



Mouth Care to Reduce Ventilator-Associated Pneumonia

Why good oral hygiene is critical to infection control.

OVERVIEW: Despite the well-established association between good oral hygiene and the prevention of ventilator-associated pneumonia (VAP), the importance of mouth care in infection control is seldom recognized. The authors discuss the pathophysiology of VAP and why oral care is crucial to its prevention. They also provide an evidence-based, step-by-step guide to providing optimal oral care for intubated patients.

Keywords: hospital-acquired infection, infection control, mechanical ventilation, mouth care, oral hygiene, respiratory intubation, ventilator-associated pneumonia

Although meticulous oral care has been shown to reduce the risk of ventilator-associated pneumonia (VAP), oral care practices among critical care nurses remain inconsistent, with mouth care often perceived as a comfort measure rather than as a critical component of infection control.¹⁻⁶ VAP develops from a bacterial infection of the lung parenchyma and may emerge as early as 48 to 96 hours following respiratory intubation.⁷⁻⁹ In adult critical care units, mean VAP rates range from zero to six per 1,000 ventilator days, with the risk of infection increasing with the duration of mechanical ventilation.¹⁰ As frontline care providers, nurses need to recognize that maintaining oral hygiene to prevent VAP is an infection control priority.

As one of the most common hospital-acquired infections, VAP is a leading cause of morbidity and death in ICUs.¹¹ Each case of VAP increases hospital expenses by an estimated \$10,000 to \$25,000.^{11,12} In reducing the incidence of VAP, the Institute for Healthcare Improvement recognizes the importance of nursing interventions, such as comprehensive oral care.¹³ Although the Joint Commission sanctioned the use of VAP rates as a nursing-sensitive performance measure in 2009 and scheduled full

implementation of evidence-based practices to prevent VAP as a national patient safety goal effective January 2013, few articles have addressed the importance of oral care as an infection control practice.^{14,15} This article seeks to improve nurses' understanding of oral care as an infection control measure by briefly summarizing the pathophysiology of VAP and the empirical links between VAP and oral care. In addition, we will discuss barriers to the provision of oral care and offer recommendations for delivering optimal oral care.

PATHOPHYSIOLOGY OF VAP

Intubated patients develop VAP through the translocation of exogenous or endogenous bacteria into the normally sterile lower respiratory tract. Although this type of translocation can occur through inhalation of bacteria from contaminated respiratory equipment, gastric colonization, hematogenous seeding, or contiguous spread, VAP most often results from the aspiration of oropharyngeal pathogens.⁷

In the majority of intubated patients, oral flora forms a biofilm around the endotracheal tube, which provides direct access to the lower airway. While the lower respiratory tracts of healthy individuals are

protected from microbial inundation by such defenses as anatomic barriers (the glottis and larynx) and the cough reflex, which reduces risk of aspiration, these defenses are impaired in intubated patients.

The link between VAP and oral hygiene is well established.^{2, 4, 6} In well patients, the oral cavity is home to species of normal flora as well as potentially infectious microbes, which are kept in check by intact immune defenses. In critically ill patients, however, immunologic defenses may be unable to overcome the infectious organisms. In this population, the mouth often serves as a reservoir for pathogens and plaque, and inadequate oral hygiene combined with invasive ventilatory support increases the risk of developing VAP. Oral care not only reduces the mouth's bacterial burden, but also stimulates the flow of saliva, which further aids in the removal of microbial plaque, contains protective immunoglobulins, and minimizes bacterial proliferation secondary to xerostomia.^{16, 17}

