Patients’ weaning from mechanical ventilation: Complete versus incomplete ventilator bundle implementation

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ABSTRACT

Aims and objectives: To examine the effect of complete versus incomplete ventilator bundle implementation on weaning scores among mechanically ventilated patients.

Background: Implementation of the elements bundle alone or with other preventive measures is associated with reducing ventilator-associated pneumonia (VAP) rates. Few research studies were conducted nationally and internationally on the ventilator bundle practices and its effect on weaning from mechanical ventilation.

Design: Quasi-experimental design was utilized in this study.

Methods: A convenient sample of 60 mechanically ventilated patients including all modes except continuous positive airway pressure (CPAP) mode were enrolled and then divided randomly into study and control group. The study group included patients for whom all elements of the ventilator bundle were implemented completely by the trained nurses while the control group included patients who received traditional care where ventilator bundle elements were not done completely. Sociodemographic, medical data, ventilator bundle compliance checklist, and Burns’ wean Assessment Program (BWAP) checklist were collected and evaluated.

Results: There was a significant statistical difference between study group and control group regarding the duration of mechanical ventilation and weaning scores. As most of the study group demonstrated shorter duration of the connection to mechanical ventilation when compared to the control group. As well, the study group obtained higher weaning scores than the control group.

Conclusion: The study group who received complete ventilator bundle practices has got higher weaning scores and shorter duration of the connection to mechanical ventilator than the control group.

Relevance to clinical practice: implementation of complete ventilator bundle elements together among mechanically ventilated patients by the trained nurses could be effective in accelerating the safe weaning of patients and decreasing the duration of the connection to mechanical ventilation.

1. Introduction

Mechanical ventilation is a lifesaving procedure which is indicated in critically ill patients for many reasons. These reasons include managing the patient’s respiration during treatment of severe traumatic brain injury, oxygenating the patients’ lung when the ventilator efforts are deficient (Suzanne & Bare, 2010). Although most of the patients need mechanical ventilation for a short period of time, some patients may need ventilator support for a long time. This prolongation of ventilator support may potentiate the risk of lethal complications (Figueroa-Casas et al., 2015). These complications include baro-traumas, aspiration, ventilator-associated pneumonia, stress ulcer, gastrointestinal bleeding, deep venous thrombosis (Jones & Fix, 2014) and weaning failure (Grap, 2009). Weaning process aims to disconnect the patients from ventilator support to breathing without assistance from ventilation (Epstein & Walkey, 2013).

Readiness for weaning from mechanical ventilation may include many criteria that include treating the cause that made the patient requires mechanical ventilation, adequate respiratory efforts, cough reflex, and absence of profuse bronchial secretions; stabilization of hemodynamic status, stabilization of metabolic functions; adequate oxygenation and no sedation to ensure patient’s cooperation effectively (Pu et al., 2015). Mechanical ventilation is a lifesaving procedure which is indicated in critically ill patients for many reasons. These reasons include managing the patient’s respiration during treatment of severe traumatic brain injury, oxygenating the patients’ lung when the ventilator efforts are deficient (Suzanne & Bare, 2010). Although most of the patients need mechanical ventilation for a short period of time, some patients may need ventilator support for a long time. This prolongation of ventilator support may potentiate the risk of lethal complications.
These complications include barotraumas, aspiration, ventilator-associated pneumonia, stress ulcer, gastrointestinal bleeding, deep venous thrombosis (Jones & Fix, 2014) and weaning failure (Grap, 2009). Weaning process aims to disconnect the patients from ventilator support to breathing without assistance from ventilation (Epstein & Walkey, 2013).

The Institute for Healthcare Improvement (IHI) developed and implemented the evidence-based ventilator bundle practices for healthcare-related infections that delay weaning (Evans, 2005). The Ventilator Bundle encompasses maintaining of 30–45° head of the bed elevation, mouthwash with chlorhexidine, daily sedation interruption and daily assessment of readiness to extubate, peptic ulcer disease prophylaxis, and deep venous thrombosis prophylaxis. Implementation of ventilator bundle aimed to improve mechanically ventilated patients’ condition that facilitates the early weaning and decrease the length of the ICU stay (O’Keefe-McCarthy, Santiago, & Lau, 2008).

