Issue 3

KNOWLEDGENETWORK
Kimberly-Clark Health Care Education

THE clinical issue

ORAL CARE IS CRITICAL CARE:
The Role of Oral Care in the Prevention of Hospital-Acquired Pneumonia

By Suzanne Pear, R.N., Ph.D., C.I.C.
Kathleen Stoessel, R.N., B.S.N., M.S.
Susan Shoemake, B.A.

Table of Contents:

Introduction

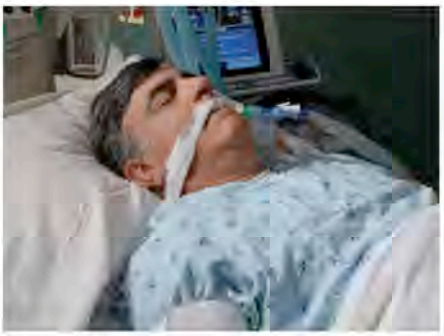
The cost of hospital-acquired pneumonia (HAP) can be staggering in terms of incidence, lives and dollars. HAP is the second most common cause of infection in healthcare. Pneumonia accounts for nearly 15% of all nosocomial infections and 24% to 27% of all those acquired in coronary care units and medical ICUs respectively.[1,2] When a patient develops HAP, it greatly increases the likelihood that the patient may require ventilatory assistance, also increasing the time a patient must receive mechanical support and the amount of supplemental oxygen required. Approximately 90% of the incidence of nosocomial pneumonia occurs in ventilated patients.

Pneumonia is the most frequent infection occurring in mechanically ventilated patients in the intensive care unit (ICU). Approximately 9% to 27% of ventilated patients may develop ventilator-associated pneumonia (VAP) - at a rate of 1 to 3% per day of intubation - a 6 to 20 fold higher risk of developing pneumonia compared to the non-ventilated ICU patient.[3-9] Additionally, patients with VAP have longer lengths of stay in the ICU by approximately 6 days and excess total hospital lengths of stay (LOS) averaging an additional 7-9 days.[10-14] (continued next page)

Kimberly-Clark
Trusted Clinical Solutions*

(Intro. continued)

In spite of extensive efforts to prevent and treat this complication, a mortality rate ranging from 25% to 70%,[13,14] the highest mortality rate for any healthcare-associated infection, is still associated with VAP and it is recognized that 60% of all HAI-related deaths are attributable to this infection.[12] Furthermore, even if patients do not die from the infection, the subsequent lingering debility can be severe.



Ventilated Patient

HAP and VAP also increase healthcare costs. In the United States alone, a hospital-acquired pneumonia typically increases the cost of care by as much as $40,000 dollars per episode[1,13,14] adding an estimated $1.2 billion dollars per year cost for the US healthcare system.[15]

Several organizations and institutions have recommended strategies and approaches in an effort to address this prevalent infectious disease.[11,16-18] Among the most commonly recommended prevention strategies is one that is often overlooked at the patient's bedside – comprehensive oral care. By understanding how hospitalized patients develop pneumonia and the evidence-based oral care strategies for reducing its occurrence, HAP/VAP can be prevented. Comprehensive *oral care is critical care*.

Definitions

Nosocomial Infection (NI)

A Nosocomial Infection is defined as an infection which occurs to a hospitalized patient at least 48 hours after admission and which was not present or incubating on admission.

Hospital-Acquired Pneumonia (HAP)

Hospital-Acquired Pneumonia (HAP) is defined as pneumonia that develops at least 48 hours after admission and the infection was not present or incubating on admission. A quarter of a million cases of HAP occur in the United States each year.[1]

Ventilator-Associated Pneumonia (VAP)

A subset of HAP, Ventilator-Associated Pneumonia (VAP) refers to those cases that occur in patients who have been on ventilatory support for at least 48 hours. The mechanisms for HAP and VAP infections are similar, although due to the fact that host defenses against pneumonia are bypassed by an endotracheal tube, the risk of pneumonia in ventilated patients is much higher.[1]

Risk Factors for Pneumonia

Most, if not all, hospitalized patients are susceptible to pneumonia due to risk factors such as:[2]

- **coma**
- **malnutrition**
- **supine position**
- **extremes of age**
- **insertion of nasogastric tube**
- **administration of tube feedings**
- **severe underlying conditions**

