The Power of One: Impacting Patient Outcomes by Returning to the Basics

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Disclosures for Kathleen Vollman

- Consultant-Michigan Hospital Association Keystone Center
- Subject matter expert for CAUTI and CLABSI, HAPI, C-Diff and Sepsis for CMS/HIIN
- Consultant and speaker bureau:
  - Sage Products LLC
    - Will be addressing an off label use of a 2% CHG pre-op prep cloth
  - Eloquest Healthcare
  - Urology division of Medline Industries
Session Objectives

- Identify practices areas where we can successfully reduce harm with evidence
- Determine evidence-based strategies for reduction of pressure injuries
- Outline evidence-based practices for mitigating the risk for pneumonia
Notes on Hospitals: 1859

“It may seem a strange principle to enunciate as the very first requirement in a Hospital that it should do the sick no harm.”

Florence Nightingale

Advocacy = Safety
INTERVENTIONAL PATIENT HYGIENE (IPH)

VAP/HAP

Oral Care/ Mobility

HAND HYGIENE

CLEAN GLOVES

PATIENT

CLEAN GLOVES

HAND HYGIENE

Catheter Care

Skin Care/ Bathing/Mobility

CA-UTI

CLA-BSI

SSI

Falls

HASI

Background of the Problem: 5th Most Common Preventable Condition

State-wide audits estimate PI prevalence in hospitals ranges from 9.5 to 17.6%.

- Estimated total cases of 121,645 in 2012-2013 & 524,663 bed days lost
- Treatment Cost estimated to be $983 million per year
- 1.9% of all public hospital expenditure
- Wastage can be reduced by preventing moderate injury 1-3 advancing to 3 & 4
- Severe cases 12% incidence but 30% of cost
Australian Data: HAC-Pressure Injury

- Around 4,300 hospital-acquired pressure injuries occur each year in Australian hospitals.
- Hospital-acquired pressure injuries increase the length of stay and the cost of admission.
- Highest rate of this HAC at Principal Referral Hospitals: 28.9%
- Aggregate rate of this HAC at Principal Referral Hospitals: 9.8 per 10,000 hospitalisations.
- If all hospitals reduced their rate of this HAC to less than 9.8 per 10,000 hospitalisations it would prevent at least 727 pressure injuries.

<table>
<thead>
<tr>
<th>Readmission condition</th>
<th>Readmission diagnosis</th>
<th>Readmission interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure injury</td>
<td>Stage III ulcer</td>
<td>14 days</td>
</tr>
<tr>
<td></td>
<td>Stage IV ulcer</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Unspecified decubitis and pressure area</td>
<td>14 days</td>
</tr>
</tbody>
</table>

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<tr>
<th></th>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pressure Injury</td>
<td>2,831</td>
<td>2,965</td>
<td>3,393</td>
<td>4,369</td>
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<tr>
<td>2</td>
<td>Falls resulting in fracture or other intracranial injury</td>
<td>1,614</td>
<td>1,764</td>
<td>1,930</td>
<td>2,036</td>
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<td>3</td>
<td>Healthcare associated infection</td>
<td>51,803</td>
<td>54,131</td>
<td>58,692</td>
<td>61,297</td>
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<tr>
<td>4</td>
<td>Surgical complications requiring unplanned return to theatre</td>
<td>8,165</td>
<td>8,324</td>
<td>8,946</td>
<td>9,135</td>
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<tr>
<td>5</td>
<td>Unplanned intensive care unit admission</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
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<tr>
<td>6</td>
<td>Respiratory complications</td>
<td>5,742</td>
<td>9,218</td>
<td>10,260</td>
<td>10,700</td>
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<tr>
<td>7</td>
<td>Venous thromboembolism</td>
<td>3,122</td>
<td>3,150</td>
<td>3,387</td>
<td>3,437</td>
</tr>
<tr>
<td>8</td>
<td>Renal failure</td>
<td>863</td>
<td>859</td>
<td>994</td>
<td>981</td>
</tr>
<tr>
<td>9</td>
<td>Gastrointestinal bleeding</td>
<td>5,559</td>
<td>5,637</td>
<td>6,224</td>
<td>6,330</td>
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<tr>
<td>10</td>
<td>Medication complications</td>
<td>7,628</td>
<td>10,249</td>
<td>12,517</td>
<td>13,725</td>
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<tr>
<td>11</td>
<td>Delirium</td>
<td>17,119</td>
<td>19,319</td>
<td>21,478</td>
<td>23,033</td>
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<tr>
<td>12</td>
<td>Persistent incontinence</td>
<td>2,974</td>
<td>3,211</td>
<td>3,729</td>
<td>3,801</td>
</tr>
<tr>
<td>13</td>
<td>Malnutrition</td>
<td>4,043</td>
<td>4,755</td>
<td>5,145</td>
<td>5,487</td>
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<tr>
<td>14</td>
<td>Cardiac complications</td>
<td>17,746</td>
<td>29,105</td>
<td>31,173</td>
<td>31,096</td>
</tr>
<tr>
<td>15</td>
<td>Third and fourth degree perineal laceration during delivery</td>
<td>5,008</td>
<td>5,154</td>
<td>5,764</td>
<td>5,642</td>
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<tr>
<td>16</td>
<td>Neonatal birth trauma</td>
<td>745</td>
<td>809</td>
<td>990</td>
<td>1,108</td>
</tr>
</tbody>
</table>
What Would It Look Like

If we reduce the rate to the level of the best 25% of peer hospitals

<table>
<thead>
<tr>
<th>In Principal Referral Hospitals</th>
<th>In Public Acute Group A</th>
<th>In Public Acute Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7</td>
<td>3.3</td>
<td>2.1</td>
</tr>
</tbody>
</table>

This would result in 986 fewer pressure injuries with a possible value capture of 29,447 bed days $58,894,248

