

DENTAL HYGIENE INTERVENTION TO PREVENT NOSOCOMIAL PNEUMONIAS

Caren M. Barnes, RDH, MS

SORT SCORE			
A	B	C	N/A

SORT, Strength of Recommendation Taxonomy

LEVEL OF EVIDENCE		
1	2	3

See page A8 for complete details regarding SORT and LEVEL OF EVIDENCE grading system

Applied and Clinical Research,
Department of Dental Hygiene,
Nebraska Center for Materials
and Nanoscience, University of
Nebraska Medical Center,
College of Dentistry, Lincoln, NE
68583-0740, USA

*Corresponding author. Tel: +1 402 472
5168, +1 402 890 2105 (mobile). E-mail:
cbarnes@unmc.edu*

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ABSTRACT

Nosocomial and ventilator associated pneumonias that plague critically ill, elderly and long-term care residents could be reduced with effective oral hygiene practices facilitated collaboratively between nurses and dental hygienists.

Background

Nosocomial pneumonias, specifically aspiration pneumonias and ventilator-associated pneumonias in the elderly and infirm have become a major health care issue. The provision of oral care in hospital and hospital-like facilities presents challenges that can prevent patients from receiving optimal oral care. One sequela can be aspiration pneumonia which ranks first in mortality and second in morbidity among all nosocomial infections. Since aspiration pneumonia is linked to the colonization of oral bacteria in dental plaque and biofilm, it is time to look for creative solutions to integrating the expertise of dental hygienists into health care teams in these institutional settings.

Methods

A comprehensive review of the literature was conducted regarding the etiology and prevalence of health care related pneumonias. Evidence describing the challenges and barriers that the nurses, nursing staff, and dental hygienists face in the provision of oral care in hospitals and long-term care facilities is provided. Intercolaborative solutions to providing optimal oral care in hospitals and long-term care facilities are suggested.

Conclusion

Dental hygienists have the expertise and practice experience to provide oral care in hospitals, long-term care and residential facilities. They can contribute to solving oral care challenges through intercollaboration with other health care team members. Yet, there are long-standing systemic barriers that must be addressed in order to provide this optimal care. Dental hygienists becoming better assimilated within the total health care team in hospital and residential facilities can positively impact the suffering, morbidity and mortality associated with aspiration pneumonias.

Key words: Dental hygiene, prevention, nosocomial infections, nursing home, critically ill aspiration pneumonia, ventilator associated pneumonia barriers to oral care

INTRODUCTION

There is an abundance of literature that suggests various associations between oral and systemic conditions.¹⁻⁹ As research evolves, the evidence grows stronger that oral flora are associated with systemic diseases, especially in states of chronic infection. Some associations between oropharyngeal colonization in chronic oral infections and systemic diseases are stronger than others. Oropharyngeal colonization and inflammation have been associated with cardiovascular disease, endocarditis, diabetes, obesity, prosthetic joint infections, fetal development, pulmonary disease, rheumatoid arthritis, osteoporosis, chronic obstructive pulmonary disease, and chronic kidney disease.¹⁻⁹

Concomitant with the association between oropharyngeal colonization and systemic diseases, there has been a burgeoning recognition among a variety of health care professions that oral hygiene plays a critical role in one of the most common and costly health outcomes, aspiration pneumonia.^{10–12} The attention is specifically on the elderly, chronically and critically ill patients in hospitals and long-term care facilities, particularly when dependent on ventilators. Research in this arena is being conducted internationally dental hygienists, dentists, nurses, physicians and speech pathologists.^{10–12} Aspiration pneumonia ranks first in mortality and second in morbidity among nosocomial infections, which broadly defined includes infections associated with the provision of health care.^{10–12} The enormity of morbidity, mortality and financial costs calls for an urgent response. The dental hygienist has appropriate expertise to provide efficacious solutions. They can provide the preventive oral care and therapeutic services as well as mentor nursing personnel who may be providing the oral care.^{10–33} This review will explore: (1) nosocomial pneumonias, specifically aspiration pneumonias, (2) the pathogenetic changes that occur in the oral flora of patients that are hospitalized or receive long-term care, (3) the types of patients predisposed to or who are at high-risk for aspiration pneumonias, (4) reasons that aspiration pneumonias are a major cause of morbidity and mortality to those who are vulnerable to this infection, (4) barriers to the provision of oral care for at-risk patients, and (5) solutions to address many of the morbidities and mortalities related to aspiration pneumonia, some of which can be provided by dental hygienists.

DEFINING NOSOCOMIAL INFECTIONS

'Nosocomial infection' is the term that traditionally has been used to describe new infections that occur within 24–72 hours of admission to a hospital, 3 days after discharge or 30 days after a surgical operation. A nosocomial infection is acquired in a hospital, and was not present or incubating at the time the patient was admitted to the health care facility. In some recent scientific literature the definition of 'nosocomial infections' has been expanded and is now inclusive of hospital settings, nursing homes (NH), outpatient delivery services such as day-surgery and dialysis centers, home parenteral therapy and additional sites other than acute-care facilities. The expanded definition of nosocomial infections is referred to as health care associated infections.³⁴ Nosocomial infections are caused by viral, bacterial, and fungal pathogens. The most common types of nosocomial infections occur in the bloodstream, lungs, surgical sites and the urinary bladder.