- **compromised immune system**
- **admission to the intensive care unit**
- **administration of antimicrobial agents**
- **immobilization due to trauma or illness**
- **initial or repeat endotracheal intubation**
- **presence of underlying chronic lung disease**
- **conditions requiring prolonged use of mechanical ventilatory support**
- **surgical procedure involving the head, neck, thorax or upper abdomen**

Ventilated patients are especially susceptible to pneumonia as their normal host defenses are hampered, blocked or disabled during mechanical ventilation by the physical presence of the assisted-breathing device. Bacteria and other microorganisms, which are normally blocked or carried away from the respiratory tract, have the ability to bypass the normal body defenses and enter the lungs.

The Path to VAP

When there is an endotracheal tube (ET tube) in place, all normal functions change. Foreign body reactions in the tracheal tissues may occur and extreme pressures from the cuff can injure the tracheal wall, potentially causing long-term damage.[3] The ET tube may also provide an environment wherein a biofilm may form and proliferate. Furthermore, its presence impairs natural host protection and secretion clearance mechanisms in many ways. (See Figure 1)

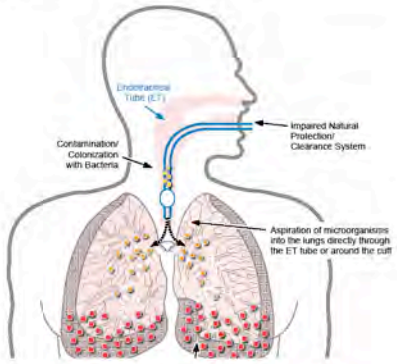


Figure 1. Pathway to VAP

Bypasses Normal Filtration

The ET tube bypasses the normal filtration and physical capture functions by prohibiting nasal warming and humidification. This lack of warming decreases the ability of the air to carry moisture. The lack of humidity causes the mucus to become dried, thickened, and difficult to transport, thus allowing clumps to develop. These normally moist patches of oral and pulmonary tissues become more vulnerable to injury and infection.[3]

Compromises Mucociliary Clearance Mechanism

The mucociliary clearance mechanism is also compromised by the presence of the ET tube.[4] In many ways, the ET tube acts as a direct conduit for pathogen access into the lungs.[4,5] It blocks and disrupts normal mucus clearance via the mucociliary escalator above the ET

tube cuff by interfering with swallowing and forcing the epiglottis into an open position. Secretions accumulate above the cuff,[5] drain to the back of the throat and contaminate the subglottic pool[5] providing an environment where normal flora and potentially pathogenic bacteria can rapidly multiply.[5] Also, by keeping the trachea's "trap door" open,[3] contaminated secretions can drain into the trachea through the glottis between the vocal cords instead of into the esophagus.[5] These secretions may then leak around the ET tube cuff and be apirated into the lungs.

The ET tube also affects the function of the mucociliary escalator *below the cuff* as the movement of mucus from the trachea and lungs past the cuff is prohibited. Therefore, the mucus accumulates in the trachea below the distal tip of the ET tube until it is manually removed.[3] If not suctioned away, this bacteria-laden mucus and any dislodged biofilm particles can clog the opening of the ET tube or fall into the lungs.[3]

Inhibits the Cough Mechanism

Inhibiting the cough mechanism is another negative consequence of intubation. The patient is usually sedated, thus muting physical responsiveness and normal responses to the presence of excess secretions. The ET tube blocks the cough reflex[4] and positive pressure from the ventilator also pushes against any efforts to cough.

As this cycle of contamination, pathogen multiplication and aspiration continues, these pathogenic microorganisms may overwhelm the body's antibacterial defenses and the patient develops pneumonia.

The Role of the Oral Environment in the Development of Pneumonia

Because of the role contaminated oropharyngeal secretions play in the path to VAP, it is important to have a thorough knowledge of the microbiological environment of the mouth and the changes which occur when a patient becomes critically ill, is hospitalized and is placed on a ventilator.