When oral care is not provided to a person who is mechanically ventilated, opportunistic organisms flourish, often colonizing the oropharyngeal site with such respiratory pathogens as *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Acinetobacter* species, *Escherichia coli*, *Enterobacter* species, *Serratia* species, and *Pseudomonas aeruginosa*, the latter of which is notoriously able to form resistance to many antibiotics and has a distinct odor that is sweet, slightly putrid, and frequently described as "fruity" or "grape-like." Routine oral care can remove causative microorganisms in oral cavities, reducing the likelihood of their aspiration or inhalation into the lungs. Adequate oral care and decontamination help prevent not only oral disease but also associated respiratory infections, such as VAP. Research shows that implementing an oral care protocol can reduce the incidence of VAP by 46% to nearly 90%, substantially decreasing associated costs.^{6, 18, 19}

BARRIERS TO EFFECTIVE ORAL CARE

The substantial morbidity and mortality associated with VAP, the high cost of its treatment, and the considerable evidence that oral care can be an effective means of reducing VAP risk all suggest that oral care for intubated patients should be a prioritized nursing activity. Nevertheless, oral care continues to be perceived as a nonessential comfort measure that may be safely omitted rather than as a fundamental aspect

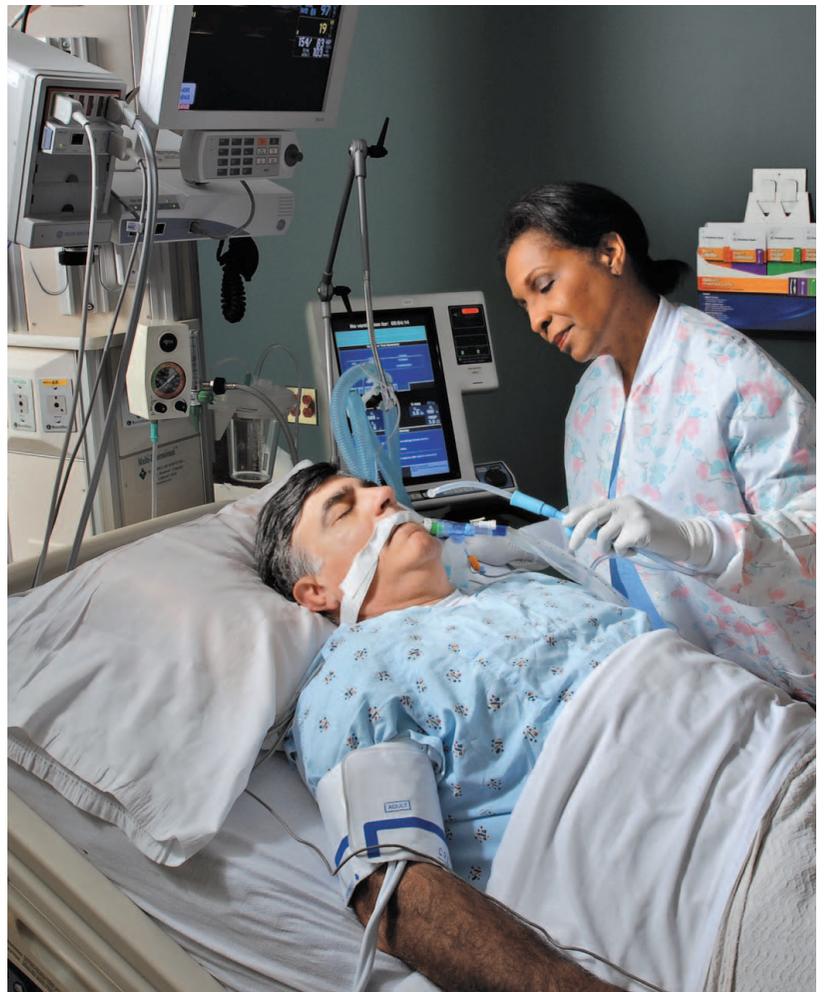


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of infection control. Furthermore, when nurses deliver oral care, it is often performed incorrectly, based on outmoded ideas and persistent habits rather than evidence.²⁰ In order to provide effective oral care, nurses must overcome a number of knowledge, patient, and system barriers.