Around 2,840 stage 3 and 4 pressure injuries occur each year in Australian public hospitals.
Top-Down vs Bottom Up Tissue Damage

Top-Down
- Stage 1, 2

Bottom-Up
- Stage 3, 4, Unstageable, DTI

Moisture Injury: Incontinence Associated Dermatitis

- Inflammatory response to the injury of the water-protein-lipid matrix of the skin
  - Caused from prolonged exposure to urinary and fecal incontinence
- Top-down injury
- Physical signs on the perineum & buttocks
  - Erythema, swelling, oozing, vesiculation, crusting and scaling
- Skin breaks 4x more easily with excess moisture than dry skin

Brown DS & Sears M, OWM 1993;39:2-26
IAD: Multisite Epidemiological Study

• 5,342 patients in 189 acute care facilities in 36 states
• Prevalence study
  – To measure the prevalence of IAD, describe clinical characteristics of IAD, and analyze the relationship between IAD and prevalence of sacral/coccygeal pressure ulcers
• Results: 2492 patients incontinent (46.6%)
  – 57% both FI and UI, 27% FI, 15% UI
  – 21.3% IAD rate overall/14% also had fungal rash
  – 45.7% in incontinent patients
    • 52.3% mild
    • 27.9% moderate
    • 9.2% severe
  – 73% was facility-acquired
  – ICU a 36% rate
  – IAD alone and in combination with immobility statistically associated with FAPI

Gray M. Giuliana K. JWOCN. 2018;45(1):63-67
IAD Rates: Health District in Australia

- Mixed methods study
- 4 hospitals, 12 units (Higher HAPI’s)
- 250 patients
- Relationship among IAD, HAPI and nursing practice

Results

- 44% incontinence, 23.2% urinary, Dual 22%, Fecal 1.2%
- IAD prevalence in incontinent patients 20.7%
Assess all patients as soon as possible following admission to service and within a minimum of eight hours (or on initial visit for patients in the community). Consult the patient and multidisciplinary team for care planning. Refer to guideline and/or product information for contraindications for therapies.

**Nutritional screening**
Use a validated tool appropriate to the clinical setting (Grade B)

- Conduct a comprehensive risk assessment including assessment of:
  - Clinical history
  - Mobility and activity
  - Intrinsic and extrinsic risk factors
- Use a validated pressure injury risk (PI) assessment scale (Grade B)
- Conduct a complete skin assessment (Grade C).

**Nutritional assessment**
Use a validated tool appropriate to the clinical setting (Grade B)

- Is the patient at nutritional risk?
  - NO
  - Conduct a comprehensive risk assessment including assessment of:
    - Psychosocial history
    - Continence
    - Cognition
- Use a validated pressure injury risk (PI) assessment scale (Grade B)
- Conduct a complete skin assessment (Grade C).

**Strategies for patients at high risk**
- Use a high specification foam reactive (constant low pressure) support surface (Grade A) OR consider using an active alternate pressure) support surface (Grade A)
- Implement skin protection strategies
- Provide high protein nutritional supplements (Grade B)
- Consider arginine supplements (Grade C)
- Consider more frequent repositioning (Grade A)
- Patient education.

**Preventative strategies**
- Implement skin protection strategies
- Use constant low pressure redistribution support surfaces (Grade A)
- Regular repositioning (Grade A)
- Patient education.
Inpatient Pressure Injury (PI) Prevention and Management Flowchart

Patient presents to hospital

Within 8 hours of presentation, two part PI assessment/screening process to be completed to guide clinical decision making.
- Use a validated PI risk assessment tool/process appropriate for the patient population
- Skin assessment based on visual inspection

Does the patient have existing PI?

- Yes
  - Reassess as per BOX A
    - Complete an IMIS Notification for each PI using the NPUAP/EPUAP classification system
    - For patients with PI, skin inspection and pain assessment should occur at each patient care intervention and/or each positioning change

- No
  - Does the patient have existing PI?

Reassess:
- If there is a change to health status or mobility
- On transfer of care
- If a PI develops
- At least weekly

Is the Patient ‘At Risk’?

- No
  - No

- Yes
  - BOX A - Reassess:
    - Daily PI risk assessment using the two part pressure injury assessment and:
      - If there is a change to health status or mobility
      - Pre-operatively, and repeated as soon as possible after surgery
      - On transfer of care
      - If a pressure injury develops

Develop the care plan in consultation with the patient and/or carer
- Implement prevention strategies appropriate to the level of risk e.g. equipment needs, repositioning
- Make referrals as appropriate
- Detailed documentation in patient health care record
- Communicate PI risk and management at handover and transfer of care
The Goal: Patient & Caregiver Safety

Culture of Safety!

- Safe Patient Handling
- Pressure Injury Prevention
- Falls Prevention
- Early Mobility

Leadership
Pressure & Shear as a Risk Factor

Sacrum & Heels
EBP Recommendations to Achieve Offloading & Reduce Pressure (A)

• Turn & reposition every (2) hours (avoid positioning patients on a pressure ulcer)
  – Repositioning should be undertaken to reduce the duration & magnitude of pressure over vulnerable areas
  – Consider right surface with right frequency*
  – Cushioning devices to maintain alignment /30 ° side-lying & prevent pressure on boney prominences
    • Between pillows and wedges, the wedge system was more effective in reducing pressure in the sacral area (healthy subjects) (Bush T, et al. WOCN, 2015;42(4):338-345)
    • Between pillows and wedges, wedges maintain lateral position better. (Kapp S, et al. Int Wound J. 2019;1-7)
  – Assess whether actual offloading has occurred
  – Use lifting device or other aids to reposition & make it easy to achieve the turn

EBP Recommendations to Reduce Shear & Friction

- Loose covers & increased immersion in the support medium increase contact area
- Prophylactic dressings: emerging science
- Use lifting/transfer devices & other aids to reduce shear & friction.
  - Mechanical lifts
  - Transfer sheets
  - 2-4 person lifts
  - Turn & assist features on beds
  - Do not leave moving and handling equip underneath the patient