ASPIRATION PNEUMONIA AND ASPIRATION PNEUMONITIS

Aspiration pneumonia occurs with the micro-aspiration of oropharyngeal secretions into the trachea and lungs. The bacteria and other types of microorganisms infiltrate the lungs. If the host defenses are not successful at clearing the bacteria,

the result is a unilateral or bilateral lung infection (see **Figure 1**). Research indicates the right lower lobe of the lung is the most frequent site of the infection.³¹ Aspiration pneumonia is a leading cause of death among residents of nursing homes and for some types of hospitalized patients.^{32,33} Additionally, aspiration pneumonia is the most common reason for nursing home residents to be transferred to hospitals.³¹ The clinical symptoms of aspiration pneumonia, cough, fever, chest pain and dyspnea are often indistinguishable from other types of pneumonia.

Aspiration pneumonia differs from *aspiration pneumonitis* (Mendelson's Syndrome) which occurs when highly acidic gastric contents are aspirated into the lower respiratory tract. The gastric contents, which are usually sterile, create a chemical injury to the lung tissues which in turn causes an intense inflammatory reaction. By contrast, aspiration pneumonia is a true infection of the lower respiratory tract due to the oropharyngeal secretions that are colonized by pathogenic bacteria.^{32,33} In some cases aspirated gastric contents can cause aspiration pneumonia. Gastric contents can be contaminated with oropharyngeal bacteria and gastric bacteria, especially in patients who have been treated with acid-suppressing drugs. In the absence of certain strong gastric acids, bacteria can thrive that otherwise would not survive the acidic environment.

COMMUNITY-ACQUIRED PNEUMONIA AND NOSOCOMIAL-ACQUIRED PNEUMONIAS

Aspiration pneumonia can be a *community-acquired infection* or a *nosocomial infection*, also referred to as hospital acquired pneumonia (HAP), health care-associated pneumonia (HCAP) or nursing home acquired pneumonia (NHAP).^{28,34} Community-acquired pneumonia (CAP) develops in non-institutionalized people during the course of their daily lives. Both nosocomial acquired pneumonias (NAP) and CAP are commonly polymicrobial, however, the microbial etiology for each of the pneumonias is distinctly different.^{27,28,33,34} CAP is commonly caused by pathogens that reside in the upper respiratory airways such as: *Candida albicans*, *Chlamydia pneumoniae*, *Haemophilus influenzae*, *Legionella pneumophila*, *Moraxella catarrhalis*, *Streptococcus pneumoniae*, *Mycoplasma pneumoniae* and some anaerobic species.^{27,35–37} CAP most often presents as low-severity disease.³⁷

NAPs are associated with more severe disease, longer hospital stays, and higher mortality rates than CAPs. The overall mortality rate for CAP patients who are admitted to the hospital is 10%, while a mortality rate of 30% is associated with NAP, although this rate is not universally accepted.³⁸

ETIOLOGY OF ASPIRATION PNEUMONIA

Aspiration pneumonia is most often caused by bacteria that are not common to upper respiratory airways, which suggests that

Figure 1. Chest radiography in an 85-year-old man with bilateral extensive aspiration pneumonia and glottic dysfunction. Reprinted with permission from Janssens JP, Krause KH. Pneumonia in the very old. *Lancet Infect Dis* 2004;4(2):112-24.



aspiration pneumonia is distinct from CAP. Specifically, the organisms associated with the etiology of NAP are predominately gram negative. It has long been recognized that the prevalence of gram negative bacteria correlates with severity of illness.³⁹ Historically, the organisms reported to be associated with aspiration pneumonia include *Escherichia coli*, *Klebsiella pneumonia*, *Serratia* spp., *Enterobacter* spp., *Pseudomonas aeruginosa*, and *Staphylococcus aureus* (which can be methicillin-resistant).^{27,35-37} There is strong scientific evidence that these are not the only types of organisms that serve as the etiology for aspiration pneumonia.²⁶⁻⁴¹ Notably, organisms from dental plaque biofilms have been isolated from the respiratory system of patients with aspiration pneumonia. Given the over 500 species of aerobic and anaerobic bacteria that are associated with dental plaque oral biofilm, it is not surprising that oral bacteria make their way into the pharynx and lower respiratory tract.^{11,38} As previously cited, most aspiration pneumonia occurs in the lower right lobe of the lung, a logical finding, given the anatomy of the oropharyngeal structures leading into the lungs.^{31,42} The oral cavity is proximal and contiguous with the trachea and the right main stem bronchus is positioned more vertically than the left. This anatomical configuration allows for easy transport of the aspirate and can serve as a natural portal for the colonization of respiratory pathogens.⁴²

Some of the bacterial species that are associated with NAP include: *Actinobacillus actinomycetemcomitans*, *Actinomyces israelii*, *Capnocytophaga* spp., *Eikenella corrodens*, *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Streptococcus constellatus* and *P. aeruginosa*.^{27,35-46}

