INTRODUCTION

Ventilator-associated pneumonia (VAP) is defined as a nosocomial pneumonia that develops in a patient intubated for 48 hours or more. VAP is the most frequent nosocomial infection in mechanically ventilated patients, with the most recent National Health Safety Network prevalence estimates ranging from 2.4 to 16.7. Hospital mortality rates in patients with VAP are significantly higher than those in patients who do not have VAP and VAP is associated with increased morbidity and higher medical care costs. It is estimated that one case of VAP can add an additional US$40,000 to the usual cost of hospitalization.

The Institute for Healthcare Improvement (IHI) has developed multiple bundles of care designed to prevent facility-acquired conditions. The IHI ventilator bundle has 5 major components, which are designed to be implemented together to decrease the incidence of VAP and complications associated with mechanical ventilation. The components of the ventilator bundle are as follows:

1. Elevation of head of bed to >30°
2. Daily prophylaxis for deep venous thrombosis
3. Daily prophylaxis for peptic ulcer disease
4. Daily assessment of readiness to wean
5. Daily sedation vacation

The Central Mississippi Medical Center recognized the importance of preventing VAP and instituted the IHI ventilator bundle in April 2008.

After a period of 2 months, the infection control team recognized the need to reassess the effectiveness of the ventilator bundle and opted to add a sixth component to the ventilator bundle. This additional component consisted of an oral care protocol that involved the use of a comprehensive oral care kit designed to cleanse, debride, suction, and moisturize the oral cavity.

VAP is the most frequent nosocomial infection in mechanically ventilated patients.

METHODS

Implementation of the oral care protocol

- Education of the licensed nursing staff was implemented in April 2008, which included re-emphasis of the importance of the IHI ventilator bundle and of various components of the comprehensive oral care protocol.
- In June 2008, the oral care protocol was initiated and compliance was tracked.
  - The oral care protocol consisted of a comprehensive oral care system containing q2 oral cleansing, moisturizing and swabbing, and q12 brushing with chlorhexidine gluconate (CHG).
  - Compliance tracking was done by monitoring the electronic scanning of CHG.

Biostatistical methods

Our primary hypothesis was that there would be a decrease in VAP rates in the intensive care unit (ICU), critical care unit (CCU), and cardiovascular recovery (CVR). The time periods for comparison were November 2007 through May 2008 for the pre-intervention period and June 2008 through May 2009 for the post-intervention period.

Sample Size: With data from more than 2000 ICU ventilator days, there was adequate statistical power to detect the observed absolute difference of greater than 5% in the cumulative VAP rate per 1000 ventilator days at an alpha level of 5% and a beta level of 20%.

Statistical Methods: Chi-square tests or Fisher’s exact tests were used as appropriate to assess the change in rates over time. Counts per 1000 ventilator days were presented as the cumulative VAP rate in the ICU, CCU, and CVR. In addition, the test statistics and P-values were reported. A P-value less than or equal to an alpha level of 0.05 was considered statistically significant.

Clinical Implications

VAP results in increased length of stay, increased ventilator time, increased costs related to VAP, and increased mortality.

RESULTS

Table 1: Results of the statistical analysis are presented in Table 1.

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Count/Procedures</th>
<th>Test Statistic</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU VAP Rate</td>
<td>Before 3/132 (22.7%)</td>
<td>2.2 0.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After 3/752 (4%)</td>
<td>4.1 0.05</td>
<td></td>
</tr>
<tr>
<td>CCU VAP Rate</td>
<td>Before 3/752 (4%)</td>
<td>4.1 0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After 3/1499 (2%)</td>
<td>4.1 0.05</td>
<td></td>
</tr>
<tr>
<td>CVR VAP Rate</td>
<td>Before 7/952 (7.4%)</td>
<td>2.2 0.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After 3/1499 (2%)</td>
<td>4.1 0.05</td>
<td></td>
</tr>
</tbody>
</table>


After 2/312 (6%) 2.2 0.16
Before 3/132 (22.7%)

Cost savings to organization

- Improved patient outcomes
- Decrease in length of stay
- Decrease in ventilator time
- Decrease in VAP occurrence

Data from more than 2000 ICU ventilator days, there was adequate statistical power to detect the observed absolute difference of greater than 5% in the cumulative VAP rate per 1000 ventilator days at an alpha level of 5% and a beta level of 20%.

In addition, the test statistics and P-values were reported. A P-value less than or equal to an alpha level of 0.05 was considered statistically significant.

HealthTrust University Conference, August 17-19, 2009

Reprints provided compliments of Sage Products, Inc.
800-323-2220 • www.sageproducts.com
**RESULTS**

The data analysis showed a statistically significant reduction in the ICU VAP rates over time from 7.4% (7/952) to 2% (3/1499)—a relative reduction of 73%. The CCU VAP rate also decreased, from 4% (3/752) to 0% (0/1180), but the difference was only marginally significant. The CVR VAP rate decreased from 22.7% (3/132) to 6% (2/312), which was not statistically significant. The results of the statistical analysis are presented in Table 1.

![The oral care intervention resulted in an estimated savings of $320,000](image)

**TABLE 1. Results of the biostatistical analysis from before (January) to after (July) the intervention**

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Count/procedures per 1000 ventilator days</th>
<th>Test statistic</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU VAP rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>7/952 (7.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After</td>
<td>3/1499 (2%)</td>
<td>4.1</td>
<td>0.05</td>
</tr>
<tr>
<td>CCU VAP rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>3/752 (4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After</td>
<td>0/1180 (0%)</td>
<td>4.7</td>
<td>0.06</td>
</tr>
<tr>
<td>CVR VAP rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>3/132 (22.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After</td>
<td>2/312 (6%)</td>
<td>2.2</td>
<td>0.16</td>
</tr>
</tbody>
</table>

It is important to note that the relative reduction is larger from some endpoints that did not reach statistical significance compared with the endpoints that did reach statistical significance. This was due to the fact that there was lower statistical power to detect a difference as statistically significant with a lower number of ventilation days for a certain endpoint.

**DISCUSSION**

Implementation of the IHI ventilator bundle resulted in a decrease in VAP rates in the ICU, CCU, and CVR. The addition of a comprehensive oral care protocol resulted in a substantial reduction in the incidence of VAP. Furthermore, the addition of the oral care protocol to the IHI ventilator bundle resulted in an estimated savings of $320,000 and an approximate 61.5% decrease in costs related to VAP.

**CLINICAL IMPLICATIONS**

- Decrease in VAP occurrence
- Decrease in ventilator time
- Decrease in length of stay
- Improved patient outcomes
- Cost savings to organization

**References**