THE EFFECT OF A COMPREHENSIVE ORAL CARE PROTOCOL ON PATIENTS AT RISK FOR VENTILATOR-ASSOCIATED PNEUMONIA

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ABSTRACT

Mechanically ventilated patients are at the highest risk for the second most common nosocomial infection, pneumonia. This retrospective study evaluates the impact of a comprehensive oral care protocol on the ventilator-associated pneumonia (VAP) rate in adult ICU patients. The oral care procedure addresses three recognized VAP risk factors: (1) oropharyngeal colonization, (2) oral secretions that can migrate to the subglottal area and (3) dental plaque. Included are revisions to the policy and procedure, as well as the rationale for procedural components and product selection. Finally, statistical process control methods (SPC) are used to document a decrease in the VAP rate.

BACKGROUND

Pneumonia is the second most common nosocomial infection in the United States and patients who receive mechanical ventilation are at the highest risk for acquiring the infection.[1] Studies show that patients who develop ventilator-associated pneumonia (VAP) can have as high as a 7-fold increase in the number of days on mechanical ventilation, a 2- to 5-fold increase in the length of stay in the Intensive Care Unit (ICU) and a doubling of the overall hospital stay.[2,3]

The identification and modification of patient risk factors have led to the development of preventive strategies aimed at reducing VAP. These strategies address the causes of VAP, its treatment, and infection control-related measures that have contributed to the decrease of VAP rates nationally.[4] Multiple risk factors in the critically ill patient and the emergence of antibiotic-resistant organisms require an aggressive approach toward prevention strategies to decrease VAP. Ultimately, implementation of such practices will improve the quality of patient care and contribute to reducing costs.

Oral and dental care have been identified as preventative measures against acquiring VAP.[1-3,5-14] Risk factors affected by oral and dental care are bacterial colonization of the oropharyngeal area, aspiration of subglottal secretions and colonization of dental plaque with respiratory pathogens. The implementation of a comprehensive oral care procedure, including oral suctioning and cleansing, may contribute to decreasing a patient's risk of acquiring VAP.[15] However, studies that establish evidence-based practices by defining the type and frequency of oral care are lacking.

OBJECTIVE

The purpose of this retrospective study was to evaluate the impact of a comprehensive oral care protocol on the VAP rate in adult ICU patients. The study population included all adult mechanically ventilated patients in Advocate Good Shepherd Hospital's 10-bed Medical/Surgical Intensive Care Unit (ICU).

INTERVENTION

In the fall of 1999, an article published in the American Journal of Critical Care highlighted the importance of an oral care protocol to improve the oral health of patients in the ICU.[16] Based on that article, ICU nursing staff at the study facility concluded that current policy and practice did not designate a consistent oral care procedure for unconscious or ventilated patients. Therefore, a continuous quality improvement (CQI) project was initiated to investigate alternative protocols to improve the quality of oral care. During this process, the staff discovered that implementing the new oral care policy and procedure may have had an effect on the occurrence of VAP.

A Critical Care Clinical Nurse Specialist (CCRN) and an ICU Registered Nurse partnered to revise the hospital's policy and procedure for the performance of oral care (See Table 1). Current research and literature were reviewed to identify recommendations for comprehensive oral care on ventilated patients. The following best practices were identified:

- A daily assessment should be performed to evaluate the level of oral dysfunction and provide the most appropriate care to keep the patient comfortable and prevent complications.[8,13,14,16-18]
- Brushing a patient's teeth should occur at a frequency of every 2 to 4 hours and as needed to prevent the formation of plaque, which can be a reservoir for respiratory pathogens.[2,3,6,8,14,16-18]
- Alcohol-free, antiseptic oral rinse should be used to prevent bacterial colonization of the oropharyngeal area.[5,6,8,9,18]

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- Suctioning of oral secretions in both the oral cavity and the oropharyneal area should be performed to prevent the aspiration of microorganisms.[1-3,7,8,10,12,14,18,19]

- Application of a water-based mouth moisturizer should be used to maintain the integrity of the oral mucosa.[16-18]

Table 1. Revisions to Advocate Good Shepherd Hospital Oral Care Policy and Procedure

Policy

1. The oral cavity is assessed initially and daily by the Registered Nurse.
2. Unconscious or intubated patients are provided oral care every 2–4 hours and prn.
3. Intubated patients will be assessed to determine the need for removal of oropharyngeal secretions every 8 hours as well as prior to repositioning the tube or deflation of the cuff.