IMPACT ON DENTAL PLAQUE AND ORAL BIOFILMS

Patients that are stricken with aspiration pneumonias have more in common than being institutionalized; the dental plaque biofilms in these patients increase in volume and complexity because they become inhabited by respiratory pathogens (RPs) from the hospital or nursing home environment. Patients with teeth or dentures have non-shedding surfaces that become covered with oral biofilms, which are susceptible to colonization by RPs. Not surprisingly, there is a heightened risk for RPs to colonize in dental plaque biofilm in the presence of poor oral hygiene, whether on teeth or dentures. Mouths of edentulous patients are colonized by markedly fewer anaerobic microorganisms than dentate patients, yet they have more yeast and lactobacilli.^{47,48} Nonetheless, dental plaque biofilms that colonize dentures are as responsible for respiratory infections as those found in dentate individuals.⁴⁸ In a study of patients in the intensive care unit (ICU), Scannapieco and his co-investigators compared the dental plaque biofilm of patients receiving treatment in the ICU with matched, untreated control subjects.³⁴ They found that there was a correlation between the patients that had been treated with antibiotics and having their dental plaque colonized by RPs. A similar study investigated dental plaque biofilm colonization by RPs in 57 ICU patients.³⁷ Twenty-three percent of those patients tested positive for RPs on the day of admission, while 46 percent tested positive for the RPs on day ten in the ICU. Notably, 37% of these patients developed pneumonia.⁴¹

There are additional changes that occur in the oral cavity during hospitalization. Mucous membranes can undergo deterioration; with poor or neglected oral care, the oral environment will undergo further deterioration.⁴² Significant oral problems occur if the patient develops xerostomia, which can be caused by a medical condition, radiation treatment to the head and neck, and is a side effect of a variety of oxygen therapies and medications. Xerostomia is more often caused by medication rather than the aging process. In many instances, xerostomia is due to polypharmacy, the result of taking several medications. Persons taking three or more medications per day have a 60% chance of having xerostomia. And, the intensity of the oral dryness is directly related to the blood levels of the medications that cause xerostomia. The higher the blood levels of the medications, the more desiccation of the oral tissues will occur (see Spolarich, *Risk Management Strategies for Reducing Oral Adverse Drug Events*, this publication).

Approximately 20% of the elderly are affected by xerostomia and there are more than 400 medications that can cause xerostomia. Some examples of the categories of medications that can cause xerostomia are listed in [Table 1](#), with examples of medications from each category.

Xerostomia can contribute to multiple oral conditions that affect the patient's quality of life such as difficulty in swallowing and speaking, fissured tongue, hairy tongue, burning mouth syndrome, cheilitis, candidiasis (see [Figure 3](#)), painful ulceration of the tongue and mucous membranes and mucositis.^{52–56} Because there is a scant amount of saliva present, the self-cleansing that would occur is absent and dental plaque biofilms become thickened and more acidic, with bacterial endotoxins still present. These conditions set up a high risk environment where rampant dental caries can develop, especially root caries in the elderly. Moreover, the periodontal tissues lose some antibacterial components normally present in saliva; gingival inflammation and periodontal disease can ensue. The most significant issue associated with xerostomia is its contribution to deteriorating oral health, which, in turn, is associated with HAP. Hospital-acquired pneumonias increase morbidity, mortality and health care costs. Each of these factors could be lessened if nursing home residents and hospitalized and critical care patients with xerostomia were provided with appropriate oral care interventions to maintain oral health.

NOSOCOMIAL-ASPIRATION PNEUMONIAS: HOSPITAL-ACQUIRED PNEUMONIA, NURSING HOME-ASSOCIATED PNEUMONIA AND VENTILATOR-ASSOCIATED PNEUMONIA

The 3 types of nosocomial aspiration pneumonias are hospital-acquired pneumonia (HAP), nursing home-acquired pneumonia (NHAP) and ventilator-associated pneumonia (VAP).

HAP is a pneumonia that occurs within 48 hours after admission to a hospital and one that was not incubating at the time of admission. NHAP, is pneumonia that occurs in nursing home residents or residents of long-term care facilities.⁴⁶ Hospital-acquired and NHAP are quite similar in etiology and the dental plaque biofilms in these patients typically undergo colonization with RPs that contaminate the lower respiratory tract.^{43,44}

While NHAP and HAP most commonly occur as the result of oropharyngeal colonization that infects the lower respiratory tract, VAP can have a somewhat more varied etiology, as the risk for pneumonia is increased by the presence of the endotracheal tube.⁴⁴ VAP, which occurs in intubated patients, can develop from translocation of endogenous or exogenous bacteria into the lower respiratory tract or through gastric colonization. Since the endotracheal tube is a foreign device, it can become seeded with oropharyngeal organisms which can

enter the trachea during the insertion of the tube (see [Figure 2](#)). Additionally, the surface of the endotracheal tube may become contaminated with bacterial biofilm that locates the bacteria in the lower respiratory tract. This can also occur from inhalation of bacteria from contaminated respiratory equipment; these infections are often resistant to host defenses or antibiotics.⁴⁸ Importantly, just as with NHAP and HAP, the etiology of VAP is most often from the aspiration of oropharyngeal pathogens.^{12,44} Ventilator-associated pneumonia is classified as early or late onset. Early onset VAP often occurs less than 96 hours after admission to an intensive care unit (ICU) and is often attributed to antimicrobial-sensitive bacteria. Late onset VAP occurs 96 or more hours after ICU admission and is attributed to multi-drug resistant bacteria.⁴⁶