Systematic Review: Use of Prophylactic Dressing in Pressure Injury Prevention

- 21 studies met the criteria for review
- 2 RCTs, 9 had a comparator arm, five cohort studies, 1 within-subject design where prophylactic dressings were applied to one trochanter with the other trochanter dressing free

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Events</th>
<th>Control Events</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
<th>Risk Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callaghan 1998</td>
<td>2</td>
<td>8</td>
<td>0.31 (0.09, 1.08)</td>
<td></td>
</tr>
<tr>
<td>Huang 2009</td>
<td>6</td>
<td>10</td>
<td>0.63 (0.37, 1.05)</td>
<td></td>
</tr>
<tr>
<td>Weng 2008</td>
<td>28</td>
<td>60</td>
<td>0.49 (0.37, 0.64)</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>78</td>
<td>48</td>
<td>0.50 (0.39, 0.64)</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>36</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00, Ch² = 1.42, df = 2 (P = 0.49); P = 0%
Test for overall effect Z = 5.61 (P < 0.00001)

Evaluated nasal bridge device injury prevention
Evaluated sacral pressure ulcer prevention

EBP Recommendations to Reduce Shear & Friction

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  - Mechanical lifts
  - Transfer sheets
  - 2-4 person lifts
  - Turn & assist features on beds
  - Breathable slide stay in bed glide sheet
- Do not leave moving and handling equip underneath the patient

Current Practice: Turn & Reposition

Specialty Bed

Disposable Slide Sheets

Breathable Glide Sheet

Draw Sheet/Pillows/Layers of Linen

Lift Device
Oh, My Aching Back!

Back Pain Incidence in Nursing:
- 8 out of 10 nurses work despite experiencing musculoskeletal pain\(^1\)
- 62% of nurses report concern developing a disabling musculoskeletal injury\(^1\)
- 56% of nurses report musculoskeletal pain is made worse by their job\(^1\)
- Nursing assistants had the 2\(^{nd}\) highest and RNs had the 6\(^{th}\) highest number of musculoskeletal disorders in the U.S.\(^2\)


Australian Healthcare Worker Data

Healthcare & Social assistance accounts for the highest proportion of workers’ compensation claims, with 17,795 claims per year.

The frequency rate for serious claims has decreased by 29 per cent over the last decade.

Older workers account for the majority of worker fatalities and recorded the highest serious claim frequency rates.

The hospitals, and residential care services sub-sectors account for the majority of serious claims and recorded the highest frequency rates.

In Hospitals:
Muscular stress while handling objects 28%
Muscular stress while lifting, carrying 15%
Falls 14%

Health professionals 19% of the claims

What About Staff Harm?

• Health care is the only industry that considers 100 pounds to be a “light” weight

• Other professions use assistive equipment when moving heavy items

• On average, nurses and assistants lift 1.8 tons per shift (ANA, n.d.)


Kelly, 2015
Factors Impacting the ability to Achieve Quality Nursing Outcomes at the Point of Care

Resource & System
- Breathable glide sheet/stays
- Foam Wedges
- Microclimate control
- Reduce layers of linen
- Wick away moisture body pad
- Protects the caregiver

Impact of a Turn & Position Device on PI & Staff Time

- Prospective, QI study (1 SICU & 1 MICU)
- 2 phases
  - SOC: pillows, underpads, standard low airloss bed and additional staff if required
  - Interventional: turn and position system, a large wicking pad (part of the product)
- Inclusion criteria: newly admitted, non-ambulatory, required 2 or more to assist with turning/repositioning
- Turning procedures were timed/admitting till ICU discharge

Results
- No difference in sociodemographic and clinical data between the groups
- Phase 1: 14 patients (28%) Stage II sacral PI
- Phase 2: zero sacral PI (p<.0001)
- Timing:
  - Phase 1: 16.34 mins (range 4-60min) SD= 10.08
  - Phase 2: 3.58 mins (range 1.12-8.48) SD = 2.31 (p=0.0006)

Reducing HAPI & Patient Handling Injuries

- Compared pre-implementation turning practice: pillows/draw sheet vs turn and position system (breathable glide sheet/foam wedges/wick away pad)
- Baseline: November 2011-August 2012
- Implementation period: November 2012 to August 2015
- 3660 patients
- Compared HAPI rates, patient handling injuries and cost

Way H, Am JSPHM, 2016;6(4):160-165
In-Bed Technology
EBP Recommendations to Achieve Offloading & Reduce Pressure

– Ensure the heels are free of the bed surface
  • Heal-protection devices should elevate the heel completely (off-load) in such a way as to distribute weight along the calf
  • The knee would be in slight flexion
  • Remove device periodically to assess the skin

Heel Protectors

Heel Pads

Miller SK, et al WOCN, 2015;42(4):346-351
Sustainability of Heel Injury Reduction: QI Project

- 490 bed facility
- Evidence based quality Improvement initiative
- 4 tier Process
  - Partnership
  - Comprehensive product review
  - Education & engagement
  - Support structures & processes

Hanna-Bull D. WOCN, 2016;43(2):129-132
Prevention Strategies for IAD
Evidence-Based Components of an IAD Prevention Program

• Skin care products used for prevention or treatment of IAD should be selected based on consideration of individual ingredients in addition to consideration of broad product categories such as cleanser, moisturizer, or skin protectant. (Grade C)
  – A skin protectant or disposable cloth that combines a pH balance no rinse cleanser, emollient-based moisturizer, and skin protectant is recommended for prevention of IAD in persons with urinary or fecal incontinence and for treatment of IAD, especially when the skin is denuded. (Grade B)
  – Commercially available skin protectants vary in their ability to protect the skin from irritants, prevent maceration, and maintain skin health. More research is needed (Grade B)
EBP Recommendations to Reduce Injury From Incontinence & Other Forms of Moisture

