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A photograph of four healthcare professionals in a clinical setting. On the left, a woman in a white lab coat and glasses. In the center, a woman in dark blue scrubs holding a clipboard. On the right, a man in a white lab coat with a stethoscope. In the foreground on the right, a woman in blue scrubs. They are all smiling and looking towards the camera.

A Risky Business

The Occupational Hazards of Healthcare

Oral Care is Critical Care

The Role of Oral Care in the Prevention of Hospital-Acquired Pneumonia

By Suzanne Pear, PhD, RN, CIC

Most critical care nurses, intensivists and healthcare epidemiologists have read the statistics about hospital-acquired pneumonia (HAP) and ventilator-associated pneumonia (VAP). Pneumonia remains one of the most common causes of death worldwide. HAP is one of the most common healthcare-associated (HAI) infections identified in U.S. hospitalized patients, with 90 percent of the 300,000 annual HAP cases occurring in ventilated patients (VAP).¹ Nine to 27 percent of mechanically ventilated patients develop VAP, and one episode of VAP can increase the hospital length of stay by an average of nine days and the cost of care by approximately \$40,000.²

Sixty percent of healthcare-associated infection (HAI) deaths are due to HAP/VAP. Most articles on the subject of HAP/VAP usually begin by quoting similar facts and figures, in order to gain our attention and remind us how costly HAP/VAP is in terms of patient lives and healthcare dollars. This is good, as we need to be reminded and constantly vigilant in our HAP/VAP prevention efforts.

Another positive impact is that organizations like the Institute for Healthcare Improvement's (IHI) "Lives Saved" campaigns' VAP bundle³, the American Thoracic Society (ATS) pneumonia management guidelines² and the Centers for Disease Control and Prevention (CDC)'s HAI pneumonia prevention guideline,⁴ have provided programs so that clinicians everywhere understand the synergistic benefits of bundling evidence-based practices to prevent HAP/VAP.

We now know there is no single patient-care intervention that will eliminate HAP/VAP and that these bundles or guideline components need to be reliably performed for the full benefits to be realized. Although not all of the evidence-based HAP/VAP prevention guidelines recommend the same strategies, one intervention that has been recognized as a core or adjunct component of a pneumonia prevention program is comprehensive oral care/oral-hygiene. The purpose of this article is to help connect the clinical dots between the reliable provision of comprehensive oral care and HAP/VAP prevention.

What Is Comprehensive Oral Care?

The CDC's pneumonia guideline discusses the need to "develop and implement a comprehensive oral-hygiene program ...for oropharyngeal cleaning and decontamination with an antiseptic agent"⁴ but leaves the specific procedures to clinicians. Although the IHI's VAP bundle doesn't include oral care as a core measure, it is frequently

included in VAP prevention success stories on its Web site.⁵ The American Association of Critical Care Nurses (AACN), recognizing the urgent need for clarification, issued a Practice Alert in August 2006 on the issue of "Oral Care in the Critically Ill." This document specifies the need to "develop and implement a comprehensive oral care program for patients in critical care and acute care settings who are at high risk for healthcare-associated pneumonia."⁶ Such a program should include brushing teeth, gums and tongue at least twice a day with a soft pediatric or adult toothbrush and moistening oral mucosa and lips every two to four hours.

The AACN oral care guideline also recommends using an oral chlorhexidine gluconate (0.12 percent) rinse twice daily, but only on adult cardiac surgery patients during their perioperative period.⁶ As part of VAP prevention, the Association for Professionals in Infection Control and Epidemiology (APIC) exhorts clinicians to make "patient oral hygiene standard practice" for ventilated patients.⁷

Aligning with the CDC, this clinical guidance document describes oral hygiene as consisting of "frequent tooth brushing, oral suctioning and swabbing of the mouth with antiseptic agents."⁷ According to this healthcare worker (HCW) education publication, making routine oral hygiene a standard patient care intervention has been found to reduce the incidence of VAP by 57.6 percent.

