**Pneumonia Prevention – The Vent and Beyond**

Kathleen M. Vollman, Advanced Nursing
Teleclass broadcast sponsored by Sage Products (www.sageproducts.com)

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### DISCLOSURES

- Sage Products
  - Speaker Bureau & Consultant
- Hill-Rom
- E.L. Lilly
- Merck

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### IT IS TIME TO CHANGE!!

- 44,000 to 98,000 preventable death in hospitals related to medical errors annually (IOM report, 1999)
- 92,888 deaths directly attributable to safety indicators between 2005-2007 (HealthGrades 2009)
  - Failure to rescue, pressure ulcers and post-op infections (VAP)
- Professional Nursing: Back to the Basics
- Quality organizations
  - Safer HealthCare Now (SHN) & IHI
  - Quebec Campaign: Together, lets improve healthcare safety
- Preventable injury is expensive

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### 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

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### INTERVENTIONAL PATIENT HYGIENE

- Hygiene…the science and practice of the establishment and maintenance of health
- Interventional Patient Hygiene….nursing action plan directly focused on fortifying the patients host defense through proactive use of evidence based hygiene care strategies
- Incontinence Associated Dermatitis Prevention Program
- Pressure Ulcer Prevention

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**VENTILATOR ASSOCIATED PNEUMONIA**

- Adult cases of VAP ~ 4000 per year
- 230 deaths
- 17,000 excess ICU days (2% of all ICU days in Canada)
- Costing 46 billion per year
- If 1 is prevented, cost savings of $14,000.00
- Controversy over the definition
- Safer Healthcare now supports reporting of VAP rates and compliance of bundle measures

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**HOSPITAL ACQUIRED PNEUMONIA (HAP) AND VENTILATOR-ASSOCIATED PNEUMONIA (VAP)**

- VAP crude mortality approximately 10-40%.
- HAP crude mortality 15-18%
- Pooled mean ranges 0.7 (Ped CVICU) to 7.4 (Burn ICU) per 1000 ventilator days
- HAP rates 5-15 per 1000 patient days
- Est cost $30,000-$40,000 per VAP
- Calculated loss for VAP against matched controls=$12,780
- Increase LOS up to 4-14 days
- Annual cost $2 billion dollars.

**HOSPITAL ACQUIRED PNEUMONIA (HAP) IN CANADA**

- Adult cases of VAP ~ 4000 per year
- 230 deaths
- 17,000 excess ICU days (2% of all ICU days in Canada)
- Costing 46 billion per year
- If 1 is prevented, cost savings of $14,000.00
- Controversy over the definition
- Safer Healthcare now supports reporting of VAP rates and compliance of bundle measures

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**VAP DIAGNOSIS**

**Preventing VAP in Adult Patients**

- **Defining VAP in Adults**
  - Ventilator-associated pneumonia (VAP) is defined as a pneumonia occurring in patients requiring mechanical ventilation for at least 48 hours, or who are returned to the ICU within 48 hours after extubation through inappropriate, or endotracheal tube. Further, the device must have been in place within the 48-hour period before onset of infection and for at least two consecutive days.


**Microbiological evidence:**

- Sputum culture growing the same organism

**Clinical evidence:**

- High fever
- Temperature >38°C ± other criteria

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**COMPONENTS OF SUCCESSFUL LONG LASTING CHANGE**

- Skills & Knowledge
- Resources & System
- Value
- Attitude & Accountability
- Factors Impacting the ability to Achieve Quality Nursing Outcomes at the Point of Care

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Vollman KM. Australian Crit Care, 2009;22(4): 152-154

Vollman KM. Australian Crit Care, 2009;22(4): 152-154
DEFINITION IS CHANGING 1/2013: VENTILATOR ASSOCIATED EVENTS

- Foundation:
  - Criteria: objective, clinical data that are expected to be readily available across the spectrum of mechanically-ventilated patients, intensive care units and facilities
- New definition only for the following patients:
  - Patients ≥ 18 years of age;
  - Patients who have been intubated and mechanically ventilated for at least 3 calendar days;
  - Patients in acute and long-term acute care hospitals and inpatient rehabilitation facilities.