Procedure

1. Set up suction equipment.
2. Position patient's head to the side or place in semi-fowlers.
3. Provide deep suction, as needed, in intubated patients to remove oropharyngeal secretions that can migrate down the tube and settle on top of the cuff.
4. Brush teeth using suction toothbrush and small amounts of water and alcohol free antiseptic oral rinse.
   - 4.1 Brush for approximately one to two minutes.
   - 4.2 Exert gentle pressure while moving in short horizontal or circular strokes.
5. Gently brush the surface of the tongue.
6. Use suction swab to clean the teeth and tongue if brushing causes discomfort or bleeding.
   - 6.1 Place swab perpendicular to gum line, applying gentle mechanical action for one to two minutes.
   - 6.2 Turn swab in clockwise rotation to remove mucous and debris.
7. Apply mouth moisturizer inside mouth.
8. Apply lip balm if needed.

To meet oral care needs, the staff evaluated and provided input into currently marketed products. The Complete Care Suction Oral System, from Sage Products, Inc., was selected by the ICU Clinical Practice Committee based on the following criteria:

- A soft-tipped, covered yankauer for nontraumatic oral suctioning.

- A soft suction toothbrush with a compact head that could maneuver around the ET tube.

- A suction oral swab for stimulation of mucosal tissue.

- A 1.5% hydrogen peroxide mouth rinse for oral cleansing and reduction of respiratory pathogens.

- A water-based mouth moisturizer with vitamin E to improve the healing of lesions.

- A deep suction catheter for suctioning oropharyngeal secretions.

- A dedicated oral suction line for infection control and nursing convenience.

Once the new Policy and Procedure statement was finalized, copies were distributed to ICU nursing staff. Group education on the rationale for the changes and instructions on proper product usage was provided by the manufacturer. The manufacturer also provided posters, evaluation forms, and follow-up to further clarify, troubleshoot and educate staff. Initially, follow-up was scheduled weekly to ensure proper utilization of the new equipment and to answer questions. Follow-up became less frequent as the new practices and products were incorporated into daily use. The presence of a "champion" for this process change, a registered nurse from the ICU, provided leadership, accountability and support to ensure a successful transition to the new process and products.

INDICATOR AND DATA COLLECTION

The specific indicator selected for analysis was the VAP rate. This indicator has been tracked at Good Shepherd Hospital since 1996.

The VAP rate is reported as the number of pneumonia occurrences per 1,000 ventilator days and is defined as follows:

- **Numerator** — Total number of inpatient ICU occurrences of VAP
- **Denominator** — Total number of days ICU patients spent on a ventilator
- This value is then multiplied by a constant of 1,000, so the rate can be compared with national data.

The population for this study consisted of all adult ICU patients mechanically ventilated for at least 24 hours. A diagnosis of pneumonia was based on National Nosocomial Infections Surveillance System (NNIS) criteria (See Table 2).[20] Patients who developed pneumonia within 48 hours of admission or 48 hours or more after discharge from the ICU were excluded from the occurrences of VAP.