Microbial Environment

Most oral bacteria are considered to be part of the patient's normal flora and may consist of up to 350 different species. These various organisms possess a tendency to colonize different surfaces in the mouth. For example, *Streptococcus mutans, Streptococcus sanguis, Actinomyces vicosus and Bacteroides gingivalis* mainly colonize the teeth while *Streptococcus salivarius* mainly colonize the dorsal tongue. Finally, *Streptococcus mitis* is found on both buccal and tooth surfaces.[6] These flora are usually considered low-level pathogens which may take years or decades to produce disease. (See Figure 2)

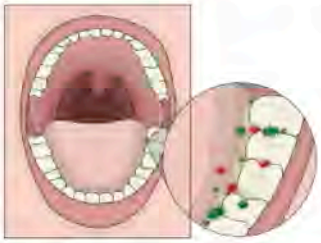


Figure 2. Oral Niches of Microbial Contamination

The oral flora of critically ill patients differs from that of healthy individuals and contains organisms that can rapidly cause pneumonia. Within 48 hours of admission, the composition of the oropharyngeal flora of critically ill patients undergo 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 cause VAP.[7] Also, increased levels of proteases in the oral secretions of critically ill patients removes from their epithelial cell surfaces a glycoprotein substance called fibronectin. Normally, fibronectin is present on cell surfaces and acts as a host defense mechanism, blocking pathogenic bacterial attachment to oral and tracheal mucus membranes. This depletion of fibronectin allows cell receptor sites to replace normal flora with virulent pathogens such as *Pseudomonas aeruginosa* on buccal and pharyngeal epithelial cells.[6]

If the intubated patient does not receive effective, comprehensive oral hygiene, dental plaque and hardened bacterial deposits 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.[8]

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] (See Figures 3 and 4)

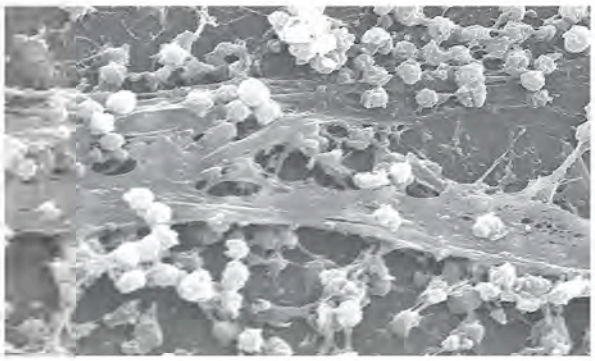


Figure 3. Biofilm with Glycocalyx
(Micrograph courtesy of Janice Carr, CDC, Atlanta)

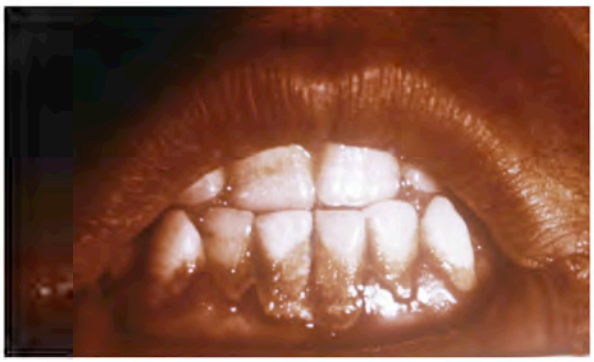


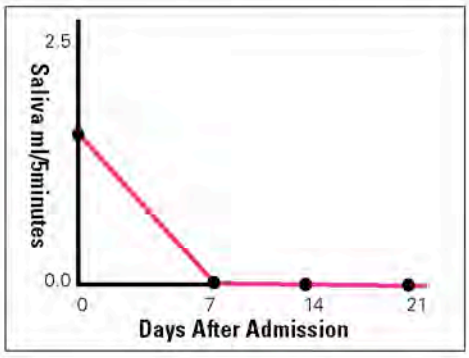
Figure 4. Dental Plaque
(Photograph courtesy of CDC, Atlanta)

Saliva

Saliva is also critical for the oral environment. The continuous production of saliva is essential to keeping the mouth and its components clean and moist. By definition, saliva is a mixed fluid secreted predominantly from the parotid, submandibular and sublingual glands. It has a number of important functions such as washing food debris and unattached microorganisms from the mouth. It neutralizes acids produced by bacteria on tooth surfaces and because it contains calcium and phosphorus, works together with fluoride in the remineralization of tooth surfaces. 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]

