison of means and standard deviation of total knowledge and practice scores in relation to sex (Total n=30).

<table>
<thead>
<tr>
<th>Item</th>
<th>Male Mean ±SD</th>
<th>Female Mean ±SD</th>
<th>t-p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge score (40)</td>
<td>34.93 ±10.11</td>
<td>37.40 ±11.21</td>
<td>4.68*</td>
</tr>
<tr>
<td>Practice score (42)</td>
<td>35.99 ±10.11</td>
<td>39.11 ±10.00</td>
<td>6.28*</td>
</tr>
</tbody>
</table>

Table (8): Comparison of means and standard deviation of total knowledge and practice scores in relation to educational level (Total n=30).

<table>
<thead>
<tr>
<th>Item</th>
<th>Tech. Institute Mean ±SD</th>
<th>Bachelor Mean ±SD</th>
<th>t-p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge score</td>
<td>37.10 ±11.01</td>
<td>39.00 ±9.80</td>
<td>6.02*</td>
</tr>
<tr>
<td>Practice score</td>
<td>38.07 ±9.88</td>
<td>39.33 ±10.20</td>
<td>5.41*</td>
</tr>
</tbody>
</table>

Table (9): Comparison of means and standard deviation of total knowledge and practice scores in relation to years of experience (Total n=30).

<table>
<thead>
<tr>
<th>Item</th>
<th>5-10 years Mean ±SD</th>
<th>10-15 years Mean ±SD</th>
<th>&gt;15 years Mean ±SD</th>
<th>F-p values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge score</td>
<td>37.00 ±10.01</td>
<td>37.10 ±11.01</td>
<td>39.88 ±11.32</td>
<td>5.89*</td>
</tr>
<tr>
<td>Practice score</td>
<td>38.33 ±9.20</td>
<td>38.30 ±10.22</td>
<td>39.99 ±10.10</td>
<td>4.56*</td>
</tr>
</tbody>
</table>
Discussion

Findings of the current study revealed that about one third of respondents were either in the age group of 21-25 years or 26-30 years or in the age group of above 30 years, with a mean age of (32.32±6.70) years. In addition, in relation to gender, majority of nurses were found to be females in the study group. Concerning total clinical experience, less than half of study group had 1-5 years of clinical experience, less than one third had 6-10 years of clinical experience and less than one third had above 10 years of clinical experience. With respect to professional educational qualification, it was observed that less than one third of the respondents were having bachelor degree in nursing and majority of respondents were with technical institute degree in nursing.

Generally in nursing education, there has been a significant gap between the theory taught in the classroom and the realities of clinical practice [23].

The present study confirms that the overall knowledge and practice in pre-test was unsatisfactory. This shows that there is lack of knowledge and practice regarding VAP. Although few of the staff nurses had some knowledge, the majority had lack knowledge regarding prevention of VAP, which shows that there is a need of educational programmes in order to improve their knowledge level, which is in line with previous literature [24,25]. A similar study was conducted by Stijn, Sonia, Dominique, Paul, and Brigitte [26] to determine ICU nurses knowledge and practice of evidence based practices for the prevention of VAP, revealed that only 20% of nurses knew that ventilator circuits should be changed once weekly and only 60% nurses knew that subglottic drainage of secretions would reduce VAP. At the end of the study they concluded that, nurses lack knowledge regarding recommendations for VAP prevention and continuing education would help to improve EBP.

The present study confirmed that there was a considerable improvement of knowledge and practice after the structured teaching programme and is statistically established as significant. Study findings shows that none of the nurses in the study sample had satisfactory total knowledge at the pre-program implementation, however, the score of total knowledge increased immediately after the program, and continued to be higher at the first and subsequent follow-up phases (statistically significant, p<0.00 1). As well, the present study shows that none of the nurses in the studied sample had adequate practice at the pre-program phase, however, the score of total practice increased immediately after the program, and continued to be higher at the first and subsequent follow-up phases (statistically significant, p<0.001). It indicates that, educational programme leads to gain in knowledge and practice, which might have an impact on prevention of VAP, these results were in line with Rall, Gessel & Chairman [27].

A similar study was conducted by Johnena [28], to determine whether educational initiative could decrease rates of VAP in a regional health care system. A self study module was introduced for ICU nurses and respiratory care practitioners. Results of the study revealed that VAP rates for all four hospitals dropped by 46% from 8.75 per 1000 to 4.74 per 1000 ventilator days after the educational intervention. They concluded that educational interventions can be associated with decreased rate of VAP [28].

In addition, Jansson [29], reported that, the intervention group’s skills for managing mechanically ventilated patients differed significantly from the control group in both the simulation environment and clinical practice after HPS education. As well, these improvements were still evident after 6 months of follow-up.

Among the demographic variables analyzed in this study age, gender, professional qualification, and clinical experience, it was found that a strong positive correlation was found between age, experience, knowledge, and practices of nurses at intensive care unite. As well, knowledge and practices were positively correlated. This study is supported by a similar study conducted by Granda, Muñoz, Heras, Sánchez, Rello & Bouza [30] to assess the knowledge of and compliance with guidelines for prevention of VAP among physicians, nurses, and students in ICUs; Health Care Workers (HCWs) were invited to complete a 20-point questionnaire. The median scores for daily clinical practice for physicians and nurses were 5 (4-6) and 4 (3-5), respectively, HCWs with more than 1 year of ICU experience scored significantly better in personal knowledge than those with less experience, Granda, et al., [29]. As well, (Blot, Labeau, Vandijck & Claes [31], Labeau et al., [24] Fulbrook, Albarran, Baktoft & Sidebottom [32], Jansson, Ala-Kokko, Syrjälä, Ylipalosaari & Kyngäs [25]) concluded that the level of ICU experience (>5yrs), age (≥240), and gender (male) have been independently associated with better knowledge scores.
The first two hypotheses H1 & H2, which stated that “The mean knowledge scores regarding prevention of ventilator associated pneumonia of nurses post intervention will be higher than their pre intervention mean knowledge scores and the post mean practice scores regarding prevention of ventilator associated pneumonia of nurses will be higher than their pre intervention mean practice scores” in the study were accepted since there were significant change found between the pre-test and post-test knowledge and practice scores regarding prevention of Ventilator Associated Pneumonia among staff nurses at \( p < 0.001 \) level (5%). Hence, there were significant improvements in knowledge scores of staff nurses after administration of the structured teaching programme. Regarding to H3 which stated that “There will be an association between age, level of education, years of experience, knowledge, and practice of intensive care nurses regarding prevention of VAP”, was accepted for significant association between age, level of education, years of experience, knowledge, and practice of intensive care nurses regarding prevention of VAP.

**Conclusion:**

The current study shows that none of the nurses in the study sample had satisfactory total knowledge at the pre-program implementation, indicating that the respondents lacked knowledge and practice. However, the score of total knowledge increased immediately after the program, and continued to be higher at the first and subsequent follow-up phases, indicating that the nurses gained knowledge after the teaching program which was implemented. On the other hand, it was observed that there was an association between age, years of experience, knowledge, and practice of intensive care nurses regarding prevention of VAP. As well, sex, level of education, and years of experience were found to have an impact on knowledge and practice scores.

**Recommendations:**

On the basis of the findings of the study, the following recommendations have been suggested:

- Nurses should take initiative to improve their knowledge and practices by using online education, virtual learning, booklets, posters, brochures, charts etc.
- Posters and simple illustrations about prevention of VAP should be available in every intensive care unit.

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