Improving oral health in critically ill adults

Cindy L. Munro
RN, ANP-BC, PhD, FAAN, FAANP, FAAAS
Associate Dean of Research and Innovation
University of South Florida College of Nursing
Oral Health

- Xerostomia (dry mouth)
  - increased cavity risk
- Gingival disease
  - hyperplasia
  - gingivitis
- Periodontal disease

Systemic Health

- Respiratory
  - pneumonia
- Cardiovascular
  - endocarditis
  - bacteremia
  - atherosclerosis
- Endocrine
  - diabetes mellitus control
- Reproductive
  - preterm birth
- Quality of life

Xerostomia (dry mouth) can increase cavity risk. Gingival disease includes hyperplasia and gingivitis. Periodontal disease is also a concern. Respiratory issues like pneumonia are linked. Cardiovascular conditions such as endocarditis and bacteremia are associated. Endocrine conditions like diabetes mellitus control are important. Reproductive health, including preterm birth, is influenced. Quality of life is also impacted.
Nursing
Ventilator-associated
Oral care
Pneumonia
Parasanguinis
Mechanically ventilated
Critical care
Endocarditis
Streptococcus
Ventilator Associated Pneumonia in the 1990’s

• Leading cause of nosocomial infection death
  – One in four mechanically ventilated adults
    • Half of those affected died from VAP

• Associated with increased
  – length of mechanical ventilation
  – length of stay
  – mortality
  – COST
Pneumonia, Oral health and backrest Elevation study

Funded by NINR R15NR04730, MJ Grap, PI
POE: Two for one!

• 66 Adult MRICU subjects enrolled within 24 hours of intubation

• Data were obtained on study days 1, 4, and 7 (or until extubation)
  – Oral Health Status
  – Back rest elevation
  – VAP (CPIS)
  – Data related to risk factors

• A mixed stepwise selection procedure was used to develop a regression model predicting risk of VAP (day 4 CPIS).
Oral health over time: POE study

Plaque score ($P<.001$) and CPIS ($P < .01$) increased over time, while salivary flow and salivary volume decreased ($P<.01$).

Lower salivary volume was associated with higher day 4 CPIS ($P=.02$).

Interaction of Plaque, APACHE II, and Day 1 CPIS in Predicting Day 4 CPIS

Lowest Plaque Tercile (Cleanest teeth)

Middle Plaque Tercile

Highest Plaque Tercile (Most plaque)

Munro, AJCC, 2006
Munro CL, Grap MJ, Carter WH, Sessler C. Oral Care Intervention in Mechanically Ventilated Adults. Funded by NIH R01 NR07652, ClinicalTrials.gov NCT00234598
RCT 2X2 Factorial Design

<table>
<thead>
<tr>
<th>Chlorhexidine (CHX) 0.12% twice a day</th>
<th>Tooth brushing three times a day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usual care</td>
<td></td>
</tr>
</tbody>
</table>
# SToPP Study VAP Results

## Table 2
Comparison of baseline and day 3 outcomes by treatment

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>All patients (n = 192)</th>
<th></th>
<th></th>
<th>Patients without pneumonia at baseline (n = 87)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 3</td>
<td>$p^a$</td>
<td>Day 1</td>
<td>Day 3</td>
<td>$p^b$</td>
</tr>
<tr>
<td>Clinical Pulmonary Infection Score, mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.36 (2.17)</td>
<td>5.26 (2.44)</td>
<td>.29</td>
<td></td>
<td>3.56 (1.29)</td>
<td>4.36 (2.11)</td>
<td>.02c</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.70 (2.35)</td>
<td>5.78 (2.20)</td>
<td></td>
<td></td>
<td>3.36 (1.16)</td>
<td>5.36 (2.08)</td>
<td></td>
</tr>
<tr>
<td>Toothbrushing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.66 (2.38)</td>
<td>5.58 (2.34)</td>
<td>.95</td>
<td></td>
<td>3.49 (1.30)</td>
<td>5.02 (2.28)</td>
<td>.30</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.41 (2.16)</td>
<td>5.48 (2.33)</td>
<td></td>
<td></td>
<td>3.43 (1.17)</td>
<td>4.66 (2.01)</td>
<td></td>
</tr>
<tr>
<td>Pneumonia, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51.1</td>
<td>41.3</td>
<td>.13</td>
<td></td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58.0</td>
<td>55.0</td>
<td></td>
<td></td>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toothbrushing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55.7</td>
<td>49.5</td>
<td>.86</td>
<td></td>
<td>40</td>
<td></td>
<td>.54</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53.7</td>
<td>47.4</td>
<td></td>
<td></td>
<td>36</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^a$ P comparing those with and without the specific intervention, for all patients; analyses controlling for intensive care unit (strata), baseline Clinical Pulmonary Infection Score, and presence of other intervention.