Knowledge barriers. The gap between evidence and practice is one of the most significant barriers to preventing hospital-acquired infections such as VAP.^{3, 21, 22} Many nurses are unaware of the link between oral health and systemic infections, because the topic is inadequately covered in nursing education.^{13, 21, 23} In fact, investigators conducting an evaluation of 68 nursing textbooks published between 1870 and 1997 found that, during this period, oral pedagogy remained formulaic, practically uninfluenced by more than a century of nursing research supporting significant changes in practice.²⁴ A more

recent review of “fundamental” nursing textbooks published in English between 2006 and 2010 and intended for students seeking RN licensure found that outdated or erroneous information regarding oral hygiene procedures was present in most of the seven textbooks reviewed.²⁵ The authors of one textbook recommended that nurses not floss the teeth of “patients fully dependent on nurses for care,” and four advocated the use of foam sponges for mouth care, though studies have repeatedly demonstrated that soft toothbrushes are both safe and superior to foam sponges in removing plaque. Not surprisingly, both the quality and quantity of delivered oral care are often insufficient to remove plaque and reduce bacterial burden, with the use of inappropriate supplies being a factor.^{26,27}

Oral assessment and care should be performed by the nurse upon admission to the unit and with the first oral care service of each shift.

Patient barriers. ICU studies suggest that routine oral care is least likely to be delivered during daytime hours and within the first two days after admission to the unit—a period in which patients are most susceptible to oral flora changes.^{16,28} This may be explained in part by the false perception that oral care is less important for patients’ health than other interventions, especially soon after ICU admission when the health care team is focused on stabilizing the patient’s condition.¹⁶ Other factors may include restricted access to the oral cavity because of the endotracheal tube and fear of dislodging the tube, provoking aspiration, or causing discomfort.^{1,20,26,29} Among nurses working in neuroscience ICUs, a particular concern is that oral care will increase patients’ intracranial pressure. Limited data suggest, however, that oral care has no adverse effect on intracranial pressure and should be further studied in intubated patients with head injuries.³⁰ Uncooperative patients also pose challenges for nurses delivering oral care.^{1,26} In particular, it may be difficult to deliver oral care to patients who are confused or have sensory deficits or communication difficulties.

System barriers. Other reasons for the omission of oral care may include a demanding workload, high patient acuity, time constraints, insufficient staffing levels, and attention directed toward other ICU care bundles. Not surprisingly, higher patient–nurse ratios were found to increase risk of VAP.³¹ Absence of hospital oral care protocols and lack

of supplies further impede oral care in intubated patients.^{3,29}

An oral care educational program that addresses these barriers can improve the quality of nurse-delivered mouth care.¹ The American Association of Critical-Care Nurses (AACN) affirms that comprehensive oral hygiene is an expected nursing practice. To facilitate consistency in care, they advocate including instruction on oral care protocols in unit orientations.³²

HOW TO IMPROVE ORAL INFECTION CONTROL

According to Society for Healthcare Epidemiology of America/Infectious Diseases Society of America practice recommendations, health care providers who deliver direct care are responsible for ensuring that “infection prevention and control practices are used at all times (including hand hygiene . . . aseptic techniques when suctioning secretions and handling respiratory therapy equipment . . . and oral care).”⁸ RNs are responsible for oral care for the following reasons:

- Oral care requires assessment both before and after its delivery. Oral assessment and care should be performed by the nurse upon admission to the unit and with the first oral care service of each shift. Subsequently, an LPN or LVN can perform these tasks under the RN’s supervision.
- Chlorhexidine, which is recommended by the Centers for Disease Control and Prevention (CDC) for use in the oral care of patients undergoing cardiac surgery³³ and is commonly used in the oral care of noncardiac patients, can be administered only by health care providers with statutory power to administer topical medications. In other words, a nurse cannot delegate procedures involving chlorhexidine to an assistant or aide who is not certified by the particular state to administer drugs.
- The provision of oral care to an intubated patient is associated with a risk of aspiration or extubation.
- RNs are directly responsible and accountable for all patient care activities.

