Health Goes South
When Pathogens
and Reflux Linger in
the Mouth

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Objectives

- Describe how the mouths of critically ill patients undergo radical changes to become reservoirs of pathogens
- Identify the means by which poor oral care in the ICU can result in complications including pneumonia
- List recommended oral care interventions and the associated evidence-based rationales

PNEUMONIA

<table>
<thead>
<tr>
<th>HAP</th>
<th>COMMUNITY-ACQUIRED PNEUMONIA</th>
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<tr>
<td>275,000 US cases</td>
<td>3 million US cases</td>
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2014 National Hospital Discharge Survey
Carol J. DeFrances, Ph.D., and Michele N. Podgornek, M.P.H., CDC Division of Health Care Statistics
The Cost of HAP & VAP in Lives and $$

Incidence:
- 3rd most common cause of infection in healthcare - 250,000/year
- 2nd most common infection in ICU - 100,000/year
- One out of four ICU infections is HAP or VAP
- 90% of ICU pneumonias is VAP
- 6-20 fold higher risk of pneumonia in vented patients
- 9%-27% of ventilated patients
- Higher VAP rate in Medical ICUs

Mortality rate:
- Highest infection mortality - 36% of HAI deaths
- Crude: 30-70% of HAP patients
- Attributable: 33-56%
- VAP 15%-50% higher than non-ventilated HAP patients

Increased costs:
- $40,000 per incident
- Additional mean ICU Length of Stay of 6 days
- Additional Total Hospital LOS 7-9 days

Clinical Presentation of Pneumonia

• Purulent secretions
• Densities on Chest x-ray
• Fever
• Leukocytosis (high wbc)

Early and Late VAP

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<th>Time</th>
<th>Pathogens</th>
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| Early Onset VAP          | Pneumonia that develops between 48-96 hours after being placed on the ventilator | Usually include:  
• Staphylococcus aureus (Methicillin sensitive-MSSA)  
• Haemophilus influenzae  
• Streptococcus pneumoniae |
| Late Onset VAP           | Pneumonia that develops after 96 hours (25 days) on ventilator              | Usually include:  
• Staphylococcus aureus (Methicillin resistant – MRSA)  
• Pseudomonas aeruginosa  
• Acinetobacter or Enterobacter |

Why are Ventilated Patients more susceptible to Pneumonia?

1. Air filtration in nasal cavity
2. Mucociliary escalator
3. Cough mechanism

Bypassed
Blocked
Inhibited

Normal Clearance Mechanisms and Reflexes are:

The Path to VAP
The Path to VAP
Aspiration pneumonia

- 30% of those who die of pneumonia are diagnosed with aspiration pneumonia.
- Most common cause of death in patients with dysphagia due to neurologic disorders.
- 5 to 15 percent of cases of community-acquired pneumonia (CAP) are aspiration pneumonia.
- Incidence of aspiration pneumonia is 18 percent in nursing home-acquired pneumonia (HCA).
- Aspiration pneumonitis occurs in approximately 10 percent of patients who are hospitalized after a drug overdose.
- Occurs in approximately 1 of 3000 operations in which general anesthesia is administered and accounting for 10 to 30 percent of all deaths associated with anesthesia.

Aspiration Definitions

- **Aspiration**: the inhalation of oropharyngeal or gastric contents into the larynx and lower respiratory tract.
- **Aspiration pneumonitis** (Mendelson’s syndrome): a chemical injury caused by the inhalation of sterile gastric/bile contents. Also known as "chemical pneumonitis" or "acid pneumonitis".
- **Aspiration pneumonia**: an infectious process caused by the inhalation of oropharyngeal secretions that are colonized by pathogenic bacteria.
- Both conditions can overlap in one patient.
- Other aspiration syndromes include airway obstruction, lung abscess, exogenous lipoid pneumonia, chronic interstitial fibrosis, and **Mycobacterium fortuitum pneumonia**.
Aspiration pneumonitis

**Clinical Features**
- Abrupt onset of symptoms with prominent dyspnea
- Fever, which is usually low grade
- Cyanosis and diffuse crackles on lung auscultation
- 12-36% develop superinfections
- Severe hypoxemia and infiltrates on chest imaging involving dependent pulmonary segments.
- Abnormalities typically appear within two hours.
- Bronchoscopy, if performed, demonstrates erythema of the bronch, indicating acid injury.