Data were collected manually on a monthly basis and then reported to the Quality Improvement Department for tabulation and analysis. Initially, the data were going to be analyzed on a monthly basis. Since there were a disproportionate number of months with no VAP occurrences, however, a decision was made to group the data by quarter rather than by month. Regrouping the

data by quarter was necessary in order to provide a sufficient number of occurrences to legitimately construct a control chart. Since it is preferable to have 20 data points for a control chart, this regrouping produces a chart with fewer data points than desired. When a chart is made with less than 20 data points, the control limits are referred to as "trial control limits." As more data become available, the limits will become more reliable and predictability will be increased. All cases meeting the inclusion criteria were used in the study (i.e., the data analysis was based on a total population rather than a sample).

Table 2. 1999 National Nosocomial Infections Surveillance System (NNIS) pneumonia diagnosis criteria for adults.[20]

Pneumonia must meet at least one of the following criteria:

Criterion 1: Patient has rales or dullness to percussion on physical examination of the chest and at least one of the following:

a. new onset of purulent sputum or change in character of sputum

b. organisms cultured from blood

c. isolation of an etiologic agent from a specimen obtained by transtracheal aspirate, bronchial brushing or biopsy.

Criterion 2: Patient has a chest radiographic examination that shows new or progressive infiltrate, consolidation, cavitation, or pleural effusion and at least one of the following:

a. new onset of purulent sputum or change in character of sputum

b. organisms cultured from blood

c. isolation of an etiologic agent from a specimen obtained by transtracheal aspirate, bronchial brushing or biopsy

d. isolation of virus from or detection of viral antigen in respiratory secretions

e. diagnostic single antibody titer (IgM) or fourfold increase in paired sera (IgG) for pathogen

f. histopathologic evidence of pneumonia.

ANALYSIS AND FINDINGS

To determine whether the new oral hygiene products and procedure had an effect on the incidence and prevalence of VAP, a pre/post comparison test was conducted using Statistical Process Control (SPC) methods.[21-25] The VAP rates prior to implementing the new oral hygiene protocol were compared to the rates after the process was changed. If the VAP rate declined after the protocol was introduced, then the control chart, a u-chart, will document the nature and extent of the change.

Figure 1 shows the u-chart comparing pre-protocol VAP rates with those after the new oral hygiene equipment and protocol were introduced. Eight quarters of data form the baseline or pre-protocol period. All the data points fall between the upper control limit (UCL) and lower control limit (LCL) and there are no abnormal data patterns occurring between them (e.g., a trend or a shift in the process). In short, the pre-protocol period reflects common cause variation.

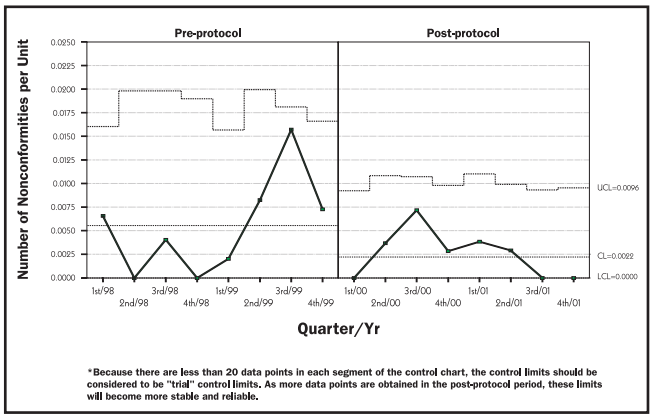

Figure 1. Ventilator-Associated Pneumonia Rate (u-chart) (January 1998 - December 2001)

The new oral hygiene protocol was introduced at the end of the 4th quarter of 1999. A vertical line has been drawn on the control chart to identify this point. The data after this point reflect a shift in the process. Not only are the control limits closer together, but the centerline has also dropped. The VAP rate during the baseline period was 5.6 VAPs per 1,000 ventilator days with the comparative reference mean rate from the NNIS database being 9.9 per 1,100 vent days from December 1999. After the protocol was introduced, the rate dropped to 2.2 per 1,000 ventilator days with the comparative reference mean rate from the NNIS database being 8.7 per 1,000 vent days from December 2001.