- Clean the skin as soon as it becomes soiled.
- Use an incontinence pad and/or briefs that wick away
- Use a protective cream or ointment
  - Disposable barrier cloth recommend by IHI & IAD consensus group
- Ensure an appropriate microclimate & breathability
- < 4 layers of linen
- Barrier & wick away material under adipose and breast tissue
- Support or retraction of the adipose tissue (i.e. KanguruWeb)
- Pouching device or a bowel management system

www.ihi.org
Current Practice: Moisture Management

Reusable Incontinence pads

Disposable Incontinence Pads

Airflow pads for Specialty Beds

Adult diaper
EBP Recommendations to Reduce Injury From Incontinence & Other Forms of Moisture

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www.ihi.org
IAD/HAPU Reduction Study

• Prospective, descriptive study
• 2 Neuro units
• Phase 1: prevalence of incontinence & incidence of IAD & HAPU
• Phase 2: Intervention
  • Use of a 1 step cleanser/barrier product
  • Education on IAD/HAPU
• Results:
  • Phase 1: incontinent 42.5%, IAD 29.4%, HAPU 29.4%, LOS 7.3 (2-14 days), Braden 14.4
  • Phase 2: incontinent 54.3%, IAD & HAPU 0, LOS 7.4 (2-14), Braden 12.74

IAD Prevention Practices: Implementation Science Approach

- Identified evidence gaps in previous study (4 hospitals-250 patients)
- Using implementation science approach to introduce evidence based IAD practices
- IAD committee: education about correct pad sizing, washable and disposable pads and plastic sheets removed from the wards. All in one barrier cloth that cleans, protects and moisturizes was introduced
- Nurses from wards ask to participate in 1 of 6 focus groups post implementation

IAD Prevention Practices: Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Implementation N=250</th>
<th>Post Implementation N=259</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>IAD</td>
<td>23 (9.2%)</td>
<td>6 (2.3%)</td>
<td>.015</td>
</tr>
<tr>
<td>HAPI</td>
<td>9 (3.6%)</td>
<td>2 (0.8%)</td>
<td>.034</td>
</tr>
<tr>
<td>Bed protection use</td>
<td>154 (64.7%)</td>
<td>6 (2.3%)</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Continent patients with incontinent products</td>
<td>73 (29.2%)</td>
<td>28 (10.8%)</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Nurse Focus Groups: 31 nurses, 4 themes
- Benefit to patient: improved skin condition, patient comfort
- Usability: fewer steps
- Problems encountered: not seeing barrier in place
- Related factors: confusion between IAD and pressure injury

Having a medical device you are 2.4 x more likely to develop a HAPI of any kind (p=0.0008)


High variation of incidence from 0.9% to 41.2%, Barakat-Johnson M, et al of Wound Care. 2019;2(28):512-521

10% incidence in a recent metanalysis
Prevention of MDR’s-HAPI

Best Practices for Prevention of Medical Device-Related Pressure Ulcers in Critical Care

- Choose the correct size of medical device(s) to fit the individual
- Cushion and protect the skin with dressings in high-risk areas (e.g., nasal bridge)
- Inspect the skin in contact with device at least daily (if not medically contraindicated)
- Avoid placement of device(s) over sites of prior or existing pressure ulcer
- Educate staff on correct use of devices and prevention of skin breakdown
- Be aware of edema under device(s) and potential for skin breakdown
- Confirm that devices are not placed directly under an individual who is bedridden or immobile

Haugen V, Perspectives; 2016 [http://www.perspectivesinnursing.org/current.html](http://www.perspectivesinnursing.org/current.html)
Clinical Findings Which Prevent Patient Turning

1. Development of life threatening arrhythmia with symptomatic response (VFIB/VTACH/SVT) This does NOT include asymptomatic AFIB.

2. Active Fluid Resuscitation: (i.e. no volume going in= no systemic blood pressure).

3. Active Hemorrhaging:
   - Following Cardiac Surgery/Active Tamponade
   - Massive GI bleeding with use of Blakemore tube.
   - Active hemorrhage following Trauma.

4. Change in baseline hemodynamic parameters (BP, HR, Oxygen Saturation, RR, etc) that does not recover within 10 Minutes of position change and is not an expected result based on diagnosis.

Recommended Interventions for the Unstable Patient

IF PATIENT IS DEEMED TOO UNSTABLE TO TURN BY ABOVE PARAMETERS:

A TRIAL TURN SHOULD BE ATTEMPTED AT LEAST EVERY 8 HOURS TO DETERMINE ABILITY TO RESUME FREQUENT TURNING AT LEAST EVERY 2 HOURS

1. Provide mini-turns
2. Weight shift patient at least every 30 minutes
3. Elevate heels from surface of bed
4. Reposition patient’s head, arms and legs at least every hour, consider passive ROM
5. Consider use of Continuous Lateral Rotation Therapy to prevent development of “gravitational equilibrium”. Begin: SLOW AND LOW angles of turning to gauge patient response.
6. When turning patient: GO SLOW! Provide serial small turns from supine to lateral position to achieve linen changes, hygiene checks, and reposition with wedges and pillows.

UNSTABLE FRACTURES

1. Patient’s with unstable pelvis injuries LOG ROLL PATIENT ONLY with approval of Attending MD. Consider wedges or pillows placed between the legs to maintain proper alignment.
2. DO NOT use continuous lateral rotation therapy (CLRT) with unstable spinal fractures: these patients should be positioned with multiple wedges to maintain proper alignment
3. Cervical Fractures / UNSTABLE: Patient must have appropriately fitted cervical collar in place. Ensure security and proper positioning of collar, then log roll patient, and wedge in proper alignment.
Source Control: The Oral Cavity as a Risk Factor in NV-HAP and VAP
Australian Pneumonia Data

Pneumonia refers to an infection of the lungs.