$^b$ P comparing those with and without the specific intervention, for patients without pneumonia at baseline; analysis controlling for intensive care unit (strata), baseline Clinical Pulmonary Infection Score, and presence of other intervention.

$^c$ Statistically significant ($P \leq .025$).

$^d$ Dash indicates not applicable.
# SToPP Study VAP Results

## Table 2
Comparison of baseline and day 3 outcomes by treatment

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>All patients (n = 192)</th>
<th>Patients without pneumonia at baseline (n = 87)</th>
<th>( p^a )</th>
<th>( p^b )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Pulmonary Infection Score, mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5.36 (2.17)</td>
<td>5.26 (2.44)</td>
<td>.29</td>
<td>3.56 (1.29)</td>
</tr>
<tr>
<td>No</td>
<td>5.70 (2.35)</td>
<td>5.78 (2.20)</td>
<td></td>
<td>3.36 (1.16)</td>
</tr>
<tr>
<td>Toothbrushing</td>
<td></td>
<td></td>
<td>.95</td>
<td>.30</td>
</tr>
<tr>
<td>Yes</td>
<td>5.66 (2.38)</td>
<td>5.58 (2.34)</td>
<td></td>
<td>3.49 (1.30)</td>
</tr>
<tr>
<td>No</td>
<td>5.41 (2.16)</td>
<td>5.48 (2.33)</td>
<td></td>
<td>3.43 (1.17)</td>
</tr>
<tr>
<td>Pneumonia, %</td>
<td></td>
<td></td>
<td>.13</td>
<td>.006c</td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>51.1</td>
<td>41.3</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>No</td>
<td>58.0</td>
<td>55.0</td>
<td></td>
<td>52</td>
</tr>
<tr>
<td>Toothbrushing</td>
<td></td>
<td></td>
<td>.86</td>
<td>.54</td>
</tr>
<tr>
<td>Yes</td>
<td>55.7</td>
<td>49.5</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>No</td>
<td>53.7</td>
<td>47.4</td>
<td></td>
<td>36</td>
</tr>
</tbody>
</table>

*a* \( p \) comparing those with and without the specific intervention, for all patients; analyses controlling for intensive care unit (strata), baseline Clinical Pulmonary Infection Score, and presence of other intervention.

*b* \( p \) comparing those with and without the specific intervention, for patients without pneumonia at baseline; analysis controlling for intensive care unit (strata), baseline Clinical Pulmonary Infection Score, and presence of other intervention.

*Statistically significant \( (P \leq .025) \).*

*Dash indicates not applicable.*
Chlorhexidine, Toothbrushing, and Preventing Ventilator-Associated Pneumonia in Critically Ill Adults
Cindy L. Munro, Mary Jo Grap, Deborah J. Jones, Donna K. McClish and Curtis N. Sessler

© 2009 American Association of Critical-Care Nurses
Published online http://www.ajcconline.org

Toothbrushing alone did not reduce ventilator-associated pneumonia, and combining toothbrushing with chlorhexidine did not provide additional benefit over chlorhexidine alone.
Changes in Practice

• Institute for Healthcare Improvement (IHI) Ventilator Bundle
  – Elevation of the Head of the Bed
  – Daily “Sedation Vacations”; Assessment of Readiness to Extubate
  – Peptic Ulcer Disease Prophylaxis
  – Deep Venous Thrombosis Prophylaxis
  – Oral care with CHX (added 2010!)
    • STToPP study cited as evidence
Next step...SToPP2!

- Application of chlorhexidine BEFORE intubation (in patients other than cardiac surgery)

Munro CL, Grap MJ, Elswick RK, Sessler C. Oral Care Intervention in Mechanically Ventilated Adults. Funded by NIH R01 NR07652, ClinicalTrials.gov NCT00893763.
SToPP2 Results

• Preintubation CHX did not provide additional benefit to daily CHX
SToPP2 Results

- ETT colonization rates were equivalent between groups

![Distribution of Semiquantitative ETT Culture Results](image)

- Many
- Moderate
- Few
- Rare
- No Growth
Preintubation Application of Oral Chlorhexidine Does Not Provide Additional Benefit in Prevention of Early-Onset Ventilator-Associated Pneumonia

Cindy L. Munro, PhD, RN, ANP; Mary Jo Grap, PhD, RN; Curtis N. Sessler, MD, FCCP; Ronald K. Elswick Jr, PhD; Devanand Mangar, MD; Rachel Karinoski-Everall, PhD; and Paula Cairns, BSN, RN

BACKGROUND: Daily application of oral chlorhexidine gluconate (CHX) following intubation to reduce the risk of ventilator-associated pneumonia (VAP) is now the standard of care in many ICUs. This randomized clinical trial evaluated the benefit of adding a preintubation CHX dose to the known benefit of postintubation CHX to reduce the risk of early-onset VAP. A secondary aim was to test the effect of a preintubation oral application of CHX on early endotracheal tube (ETT) colonization.