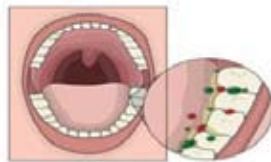


Figure 1. Sites of bacterial attachment in the mouth

Why Comprehensive Oral Care is Necessary to Prevent VAP

Normal Oral Flora

In order to appreciate why oral care is essential for VAP prevention, it is necessary to understand the mouth of a healthy adult as well as the changes that occur in the mouth of the critically ill patient soon after admission into the healthcare setting. Most oral bacteria are considered to be part of the patient's normal flora and may consist of up to 350 different species. Various organisms tend to colonize different surfaces in the mouth. For example, *Streptococcus mutans*, *Streptococcus sanguis*, *Actinomyces viscosus* and

Bacteroides gingivalis mainly colonize the teeth while *Streptococcus salivarius* mainly colonize the dorsal tongue. Another common commensal, *Streptococcus mitis*, is found on both buccal and tooth surfaces.⁸ These flora are usually considered low-level pathogens which may take years or decades to produce clinically significant disease.

Role of Saliva

Another important component of oral health is the continuous production of saliva, which is essential to keeping the mouth and its components clean and moist. Saliva is a mixed fluid secreted predominantly from the parotid, submandibular and sublingual glands. It provides a number of important functions such as washing food debris and unattached microorganisms from the mouth. In addition, saliva contains a number of immune substances such as immunoglobulin A which obstructs microbial adherence in the oral cavity and lactoferrin which inhibits bacterial infection in the healthy individual.⁹ The dorsal surface of the tongue often traps residual debris not removed during swallowing and is known to harbor millions of organisms. Routine tongue cleaning is not generally performed by either patients or care providers.¹⁰

Oral Environment of Critically Ill

The oral flora of critically ill adults differs from that of healthy adults and contains organisms that can rapidly cause pneumonia. Within 48 hours of admission, the composition of the oropharyngeal flora of critically ill patients undergoes a change from the usual predominance of gram-positive streptococci and dental pathogens to predominantly gram-negative organisms, constituting more virulent flora, including pathogens that can cause HAP/VAP within hours or days.¹¹

Also, increased levels of proteases in the oral secretions of critically ill patients remove from their epithelial cell surfaces, a glycoprotein substance called fibronectin. Normally, fibronectin is present on cell surfaces and acts as a host defense mechanism by blocking pathogenic bacterial attachment to oral and tracheal mucus membranes. This depletion of fibronectin in the critically ill allows cell receptor sites to replace normal flora with virulent pathogens such as *Staphylococcus aureus* and different strains of gram negative bacteria, including *Pseudomonas aeruginosa* and *Acinetobacter* on buccal and pharyngeal epithelial cells.⁸

If the critically ill or intubated patient does not receive effective, comprehensive oral hygiene, then dental plaque and hardened bacterial depos-

its may develop on the teeth within 72 hours. This is followed by emerging gingivitis, gum inflammation, infection and a subsequent shift from primarily *Streptococcus* and *Actinomyces* spp. to increasing numbers of aerobic gram-negative bacilli.¹⁰ Since adhesion to a surface in the mouth is important for the continued existence and proliferation of organisms, bacteria which attach to the tooth surface gradually coalesce to produce a biofilm and after further development, lead to the formation of dental plaque.⁹

Xerostomia and Mucositis in the Critically Ill Patient

Xerostomia is dry mouth and mucositis means oral inflammation. Studies by Dennesen et al. have documented a nearly absent salivary flow in intubated sedated ICU patients which can be explained by several circumstances such as the severity of the disease resulting in intubation and admission to the ICU, lack of normal oral intake, fluid balance disturbances, extended use of morphine required because of controlled mechanical ventilation or pain management.¹²