Despite the availability of protocols and clinical practice guidelines for preventing VAP through good oral hygiene,^{1,3-5} nurses’ knowledge and use of evidence-based oral care practices remain variable, but improve with experience and specialization.³⁴ Lemon glycerin swabs, which inhibit salivary production, causing dry mouth and promoting the growth of bacteria and plaque, are still used as a method of oral care.^{2,17} Another common but unsafe custom is the use of tap water to brush the teeth or rinse the mouth of critically ill patients. This practice is harmful because tap water contains bacteria, which can cause infection in people with depressed immune function.^{2,35} In some cases,

Table 1. Oral Care Practices Recommended for Preventing Ventilator-Associated Pneumonia

| | Institution or Guideline Supporting Practice | | | | | | | |
|--|--|----------------------------|------------------------|------------------|-------------------|----------------------------|----------------------------|--------------------|
| | CDC ³³ | AACN ^{32, 37, 38} | APIC ^{36, 39} | JC ¹⁵ | IHI ¹³ | ATS/ IDSA ⁴⁰ | SHEA/ IDSA ⁸ | NCCG ³⁵ |
| Step 1. Wash hands and apply gloves | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Step 2. Assess oral cavity | | | ✓ | | | | | ✓ |
| Step 3. Suction the mouth | | | ✓ | | | | | |
| Step 4. Brush the patient's teeth for three to four minutes | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Step 5. Rinse mouth with sterile water | | | | | | | | ✓ |
| Step 6. Suction subglottic secretions | ✓ | ✓ | ✓ | | | ✓ | | ✓ |
| Step 7. Moisturize the lips and oral mucosa after and in between brushings | | ✓ | | | | | | |
| Step 8. Maintain endotracheal tube cuff pressure between 20 and 30 cm H ₂ O, and change position of the tube after brushing and suctioning | | | ✓ | | | ✓ | | |
| Step 9. Discard swabs and brushes, and rinse and store reusable tools in a clean container | ✓ | | ✓ | | | | | ✓ |
| Step 10. Remove gloves and other personal protective equipment, and wash hands as described in Step 1 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Step 11. Document oral care | | ✓ | ✓ | ✓ | | | | |

AACN = American Association of Critical-Care Nurses; APIC = Association for Professionals in Infection Control and Epidemiology; ATS = American Thoracic Society; CDC = Centers for Disease Control and Prevention; IHI = Institute for Healthcare Improvement; IDSA = Infectious Diseases Society of America; JC = Joint Commission; NCCG = Nursing-Focused Consensus-Based Clinical Guideline; SHEA = Society for Healthcare Epidemiology of America.

hydrogen peroxide is used, but it is not recommended for critically ill patients because if not sufficiently diluted or used too often, it can irritate sensitive gums.^{20, 26}

The CDC and the Association for Professionals in Infection Control and Epidemiology recommend that health care institutions educate direct care staff on preventing hospital-acquired pneumonia.^{33, 36} Educational programs should include the importance of oral care in infection control, recommended oral care products and practices, institutional policies, and institutional VAP rates. When developing oral care protocols for a health care institution,

nurses can compare recommendations supported by several clinical guidelines and health care associations.

STEP-BY-STEP GUIDE TO ORAL CARE

Based on current recommendations, we developed the following step-by-step guide to oral care (see Table 1).^{8, 13, 15, 32, 33, 35-40}

Step 1. Wash hands and apply gloves. When isolation precautions are in effect or risk of contamination from oral secretions is present, use additional personal protective equipment, such as a gown and face shield.

Practice technique: Wash hands using gentle friction for approximately 20 seconds with warm water and antiseptic soap. (Alternatively, rub a palmful of an alcohol-based hand sanitizer over all surfaces of the hands until dry.)

Rationale: Handwashing and gloving are proven methods of infection control; friction helps remove germs.

Step 2. Assess oral cavity every eight hours using a valid and reliable assessment tool.