METHODS: Subjects (N = 314) were recruited from two teaching hospitals and were randomly assigned to oral application of 5 mL CHX 0.12% solution before intubation (intervention group, n = 157), or to a control group (n = 157) who received no CHX before intubation. All subjects received CHX b.i.d after intubation. Groups were compared using a repeated-measures model with Clinical Pulmonary Infection Score (CPIS) as the response variable. In a planned subset of subjects, ETTs were cultured at extubation.

RESULTS: Application of a preintubation dose of CHX did not provide benefit over the intervention period beyond that afforded by daily oral CHX following intubation. ETT colonization at extubation was <20% in both groups (no statistically significant difference). Mean CPIS remained below 6 (VAP threshold score) in both groups.

CONCLUSIONS: Although it is feasible to deliver CHX prior to intubation (including emergent or urgent intubation), the results suggest that preintubation CHX may be inconsequential when the ventilator bundle, including daily oral CHX, is in place. During the preintubation period, providers should focus their attention on other critical activities.

TRIAL REGISTRY: ClinicalTrials.gov; No.: NCT00893763; URL: www.clinicaltrials.gov

CHEST 2015; 147(2):328-334
Ventilator Associated Pneumonia in the 2010’s

• Reduced incidence
• New CDC surveillance definitions
  – VAE (ventilator-associated *events*)
    • VAC (ventilator-associated *condition*)
      – IVAC (*infection-related* ventilator-associated *complication*)
        » VAP (ventilator-associated pneumonia)
  – No use of chest radiographs in surveillance
    • Implications for CPIS
  – VAC identified only after 3 days of stability or improvement
  – VAP for internal reporting purposes
Where to next?
Assuming one tooth brushing for each patient for each day of ICU care in the US,
Assuming one tooth brushing for each patient for each day of ICU care in the US,
tooth brushing is performed at least 18 million times annually in the ICU.
Assuming one tooth brushing for each patient for each day of ICU care in the US,

tooth brushing is performed at least 18 million times annually in the ICU.

We have NO evidence to guide frequency of tooth brushing in the ICU!
Frequency of Oral Care Intervention Study: FOCIS

• Design permits assessment of clinical equivalence and safety—“best practice” recommendation

• Determining the best brushing interval
  – Balancing risk and benefit

• Randomized to or or daily

Munro CL, Grap MJ, Kip, K. Oral Care Intervention in Mechanically Ventilated Adults. Funded by NIH R01 NR07652, ClinicalTrials.gov NCT02289131.
Dental Plaque
Mucosal Inflammation

Pneumonia
Bacteremia
SIRS, Sepsis

Clinical Equivalence (non-inferiority)

Safety

Benefit
Dental Plaque
Mucosal Inflammation

Risk
Pneumonia
Bacteremia
SIRS, Sepsis

Benefit
Risk
Strategies to Prevent Pneumonia (SToPP)

545 mechanically ventilated adults
VAP: CHX beneficial, tooth brushing not, no interaction

SToPP2
325 mechanically ventilated adults
CHX before intubation: no VAP difference

Observational studies, POE, SToPP-IT

Frequency of Oral Care Intervention Study (FOCIS)
Behind every exquisite meal someone peels the potatoes
Dr. Mary Jo Grap and students

VCU Colleagues
Dr. Curt Sessler
Dr. R.K. Elswick
Dr. Kevin Ward

USF Colleagues
Paula Cairns
Dr. Devanand Mangar
Dr. Rachel Karlmosky

AJCC colleagues
Dr. Richard Savel
Dr. Melissa Jones
Michael Muscat

Dr. Mary Lou Sole

Behind every exquisite meal someone peels the potatoes

Dr. Frank Macrina and lab and students
Dr. Todd Kitten and lab and students
Dr. Ping Xu and lab and students

Dr. Deborah Jefferson Jones
Dr. Michele Weiglewsic
Dr. Chris Szabo
Julie Fitch Kubiack
Sara Williamson

FUNDERS and Institutions:
NIH (Special Kudos to NINR)
Virginia Commonwealth U
U South Florida
MedImmune, Inc
VCU Health System
Tampa General Hospital

ALL of the nurses who supported the work!