NOTE: Patients receiving rescue mechanical ventilation therapies [e.g., high-frequency ventilation, extracorporeal membrane oxygenation, or mechanical ventilation in the prone position] are excluded from surveillance using the new, proposed definition algorithm.

PROPOSED ALGORITHM

THE VAP BUNDLE JULY 2012!

- SHNs VAP Bundle (not listed in order of importance)
  - Elevation of HOB to 45° when possible, otherwise attempt to maintain the HOB > 30° should be considered
  - Daily evaluation of readiness for extubation
  - The utilization of endotracheal tubes with subglottic secretion drainage
  - Oral care and decontamination with Chlorhexidine
  - Initiation of safe enteral nutrition within 24-48hrs of ICU admission

45% reduction in VAP when using a VAP Bundle

THE VENT BUNDLE...TO THE VAP BUNDLE

- Applying evidence-based practice
- 5 activities that when done 100% of the time has shown a reduction in
  - VAP
  - LOS
  - Time on Vent
  - Cost
- HOB 30°, Peptic Ulcer Disease (PUD) prophylaxis, DVT prophylaxis, Sedation vacation, Daily assessment for SBT and Oral care with an antiseptic
- Additions: Mobility, EVAC tube, OG vs. NGT

EUROPEAN VAP BUNDLE

- No ventilator circuit change unless specifically indicated
- Alcohol based hand hygiene
- Appropriately educated and trained staff
- Incorporation of sedation and weaning protocols
- Oral care with CHG


PROPOSED ALGORITHM

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MacIntyre N. Semin Resp Crit Care Med, 2004;25:390-392

### Mechanical Ventilation Wean Protocol

An automatic weaning protocol should be in place and mechanically ventilated patients should undergo assessment of readiness to wean. The readiness to wean involves two main steps:

- **Readiness to Wean:** Arousable, Low ventilatory and end expiratory pressure requirements, No new potentially serious conditions, Hemodynamically stable, with or without vasopressor support, Requires levels of FiO2 that could be delivered with a face mask or nasal cannula.
- **Perform a Spontaneous Breathing Trial:** 30 to 120 minutes with assessment of vent pattern, gas exchange, hemodynamics, and comfort.

### Healthcare Acquired Pneumonia

- **Risk Factor Categories**
  - Factors that increase bacterial burden or colonization
  - Factors that increase risk of aspiration

### Appropriate Sedation: Impacting Ventilator Outcomes

- Around the clock sedation administered via a protocol based on evaluation of sedative levels with a reliable and valid tool: short time on ventilator, ICU & hospital length of stay, need for a trach
- Daily interruption of sedative drug infusions decreases the duration of mechanical ventilation and LOS in the ICU. In the group that had daily interruption, the duration of mechanical ventilation was reduced by 33% (2.4 days) and ICU LOS was reduced by 35% (3.3 days) and lower impact on PTSD.
- Wake up and breathe protocol resulted in time on ventilator, ICU & hospital stay and reduced 1 year mortality (NNT=7).
- When dexmedetomine was compared to midazolam in long-term sedation, it showed time to extubation, ICU stay, delirium prevalence and delirium free days, problems with Bradycardia.

### Sneak Peek at New Guidelines

- PAD Guidelines Coming (Evidence Based)
- Pain (Non-pain & Pharmacological: Remifentanil or Fentanyl)
- BPS (Behavioral Pain Scale)
- CPOT (The Critical Care Pain Observation Tool)
- Agitation (non-benzodiazepine, Dexmedetomidine or Propofol) light sedation & interruption
- RASS
- SAS
- Delirium (use atypical antipsychotics: Olanzapine/Quetiapine)
- ICU-CAM
- ICU Delirium Screening Checklist
- PAD Bundle