Previous studies have illustrated that implementation of the ventilator bundle individual element alone or with other preventive measures are accompanied by a reduction of VAP rates. But few researchers studied the impact of complete ventilator bundle practices compliance on patients’ weaning from mechanical ventilator and revealed that implementation of these practices may reduce the complications and improve the patient condition (Keyt, Faverio, & Restrepo, 2014). The IHI had defined operationally the ventilator bundle compliance as the percentage of mechanically Ventilated patients in the ICU for whom all Ventilator Bundle elements are performed and documented on daily basis in the medical record with a target compliance of 95% (Resar et al., 2005). Therefore, the researchers aimed to examine and compare the effect of complete versus incomplete VAP bundle implementation on weaning and duration of patients’ connection to mechanical ventilation among critically ill patients in adult ICU.

2. Problem statement

Patients who experience difficulty in weaning need a longer hospital stay and have higher morbidity and mortality. Consequently, trials to decrease the duration of weaning are desirable to reduce the length of mechanical ventilation and related complications. Standardized weaning practices are safe and effective in reducing the time spent on mechanical ventilation. However, the evidence supporting their use in practice is inconsistent. The discordant results of studies may reflect the fact that weaning protocols differ in composition and are implemented in different environments by various healthcare providers (Blackwood et al., 2009).

3. Purpose of the study

To compare the effect of complete versus incomplete ventilator bundle implementation on weaning and duration of mechanical ventilation among patients in medical ICU.

4. Objectives of the study

4.1. The objectives of the study were to

1. to assess weaning score in the study and control group
2. to assess length of mechanical ventilation in the study and control group
3. to compare the weaning scores between the study and control group
4. to compare the length of mechanical ventilation in the study and control group

5. Research methodology

5.1. Study design

The quasi-experimental two-group design was utilized among critically ill patients in medical ICU affiliated to private health sector at El Maadi District in Egypt. The rationale for that selection is to determine causal relationships by applying a treatment or condition to one group and comparing the outcome with a control group. Moreover, the validity of quasi-experimental research can be improved by specific methods that help in identifying a comparison group, controlling bias, and using suitable statistical analyses (Campbell & Stanley, 2015).

5.2. Research hypothesis

The study groups of patients who receive complete ventilator bundle practices together by the trained nursing personnel will get higher weaning scores and shorter duration of the connection to mechanical ventilation than the control group who will receive traditional (incomplete) ventilator bundle practices.

5.3. Study setting

The study was conducted in a critical care unit in Maadi District private hospital. The nurse-patient ratio was 1:2. That hospital provides other various services including various outpatient clinics, maternity, and obstetrics, medical, surgical and anesthetics.

5.4. Sample and sampling technique

A convenient sample of 60 adult medical and surgical mechanically ventilated patients from September 2013 to September 2015 was included in the study. The exclusion criteria included those patients who were diagnosed with pulmonary embolism or had gastrointestinal bleeding prior to admission. After selection of all eligible patients who met the inclusion criteria, they were divided randomly into the study and control groups. The random assignments were generated by computer and then concealed in sealed envelopes. Patients’ assignment to the intervention group or the control group was known only to the study investigators. One investigator accompanied the study group of patients with their trained nurses and the other accompanied the control group with their nurses all over the extended period of research.

5.4.1. Baseline data sheet

It included patient’s age, gender, and smoking status, current medical diagnosis, and co-morbidities.

5.4.2. Ventilator bundle compliance checklist

It was adopted based on Institute for Healthcare Improvement guidelines (Resar et al., 2005) to assess the compliance with ventilator bundle practices. This tool was examined by a panel of three medical and three nursing experts to assess its validity and reliability. The principal components of the ventilator bundle checklist were as follows; elevation of the head of the bed, mouth care with chlorhexidine, daily sedation interruption, and assessment of readiness to extubate, peptic ulcer prevention and deep venous thrombosis prophylaxis. The entire bundle was considered only compliant if all 5 items were completed. All the critical care nurses were educated in a seminar conference about the complete implementation of ventilator bundle 2 times on a daily basis and maintaining compliance throughout the mechanical ventilation period. If the compliance with the bundle implementation was less than 95%, it would be considered noncompliant and these cases were excluded from the study group.

