2008 APIC Annual Conference: June 15-19, 2008

A Comprehensive Oral Care Program Reduces Rates of Ventilator-Associated Pneumonia in Intensive Care Unit Patients

Kathy Hutchins, RN, MSN, George Karras, MD, Joan Erwin, RN, BSN, and Kevin Sullivan, RN, BSN, CIC • Mercy Medical Center, Springfield, MA

ABSTRACT

A Comprehensive Oral Care Program Reduces Rates of Ventilator-Associated Pneumonia in Intensive Care Unit Patients

Background:

Ventilator-associated pneumonia (VAP) is a nosocomial pneumonia that develops in patients on mechanical ventilation for 48 hours or more. VAP rates occur an estimated 1 to 3% per day of ventilation. Pneumonia typically occurs when the upper respiratory tract is colonized with pathogens followed by aspiration of oral secretions. Patients in the intensive care unit (ICU) are at risk for colonization because of exposure to pathogens endemic to the ICU, multiantibiotic regimens, impaired mucosal defenses, accumulation of secretions, and the unique environment created by the endotracheal tube for dispersing pathogenic bacteria.

Objectives:

For 8 consecutive years (1997-2004), our annual average rates of VAP were in the range of 10.01 to 19.19. A performance improvement project was instituted combining an oral care protocol with a ventilator bundle.

Methods:

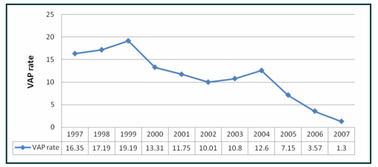
Q4h and as needed instructions were as follows:

- Replace suction liner, tubing, and covered oral suction device Q24h
- Brush teeth using suction toothbrush with cetylpyridinium chloride (CPC) BID on even hours and as needed (changed to chlorhexidine gluconate [CHG] in 2007); brush 1-2 minutes applying suction at completion and as needed; gently brush surface of tongue
- Use suction swabs with hydrogen peroxide solution Q4h on even hours to clean teeth and tongue
- Apply mouth moisturizer to mucous membranes, buccal cavity, and lips Q4h after completion of oral care
- Perform deep-oral pharyngeal suctioning with disposable oropharyngeal suction catheter Q12h
- Use suction catheters to assist in controlling secretions prior to major position changes, extubation, cuff deflation, repositioning of tube, and as needed

The initial oral care system used was a Q4 hour oral care system with CPC, subsequently changed to CHG in 2007. The primary endpoint was VAP diagnosis in patients mechanically ventilated for 48 hours.

Results:

Historical average (2004) was 12.6 cases per month. The protocol was instituted beginning May, 2005. VAP rate (cases/patient ventilator days X 1000) for May was 5.1, 5.2 for June, 4.0 for July, and 0.0 for August, September, and October. The mean for the first 6 months of the study was 3.17. Rates of VAP continued to drastically fall through 2005, 2006, and 2007. It is important to note in 2007, CHG was the primary active ingredient in the oral care regimen, leading to further VAP reduction.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
VAP rate	16.35	17.19	19.19	13.31	11.75	10.01	10.8	12.6	7.15	3.57	1.3

Conclusions:

The use of an Oral Care Protocol intervention and ventilator bundle led to a 90% reduction in the rate of VAP in mechanically ventilated patients (based on the comparison of the 2007 rate with the 2004 rate). Products used in the Oral Care Protocol may have reduced the VAP rates by reducing the oral bacterial load through removal of plaque, mucous, and bacteria from the mouth and teeth and through the antibacterial activity of the antiplaque solution, hydrogen peroxide mouth wash, and subsequent addition of CHG. Routine suctioning and application of a moisturizer may also have contributed to VAP reduction.

BACKGROUND

Ventilator-associated pneumonia (VAP) is a nosocomial pneumonia that develops in patients who have been on mechanical ventilation for 48 h or more.[1]

- In a study of intensive care unit (ICU) patients by Ibrahim et al,[2] 15% of mechanically ventilated patients developed VAP.