**Around 17,900 hospital-acquired episodes of pneumonia occur each year in Australian hospitals**

**167.4** Highest rate at Principal Referral Hospitals

**46.6** Aggregate rate at Principal Referral Hospitals Per 10,000 hospitalisations

If all hospitals reduced their rate to less than 46.6 per 10,000 hospitalisations, it would prevent at least **2,830 episodes of pneumonia**

The cost associated with Hospital Acquired Pneumonia in Australia

Could cost the hospital an additional **$39,406**

Patients with this Pneumonia require 19.0 extra days in the hospital compared to those who don’t have a Pneumonia.
VAP Data in the US

- VAP is associated with ↑ MV days and ↑ ICU & hospital LOS
- Attributable mortality estimated to be 4.0–13.5%
- Financial cost of a VAP episode has been estimated as approximately $20,000 to $40,000

Risk Factor Categories for Hospital Acquired Pneumonia

- Factors that increase bacterial burden or colonization
- Factors that increase risk of aspiration
Oral Cavity & VAP

- 89 critically ill patients
- Examined microbial colonization of the oropharynx throughout ICU stay
- Used pulse field gel electrophoresis to compare chromosomal DNA

Results:
- Diagnosed 31 VAPs
- 28 of 31 VAPs the causative organism was identical via DNA analysis

- 49 elderly nursing home residents admitted to the hospital
- Examined baseline dental plaque scores & microorganism within dental plaque
- Used pulse field gel electrophoresis to compare chromosomal DNA

Results
- 14/49 adults developed pneumonia
- 10 of 14 pneumonias, the causative organism was identical via DNA analysis

El-Solh AA. Chest. 2004;126:1575-1582
This attachment structure requires mechanical removal with a good toothbrush.
What Does the Evidence Tell Us?

Brush
CHG rinse alone
CHG rinse in combination
Swab/Clean/Moisturize
Suction

All of the above

Comprehensive Oral Care Program
Literature Review: Oral Care Impact of VAP

Comprehensive Oral Care:

- Reduction in VAP from 5.6 to 2.2 (Schleder B. et al. J Advocate Health 2002;4(1):27-30)
- Reduction in VAP from 12.0 to 8.0 (p=.060) with 80% compliance, vent bundle already being preformed, 1538 patients randomized to control or study group. Additional outcomes: ↓ vent days (p=.05), ↓ ICU LOS (p=.05), ↓ time to VAP (p= <.001), & reduction in mortality (p=.05) (Garcia R et al AJCC, 2009;18:523-534)
Literature Review: Oral Care Impact of VAP

Comprehensive Oral Care & CHG:

- Reduction in VAP to zero for 2 years, vent bundle, mobility, oral care & CHG with comprehensive education preformed (Murray TM et al. AACN Advanced Critical Care. 2007;18(2):190-199)

Dickinson S et al. SCCM Critical Connections, 02/2008

Type of Oral Care Impacted on VAP

- Multi-center prospective RCT (6 month trial)
- 1716 admitted to the ICUs; 219 fulfilled the criteria for inclusion and 213 were analyzed
- 108 were randomized to control group and 105 to intervention group (Tooth brushing with 0.12% CHG or 0.12% CHG alone q 12 hrs)
- Examine impact on VAP, time on vent & LOS

Vidal CF, et. al. BMC Infectious Diseases (2017) 17:112

<table>
<thead>
<tr>
<th>Events</th>
<th>Control group (n = 108)</th>
<th>Intervention group (n = 105)</th>
<th>RR</th>
<th>CI(95%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAP</td>
<td>80 (47.6%)</td>
<td>88 (52.4%)</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Death</td>
<td>28 (62.2%)</td>
<td>17 (37.8%)</td>
<td>1.81</td>
<td>0.93 – 3.57</td>
<td>0.084</td>
</tr>
</tbody>
</table>
| Duration of mechanical ventilation
  Mean ± sd               | 11.1 ± 7.6              | 8.7 ± 5.0                    | 1.063| 1.011 – 1.120   | 0.018*  |
| Categorization
  Up to 5 days           | 13 (37.1%)              | 22 (62.9%)                   | 1.0 | -               | -       |
| 6 to 10 days            | 40 (48.8%)              | 42 (41.2%)                   | 1.61| 0.71 – 3.70     | 0.249   |
| 11 days and more        | 28 (57.1%)              | 21 (42.9%)                   | 2.27| 0.93 – 5.55     | 0.073   |
| Length of ICU
  Mean ± sd              | 13.9 ± 8.6              | 11.9 ± 7.77                  | 1.032| 0.999 – 1.065   | 0.064   |
| Categorization
  Up to 5 days           | 11 (39.3%)              | 17 (60.7%)                   | 1.0 | -               | -       |
| 6 to 10 days            | 17 (60.7%)              | 11 (39.3%)                   | 1.0 | 0.64 – 3.70     | 0.333   |
| 11 days and more        | 23 (47.1%)              | 23 (47.1%)                   | 1.0 | 0.78 – 4.34     | 0.164   |

RR of Death 41% > in Control Group
Risk Reduction of VAP with Oral Antisepsis: A Systematic Review & Meta-analysis


P=0.004

Villar CC, Respiratory Care,2016 Sep;61(9):1245-59.

P=0.14
Impact of Oral CHG on Frequency of VAP

Villar CC, Respiratory Care. 2016 Sep;61(9):1245-59.