Apart from the inadequate flow, the saliva is not distributed through the oral cavity in a supine sedated patient and severe xerostomia, severely reduced salivary flow and dry mouth, is therefore generally present in ICU patients. As the mucus membranes of the mouth dry out, the tissues become inflamed. A severe reduction of salivary flow and subsequent xerostomia and mucositis may result in increased oropharyngeal colonization with respiratory pathogens. As mucositis or oral inflammation increases in the hospitalized and ventilated patient's mouth, the level of oral bacteria increases as well. The greater the level of oral bacteria, the greater the amount of biofilm that attaches to the patient's teeth. Allowing build-up of biofilm and resultant dental plaque, if not removed, increases the bacterial load in oropharyngeal secretions. Given the fact that all patients aspirate secretions, even non-ventilated patients, the greater the amount and microbial contamination of aspirated secretions, the more likely that lung infection, i.e., HAP/VAP will occur. Therefore, a critical component of any evidence-based HAP or VAP prevention bundle must be the prevention of plaque formation by ensuring that patients perform or receive thorough oral care, especially mechanical debridement of biofilm and plaque at least twice daily.¹³ Comprehensive oral care interventions should focus on plaque removal and stimulation of salivary flow.¹⁴

The Pathway to VAP

Why are ventilated patients more susceptible to pneumonia? Two words – endotracheal (ET) tube. The ventilated patient's normal defenses are hampered, bypassed, blocked or disabled during endotracheal tube-assisted mechanical ventilation by the physical presence of the assistive-breathing device as well as by medications used to keep these patients sedated.¹⁵ The presence of the ET

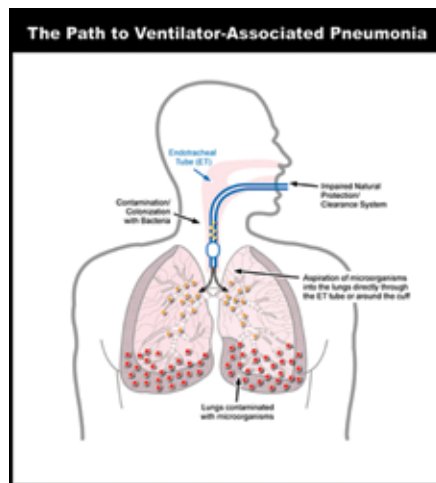


Figure 2. The Pathway to VAP

tube hampers natural host protection and secretion clearance mechanisms. It bypasses normal air filtration and physical capture of microorganisms and particulates. The ET tube also blocks the mucociliary clearance mechanism as well as disables the cough reflex and inhibits phagocytosis in the alveoli. Its very presence initiates “foreign body” reaction in the tracheal tissues, increasing secretory and inflammatory responses.

In addition, the ET tube acts as a direct conduit for pathogen access into the lungs, allowing a biofilm or “slime layer” to form that allows microbes to multiply on its surface, which can then dislodge and drop into the lungs. Over pressure of the ET tube cuff can damage (necrose) the tracheal wall, potentially causing long term damage as well as providing an inflamed site for bacteria migration and growth. Contaminated secretions or dislodged biofilm particles fall into the lungs directly through the ET tube or around the ET tube cuff. The lungs become contaminated with pathogenic microorganisms which may additionally proliferate within the lung tissue. This cycle of contamination, aspiration and pathogen multiplication continues. If these pathogenic microorganisms overwhelm the body's antibacterial defenses, the patient develops pneumonia.

The Recommended Interventions and Rationales of a Comprehensive Oral Care Protocol

Recommended oral care interventions for all hospitalized patients¹⁶

Written Protocol and Training

- Intervention: Written oral care protocol and training should be in place.
- Rationale: Policy is designed to provide a standard of care which should be reinforced in training and should allow for consistent care of all patients.

Initial Assessment

- Intervention: Conduct an initial admission assessment of the patient's oral health and self-care deficits.
- Rationale: Assessment allows for initial

identification of oral hygiene problems.

Dental Plaque Removal

- Intervention: Use a small, soft toothbrush to brush teeth, tongue and gums at least twice daily to remove dental plaque. Foam swabs or gauze should not be used, as they are not effective tools for this task.
- Rationale: Dental plaque, identified as a source of pathogenic bacteria associated with respiratory infection, requires mechanical debridement from tooth, tongue and gingival surfaces.

Toothpaste

- Intervention: Use toothpaste which contains additives that assist in the breakdown of mucus and biofilm in the mouth.
- Rationale: Additives such as sodium bicarbonate have been shown to assist in removing debris accumulations on oral tissues and teeth.