Pneumonia typically occurs when the upper respiratory tract is colonized with pathogens, which is followed by aspiration of oral secretions.[3] ICU patients are at risk of bacterial colonization because of:

- exposure to pathogens endemic to the ICU,
- the use of multiantibiotic regimens,
- impaired mucosal defenses,
- accumulation of oral secretions, and
- the unique environment created by the endotracheal tube that is conducive to the dispersement of pathogenic bacteria.[3]

VAP increases mortality and morbidity.

- In a study of ICU patients, Bercault and Boulain[4] found that VAP increases the risk of death in ventilated patients (odds ratio: 2.1).
- Ibrahim et al[2] found a mortality rate of 32.2% in patients without VAP compared with 45.5% in patients with VAP.

VAP contributes to longer ICU stays and higher medical care costs, which are estimated to be up to $40,000 per case.[5]

An organized approach to prevention can reduce the rate of VAP. The "ventilator bundle" is a group of interventions for intubated patients that can reduce the rate of VAP when combined with compliance audits.[6]

The Institute for Healthcare Improvement (IHI) includes prevention of VAP as one of its goals for reducing patient harm and recommends a ventilator bundle that includes the following interventions:

- elevating the head of the bed,
- daily "sedation vacations",
- daily assessment of readiness for extubation, and
- prophylaxis for peptic ulcer disease and deep venous thrombosis.[1]

In addition to the ventilator bundle, oral care can play a role in reducing the incidence of VAP.

- Scannapieco et al[7] found that the bacteria that colonize dental plaque also commonly cause nosocomial pneumonia, which suggests that dental plaque may provide a reservoir for pathogenic bacteria that could increase the risk of VAP.
- Previous studies have shown that oral decontamination reduces the rate of VAP, which further supports the idea that oral bacterial loads contribute to the development of VAP.[8]

OBJECTIVE

For 8 consecutive years (1997-2004), our annual average VAP rates (cases/patient ventilator days X 1000) ranged from 10.01 to 19.19. In May 2005, we instituted a performance improvement project that included both the ventilator bundle and an oral care protocol with the goal of reducing VAP rates.

METHODS

All mechanically ventilated patients admitted to the ICU between May 2005 and December 2007 were included in the performance improvement project study population. Patients were excluded if they had a contraindication to the oral care intervention (e.g., severe oral trauma).

The IHI ventilator bundle was adopted and the patients received a minimum of oral care every 4 h and as needed. Compliance was automatically monitored in the medical record and was reported as the number of kits/number of ventilator days (1 kit is used per ventilator day). Instructions for oral care were as follows:

- Replace suction liner, tubing, and covered oral suction device every 24 h
- Brush teeth using suction toothbrush with cetylpyridinium chloride (CPC) twice a day on even hours and as needed (changed to chlorhexidine gluconate [CHG] in 2007); brush 1-2 min while applying suction at completion and as needed; gently brush surface of tongue

- Use suction swabs with hydrogen peroxide solution every 4 h on even hours to clean teeth and tongue
- Apply mouth moisturizer to mucous membranes, buccal cavity, and lips every 4 h after completion of oral care
- Perform deep-oral pharyngeal suctioning with disposable oropharyngeal suction catheter every 12 h
- Use suction catheters to assist in controlling secretions prior to major position changes, extubation, cuff deflation, and repositioning of tube and as needed

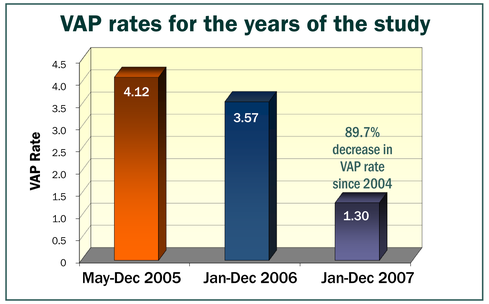
The initial oral care system used was a 4-h oral care system that used CPC. The primary endpoint was a VAP diagnosis in patients mechanically ventilated for ≥48 h. The diagnosis of VAP was made by a medical doctor on the basis of clinical judgment, microbiologic data (Gram stain and culture results), and radiographic evidence of a new pneumonia.