RISK ASSESSMENT

Individuals who are critically ill, undergo long-term hospitalization or treatment in long-term care facilities, are nursing home residents, or require endotracheal intubation, are considered at high risk for aspiration pneumonias. Other conditions that can predispose patients for aspiration pneumonia are listed in [Table 2](#). Also, some patients will aspirate during sleep.⁵⁷

One additional condition that presents as a significant risk factor for aspiration pneumonia is oropharyngeal dysphagia.⁵⁸ In some individuals, dysphagia will be obvious and in others it will require careful diagnosis. Diagnosis and treatment of dysphagia may require an interprofessional team of health care providers such as speech pathologists, dental hygienists, dentists, physicians and nurses.⁴³ Neurologic damage or neurologic disease can affect swallowing, which is categorized as a trained activity rather than a reflexive activity.⁵⁸ Dysphagia is not uncommon in individuals with Parkinson's disease, Sjogren's syndrome, amyotrophic lateral sclerosis, and can result from stroke, head and neck cancer, or other neurological disorders.^{58–61} It is also common in individuals with xerostomia, whether as a result of a disease process, medications, and/or head and neck cancer irradiation treatment.^{43–48,52–61} Dysphagia can also occur following the administration of strong sedatives or paralytics administered during mechanical ventilation.⁴³ Additionally, dysphagia may occur in the absence of illness or medication, but simply as part of the aging process. The effect of the aging process on swallowing is generally to slow the swallow and to mildly but significantly reduce the efficiency of the swallow.⁵⁸ The foremost risk factors for aspiration are increased bacterial load and bacterial colonization in the oropharyngeal cavity and compromised immunity and/or dependency on ventilation.

Aspiration pneumonia first came to the attention of health care providers in the 1990s when they noticed it increasing at a rate 4 to 5 times faster than other types of pneumonia. There was no explanation for the escalating growth.⁴³ It seems reasonable that the exceedingly high growth rate of

Table 1. Medications that can cause xerostomia^{49–51}

Drug category	Examples of drugs in each category: Generic name (trade names)
Anorexiant	Phentermine (Adipex, Suprenza, Ionamin) Phendimetrazine (Bontril)
Anti-anxiety	Hydroxyzine (Atarax), Lorazepam (Ativan), Prazepam (Centrax), Diazepam (Diastat, Valium)
Antidepressants	Amitriptyline (Elavil), Imipramine (Tofranil, Tofranil-PM), Doxepin (Silenor, Prudoxin, Zonalon) Sertraline (Zoloft), Paroxetine (Paxil, Pexeva), Fluoxetine (Serafem, Prozac)
Anticholinergics	Oral Atropine (Sal-Tropine), Scopolamine (Transderm Scop), Dicyclomine (Bentyl), Mepenzolate (Cantil)
Anti-convulsants	Felbamate (Felbatol), Gabapentin (Neurontin, Gralise, Horizant, Fanatrex)
Anti-emetics	Meclizine (Antivert, VertiCalm, Bonine)
Antihistamines	Diaphenhydramine (Benadryl, Somnex, Diphenhist, Hydramine, Wal-dryl, Banophen, Dicopanor, Silphen)
Anti-hypertensive drugs	Clonidine (Catapres, Kapvay, Duraclon, Nexiclon, Methyldopa (Aldomet) Reserpine, Prazosin (Minipress), Guanfacine (Intuniv, Tenex), Metirosine (Demser))
Anti-Parkinson agents	Biperiden (Akineton), Selegiline (Emsam, Eldepryl, Zelapar)
Antipsychotic drugs	Clozapine (Clozaril, FazaClo), Chlorpromazine (Phenothiazine, Antiemetic)
Bronchodilators	Ipratropium (Atrovert), Albuterol (Proventil, AccuNeb), Metaproterenol (Alupent)
Decongestants	Pseudoephedrine (Sudafed, Wal-Phed, Suphedrine, SudoGest)
Diuretics	Spimolactone (Aldactone), Chlorothiazide (Diurile), Furosemide (Lasix)
Muscle relaxants	Cyclobenzaprine (Flexeril, Amrix, Fexmid), Baclofen (Gablofen, Kemstro, Lioresal)
Narcotic analgesics	Meperidine (Demerol), Morphine (Avinza, Duramorph, Kadian, Depodur, Astramorph) Hydrocodone (Norco, Anexsia, Dolorex Forte, Hycet, Lorcet, Lortab, Maxidone, Polygesic, Stagesic, Vicodin, Xodol, Zydone)
Illicit drugs	Cocaine, Ecstasy, Methamphetamines

aspiration pneumonia in the elderly could have been related to the aging of the post-World War II 'baby boomers' Within the last 2 decades, the large population of post-World War II babies began entering their senior years; this aging trend in the United States and other populations is expected to continue in coming decades.⁶¹ Many of these seniors are faced with organ failures, consequences of years of suffering from chronic diseases and comorbidities. A number of these conditions require hospitalization or care provided in a nursing home or long-term care facility (see Yellowitz and Schneiderman, *Elders' Oral Health Crisis*, this publication).