Antiseptic Mouth Rinse

- Intervention: Use an alcohol-free, antiseptic rinse to prevent bacterial colonization of the oropharyngeal tract.
- Rationale: Mouthwashes with alcohol cause excessive drying of oral tissues. Hydrogen peroxide and CHG-based rinses have been shown to assist in removing oral debris as well as provide antibacterial properties.

Moisturizer

- Intervention: Use a water-soluble moisturizer to assist in the maintenance of healthy lips and gums at least once every two hours.
- Rationale: Dryness and cracking of oral tissues and lips provide regions for bacterial proliferation. A water-soluble moisturizer allows tissue absorption and added hydration.

Avoid Lemon Glycerin Swabs

- Intervention: Avoid using lemon-glycerin swabs for oral care to moisten oral mucosa.
- Rationale: Lemon-glycerin compounds are acidic and cause drying of oral tissues.

Assessment of Oral Cavity¹⁶

- Intervention: Conduct an initial admission as well as daily assessment of the lips, oral tissue, tongue, teeth, and saliva of each patient on a mechanical ventilator.
- Rationale: Assessment allows for initial identification of oral hygiene problems and for continued observation of oral health.

Elevate Head

- Intervention: Keep head of bed elevated at least 30 degrees, and position patient so that oral secretions pool into the buccal pocket; especially important during feeding, brushing teeth, etc.
- Rationale: Elevation prevents reflux and aspiration of gastric contents; oral secretions may drain into the subglottic area where they can become rapidly colonized with pathogenic bacteria.

Oral and Orotracheal Suctioning

- Intervention: Suction patient's mouth and oropharynx routinely and as indicated by patient's secretion production, using either continuous subglottic suctioning or manual method. Do not use same catheter to suction both mouth and trachea.
- Rationale: Minimize aspiration of contaminated secretions into lungs.

Does Reduction of Oral Microbial Colonization and Dental Plaque Really Reduce VAP?

The oral care intervention project reported by Garcia and colleagues helps connect the clinical dots between dental plaque reduction and VAP prevention.¹⁷ This study compared patients who received standard oral care (which consisted of yankauer suctioning and glycerin swabs for mouth care) to patients who received comprehensive oral care. Comprehensive oral care included daily oral assessment, teethbrushing, oral and oro-tracheal suctioning, hydrogen peroxide rinse, oral mucosa moisturizer, and use of a covered yankauer. The results of the study were that the group of ventilator patients who received the comprehensive dental intervention had 42 percent fewer episodes of pneumonia. The researchers concluded that careful oral assessment and improved oral care reduces contaminated aspirates and results in significant reduction in the incidence of subsequent VAP.

Are Toothbrushes Better Than Foam Swabs for Plaque Removal?

To answer this question, Pearson and Hutton conducted a time-series, cross-over controlled trial with 34 volunteers which studied plaque accumulation and removal with the two oral care tools.¹⁸ The study found that toothbrushes performed substantially better than foam swabs in removing plaque from sheltered areas of teeth. The researchers concluded that nurses should be educated on toothbrushing skills and need to be supported in developing oral care protocols, practice and assessment abilities.

Can Chlorhexidine Gluconate (CHG) Mouth Rinse Take the Place of Toothbrushing?

A large number of studies have reviewed the effect of CHG mouth rinse on prevention of VAP, with conflicting results.^(13,19-21) Two meta-analyses of these studies report that although CHG may reduce the incidence of VAP, it doesn't reduce time on the ventilator or lower the mortality rate.^(22,23) This confusing finding may be the result of a number of factors, the most relevant of which may be that CHG is not a very effective antibacterial agent against gram-negative or multiresistant bacteria, which are the pathogens most commonly associated with

VAP.⁽²⁴⁾ Considering these data, it would seem that at best, CHG mouth rinse should be used as an adjunct to mechanical plaque removal with a toothbrush, as opposed to replacing this essential component of comprehensive oral care.

What is the Current Practice of Oral Care in the Adult ICU?