In the intensive care patient, a severe reduction of salivary flow and subsecuent xerostomia (dry mouth)[10] and subsequent mucositis (oral inflammation)[11] may result in oropharyngeal colonization with respiratory pathogens, expediting the progression to VAP. During the day, in the healthy individual, unstimulated salivary flow ranges from 0.25 to 0.35 mL/min while stimulated flow may reach quantities of 4 to 6 mL/min. Severe xerostomia is defined as an unstimulated salivary flow of less than 0.1 mL/min.[12] Conditions in the critically ill which impact salivary flow include fever, diarrhea, burns, reduced fluid intake and a number of medications such as opiates, anticholinergics and diuretics.[13]

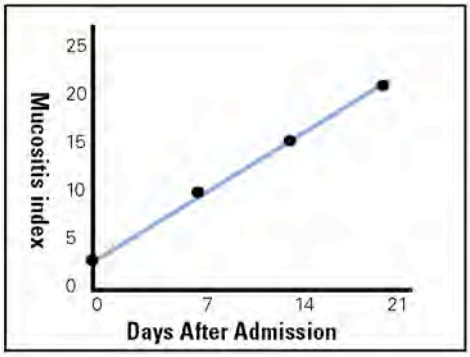
Studies by Dennesen et al. have documented a nearly absent salivary flow in intubated, sedated ICU patients (See Graph 1) which can be explained by several circumstances such as the severity of the disease resulting in intubation and admission to the ICU, lack of normal oral intake, fluid balance disturbances or extended use of morphine required because of controlled mechanical ventilation or pain management.



Graph 1. Salivary Flow and Days in ICU

Apart from the inadequate flow, the saliva is not distributed throughout the oral cavity in a supine, sedated patient and severe xerostomia with its resultant mucositis is therefore generally present in ICU patients, as seen in Graph 2.

As mucositis or oral inflammation increases in the intubated patient's mouth, the level of oral bacteria increases as well. The greater the level of oral bacteria, the more biofilm will attach to the patient's teeth. Allowing build-up of biofilm (dental plaque) increases the bacterial load in oropharyngeal secretions.



Graph 2. Mucositis Index and Days in ICU

All patients aspirate secretions, even non-ventilated patients. The greater the amount and microbial contamination of aspirated secretions, the more likely pneumonia will occur.

Oral Care Interventions and the Evidence-Based Rationales

Several organizations and patient safety initiatives, including the Centers for Disease Control and Prevention (CDC),[2] the Association for Professionals in Infection Control and Epidemiology (APIC),[13] Institute for Healthcare Improvement (IHI),[14,15] and the American Association of Critical Care Nurses (AACN)[16] have developed evidence-based patient-care treatment practices for reducing the occurrence of HAP and VAP.

Component	CDC	APIC	IHI	AACN
Head of bed elevation (semi-recumbent patient positioning 30°- 45°)	✔	✔	✔	✔
Daily "sedation vacation" and daily assessment of readiness to extubate	✔	✔	✔	
Peptic ulcer disease (PUD) prophylaxis	✔	✔	✔	
Reilable, comprehensive oral hygiene program	✔	✔	✔	✔
Cleaning of equipment	✔	✔		
Avoid routinely replacing ventilator circuts	✔	✔		✔
Hand Hygiene	✔	✔		
Subglottic secretion drainage - continuous or intermittent	✔	✔		✔
Prevention of oropharyngeal colonization	✔	✔		

Table 1. Recommended VAP Prevention Strategies by Organizaton.

Comprehensive oral hygiene has consistently been recognized as critical to the prevention of pneumonia in the hospitalized patient. (See Table 1) The CDC Guidelines for Preventing Healthcare-Associated Pneumonia recommend making comprehensive patient oral hygiene standard practice as a VAP prevention strategy. Routine oral decontamination is an effective method for reducing VAP by decreasing the microbial load in the oropharyngeal cavity.

It has been found that the incorporation of routine oral hygiene into standard practice may reduce VAP by as much as 60%.[11]

Most important for all patients is that the health care institution have a written oral care protocol and training plan in place with the goal of ensuring that all patients receive comprehensive oral care in a consistent manner and reliably performed as indicated. There are a number of oral care interventions that all hospitalized patients should receive and a few additional ones that are specific to ventilated patients.

Recommended Oral Care Interventions for ALL Hospitalized Patients[17]

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 concerns.