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Chlorhexidine</th>
<th>Control</th>
<th>Total</th>
<th>Weight</th>
<th>Risk Ratio</th>
<th>Risk Ratio</th>
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<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Events</td>
<td>Total</td>
<td></td>
<td>IV, Random</td>
<td>95% CI</td>
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<td>3.1.1 Single Dose</td>
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<td></td>
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<tr>
<td>Grap, 2004</td>
<td>4</td>
<td>11</td>
<td>23</td>
<td>5.2%</td>
<td>2.79 [0.75, 10.37]</td>
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<tr>
<td>Subtotal (95% CI)</td>
<td>11</td>
<td>23</td>
<td>23</td>
<td>5.2%</td>
<td>2.79 [0.75, 10.37]</td>
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<td>Total events</td>
<td>4</td>
<td>3</td>
<td>7</td>
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<td>Heterogeneity: Not applicable</td>
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<td></td>
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<tr>
<td>Test for overall effect: Z = 1.53 (P = 0.13)</td>
<td></td>
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<tr>
<td>3.1.2 1x/day</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Scannapieco, 2009</td>
<td>7</td>
<td>58</td>
<td>59</td>
<td>9.5%</td>
<td>0.59 [0.25, 1.40]</td>
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</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>58</td>
<td>59</td>
<td>59</td>
<td>9.5%</td>
<td>0.59 [0.25, 1.40]</td>
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<tr>
<td>Total events</td>
<td>7</td>
<td>12</td>
<td>19</td>
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<td>Heterogeneity: Not applicable</td>
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<td>Test for overall effect: Z = 0.36 (P = 0.71)</td>
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<td>3.1.3 2x/day</td>
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<tr>
<td>Berry, 2011</td>
<td>4</td>
<td>71</td>
<td>75</td>
<td>9.5%</td>
<td>4.39 [0.50, 38.39]</td>
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</tr>
<tr>
<td>Scannapieco, 2009</td>
<td>7</td>
<td>58</td>
<td>59</td>
<td>9.5%</td>
<td>0.59 [0.25, 1.40]</td>
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<tr>
<td>Subtotal (95% CI)</td>
<td>74</td>
<td>125</td>
<td>125</td>
<td>9.5%</td>
<td>1.25 [0.19, 8.31]</td>
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</tr>
<tr>
<td>Total events</td>
<td>11</td>
<td>13</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Tau² = 1.30; Chi² = 2.83, df = 1 (P = 0.09); Ι² = 65%</td>
<td></td>
<td></td>
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<tr>
<td>Test for overall effect: Z = 0.23 (P = 0.82)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3.1.4 3x/day</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Belissimo-Rodrigues, 2009</td>
<td>16</td>
<td>64</td>
<td>80</td>
<td>9.5%</td>
<td>1.01 [0.56, 1.83]</td>
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<tr>
<td>Cabov, 2010</td>
<td>1</td>
<td>17</td>
<td>18</td>
<td>9.5%</td>
<td>0.23 [0.03, 1.70]</td>
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</tr>
<tr>
<td>Fourrier, 2000</td>
<td>5</td>
<td>30</td>
<td>35</td>
<td>9.5%</td>
<td>0.29 [0.12, 0.69]</td>
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<tr>
<td>Fourrier, 2005</td>
<td>13</td>
<td>114</td>
<td>127</td>
<td>11.2%</td>
<td>1.08 [0.52, 2.27]</td>
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<tr>
<td>Subtotal (95% CI)</td>
<td>130</td>
<td>203</td>
<td>203</td>
<td>11.2%</td>
<td>0.64 [0.31, 1.31]</td>
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<tr>
<td>Total events</td>
<td>35</td>
<td>52</td>
<td>87</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Heterogeneity: Tau² = 0.31; Chi² = 7.87, df = 3 (P = 0.05); Ι² = 62%</td>
<td></td>
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<td>Test for overall effect: Z = 1.22 (P = 0.22)</td>
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<td></td>
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<tr>
<td>3.1.5 4x/day</td>
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<td></td>
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<td></td>
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<tr>
<td>Koeman, 2006</td>
<td>13</td>
<td>127</td>
<td>140</td>
<td>13.1%</td>
<td>0.58 [0.31, 1.09]</td>
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</tr>
<tr>
<td>Ozgaka, 2012</td>
<td>12</td>
<td>32</td>
<td>44</td>
<td>15.8%</td>
<td>0.58 [0.35, 0.97]</td>
<td></td>
</tr>
<tr>
<td>Tantipong, 2008</td>
<td>5</td>
<td>102</td>
<td>107</td>
<td>7.7%</td>
<td>0.43 [0.16, 1.17]</td>
<td></td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>161</td>
<td>269</td>
<td>269</td>
<td>36.4%</td>
<td>0.56 [0.38, 0.81]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>30</td>
<td>57</td>
<td>87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Tau² = 0.00; Chi² = 0.30, df = 2 (P = 0.66); Ι² = 0%</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 3.11 (P = 0.002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>684</td>
<td>724</td>
<td>1408</td>
<td>100.0%</td>
<td>0.69 [0.49, 0.96]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>87</td>
<td>137</td>
<td>224</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Tau² = 0.12; Chi² = 16.98, df = 10 (P = 0.07); Ι² = 41%</td>
<td></td>
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</tr>
<tr>
<td>Test for overall effect: Z = 2.18 (P = 0.03)</td>
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<tr>
<td>Test for subgroup differences: Chi² = 5.88, df = 4 (P = 0.21), Ι² = 32.0%</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Fig. 4. Effect of chlorhexidine frequency of use on ventilator-associated pneumonia incidence.
Does Compliance Make A Difference?

Oral care compliance & use of the ventilator bundle resulted in a 89.7% reduction in VAP

Impact of a New Bundle/2 State Collaborative

- 38 hospitals, 56 ICU’s in 2 states from October 2012 to March 2015
- Evidence based interventions, teamwork & safety culture
- Head-of-bed elevation, use of subglottic secretion drainage endotracheal tubes, oral care, chlorhexidine mouth care, and daily spontaneous awakening and breathing trials.


- VAE: 7.34 to 4.58 cases per 1,000 ventilator-days (p = 0.007)
- IVAC 3.15 to 1.56 per 1,000 ventilator days (p = 0.018)
- PVAP 1.41 to 0.31 cases per 1,000 ventilator-days (p = 0.012)
Non-Vent Pneumonia: Addressing Risk Factors

Some slides courtesy of Barb Quinn
Build the Will: NV-HAP?