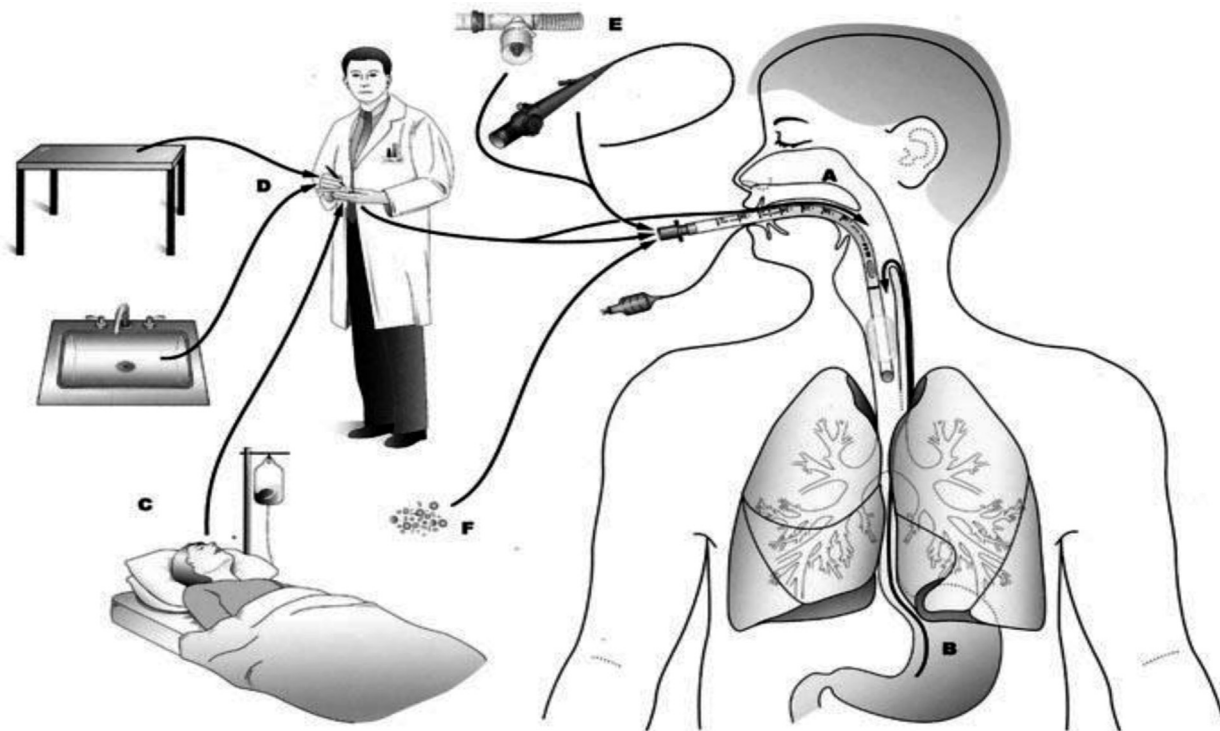
The current population of aging seniors has had greater access to dental treatment services and advances in oral hygiene than previous generations. These advances have resulted in more seniors having all or most of their teeth and accompanying dental plaque biofilms when entering hospitals, long-term care facilities and nursing homes.^{27,28} Consequently, these individuals require more oral care than they are receiving, as publicized in a 2013 New York Times article titled, *In Nursing Homes, an Epidemic of Poor Dental Hygiene*.²⁰

NURSING AND ORAL CARE

Once the rapid growth of aspiration pneumonia became apparent, research was initiated to investigate all facets of AP.

The scientific evidence is strong that the etiology of aspiration pneumonia is colonized oropharyngeal bacteria, specifically from dental plaque biofilms.^{19–48,52–64} Prevention can be straightforward with thorough dental plaque biofilm removal on a daily basis. But seriously ill patients in hospitals and in long-term care facilities who cannot care for themselves must rely on others for this care. Unfortunately, such oral care is often substandard or non-existent. Oral care in hospitals, nursing homes and long-term care facilities is considered an essential nursing activity.^{19,64} Thus, oral care may be delegated to nursing aides or medical assistants with less educational experience and information about oral care than registered nurses. A clean mouth is critical since the oral cavity is often the portal for life-sustaining interventions such as endotracheal intubation and orogastric tubes for nutrition. Intubated patients rely on nurses and other nursing staff to assist them with the alleviation of thirst, discomfort from orogastric or endotracheal tubes and, to remove accumulated saliva, sputum and dental plaque biofilms.¹⁵ The nursing literature describes the role of nurses in providing oral care to prevent aspiration pneumonias. Reasons that oral care is lacking for patients in hospitals and long-term care facilities and nursing homes is complex. Maintaining oral health in critically ill patients has traditionally been a challenge for nursing care staff. There is significant literature describing the important

Figure 2. Routes of colonization/infection in mechanically ventilated patients. Colonization of the aerodigestive tract may occur endogenously (A and B) or exogenously (C through F). Exogenous colonization may result in primary colonization of the oropharynx or may be the result of direct inoculation into the lower respiratory tract during manipulations of respiratory equipment (D), during using of respiratory devices (E), or from contaminated aerosols (F). Reprinted with permission from: Safdar N, Crnich CJ, Maki D. The pathogenesis of ventilator-associated pneumonia: its relevance to developing effective strategies for prevention. *Respir Care* 2005;50(6):725-41.