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 containing additives which 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 chlorhexidine gluconate (CHG)-based rinses have been shown to assist in cleaning debris buildup and 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 provides regions for bacterial proliferation. A water-soluble moisturizer allows tissue absorption and added hydration.
- 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.

Recommended Oral Care Interventions for Ventilated Patients[17]

Assessment of Oral Cavity

- 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 and early identification of oral hygiene problems and for continued observation of oral health.

Maintain Saliva

- Intervention: Unit specific protocols should be implemented that assist patients at risk of VAP in maintaining saliva production, oral tissue health and minimizing development of mucositis.
- Rationale: Saliva provides both mechanical and immunological effects which act to remove pathogens colonizing the oropharynx.

Elevate Head

- Intervention: Keep head of bed elevated at least 30° [unless medically contraindicated], and position patient so that oral secretions pool into the buccal pocket; especially important during such activities as feeding and brushing teeth.
- Rationale: Elevation aids in preventing reflux and aspiration of gastric contents; oral secretions may drain into the subglottic area where they can become rapidly colonized with pathogenic bacteria.

Subglottic Suctioning

- Intervention: Patients' oral and subglottic secretions should be suctioned continuously or intermittently/routinely with the frequency dependent upon secretion production.
- Rationale: Minimize aspiration of contaminated secretions into lung.

Centers for Disease Control & Prevention (CDC) Healthcare Infection Control Practices Advisory Committee (HICPAC)[16]

Prevention of Health-Care–Associated Bacterial Pneumonia
IV. Modifying Host Risk for Infection

B. Precautions for prevention of aspiration

3. Prevention or modulation of oropharyngeal colonization
   a. Oropharyngeal cleaning and decontamination with an antiseptic agent: develop and implement a comprehensive oral-hygiene program (that might include the use of anantiseptic agent) for patients in acute-care settings or residents in long-term–care facilities who are at high risk for healthcare–associated pneumonia (II) (156,157).
   b. Chlorhexidine oral rinse
      1) No recommendation can be made for the routine use of an oral chlorhexidine rinse for the prevention of healthcare–associated pneumonia in all post operative or critically ill patients and/or other patients at high risk for pneumonia (Unresolved issue) (II) (158).
      2) Use an oral chlorhexidine gluconate (0.12%) rinse during the perioperative period on adult patients who undergo cardiac survery (II) (158).
   c. Oral decontamination with topical antimicrobial agents.
      1) No recommendation can be made for the routine use of topical antimicrobial agents for oral decontamination to prevent VAP (Unresolved issue) (159).

Association of Critical-Care Nurses (AACN)[36]

"Assess oral cavity and lips every 8 hours, and perform oral care every 2 to 4 hours and as needed.[1] With oral care, assess for build-up of plaque on teeth or potential infection related to oral abscesses."

"Perform oral hygiene, using pediatric or adult (soft) toothbrush, at least twice a day. Gently brush patient's teeth to clean and remove plaque from teeth."[1]

"In addition to brushing twice daily, use oral swabs with a 1.5% hydrogen peroxide solution to clean mouth every 2 to 4 hours."[1]

"With each cleansing, apply a mouth moisturizer to the oral mucosa and lips to keep tissue moist."[1]

"Suction oral cavity/pharynx frequently."[2]

Conclusion

Pneumonia is a prevalent, morbid infectious disease that accounts for approximately 15% of all hospital-acquired infections. Due to the severity of this disease, it is imperative that medical personnel become knowledgable about risk factors associated with the development of hospital-acqu red pneumonia and the evidence-based prevention strategies that should be routinely incorporated into patient care practice. Ventilated patients are especially at risk for pneumonia as their normal host defenses and secretion clearance mechanisms are disrupted by assisted-breathing devices. Establishing and following effective pneumonia prevention strategies is essential in reducing the occurrence of HAP/VAP. One basic prevention strategy that is often overlooked in today's complex and turbulent healthcare environment is a comprehensive oral care protocol. So that clinicians appreciate how essential the provision of reliable oral care is to optimal patient outcomes and prioritize care appropriately, they must have a thorough understanding of the oral environment's role in the development of pneumonia. By incorporating a comprehensive oral care protocol into the facility's current VAP reduction bundle of best practices, patient lives can be spared and financial resources can be saved!