The compliance rate was calculated by dividing actual daily compliance with the number of times the patient has been receiving ventilation. This figure was multiplied by 100 to calculate percentage of
compliance (Beattie, Shepherd, Maher, & Grant, 2012).

**Calculation for VAP bundle compliance:**

The number of times the patient receives the bundle \( \times \frac{100}{\text{The number of opportunities the patient could receive the bundle (number of ventilated days)}} \)

The final percentage of ventilator bundle compliance for the patient was calculated based on the total percentage of nurses’ compliance with all ventilator bundle practices together throughout the ventilator days. VAP bundle Compliance was assessed twice daily by the ICU team for the study group and control group.

5.4.3. **Burns’ Wean Assessment Program (BWAP) checklist**

This tool was developed by Burns 1990 and was used to assess weaning progress of the mechanically ventilated patients. It is a 26-factor scoring instrument. It was used to reduce variation in managing patients on mechanical ventilators. The instrument consisted of three components; general assessment, respiratory assessment and ABGs results. The response of each component of these subscales was “yes”, “no” or “not assessed”. A cutoff point for the instrument is 50. If the score was more than 50, this means that the patients were more likely to be weaned successfully. And if the score was less than 50, this indicates that the patients were more likely to have unsuccessful weaning. The BWAP is an indicator of the successful weaning process and considered valid; the inter-rater reliability of the instrument is 95% (Epstein, El-Mokadem, & Peerless, 2002).

5.5. **Data collection procedure**

Managerial arrangements were carried through obtaining formal consent from administrative authorities at a selected private hospital. The enrolled patients and their relatives were informed individually about the purpose and nature of the study. Later, the researcher obtained written consent from those who agreed to participate in the study. Later, data were collected by obtaining patients' baseline and medical data. Then, the critical care nurses were educated about the study. Later, data were collected by obtaining patients' baseline and medical data. Then, the critical care nurses were educated about the bundle practices together, it was assessed by the ICU team utilizing compliance checklist twice a day till the patient was weaned. Concerning the compliance of the healthcare professionals with the ventilator bundle practices together, it was assessed by the ICU team utilizing compliance checklist twice a day till the patient was weaned. Our bundle components were as follows: (1) daily sedation interruption and daily assessment for extubation progress of the mechanically ventilated patients. It is a 26-factor scoring instrument. It was used to reduce variation in managing patients on mechanical ventilators. The instrument consisted of three components; general assessment, respiratory assessment and ABGs results. The response of each component of these subscales was “yes”, “no” or “not assessed”. A cutoff point for the instrument is 50. If the score was more than 50, this means that the patients were more likely to be weaned successfully. And if the score was less than 50, this indicates that the patients were more likely to have unsuccessful weaning. The BWAP is an indicator of the successful weaning process and considered valid; the inter-rater reliability of the instrument is 95% (Epstein, El-Mokadem, & Peerless, 2002).

5.6. **Ethical consideration**

Ethical approval for this study was obtained from the Institution of Review Board of Faculty of nursing Cairo University and the certificate ethical number was 00019803. As well, formal acceptance was obtained from the hospital administrators of the selected private hospital at Maadi district in Egypt. The nature of the study and benefits of the VAP were explained to the conscious patients to gain their cooperation and obtain their written consent with their families and physicians. In cases of patients' altered level of consciousness, their families could be allowed to give consent on their behalf. Patients' anonymity and confidentiality were assured through coding of data. Moreover, they were assured that these data wouldn't be reused without their permission.