responsibilities of nurses regarding oral care for critically ill and long-term care patients.^{1-12,57} The nursing literature elucidates that nurses perceive oral care as a task provided primarily for patient comfort.^{1-8,19,20,57} As explained by Grap et al,¹⁹ since oral care is seen by some nursing staff as an intervention for patient comfort, this may lower the priority for nurses and may cause it to be performed less frequently. Nurses have indicated they do not like to perform oral care, and find the task unpleasant and difficult.¹⁻⁸ This is not a surprising finding, since nursing curricula is commonly deficient in oral care.⁶⁵ It is logical that most nurses would not embrace a task or responsibility for which they had received little or no information. There is also a void of evidence-based oral care protocols for critically ill patients and patients in long-term care facilities.^{19,20,65} Consequently oral care responsibilities are frequently ignored and/or not regularly performed.^{1-20,65,66} This occurs in spite of oral health care guidelines and federal regulations for oral care which stipulate provision of necessary care, services, and supplies to maintain oral hygiene, which includes providing the supplies for providing oral care.^{16,66,67} One study investigated the frequency and documentation of oral care interventions in critical care patients by intensive care nurses.¹⁸ Although the

nurses reported that they valued the contribution of oral care to patient's well-being, documentation of oral care was incongruent with the nurses' self-reports of their performance of oral care practices.¹⁸

In another study, certified nursing assistants in 5 nursing homes were to deliver their usual oral care to 67 dentate nursing home residents who were dependent on oral care (required supervision, reminding or encouragement).¹⁶ The investigators used a structured observation tool and timed the oral care provided. CNAs brushed the resident's teeth for an average 16.2 seconds; the residents who brushed their own teeth did so for an average of 39.3 seconds. Observers of this study described (1) CNA's making inappropriate statements about oral hygiene, (2) oral care provided with unclean gloves, sometimes contaminated with fecal matter, (3) care often provided with foam toothettes, which have been deemed inappropriate by an expert panel (dental hygienists, dentists and nurses) and the current literature.¹⁹ Reports of poor or nonexistent oral care for critically ill, long-term care residents and residents of nursing homes are found in professional journals and lay media. The earlier cited 2013 *New York Times* article described one woman's experience.²² She became

Figure 3. Illustration of ventilator tubing placement with consequent challenge of oral care delivery.



concerned at her father’s nursing home when she found dust on his electric toothbrush. Her father’s complaints of oral pain revealed a broken tooth with half of the tooth lodged in his palate. With more elderly individuals retaining natural teeth, more care is needed than was required with dentures in the past.

BARRIERS TO EFFECTIVE ORAL CARE

There are a number of barriers that have prevented the administration of effective oral care to prevent aspiration pneumonias. Booker et al,⁵⁷ identified 3 categories of barriers to effective oral care: system barriers, knowledge barriers and patient barriers.

System barriers

Hierarchy of medical care

Tradition dictates that only medical personnel provide therapeutic care in hospitals, ICUs, long-term care facilities and nursing homes. There has been very little collaboration between medicine and dentistry. *Guidelines for Preventing Health-Care-Associated Pneumonia* were published by the CDC in 2003.⁶⁸ These guidelines were developed by the *CDC and HealthCare Infection Control Practices Advisory Committee*, with no dental hygienist or dentist members. This lack of collaboration between medical and dental providers is unfortunate especially in the case of preventing aspiration pneumonias. Costs would be equivalent for a dental hygienist and a nurse to provide oral care to prevent aspiration pneumonia. Reports state that each case of VAP increases hospital costs \$10,000–\$40,000.^{13,57} Cost savings for preventing aspiration pneumonias would be in the hundreds of millions of dollars annually.^{19,25,26} Conducting research and developing evidence-based protocols for the prevention of

Table 2. Conditions associated with predisposition of patients to aspiration pneumonia

Category	Condition
Critically ill Intensive care	<ul style="list-style-type: none"> • Patients in intensive care units • Thoracic surgery patients • Endotracheal intubation • Pulmonary surgery
Altered level of consciousness Neurological disease Neuromuscular disease	<ul style="list-style-type: none"> • Alzheimer’s disease • Amyotrophic lateral sclerosis • Multiple sclerosis • Parkinson’s disease • Myasthenia gravis • Stroke • Seizures • Head trauma • Reduced consciousness (compromises cough reflex and glottic closure)
Aging	<ul style="list-style-type: none"> • Debilitated • Residents of nursing homes • Patients in long-term care facilities • Dysphagia
Gastrointestinal disorders	<ul style="list-style-type: none"> • Gastric reflux • Surgery • Nasogastric feeding
Miscellaneous	<ul style="list-style-type: none"> • Protracted vomiting • Recumbent positioning

aspiration pneumonia provides an ideal opportunity for interprofessional collaboration. Some interprofessional collaboration regarding the prevention of aspiration pneumonia has been initiated, although, dental hygienists and dentists were not always included in the collaborative efforts.⁶⁹ Interprofessional collaboration for the prevention of aspiration pneumonia should include appropriate health care stakeholders who have the knowledge and expertise to develop research and foster evidenced-based protocols. The core intercollaborative group could include dental hygienists, nurses and speech pathologists¹¹ and include other related professionals as indicated.