COMPREHENSIVE ORAL CARE REALLY DOES MAKE A DIFFERENCE! Oral Care Is Critical Care for All Patients

Accredited Education on this Topic:

A CE accredited, speaker facilitated presentation and an in-depth study guide on this topic is available through your Kimberly-Clark Sales Representative.

References

1. American Thoracic Society, Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumon a. Am J Respir Crit Care Med. 171[4], 388-416. 2-15-2005.

2. Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R. Guidelines for preventing health-care–associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. MMWR Recomm Rep 2004 Mar;53(RR-3):1-36.

3. Hixson S, Sole M, King T. Nursing Strategies to Prevent Ventilator-Associated Pneumonia. AACN 1998 Feb;9(1):76-90.

4. Safdar N, Crnich CJ, Maki DG. The pathogenesis of ventilator-associated pneumonia: its relevance to developing effective strategies for prevention. Respir Care 2005 Jun;50(6):725-39.

5. [Anonymous]. Airway Management. In: Hess D, Kacmarek R, editors. Essentials of Mechanical Ventilation. 2nd ed. New York: McGraw-Hill; 2002. p 295-306.

6. Gibbons RJ. Bacterial adhesion to oral tissues: a model for infectious diseases. J Dent Res 68[5], 750-760. 1989.

7. Munro CL, Grap MJ. Oral health and care in the intensive care unit: state of the science. Am J Crit Care 2004 Jan;13(1):25-33.

8. Berry AM, Davidson PM. Beyond comfort: Oral hygiene as a critical nursing activity in the intensive care unit. Intensive Crit Care Nurs 2006 Jun.

9. Bagg J ea. The oral microflora and dental plaque. Essentials of microbiology for dental students. Oxford: Oxford University Press; 1999. p 229-310.

10. Adachi M, Ishihara K, Abe S, Okuda K, Ishikawa T. Effect of professional oral health care on the elderly living in nursing homes. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002 Aug;94(2):191-5.

11. Scannapieco FA, Wang B, Shiau HJ. Oral bacteria and respiratory infection: effects on respiratory pathogen adhesion and epithelial cell proinflammatory cytokine production. Ann Periodontol 2001 Dec;6(1):78-86.

12. Dennesen P, van d, V, Vlasveld M, Lokker L, Ramsay G, Kessels A, van den KP, van Nieuw AA, Veerman E. Inadequate salivary flow and poor oral mucosal status in intubated intensive care unit patients. Crit Care Med 2003 Mar;31(3):781-6.

13. APIC. Preventing Ventilator Associated Pneumonia. Infection Control Week 2004 Brochure. 8-1-2007.

14. IHI. Protecting 5 Million Lives From Harm Campaign. Getting Started Kit: Preventing Ventilator-Associated Pneumonia How-to Guide. Online . 8-1-2007.

15. Stogsdill V, Hobgood L, O'Bryan S, O'Bryan W, Thompson L, Sisley M. Reducing Ventilator-Associated Pneumonia. http://www.ihi.org/IHI/Topics/CriticalCare/IntensiveCare/ImprovementStories/ReducingVentilatorAssociatedPneumoniaOwensboro.htm. 8-1-2007.

16. Scott J, Vollman K. Procedure 4. Endotracheal Tube and Oral Care. In: Wiegand D, Carlson K, editors. AACN Procedure Manual for Critical Care. 5th ed. St. Louis: Elsevier Saunders; 2005. p 28-33.

17. Garcia R. A review of the possible role of oral and dental colonization on the occurrence of health care-associated pneumonia: underappreciated risk and a call for interventions. Am J Infect Control 2005 Nov;33(9):527-41.

At Kimberly-Clark, our mission is to deliver clinical solutions that you can depend on to meet the demands of your fast-paced world. Whether your needs involve preventing healthcare-associated infections, surgical and digestive solutions or pain management, with Kimberly-Clark you'll always have one less worry.

Healthcare-Associated Infection Solutions

Surgical Solutions

Digestive Health

Pain Management

Commitment to Excellence

If, for any reason, our products do not meet your expectations, please let us know your comments or suggestions for improvement. Your input will result in a concerted effort on our part to meet your requirements. Our goal is to provide quality products that completely meet your needs time after time.

For more information, please call your Kimberly-Clark representative or visit our web site at www.kchealthcare.com.

Kimberly-Clark

*Trusted Clinical Solutions**

H0546-07-01