DISCUSSION

While there are fewer data points used in this analysis than desired, the preliminary results suggest that the new oral care procedure may be playing a key role in reducing the VAP rate at Good Shepherd Hospital. Further study is clearly warranted to validate these results. Ideally, the next studies should be:

- Established as an experimental or quasi-experimental design to test the new protocol against the traditional approach.[26]
- Established as a multi-site design that would involve different severity levels of the same diagnosis and comparisons across different diagnosis categories.
- Designed to collect more data and run for a longer period of time. Monthly VAP occurrences at one mid-sized suburban hospital do not provide sufficient volume for monthly data collection. It would also be desirable to see if this new procedure has the same effect on different populations (age, gender and race) and different levels of severity.

If the VAP rate at Good Shepherd Hospital starts to migrate back toward the higher pre-protocol average, then it would appear that the new oral care procedure had only a temporary impact on staff behaviors, and/or other untested factors influenced the decline in the post-protocol rates. Conversely, if the post-protocol VAP rates continue to be below the pre-protocol average for several more quarters, then a shift in the process will have occurred.

CONCLUSION

Critically ill patients usually have multiple risk factors that make them prime candidates for the development of VAP. These factors include the patients age, primary diagnosis, level of consciousness, the presence of a nasogastric tube, elevated gastric pH, oropharyngeal or gastric colonization, dental plaque, the presence of endotracheal intubation, previous antibiotic therapy, and the existence and severity of chronic or underlying diseases.[2]

The new oral hygiene procedure tested in this study included components that address three risk factors: bacterial colonization of the oropharyngeal area, aspiration of subglottal secretions and colonization of dental plaque with respiratory pathogens. While it was not possible to differentiate which of these factors or combinations of factors had the greatest effect on lowering the VAP rate, the preliminary data suggest that the mere reduction of risk through better oral hygiene can lead to fewer VAPs.

In addition, the provision of effective, evidence-based care can also play a major role in reducing costs. Consider for example, that the actual average costs of providing care to a patient who acquires VAP was sited as $29,369.[27] Any reduction in the occurrence rate, therefore, could have significant impact on financial outcomes.

The result of this analysis will hopefully challenge current thinking on oral care for mechanically ventilated patients and stimulate further research on this subject. Further study is needed to demonstrate the relationship between oral care and VAP. Prospective research in the area will contribute to the establishment of an evidence-based oral care protocol for the prevention of VAP.

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REFERENCES

1 Centers for Disease Control: "Guidelines for Prevention of Nosocomial Pneumonia," *Morbidity and Mortality Weekly Report*. 46(RR-1):1–79, January 3, 1997.

2 Harris, J., Miller, T.: "Preventing Nosocomial Pneumonia: Evidence-Based Practice," *Critical Care Nurse*. 20(1):51-68, February 2000.

3 Pfeifer, L., Orser, L., Gefen, C., McGuinness, R., Hannon, C.: "Preventing Ventilator-Associated Pneumonia, What All Nurses Should Know," *American Journal of Nursing*. 101(8):24AA-24GG, August 2001.

4 Gaynes, R., Richards, C., Edwards, J., Emori, T., Horan, T., Alonso-Echanove, J., Fridkin, S., Lawton, R., Peavy, G., Tolson, J.: "Feeding Back Surveillance Data to Prevent Hospital Acquired Infections." *Emerging Infectious Diseases*. 7(2): March–April 2001. Available from: http://www.cdc.gov/ncidod/eid/vol7no2/gaynes.htm

5 Scannapieco, F.A.: "Role of Oral Bacteria in Respiratory Infection," *Journal of Periodontology*. 70(7):793–802, July 1999.

6 Scannapieco, F.A., Stewart, E., Mylotte, J.: "Colonization of Dental Plaque by Respiratory Pathogens in Medical Intensive Care Patients," *Critical Care Medicine*. 20(6): 740–745, June 1992.