State laws governing dental hygiene practice and access to care

Some states, such as Nebraska, have laws that allow dental hygienists to provide care in nursing homes with a special permit; supervision by a dentist is not required. However, in other states the physician must write orders for oral care. In most, if not all states, there is usually a way for dental hygienists to legally provide oral hygiene prevention and therapeutic care in hospitals, long-term care facilities and

nursing homes, even if supervision is required. In states where is not within the scope of dental hygiene practice to provide oral preventive care in public health settings, hospitals, nursing homes and long-term care settings, new and urgent legislation is indicated. In states that require supervision of the dental hygienist by a dentist, a staff dentist or an 'on-call' dentist can legally provide supervision. In hospitals, the patient's physician or hospitalist may write orders for a dental hygienist to provide oral hygiene care; some states will allow dental hygienists to work under the supervision of a physician. Some hospitals, long-term care facilities and nursing homes employ dental hygienists while some entrepreneurial dental hygienists are business owners that hire dental hygienists to provide the care (see Naughton, *Direct Access Care: The Impact on Oral Health*, this publication).

KNOWLEDGE BARRIERS

Education issues

There are weaknesses in nursing educational curricula regarding oral assessment, oral pathology and preventive and therapeutic measures appropriate for hospitalized patients or patients in long-term care facilities or nursing homes.^{19,20} Furthermore, the link between oral health and systemic infections may not be as heavily emphasized in nursing/medical education as in dental/dental hygiene education. As Booker et al⁵⁷ point out, "The gap between evidence and practice is one of the most significant barriers to preventing hospital-acquired infections, such as VAP." The oral care procedures and products most described in the nursing literature are the sponge toothettes (which may be soaked in glucose), and the use of 0.2% chlorhexidine or iodophor rinses.^{18,44,53–58} These sponge toothettes are ineffective for dental plaque biofilm removal, a fact is clearly indicated in the nursing literature.¹⁹ Nevertheless, sponge toothettes are still the most widely used implement for oral care in institutions. Nurses need more education and experience in toothbrushing techniques, dental plaque identification, use of fluoride varnishes, and indicators of dental disease, such as hemorrhagic gingiva.

A review of 'fundamental' nursing textbooks published between 2006 and 2010, found outdated or erroneous information regarding oral hygiene.⁵⁷ Some of the erroneous information contained in the textbooks included statements that nurses should not floss the teeth of dependent patients. The use of sponge toothettes was promoted in 4 of the 7 textbooks, despite research indicating that soft bristled toothbrushes are safe and superior to the sponge toothettes for removing dental plaque and oral biofilms.⁵⁷

Clearly, there is an urgent need to reconstruct nursing curricula and textbooks to prepare nurses to deliver this most fundamental preventive health care task. Similarly, the educational programs of dental hygienists could provide greater emphasis on care for the ill and infirm and for palliative

oral care needs. Evidence-based protocols need to be taught that are specific for the prevention of aspiration pneumonias in patients with varying needs, such as patients with critical care needs, dysphagia, neurological disorders, dependent on ventilators and in long-term care facilities and nursing homes. Historically, the focus in dental hygiene educational programs has been on provision of care in clinical dental settings, with much less emphasis on care for critically ill or elderly people, particularly in institutional settings.

In states that disallow dental hygienists to treat patients or provide oral hygiene care to patients in hospitals, long-term care facilities or nursing homes, dental hygienists can provide educational classes and continuing education programs to nursing care providers, such as CNAs, licensed practical nurses, registered nurses and nurses with advanced degrees.

PATIENT BARRIERS

Patients with communication difficulties or sensory deficits may be uncooperative during oral care, especially if they are in an unfamiliar environment and are receiving care from individuals unknown to them. Patients who have dental fears or who are experiencing oral pain may also be uncooperative or combative. Patients without family advocates to insist that proper oral care is provided, may receive little to no oral care.

Some nurses find patient treatment equipment such as endotracheal tubes to be a barrier to the provision of oral care (see [Figure 3](#)). Nurses have reported that they have restricted access to the oral cavity due to the presence of the endotracheal tube and are fearful of dislodging the tube, causing discomfort or injury or causing the patient to aspirate.^{19,64,69}

There are ICU studies that indicate that oral care may not be provided the first 2 days in ICU⁵⁷ and is likely not to be provided during daytime hours. This 48-hour period is when the oral flora is susceptible to colonization by respiratory pathogens from the hospital or health care facility environment. Therefore, if oral care is not introduced and performed daily, the oral health of the patient deteriorates early in the hospitalization.

SOLUTIONS

Oral care to prevent and reduce aspiration pneumonias

Oral care interventions that have been most frequently researched include systemic antibiotics, topical oral chemical disinfection with antimicrobial mouth rinses and mechanical oral decontamination. The antimicrobial mouth rinses and gels include 0.12% chlorhexidine gluconate mouth rinse and 0.2% chlorhexidine gluconate gel (Europe). Mechanical oral decontamination protocols include self-toothbrushing and

professional mechanical plaque and calculus removal via toothbrushing and/or scaling by dental hygienists and/or dentists.