Practice technique: Ensure that the nursing staff is adequately trained to assess all external and internal structures of the oral cavity using a validated, reliable tool, such as the Oral Health Assessment Tool.⁴¹ The mouth should be evaluated for bleeding, inflammation, ulceration, saliva production, odor, and overgrowth of yeast or plaque.

Rationale: Oral assessment is necessary for planning, implementing, and evaluating oral care and may reveal the need for more frequent oral care or specialty care (for example, a consult with a wound care nurse, a periodontologist, or an oral surgeon).

while minimizing discomfort and mucosal irritation). Brush teeth in a linear fashion, beginning in either the right or left upper quadrant (where the molars are located) and continuing along the maxilla, down to the mandible, concluding at the lower molars. Both the lingual and buccal surfaces of teeth need to be brushed as does the tongue, which should be cleaned using a forward brushing motion. Tongue scrapers are not recommended because they can damage the tongue and papillae if used incorrectly. When brushing is contraindicated (as in patients with mucosal lesions and those at elevated risk for bleeding) or patients are edentulous, a swab may be used instead of a toothbrush, following the same technique. Swabbing can also be used in between brushings. If flossing is needed, use a water flosser or interdental stick.

Rationale: While mechanical interventions include toothbrushing, rinsing, swabbing, flossing, and oral and subglottic suctioning, brushing is the most effective way to remove debris, plaque, and biofilm. Some research shows that a power toothbrush is superior to a manual toothbrush in removing plaque.⁴³ Current

Subglottic suctioning removes bacteria-laden secretions deep in the oropharynx and has been shown to reduce the incidence of VAP.

Step 3. Suction the mouth to remove excess secretions prior to oral care.

Practice technique: Using a flexible suction catheter with a tonsillar tip, suction the oral cavity. Do not use the same suction catheter for both oral and subglottic (pharyngeal) suctioning. Recommendations regarding the frequency of suctioning vary, with nursing research suggesting every two to four hours and as needed.⁴²

Rationale: Since oral care stimulates salivary production, suctioning excess secretions beforehand reduces risk of aspiration. Using different suction catheters for oral and subglottic suctioning helps prevent transmission of oral bacteria into the lower respiratory tract.

Step 4. Brush the patient's teeth for three to four minutes using an antiseptic mouth rinse, such as chlorhexidine.

Practice technique: Although the recommended brushing frequency varies, it should be consistent and at least twice daily. In some institutions, a physician's order set may be required for the use of chlorhexidine. As with all medications, evaluate patients for contraindications to chlorhexidine prior to its use. With the head of the bed elevated to at least 30° (unless contraindicated), use a suction toothbrush or soft pediatric toothbrush (to access hard-to-reach areas

research does not support the use of any particular antiseptic rinse, except in patients undergoing cardiac surgery for whom a chlorhexidine 0.12% mouth rinse has been shown to reduce VAP rates when used before intubation and following surgery. Recommendations vary as to the use and strength of chlorhexidine mouth rinse in other patient populations, although the trend in critical care is toward the use of chlorhexidine with toothbrushing twice daily in all patients. Chlorhexidine sustains antimicrobial action for up to 12 hours. Routine use of antibiotics is not encouraged as it can create multidrug-resistant bacteria.

Step 5. Rinse the mouth with sterile water or an alcohol-free mouth rinse.

Practice technique: Using a soft or suction sponge, a swab, sprayer, or transfer pipette, apply rinse to all surfaces of the oral cavity, exerting gentle pressure in a clockwise, rotating motion for at least one minute. To reduce risk of aspiration, we recommend using no more than 15 mL of rinse, which is the amount used in healthy patients and the amount found in prepackaged oral care kits. Lemon glycerine swabs or undiluted peroxide should never be used for rinsing.

Rationale: A sterile water rinse removes any remaining chlorhexidine, debris, mucus, or excess saliva, which could be aspirated.

Step 6. Suction subglottic secretions.