**Treatment**
- Immediate tracheal suction if observed aspiration
- Support pulmonary function.
  - Positive pressure ventilation.
  - High molecular weight colloids given intravenously
  - Sodium nitroprusside infused into the pulmonary artery.
- Ventilation in patients with respiratory failure
- Antibiotics if no infiltrates develop

Aspiration pneumonia

**Clinical Features**
- Indolent symptoms
- A predisposing condition for aspiration, usually compromised consciousness due to drug abuse, alcoholism, or anesthesia; or dysphagia
- Absence of rigors
- Failure to recover likely pulmonary pathogens with cultures of expectorated sputum
- Sputum that often has a putrid odor
- Concurrent evidence of periodontal disease
- Radiograph or computed tomography (CT) scans showing evidence of pulmonary necrosis with lung abscess and/or an empyema
Aspiration Pneumonia Microbiology in CAP
- Anaerobes
  - Peptostreptococcus
  - Fusobacterium nucleatum
  - Prevotella
  - Bacteroides
- Aerobic and Microaerophilic streptococci

Aspiration Pneumonia – Microbiology in HAP
- Anaerobes
  - Peptostreptococcus
  - Fusobacterium nucleatum
  - Prevotella
  - Bacteroides
  - S. aureus
- Gram negative bacilli
  - Pseudomonas aeruginosa
  - Acinetobacter baumanii
  - Klebsiella pneumonia
  - Escherichia coli

Aspiration Pneumonia Treatment
- Antibiotics
  - Depends upon risk factors, length of stay, history of MDROs, ventilated etc
- Duration: Not well studied; 7-10 days
Role of Sinusitis in VAP

- Study suggests a link between the onset of sinusitis and the development of VAP.
- 40% of patients with positive sinus cultures (42/105) exhibited the same microorganisms in bronchotracheal aspirates.
- Early treatment of sinusitis may "significantly reduce the risk of VAP."

http://ccforum.com/content/9/5/r583

Pneumonia: Prevention is Primary!

Prevention, 1 ounce = Cure, 1 lb.

"Bundle Approach" requires 100% compliance on several key procedures
Evidence-Based Strategies for VAP Elimination

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<th>Component</th>
<th>CDC</th>
<th>APIC</th>
<th>IHI</th>
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<tr>
<td>Head of bed elevation (Semi-recumbent, patient positioning 30°-45°)</td>
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<td>Daily “sedation vacation” and daily assessment of readiness to extubate</td>
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<td>Peptic ulcer disease (PUD) prophylaxis</td>
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<td>Reliable, comprehensive oral hygiene program</td>
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<td>Cleaning of equipment</td>
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<td>Avoid routinely replacing ventilator circuits</td>
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<td>Hand hygiene</td>
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<tr>
<td>Subglottic secretion drainage – continuous or intermittent</td>
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<tr>
<td>Prevention of oropharyngeal colonization</td>
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THE MOUTH’S ROLE IN THE DEVELOPMENT OF HAP/VAP
Oral Contribution to Pneumonia

“that there was a distinct divergence between the oral bacteria of mechanically ventilated intensive care unit (ICU) patients who developed pneumonia and those who did not”

“In the case of hospitalized adults on mechanical ventilators, the change in bacteria preceded the development of pneumonia… This suggests that changes in oral bacteria play a role in the risk for developing pneumonia.”

Samit Joshi, DO, MPH November 18, 2011

Ecology of the Mouth

Oral bacteria are usually “normal flora” with up to 350 different species

- Streptococcus mutans, Streps. sanguis, Actinomyces viscosus and Bacteriodes gingivalis normally colonize teeth. Str. salivarius colonizes dorsal tongue and S. mitis on buccal/teeth surfaces.


The Tongue is Germ-laden

The dorsal posterior aspect of the tongue contains layers of debris and harbors millions of organisms.
Ecology of the Mouth

Within 48 hours changes from streptococci and dental low virulence pathogens to gram negative organisms.

Munro, CL; and Grap MJ. Oral health measurement in nursing research: state of the science. Amer Jour Crit Care 2004, 13(1) 25-33.

Normal Saliva Functions

- Washes unattached microorganisms from the mouth
- Contains a number of immune substances which prevent colonization with pathogenic organisms:
  - immunoglobulin A obstructs microbial adherence in the oral cavity
  - lactoferrin which inhibits bacterial infection in the healthy individual


Ecology of the Mouth

- During critical illness
  - increased production of proteases in oral secretions removes the glycoprotein – fibronectin from cell surfaces
  - allows attachment of gram-negative bacteria, such as Pseudomonas aeruginosa to buccal and pharyngeal cell surfaces
Ecology of the Mouth

- Biofilm and plaque formation follow, allowing large amounts of microorganisms to be stored in the mouth.

![Scanning electron micrograph of a Staphylococcal biofilm on the inner surface of an indwelling medical device. Bar, 20 µm. Used with permission of Rodney M. Donlan, Ph.D. and Janice Carr, CDC.]

Xerostomia & Mucositis

- Xerostomia, severely reduced salivary flow and dry mouth, is common in ICU patients due to fever, diarrhea, reduced intake and medication side effects.

- Mucositis, inflammation of oral mucous membranes, follows - resulting in increased oropharyngeal colonization with respiratory pathogens.

![Xerostomia & Mucositis image]

Impact of Salivary Flow on Mucositis Development

![Graph showing the impact of salivary flow on mucositis development.]