There is strong evidence that oral care can prevent and reduce the incidence of aspiration pneumonias. Literature shows that improved oral hygiene and frequent professional oral health care (POHC) have positive outcomes for high-risk elderly patients in the intensive care units of nursing homes.³¹ The occurrence of respiratory diseases and the overall incidence of aspiration pneumonia in this population were reduced by an average of 40% using protocols such as tooth brushing (mechanical plaque removal), oral disinfection and/or the use of antibiotics. It has been reported that randomized controlled trials that link oral hygiene status to pneumonias and respiratory tract infections in the elderly, "offer strong evidence that providing mechanical and oral hygiene may prevent one in ten cases of death from pneumonia and indicate a largely similar effect on the prevention of pneumonia."³¹

There seems to be a demarcation between mechanical dental plaque removal and chemical oral disinfection. Mechanical dental plaque removal consistently appears to be more effective throughout the literature than chemical oral disinfection alone. A meta-analysis evaluated a total of 11 randomized control trials that included the use of chemical oral disinfection for ventilated adult patients.⁷⁰ Oral antibiotics were utilized in 4 of the trials and did not significantly reduce the incidence of VAP. Conversely, the use of oral antiseptics did significantly reduce the incidence VAP. However, the pooling of the results of the 11 studies revealed that the use of oral antiseptics did lower the risk of VAP. However, neither antiseptic nor antibiotic oral decontamination reduced mortality or the length of time the ventilator was used or the length of stay in the intensive care unit.

OUTCOMES OF DENTAL HYGIENISTS PROVIDING ORAL CARE

As previously stated, the scientific evidence that colonized oropharyngeal bacteria are the primary etiology of aspiration pneumonias is strong,^{2-14,19-48,52-78} as is the evidence that prevention of aspiration pneumonia can be achieved with thorough dental plaque and biofilm removal on a daily basis.^{17,29,77} Strong evidence indicates that aspiration pneumonias are the major cause of morbidity and mortality among patients who are vulnerable to aspiration pneumonias. There is compelling research evidence that dental hygienists can produce pivotal outcomes in preventing aspiration pneumonia.

A 24-month study by Adachi et al,⁷⁶ evaluated the role of professional oral health care provided by dental hygienists to elderly nursing home residents. They examined oral health

care provided by the dental hygienists on the numbers and pathogenicity of oral microorganisms, respiratory pathogens, enzymatic activity in saliva, fevers, and the prevalence of influenza and aspiration pneumonia was examined. The investigators hypothesized that mechanical cleaning would be more effective than disinfectants or antibiotics for eliminating oral biofilms. To determine the effect of personal oral hygiene care on aspiration pneumonia, only the treatment group received daily personal oral hygiene care by dental hygienists. This consisted of brushing with a powered toothbrush, with an automatic water supply, an interdental brush and a sponge brush. The teeth, buccal mucosa and tongue and any removal prosthetic teeth were cleaned. The rate of fatal aspiration pneumonia was significantly lowered among the elderly nursing homes residents who received scaling and root planing, provided by dental hygienists. The scaling and root planing eliminated *Candida* species, which can colonize the oral cavity and produce *Candida* pneumonia.

Yoneyama et al,^{77,78} conducted a 2 year study in which dental hygienists and dentists provided once a week oral care to elderly in nursing homes. Nurses or caregivers provided tooth brushing for 5 minutes after every meal for dentate subjects, and edentulous subjects had their dentures or partials brushed every day with denture cleaner used once per week. The control group performed their own oral hygiene. The group receiving the combination of daily oral care by nurses or caregivers and once a week care provided by the dental hygienists and dentists showed a significant decrease in the number of elderly with febrile days, in newly diagnosed pneumonia and in death as a result of pneumonia.

INTERPROFESSIONAL COLLABORATION

Interprofessional collaboration can provide solutions for oral care for patients at high risk for all types of aspiration pneumonias. Dental hygienists have experience with oral biofilms, and equipment and techniques needed to access difficult to reach areas. Nurses have experience with techniques and medical equipment, such as central suction devices that can enhance oral care provided by dental hygienists in hospital or long-term care settings. Speech pathologists have expertise with detection of swallowing problems and have developed interventions and diagnostic tools that have assisted in decreasing aspiration pneumonias. Interprofessional collaboration provides an ideal opportunity to develop protocols that are beneficial to the patient and to the health care professionals providing the oral care. Inter collaboration of these professions to solve this health care issue addresses the goal of the Institute of Medicine of delivering 'patient-centered care as members of an interdisciplinary team, emphasizing evidence-based practice, quality improvement approaches, and informatics.'⁷⁹

CONCLUSION

Dental hygienists have the expertise and practice experience to provide oral care in hospitals, long-term care facilities and nursing homes. Yet, due to various long-standing barriers it may take more time, research, and interprofessional protocols to prevent aspiration pneumonias. Dental hygienists becoming better assimilated within the total health care team in hospital and residential facilities will likely have a positive impact on suffering, morbidity and mortality associated with aspiration pneumonias.

This manuscript is dedicated to the memory of my beloved parents, both who died due to nosocomial infections.

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