7 Young, P., Ridley, S.: "Ventilator-Associated Pneumonia, Diagnosis, Pathogenesis and Prevention," *Anaesthesia*. 54:1183-1197, 1999.

8 Hixson, S., Sole, M., King, T.: "Nursing Strategies to Prevent Ventilator-Associated Pneumonia," *AACN Clinical Issues: Advanced Practice in Acute and Critical Care*. 9(1):February 1998, Available from: http://www.aacn.org/AACN/jrnlci.nsf/GetArticle/ArticleEight91?OpenDocument

9 Zoidis, J.: "Ventilator-Associated Pneumonia," *RT: The Journal for Respiratory Care Practitioners*. 11(5):87–89,110, August/September 1998.

10 Vallés, J., Rello, J.: "Nonpharmacologic Strategies for Preventing Nosocomial Pneumonia," *Clinical Pulmonary Medicine*. 4(3):141–147, May 1997.

11 Fourrier, F., Duvivier, B., Boutigny, H., Roussel-Delvallez, M., Chopin, C.: "Colonization of Dental Plaque, A Source of Nosocomial Infections in Intensive Care Unit Patients," *Critical Care Medicine*. 26:301-308, February 1998.

12 Rello, J., Sonora, R., Jubert, P., Artigas, A., Rue, M., Valles, J.: "Pneumonia in Intubated Patients: Role of Respiratory Airway Care," *American Journal of Respiratory and Critical Care Medicine*. 154(1): 111–115, July 1996.

13 Treloar, D., Stechmiller, J.: "Use of a Clinical Assessment Tool for Orally Intubated Patients," *American Journal of Critical Care*. 4(5):355–360, September 1995.

14 Henneman, E., Ellstrom, K., St John, R.: Airway Management. In: *American Association of Critical Care Nurses' Protocols for Practice, Care of the Mechanically Ventilated Patient*. Mallinckrodt, 1999.

15 Xavier, G.: "The Importance of Mouth Care in Preventing Infection." *Nursing Standard*. 14(18):47–51, January 2000.

16 Fitch, JA., Munro, C., Glass, C., Pellegrini, J.: "Oral Care in the Adult Intensive Care Unit," *American Journal of Critical Care*. 8(5):314–318, September 1999.

17 Patient Hygiene: Part I Oral Care the Inside Story," *Nursing 99*. March 1999, Available from: http://www.springnet.com/ce/p903c.htm

18 Beck, S., Yasko, J.: *Guidelines for Oral Care, 2nd Edition*. Sage Products Inc.; 1993.

19 Shorr, A., O'Malley, P.: "Continuous Subglottic Suctioning for the Prevention of Ventilator-Associated Pneumonia, Potential Economic Implications," *Chest*. 119(13:228—235, January 2001.

20 Centers for Disease Control: *NNIS Manual*, National Nosocomial Infection Surveillance System. U.S. Department of Health & Human Services; 1999.

21 Shewhart, W. Economic Control of Quality of Manufactured Product. Van Norstrand, New York, 1931 (reprinted by the *American Society for Quality*, 1980)

22 Shewhart, W. *Statistical Method from the Viewpoint of Quality Control*. Dover Publications, Inc., New York, 1986.

23 Western Electric Company. *Statistical Quality Control Handbook*. Indianapolis: AT&T Technologies Inc., 1984.

24 Wheeler, D., and Chambers D. *Understanding Statistical Process Control*. Knoxsville, SPC Press, 1993.

25 Carey R., and Lloyd, R. *Measuring Quality Improvement in Healthcare*. Milwaukee, ASQ Press, 2000.

26 Campbell, D., and Stanley, J. *Experimental and Quasi-Experimental Designs for Research*. Houghton Mifflin Co. Boston, 1963.

27 Byers, J. and Sole, ML.: "Analysis of Factors Related to the Development of Ventilator-Associated Pneumonia: Use of Existing Databases," *American Journal of Critical Care*. 9(5);334–351, Sept. 2000.