Practice technique: Based on clinical experience, we recommend delivering oxygen at 100% for one minute before and after suctioning. Following oxygen delivery, insert the suction catheter until it meets resistance. Apply suction intermittently while withdrawing the suction catheter. Suction for no more than 10 to 15 seconds, with a maximum of two passes. Do not instill normal saline as it may provoke aspiration.

Rationale: Subglottic suctioning removes bacteria-laden secretions deep in the oropharynx and has been shown to reduce the incidence of VAP.⁴⁴ If using a closed system, oral suctioning must accompany deep subglottic suctioning.⁴² The AACN recommends continuous subglottic suctioning, whereas the CDC recommends continuous or intermittent subglottic suctioning. Research shows, however, that excessive subglottic suctioning can cause mucosal drying, irritation, and injury.⁴⁵ For these reasons, we recommend that subglottic suctioning be performed only twice daily with each brushing and as needed.

Step 7. Moisturize the lips and oral mucosa after and in between brushings, at least every two to four hours.

Practice technique: Apply a generous amount of a water-based moisturizer to the lips and then, using a separate swab, moisturize the oral mucosa to stimulate salivary production.

Rationale: Dry and cracked lips cause discomfort, are subject to bleeding, and serve as a portal of entry for bacteria. Applying moisturizer to the lips and oral mucosa helps maintain a barrier against bacterial entry. Water-based moisturizers are recommended because they can be easily absorbed through the skin. Oil-based moisturizers (such as petroleum jelly) cannot be easily broken down or eliminated if they're ingested or aspirated.

Step 8. Maintain endotracheal tube cuff pressure between 20 and 30 cm H₂O, and change the position of the tube after brushing and suctioning.

Practice technique: Use a manometer to maintain cuff pressure.

Rationale: Insufficient cuff pressures can permit microaspiration of bacteria-rich secretions, and excessive cuff pressures cause tracheal damage. Gentle palpation is commonly used to assess cuff pressure, but this method is not reliable. Changing the position of the endotracheal tube following brushing and suctioning helps prevent breakdown of the oral mucosa.

Step 9. Discard swabs and brushes, and rinse and store reusable tools in a clean container.

Practice technique: To inhibit bacterial overgrowth, after rinsing reusable oral care tools with sterile water, place them in a container that allows some airflow. All containers should be dated. Some tools and oral care kits are designated for one-time use; others, including catheter tubing, tonsillar tips, and canisters, should be changed at least every 24 hours.^{46,47} Suctioning devices

may need to be changed more often if they become clogged or coated with secretions.

Rationale: Despite a lack of evidence supporting its use, clean storage is generally recommended for reusable equipment to limit bacterial contamination and subsequent exogenous respiratory infection.

Step 10. Remove gloves and other personal protective equipment, and wash hands as described in Step 1.

Step 11. Document oral care.

Practice technique: After oral care is complete, document on a flowchart or in the electronic medical record your assessment of the oral cavity, the time and type of oral care provided (for example, brushing, swabbing, or suctioning), patient tolerance (for example, discomfort, significant oxygen desaturation, increased intracranial pressure, vomiting, or aspiration), and any other significant findings (such as oral lesions, bleeding, or odor). When oral care is not performed, its omission and the reason for its omission must be clearly documented as well.

Rationale: Documentation is necessary for standard-of-care evaluation and point-of-care surveillance. Not only must care be documented, but it must be sufficiently detailed to demonstrate nurse compliance with oral care policies and evidence-based practices. As the nursing adage says, "If it wasn't documented, it wasn't done." Documentation should be a component of every oral care protocol.

LEADING IMPROVEMENT EFFORTS

The Institute of Medicine's landmark report, *The Future of Nursing: Leading Change, Advancing Health*, calls on nurses to "lead and diffuse collaborative improvement efforts."⁴⁸ Developing or adopting an evidence-based oral care protocol provides an opportunity for nurses to lead such an initiative and reduce the incidence of VAP, one of the most common and dangerous hospital-acquired infections. ▼

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