**Table 1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study group (n = 30)</th>
<th>Control group (n = 30)</th>
<th>t/x2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean)</td>
<td>48.4 ± 11.2</td>
<td>45.4 ± 11.2</td>
<td>t = 1.036</td>
<td>0.462</td>
</tr>
<tr>
<td>Sex Male (n %)</td>
<td>21 (70%)</td>
<td>21 (70%)</td>
<td>x2 = 0.37</td>
<td>0.441</td>
</tr>
<tr>
<td>Female (n %)</td>
<td>9 (30%)</td>
<td>9 (30%)</td>
<td>x2 = 0.37</td>
<td>0.441</td>
</tr>
<tr>
<td>Smokers (n %)</td>
<td>16 (53.3)</td>
<td>13 (43.3)</td>
<td>0.475 x2</td>
<td>0.374</td>
</tr>
</tbody>
</table>

5.7. **Data analysis**

The Statistical Package for Social Sciences (SPSS) version 20 was used to analyze the data. Descriptive statistics, such as number and percentage, were used for sample patients' demographic characteristics and statement scores. The inferential statistic independent t-test at a significant level of 0.05 was used to measure the difference between study and control groups regarding weaning scores and duration of mechanical ventilation.

6. **Results**

Table 1 showed the demographic characteristics of both groups. The mean age of ventilated patients was ranged between 45 and 48 years. Males represented 70% of ventilated patients in both groups. In addition, nearly all of the studied population was smokers in both groups. So no significant statistical differences were found between them as regards demographic characteristics.

Table 2 shows medical characteristics of both groups. No significance difference between both groups except presence of edema and pressure ulcer (x2 = 4.4; p = 0.04 & x2 = 6.6; p = 0.01 respectively).

Table 3 shows a comparison of both groups by their compliance to individual elements of VAP bundle. It revealed a significant difference between patients of the two groups regarding head of bed elevation (x2 = 4.85, p = 0.046), sedation interruption (x2 = 6.4, p = 0.03) and assessment of readiness to extubate (x2 = 5.2, p = 0.02).

Table 4 comparison of both groups by their length of mechanical ventilation. A significant statistical difference was found between them. As most of the study group (60%) has got a shorter length of mechanical ventilation (3–6 days) when compared to the control group of patients whose most lengths of stay ranged between 7 and 12 days whose most length of stay ranged between 7 and 12 days.

Table 5 comparison of both groups by their weaning (BWAP score).

**Table 2**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study group</th>
<th>Control group</th>
<th>x2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. %</td>
<td>No. %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac</td>
<td>11</td>
<td>36.6</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>Respiratory</td>
<td>9</td>
<td>30</td>
<td>8</td>
<td>26.6</td>
</tr>
<tr>
<td>Neurology</td>
<td>1</td>
<td>3.3</td>
<td>5</td>
<td>16.6</td>
</tr>
<tr>
<td>GIT</td>
<td>1</td>
<td>3.3</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>RTA</td>
<td>1</td>
<td>3.3</td>
<td>5</td>
<td>16.6</td>
</tr>
<tr>
<td>Renal</td>
<td>2</td>
<td>6.6</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Co-morbid symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest infection</td>
<td>25</td>
<td>83.3</td>
<td>29</td>
<td>96.7</td>
</tr>
<tr>
<td>Nausea</td>
<td>1</td>
<td>3.3</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Vomiting</td>
<td>1</td>
<td>3.3</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>5</td>
<td>16.6</td>
<td>5</td>
<td>16.6</td>
</tr>
<tr>
<td>Constipation</td>
<td>3</td>
<td>10</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Edema</td>
<td>13</td>
<td>43.3</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Pressure Ulcer</td>
<td>4</td>
<td>13.3</td>
<td>13</td>
<td>43.3</td>
</tr>
</tbody>
</table>

* Significant.
patients by their medical characteristics. Our study findings found no significant statistical differences between patients by the distribution of their diseases as regards respiratory, cardiovascular, neurological, gastrointestinal diseases. This finding was consistent with Montasser et al. (2015) who found no significant statistical difference in cases with incomplete or complete VAP bundle application as regards medical, postoperative and traumatic patients. Concerning co-morbid signs and symptoms, there were only significant statistical differences between study and control group regarding lower limb edema and pressure ulcer.