- ↑ICU stay = ↓saliva
- ↓saliva = ↑mucositis

Dental Plaque Development

↓saliva → ↑mucositis

↑mucositis → ↑oral bacteria

↑oral bacteria →↑teeth biofilm/plaque

Suppressed Oral Functions

- Secretions of mucosal resting saliva + residue in the oral epithelium= sticky paste
- Since the self-cleaning function of the oral cavity is not working, the oral mucous membrane is not replaced.
- Mucous remains on the palate and tongue becomes coated.

If the intubated and/or critically ill patient does not receive effective oral hygiene, then bacterial plaque develops on the teeth within 72 hours.

Beyond comfort: Oral hygiene as a critical nursing activity in the intensive care unit
Berry, AM, & Davidson, PM. Intensive and Critical Care Nursing, June 23, 2006.

As Dental Plaque Increases, So Does the Risk of Pneumonia


Damage to Oral Hard Tissue

- Multiple cases of dental caries at the tooth cervix
- Crown may rot away with residual roots left
- Food adheres to root leading to plaque
- Bad breath pervades the entire room (increased risk of aspiration pneumonia)


Comprehensive Oral Care Program

Optimal oral care should focus on plaque removal and stimulation of salivary flow

**Recommended Oral Care Interventions for ALL Hospitalized Patients**

**Interventions**
- Written oral care protocol
- Staff education in comprehensive oral care
- Conduct an initial admission assessment of the patient's oral health and self-care deficits
- Use a small, soft toothbrush
- Brush teeth, tongue and gums at least twice daily to remove dental plaque
- Foam swabs or gauze should not be used for plaque removal, as they are not effective tools for this task


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**Recommended Oral Care Interventions for ALL Hospitalized Patients**

**Interventions**
- Use an alcohol-free, antiseptic rinse
- Use a water-soluble moisturizer to assist in the maintenance of healthy lips and gums at least once every two hours
- Avoid using lemon-glycerin swabs for oral care to moisten oral mucosa


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**Additional Recommended Oral Care for the Ventilated Patient**

**Interventions**
- Conduct an initial admission and daily assessment of the lips, oral tissue, tongue, teeth, and saliva of each patient on a mechanical ventilator
- Keep head of bed elevated at least 30° position patient so that oral secretions pool into the buccal pocket; especially important during feeding, brushing teeth, etc.

Oral Decontamination

Routine oral decontamination
- written policy and training should be in place
- decontamination with an antiseptic agent
- Chlorhexidine rinse recommended by many


What about Chlorhexidine Gluconate (CHG) Mouth Rinse?

Two meta-analyses report that although CHG may reduce the incidence of VAP, it doesn’t reduce time on the ventilator or lower the mortality rate.


really

DOES ORAL CARE MAKE A DIFFERENCE?
Question: What is the current practice of oral care in the Adult ICU?

STUDY #1
- Study Objectives:
  - To assess the oral status of patients in an ICU
  - Evaluate the effects of a defined oral care protocol on patients’ oral health


What is the current practice of oral care in the Adult ICU?

STUDY #1
- Findings:
  1. Nurses have not been formally trained in assessing oral status of patients in ICUs
  2. Comprehensive Oral Care resulted in decreased oral inflammation, candidiasis, purulence, bleeding, and plaque

- Conclusion:
  - Implementation of a well-developed oral care protocol by bedside nurses can improve oral health of ICU patients


Question: Does Reduction in Oral Microbial Colonization and Dental Plaque Reduce VAP

Study #2
- Background
  - All ventilator patients from Jan 2002-Dec 2002 received standard oral care – yankauer suction and glycerin swabs
  - All ventilator patients from Jan 2003-Dec 2003 received comprehensive oral care, including daily oral assessment, brushing, oral and orotracheal suctioning, hydrogen peroxide rinse, oral mucosa moisturizer, and covered yankauer

Reduction in Oral Microbial Colonization and Dental Plaque Reduces VAP

Study #2
- Results
  - Rate of VAP was reduced 42.1% in the intervention group
- Conclusion
  - Careful assessment and improved oral care reduces contaminated aspirates and subsequent VAP


Factors Affecting Quality of Oral Care in ICUs

Study #3
- 556 nurses surveyed
- 102 institutions
- response rate of 83%

Furr, L; Allen, B; Binkley, C; McCurren, C; Carrico, R. J. Adv. Nurs 2004;48(5):454-456.

Factors Affecting Quality of Oral Care in ICUs

FINDINGS:
- Nurses need oral care education
- Problem having sufficient time to provide care
- Problem prioritizing oral care
- View oral care as unpleasant

Furr, L; Allen, B; Binkley, C; McCurren, C; Carrico, R. J. Adv. Nurs 2004;48(5):454-456.
Factors Affecting Quality of Oral Care in ICUs

CONCLUSION:
Improving oral care is a multi-layered task

RECOMMENDATIONS:
- Reinforce proper oral care through education
- De-sensitize nurses to the often-perceived unpleasantness of cleaning oral cavities
- Monitor compliance and identify barriers to care


Questions?

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