The protocol was instituted in May 2005. In January 2007, the oral care kit was changed from a CPC-containing kit to a CHG-containing kit.

RESULTS

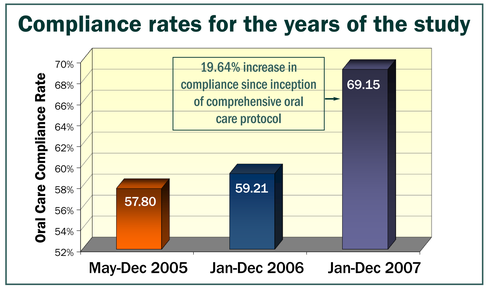
The decrease in VAP rates from 2004 to 2007 represent a 89.7% decrease.

- The 2004 historical VAP rate (cases/patient ventilator days X 1000) was 12.6.
- The 2005 VAP rate from May (when the protocol was started) through December was 4.12 (5 cases in 1211 ventilator days).
- For the year 2006, the VAP rate was 3.57 (7 cases/1959 ventilator days).
- For the year 2007, when the 0.12% CHG product was used in the oral care kits, the VAP rate was 1.3 (2 cases/1533 ventilator days)



The increase in compliance from the inception of the comprehensive oral care protocol in 2005 until December of 2007 was 19.64%

- Compliance with the comprehensive oral care protocol was 57.80% for the period May to December of 2005, 59.21% for 2006, and 69.15% for 2007.



As compliance rose, rates of VAP decreased, however, contemporaneous occurrence of these results does not prove causality.

CONCLUSIONS

- The use of an Oral Care Protocol intervention and ventilator bundle led to a **89.7% reduction in the rate of VAP** in mechanically ventilated patients.
- Products used in the Oral Care Protocol may have reduced the VAP rates by reducing the oral bacterial load through removal of plaque, mucous, and bacteria from the mouth and teeth and through the antibacterial activity of the antiplaque solution, hydrogen peroxide mouthwash, and replacement of CPC with CHG in 2007.
- Routine suctioning and application of a moisturizer may also have contributed to the reduction in VAP rates.
- In addition, the improvement in compliance over time potentially contributed to the improvement in VAP rates.
- A reduction in VAP rates would be expected to reduce medical costs; however, our study was not designed to assess medical costs.

REFERENCES

1. Institute for Healthcare Improvement. Getting Started Kit: Prevent Ventilator-Associated Pneumonia How-to-Guide. Available at: http://www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/Changes/ImplementtheVentilatorBundle.htm. Accessed April 4, 2008.
2. Ibrahim EH, Tracy L, Hill C, et al. The occurrence of ventilator-associated pneumonia in a community hospital. *Chest*. 2001;120:555-561.
3. Garcia R. A review of the possible role of oral and dental colonization on the occurrence of health care-associated pneumonia: underappreciated risk and a call for interventions. *Am J Infect Control*. 2005;33:527-541.
4. Bercault N, Boulain T. Mortality rate attributable to ventilator-associated nosocomial pneumonia in an adult intensive care unit: a prospective case-control study. *Crit Care Med*. 2001;29:2392-2394.
5. Rello J, Ollendorf DA, Oster G, et al. Epidemiology and outcomes of ventilator-associated pneumonia in a large US database. *Chest*. 2002;122:2115-2121.
6. Cocanour CS, Peninger M, Domonoske BD, et al. Decreasing ventilator-associated pneumonia in a trauma ICU. *J Trauma*. 2006;61:122-129.
7. Scannapieco FA, Stewart EM, Mylotte JM. Colonization of dental plaque by respiratory pathogens in medical intensive care patients. *Crit Care Med*. 1992;20:740-745.
8. Schleder B, Scott K, Lloyd RC. The effect of a comprehensive oral care protocol on patients at risk for ventilator-associated pneumonia. *J Adv Health Care*. 2002;4:27-30.

There are no financial disclosures.