- HAP 1st most common HAI in U.S
- Increased morbidity $\rightarrow$ 50% are not discharged back home
  - Increased mortality $\rightarrow$ 18%-29%
  - Extended LOS $\rightarrow$ 4-9 days
  - Increased Cost $\rightarrow$ $\$28K$ to $\$109K$
  - 2x likely for readmission <30 day

Current Literature:
NV-HAP is a National Problem in Hospitals

<table>
<thead>
<tr>
<th>Study</th>
<th>Incidence</th>
<th>Mortality</th>
<th>+LOS</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Davis (2012)</td>
<td>5,600 /3 yrs</td>
<td>18.9%</td>
<td>Not queried</td>
<td>$28,000</td>
</tr>
<tr>
<td>HCUP National database (P)</td>
<td>2/100 pts</td>
<td>14.5%</td>
<td>4 days</td>
<td>$36,400</td>
</tr>
<tr>
<td>Magill et al. CDC (2014)</td>
<td>13% of all HAIs</td>
<td>19%</td>
<td>4-9 days</td>
<td>$40,000</td>
</tr>
<tr>
<td>Micek, Chew, Hamptom &amp; Kollef (2016)</td>
<td>Matched controls 174 cases NV-HAP</td>
<td>15.5% vs. 1.6% 8.4 more likely to die</td>
<td>15.9 days vs. 4.4</td>
<td></td>
</tr>
<tr>
<td>See, et al. (2016)</td>
<td>Retrospective review 8 hospitals in PA 2011-2012 VAP excluded 30% of 838</td>
<td>30.9%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

References:
- Davis, Pt Safety Authority 2012 9(3).
- Giuliano, K. et al. (2016) AORN Poster 2016
- Magill, S.S. et al. (2014) NEJM. 370(13), p 1198-1208
Hospital-Acquired Pneumonia: Non-Ventilated versus Ventilated Patients in Pennsylvania

• Purpose:
  – Compare VAP and NV-HAP incidence, outcomes

• Methods:
  – Pennsylvania Database queried
  – All nosocomial pneumonia data sets (2009-2011)

Results:

- Mortality
- Incidence
- Total deaths
- Total cost
- Wide-spread

Table 1. Pennsylvania Nosocomial Pneumonia and Related Deaths

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NO. OF NV-HAP CASES</th>
<th>NO. OF NV-HAP DEATHS</th>
<th>% OF NV-HAP CASES CONTRIBUTING TO DEATH</th>
<th>NO. OF VAP CASES</th>
<th>NO. OF VAP DEATHS</th>
<th>% OF VAP CASES CONTRIBUTING TO DEATH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>1,976</td>
<td>363</td>
<td>18.4 (95% CI: 16.5 to 20.3)</td>
<td>922</td>
<td>163</td>
<td>17.7 (95% CI: 15.0 to 20.5)</td>
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<tr>
<td>2010</td>
<td>1,848</td>
<td>366</td>
<td>19.8 (95% CI: 17.8 to 21.8)</td>
<td>737</td>
<td>144</td>
<td>19.5 (95% CI: 16.3 to 22.7)</td>
</tr>
<tr>
<td>2011</td>
<td>1,773</td>
<td>315</td>
<td>17.8 (95% CI: 15.8 to 19.7)</td>
<td>640</td>
<td>127</td>
<td>19.8 (95% CI: 16.4 to 23.3)</td>
</tr>
<tr>
<td>Total</td>
<td>5,597</td>
<td>1,044</td>
<td>18.7 (95% CI: 17.5 to 19.8)</td>
<td>2,299</td>
<td>434</td>
<td>18.9 (95% CI: 17.1 to 20.7)</td>
</tr>
</tbody>
</table>

Note: NV-HAP refers to nonventilator-hospital-acquired pneumonia and VAP refers to ventilator-associated pneumonia.

NV-HAP SMCS Research Findings: 2010

24,482 patients and 94,247 patient days

Incidence:
• 115 adults
• 62% non-ICU
• 50% surgical
• Average age 66
• Common comorbidities:
  ◆ CAD, COPD, DM, GERD
• Common Risk Factors:
  ◆ Dependent for ADLs (80%)
  ◆ CNS depressant meds (79%)

Cost:
• $4.6 million
• 23 deaths
• Mean Extended LOS 9 days
• 1035 extra days

HAPPI-2 Incidence of Non-Ventilator Hospital Acquired Pneumonia

- Multicenter retrospective chart review
- Extracted NV-HAP cases as per the 2014 ICD-9-CM codes for pneumonia not POA and the 2013 CDC case definition
- 21 hospitals completed data collection
- Measured nursing care missed 24hrs before diagnosis
- Non-vent HAP occurred on every unit

Baker D, Quinn B, Amer J of Infect Control, 2018;46:2-7
HAPPI-2 Incidence of Non-Ventilator Hospital Acquired Pneumonia

Missed nursing care 24 hours prior to Non-Vent HAP dx.