Regarding a comparison of both groups by their duration of the connection to a mechanical ventilator in days, the current study finding revealed a significant difference between both groups. As most of the study group has got shorter duration (3–6 days) when compared to the control group (7–12 days). The possible scientific explanation for that finding may have relevance to the effect of utilization of full VAP bundle when compared to incomplete bundle. That finding was consistent partially with Mohamed (2014) who found VAP bundle compliance rate steadily increased from 63% to 84% during the period of VAP bundle implementation and resulted in a reduction of the duration of mechanical ventilation. As well, Hawe, Ellis and Cairns (2009) study reported that the decrease in the mean length of stay and mean duration of ventilation was statistically significant in their patients who received VAP bundle care. However, another study evaluating these components of the bundle reported a 95% adherence with the bundle and an associated reduction in VAP, but researchers mentioned that the reduction may have been related to a concurrent improvement program that focused on the care of the ventilated patient. Similarly, our finding was agreed with another study done by Montasser et al. (2015) who found a significant statistical difference between cases with incomplete or complete VAP bundle implementation as regard to duration of mechanical ventilation. Furthermore, Chen, Chang, and Chen (2015) reported that multidisciplinary bundle care decreased the cases of ventilator days.

In the present study, we compared the study and control group by their compliance rates of individual elements of VAP bundle practices. It revealed that there was a statistical difference between both groups as regards head of bed elevation at 30°. In this perspective, the current finding was congruent with a recent study conducted by nurses in a Brazilian ICU who found the head of bed elevation of their patients were between 30 and 45° and implemented it with full compliance among different work shifts. (Silva, Laus, Canini, & Hayashida, 2011). On the other hand, Gonçalves, Brasil, Ribeiro, and Tipple (2012) reported that’s keeping of elevating head-of-bed to 45° is difficult to achieve, since patients tend to change their positions. During the daily care, the studied subjects of patients on MV were frequently positioned between 10° and 30°, even though evidence recommends that patients with MV should not be positioned lower than 30°.

Regarding the comparison of both groups by their compliance rates with the individual VAP bundle pertinent to applying daily sedation interruption and assessing readiness to wean, our study finding found significant statistical differences between them. Based on this study, implementation of daily interruption of sedation element for patients who were ready for weaning was safe and fundamental in the study group. The current finding was agreed by Venkatram, Nayak, and Kanna (2010) who evaluated the daily sedation interruptions in mechanically ventilated and concluded that a regular assessment of weaning linked to daily sedation interruptions in wean able patients as a part of a ventilator bundle strategy is safe in medical intensive care units and this approach does not cause random extubations and weaning failure.

Eventually, the present study compared between study and control group of patients by their weaning scores. The significant statistical difference was detected between both groups (where \( t = 4.20; \ p = 0.001 \)), as the study group who utilized the full components of VAP bundle obtained higher weaning scores than the noncompliant of

Table 3
Comparison of both groups by their compliance to individual elements of VAP bundle.

<table>
<thead>
<tr>
<th>Component</th>
<th>Study group N %</th>
<th>Control group N %</th>
<th>x²</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head of bed elevation</td>
<td>29 (96.6%)</td>
<td>13 (43.3%)</td>
<td>4.85</td>
<td>0.0461</td>
</tr>
<tr>
<td>Oral care with chlorhexidine</td>
<td>29 (96.6%)</td>
<td>29 (96.6%)</td>
<td>0.00</td>
<td>0.9</td>
</tr>
<tr>
<td>DVT Prophylaxis</td>
<td>30 (100%)</td>
<td>26 (86.6%)</td>
<td>0.02</td>
<td>0.7</td>
</tr>
<tr>
<td>Peptic Ulcer prophylaxis</td>
<td>28 (93.3%)</td>
<td>29 (96.6%)</td>
<td>0.07</td>
<td>0.9</td>
</tr>
<tr>
<td>Daily sedation interruption</td>
<td>24 (80%)</td>
<td>5 (16.6%)</td>
<td>6.4</td>
<td>0.03</td>
</tr>
<tr>
<td>Assessment of readiness to wean</td>
<td>30 (100%)</td>
<td>6 (20%)</td>
<td>5.2</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* Significant.

Table 4
Comparison of both groups by their length of mechanical ventilation (n = 60).