A number of studies in the critical care literature document the significant variability in the quality and quantity of oral care provided to patients. In 1999, a study investigated how oral care was being performed in the adult ICU. The researchers identified that nurses had not been formally trained in assessing oral status of patients in ICUs and no formal protocol for mouth care existed. Most nurses used a foam swab dipped in water or mouthwash to provide mouth care to patients, but the method and frequency "varied from nurse to nurse and patient to patient."⁽²⁵⁾ As part of the study, the nurses then received training on oral assessment plus implementation of a formal oral care protocol, which resulted in marked improvement in their patients' oral health.

In 2004, researchers from the University of Louisville Schools of Nursing and Dentistry surveyed more than 550 nurses working in more than 100 ICUs about their oral care knowledge and practices.⁽²⁶⁾ Ninety-two percent of the nurses reported that they believed oral care to be important, but only 20% used toothbrushes and toothpaste when providing oral care. Almost half of those surveyed said they needed better oral care supplies and wanted more evidence-based education about oral care.

An interventional study which was reported in 2005 monitored baseline oral care provided to 139 mechanically ventilated patients at 5 different hospitals and 8 ICUs over a 2 month period.⁽²⁷⁾ The observers noted that none of the ICUs had formal protocols and none of the patients had their mouths assessed, their teeth brushed, lips or mouths moistened, oropharynx suctioned or suction tubing changed. Nurses were still using either suction or non-suction, moistened swabs to clean patients' mouths. Two of the ICUs had suction toothbrushes available, but staff rarely used them. Additionally, nurses reported providing oral care more frequently than was documented in the medical record. The intervention, which consisted of a multi-faceted education program, including a standardized, comprehensive protocol and adequate oral care tools, resulted in marked increase in the amount and frequency of oral care provided.

More recently, a study published in January 2007 reported the findings from a survey of 1200 nurses on their compliance with the CDC's VAP prevention guidelines.^(28,4) Only 56% of the nurses reported having a formal oral care protocol, 36% reported performing subglottic suctioning and 34% routinely maintained patients' head of bed elevated above 30°. Less than 40% of survey respondents reported knowing their unit's VAP rates or likely causative organisms.

What Are the Barriers to Reliable Comprehensive Oral Care in the ICU?

Another large survey of ICU nurses investigated the factors affecting the quality of oral care being provided in ICUs.⁽²⁹⁾ This study is important because it identified, from the nurse's perspectives, what may be preventing them from providing optimal oral care. ICU nurses reported still needing oral care education. They also said that they have insufficient time to provide oral care, have trouble seeing oral care as a priority and continue to view oral care as an unpleasant task. The researchers concluded that improving oral care in ICUs is a multi-layered task – certainly not as simple as it appears on the surface. Their recommendations for improvement included the need to reinforce proper oral care through education, de-sensitize nurses to the often-perceived unpleasantness of cleaning patients' mouths and finally, the importance of monitoring compliance while continuing to identify additional barriers to care as they emerge.

Conclusion

HAP and VAP continue to be the most lethal and likely causes of death attributable to health-care-associated infections. These infections are very costly in terms of lives lost and healthcare dollars wasted. National published guidelines for HAP/VAP prevention, which rely upon published research evidence, consider comprehensive oral care to be essential care for prevention of pneumonia in the hospitalized patient. The rapid, potentially pathologic changes in hospitalized and ventilated patients' oral environment make oral care a critical component of any HAP/VAP prevention bundle. Optimal oral care for pneumonia prevention is not the comfort care that historically had been provided, e.g., oral suctioning with a yankauer and use of moistened cotton or foam swabs.

Comprehensive oral care should focus on plaque removal and stimulation of salivary flow. However, similar to hand hygiene, compliance with consistent provision of comprehensive oral care has not been as straight forward as one would hope. The ability to provide oral care in the ICU setting is hampered by a number of factors including the competing priorities in a turbulent ICU for nurses' care and attention. It is essential that all nurses receive evidence-based education on the patient care practices which are necessary for improving patient outcomes. When nurses (and their hospital administrators) truly understand the criticality of providing comprehensive oral care to all patients, finding the time to provide oral care will no longer be problematic. Patients will then receive comprehensive oral care as needed and HAP/VAP rates will approach zero tolerance.

Comprehensive oral care really does make a difference! Oral care is critical care for all patients.