Baker D, Quinn B, Amer J of Infect Control, 2018;46:2-7
HAPPI-2 Incidence of Non-Vent Hospital Acquired Pneumonia

Results:

- 1300 NV-HAP (0.12-2.28 per 1000 pt days)
  - 18.4% mortality
  - 50% < 66 yrs old
  - 63% non-surgical
  - 70.8% outside the ICU
  - 27.3% in ICU
  - 18.8% transferred to ICU
  - 37.3% LOS >20 days
  - 57.7% LOS > 15 days
  - 40.6% admitted from home were discharged back to home
  - 19.3% readmitted within 30 days
  - $36.4 -$52.56 million in extra costs

Med-Surg (43.1%; n = 560)
Telemetry (8.5%; n = 111)
Progressive (7.2%; n = 93)
Oncology (4.9%; n = 64)
Orthopedic (2.8%; n = 37)
Neurology (1.5%; n = 19)
Obstetric (0.2%; n = 3)

Baker D, Quinn B, Amer J of Infect Control, 2018;46:2-7
Preventing NV-HAP Through Evidence Based Fundamental Nursing Care Strategies
Pathogenesis → Prevention

Germs in Mouth
- Dental plaque provides microhabitat
- Bacteria replicate 5X/24 hrs

Aspirated into Lungs
- Most common route
- 50% of healthy adults micro-aspirate in sleep

Weak Defenses
- Poor cough
- Immunosuppressed
- Multiple co-morbidities

Micro Aspiration During Sleep in Healthy Subjects

- Prospective duplicate full-night studies
- 10 normal male’s 22-55 yrs of age

Methods:
- Radioactive $^{99}$mTc tracer inserted into the nasopharynx
- Lung scans conducted immediately following final awakening
- No difference in sleep efficacy between 2 study nights

Results:
- 50% of subjects had tracer in the pulmonary parenchyma upon final awakening
- No difference in age, time spent in bed, efficacy of sleep, apnea-hypopnea index, arousal plus awakening index or % sleep in the supine position between subjects that aspirated and those that did not.

Body Position: Supine versus Semi-recumbent (30-45 degrees)

Methodology

- 19 mechanically ventilated patients
- 2 period crossover trial
- Study supine and semirecumbent positions over 2 days
- Labeled gastric contents (Tc 99m sulphur colloid)
- Measured q 30 min content of gastric secretions in endobronchial tree in each position
- Sampled ET secretions, gastric juice & pharyngeal contents for bacteria

Body Position: Supine versus Semi-recumbent (30-45 degrees)

Results

- Radioactive contents higher in endobronchial secretions in supine patients
- Time dependent:
  - Supine: 298cpm/30min vs. 2592cpm/300min
  - HOB: 103cpm/30min vs. 216cpm/300min
- Same microbes cultured in all 3 areas 32% with HOB vs. 68% supine

• Procedure 4: Endotracheal Tube Care and Oral Care
• Authors:  
  – Kathleen M Vollman
  – Mary Lou Sole
  – Barbara Quinn
Impact of Oral Care on HAP

FIGURE 2. Effects of oral care on preventing non-ventilator-associated pneumonia (non-VAP).

FIGURE 3. The effect of mechanical oral care on non-ventilator-associated pneumonia (non-VAP).
SMCS HAP Prevention Plan

Phase 1: Oral Care

- Formation of new quality team: Hospital-Acquired Pneumonia Prevention Initiative (HAPPI)
- New oral care protocol to include non-ventilated patients
- New oral care products and equipment for all patients
- Staff education and in-services on products
- Ongoing monitoring and measurement
  - Monthly audits

## Gap Analysis

<table>
<thead>
<tr>
<th>Best Practice</th>
<th>Our Gaps</th>
<th>Action To Take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive oral care for all (CDC, SHEA)</td>
<td>ICU vent patients only</td>
<td>Develop inclusive oral care protocol</td>
</tr>
<tr>
<td>Oral CHG (0.12%) periop adult CV surgery and vent pts. (CDC, ATS, IHI).</td>
<td>Not using CHG on these patients.</td>
<td>Added to preprinted orders, and to protocol</td>
</tr>
<tr>
<td>Therapeutic oral care tools (ADA)</td>
<td>Poor quality oral care tools. Absence of denture care supplies.</td>
<td>New tools and supplies.</td>
</tr>
</tbody>
</table>

## Protocol – Plain & Simple

<table>
<thead>
<tr>
<th>Patient Type</th>
<th>Tools</th>
<th>Procedure</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Care / Assist</td>
<td>Brush, paste, rinse, moisturizer</td>
<td>Provide tools Brush 1-2 minutes Rinse</td>
<td>4 X / day</td>
</tr>
<tr>
<td>Dependent / Aspiration Risk</td>
<td>Suction toothbrush kit (4)</td>
<td>Package instructions</td>
<td>4 X / day</td>
</tr>
<tr>
<td>Dependent / Vent</td>
<td>ICU Suction toothbrush kit (6)</td>
<td>Package instructions</td>
<td>6 X / day</td>
</tr>
<tr>
<td>Dentures</td>
<td>Tools + Cleanser Adhesive</td>
<td>Remove dentures &amp; soak Brush gums, mouth Rinse</td>
<td>4X / day</td>
</tr>
</tbody>
</table>

Provide Meaningful Data

- Ortho Unit had ZERO HAP cases in the last 4 months of 2013!!

- Great WORK!!

- Remember, the goal is to provide and document oral care after each meal and before bedtime.

Used with permission from Barbara Quinn
NV-HAP Incidence
50 % Decrease from Baseline

Control chart for NV-HAP
January 2010 to December 2013

Open Heart Surgery Patients: NV-HAP Reduced 75%

Used with permission from Barbara Quinn
Return on Investment

- 60 NV-HAP avoided Jan 1 – Dec. 31 2013
- $2,400,000 cost avoided
- -$117,600 cost increase for supplies
- $2,282,400 return on investment

• 8 lives saved

PRICELESS

NV-HAP ↓ 70% from Baseline!

Control chart for non-ventilator HAP
January 2010 to December 2014

- Oral care for all adult pts
- Documentation
- NGT standards revised
- Pharmacy starts PPI protocol
- Mandatory Education for Nurse Assistants
- Started oral care prior to surgery
Post operative NV-HAP (all adult inpatient surgery)
Incidence 6 months Pre Oral Care vs. 6 months After

Quinn B, Presented at AACN NTI, Houston, Tx, 2017
It is not enough to do your best; you must know what to do, and THEN do your best.

~ W. Edwards Deming
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HAI prevention courses by Kathleen Vollman

https://www.medbridgeeducation.com/certificate_programs/20336-healthcare-acquired-infections-prevention-is-key