<table>
<thead>
<tr>
<th>Length of MV</th>
<th>Study group</th>
<th>Control group</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>3–6 days</td>
<td>18</td>
<td>60</td>
<td>8</td>
<td>26.6</td>
</tr>
<tr>
<td>Mean SD</td>
<td>3.66 ± 0.70</td>
<td>4.7 ± 0.98</td>
<td>t = 4.72</td>
<td>0.0001</td>
</tr>
<tr>
<td>7–10 days</td>
<td>9</td>
<td>30</td>
<td>11</td>
<td>36.6</td>
</tr>
<tr>
<td>Mean SD</td>
<td>7.3 ± 0.70</td>
<td>8.1 ± 0.79</td>
<td>t = 4.15</td>
<td>0.0001</td>
</tr>
<tr>
<td>&gt; 10 days</td>
<td>3</td>
<td>10</td>
<td>11</td>
<td>36.6</td>
</tr>
<tr>
<td>Mean SD</td>
<td>11.9 ± 0.85</td>
<td>12.7 ± 1.92</td>
<td>t = 2.08</td>
<td>0.04</td>
</tr>
</tbody>
</table>

* Significant.

Table 5
Comparison of both groups by their weaning (BWAP score).

<table>
<thead>
<tr>
<th>Weaning score</th>
<th>t test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study group</td>
<td>19.5</td>
<td>4.20</td>
</tr>
<tr>
<td>Control group</td>
<td>14.94</td>
<td></td>
</tr>
</tbody>
</table>

* Significant.

It revealed a significant statistical difference between them were \( t = 4.20; \ p = 0.001 \). As the study group got higher weaning scores than the control group.

7. Discussion

The current study aimed to compare the effect of complete versus incomplete ventilator bundle implementation on weaning score and duration of mechanical ventilation among patients. Our study findings revealed that there were no significant differences between study and control group of patients by their demographic characteristics such age, sex, and smoking status. We postulate that this finding might be related to researcher efforts to select homogeneous and matching samples in both groups to minimize extraneous variation. This finding is partially congruent with a similar study done by Mohamed (2014) who studied the effectiveness of compliance with VAP bundle implementation on adult patients in medical-surgical ICUs. That study revealed that the mean age of patients who were studied after initiation of VAP bundle was insignificantly lower than those before VAP bundle implementation and no significant differences were found in sex distribution in the studied subjects.

On the same line, the current study finding was consistent partially with Montasser, Eita, Ayman, Abd Elbadee, and El Shanawany (2015) who studied the incidence of VAP with incomplete or complete adherence to preventive bundle practices. That study revealed no significant differences between cases in both groups in relation to age (49.57 ± 6.39 years vs. 49.42 ± 5.35 years respectively); gender (male represented 71.4% in cases with incomplete VAP bundle application and 65.0% in cases with full application of VAP bundle).

Concentrating the comparison of the study and control group of
patients who didn’t utilize the all individual components together during the mechanical ventilator period. Such a result was supported by Mohamed (2014) who concluded and highlighted that adherence with the VAP-bundle approach in ICU leads to more rapid ventilator weaning, fewer ICU days, shorter hospitalizations and it has also a great impact on patient outcomes.

8. Conclusion

The study group who received complete ventilator bundle practices has got higher weaning scores and shorter duration of the connection to a mechanical ventilator. Applying complete ventilator bundle practices is recommended to be helpful in managing and accelerating the safe weaning of patients from mechanical ventilation. Applying complete ventilator bundle practices is recommended to be helpful in managing and accelerating the safe weaning of patients from mechanical ventilation.

8.1. Relevance to clinical practice

Applying the full and complete ventilator bundle practices together among mechanically ventilated patients could be effective in accelerating the safe weaning of patients and decreasing the duration of connection to mechanical ventilation.

9. Limitations

Due to the limited national and international studies conducted regarding the correlation between weaning from mechanical ventilation and implementation of VAP bundle comparison and comparable discussion were difficult.

Funding sources

None.

Conflicts of interest

All authors declares no conflict of interest.

Acknowledgments

The authors would like to thank all nurses who were trained and participate in implementing the full bundle to their patients according to researcher instructions as well as the relevant authorities for granting permission for this study to be conducted.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ijans.2018.02.003.

References