### Endotracheal / Nasogastric Tube / Sinusitis

- Carriage of oropharyngeal bacteria during intubation
- If cuff pressure < 20 cm 4x ↑ risk VAP
- Cuff pressure range btw 25-40cm (JBI-Level A) with maintenance at 25cm-30cm of H2O pressure.
- Continuous monitoring resulted in a lower portion of out of range cuff pressure (11% vs. 51.7% < 0.001)
- NGT increases risk of sinussitis/gastric reflux & increases oropharyngeal colonization.
- Use oral ET versus nasal (CDC-Cat IB)
- Sinusitis increases the risk of nosocomial pneumonia by 3 fold

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HEAD OF BED/ BUNDLE ELEMENT

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


HEAD OF BED/ BUNDLE ELEMENT

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.


HOB RESEARCH

Methodology:
- 86 patients
- Randomly assigned to supine position or HOB 45 degrees (39 semi recumbent, 47 supine)
- Monitored clinical suspected & microbiologically confirmed nosocomial pneumonias

Results:
- Microbiologically confirmed nosocomial pneumonia lower in the semi recumbent group 2/39 (5%) vs. 11/47 (23%)
- Supine position & enteral nutrition were independent risk factors for VAP & had the greatest number of VAP's 14/28 (50%)


HOB RESEARCH

- Methodology
  - Prospective multicenter trial randomly assigned to targeted 45° vs. 10° HOB
  - 112 to targeted 45° vs. 109 patients to 10°
  - Continuous measurement of backrest elevation first wk of MV
  - Dx of VAP by bronchoscopic techniques
- Results
  - Baseline characteristics similar
  - Average elevations
    - 10° group day 1 & 7: 9.8 & 16.1
    - 45° group day 1 & 7: 28.1 & 22.6*
  - Target 45° not achieved 85% of the time
  - VAP: 10° = 6.5% vs. 45° = 10.7%

*p < .001

HOB ON VAP COMPARING 45° TO 25°

- Prospective randomized control trial comparing HOB elevation of 45 to 25 degrees on VAP rates
- There was no continual measurement of HOB or compliance with 45° was not measured
- Small sample size, 46% of randomized patients were withdrawn because of ventilation issues as well as discomfort.
- Results
  - VAP Rates: HOB 45 = 5/17
  - HOB 25 = 7/13


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**MAKING IT HAPPEN**

- Entire team involvement
- Education on what 30 and 45 really look like
- Standing orders
- Contraindications (make it safe)
- Visual strategies
  - Beds with angles built in
  - Tape on the wall
- Compliance measurements

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**ORAL CAVITY & VAP**

- 89 critically ill patients examined for microbial colonization of the oropharynx through out ICU stay
- Used pulse field gel electrophoresis to compare chromosomal DNA
- Results:
  - Diagnosed 31 VAPs
  - 28 of 31 VAP's the causative organism was identical via DNA analysis

---

**ROLE OF SALIVARY FLOW**

- Provides mechanical removal of plaque and microorganisms
- Innate & specific immune components (IgA, cortisol, lactoferrin)
- Patients receiving mechanical ventilation have dry mouth which in turn contributes to accumulation of plaque & reduced distribution of salivary immune factors

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**ORAL CARE REDUCES PNEUMONIA IN NURSING HOMES**

- 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

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**Methods**

- 11 nursing homes in Japan over 2 year period
- 417 enrolled / 366 residents analyzed (death from other causes)
- 184 received oral care program/182 did not
- Tooth brushing after each meal (teeth or dentures) & 1x weekly review by dentist/hygienist

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**Results**

<table>
<thead>
<tr>
<th>Method</th>
<th>No Oral</th>
<th>Oral Care</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>29%</td>
<td>15%</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>19%</td>
<td>11%</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Death</td>
<td>16%</td>
<td>7%</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>MMSE</td>
<td>Increase</td>
<td></td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

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**What Does the Evidence Tell Us?**

- **BRUSH**
- **CHX RINSE ALONE**
- **CHX RINSE IN COMBINATION**
- **SWAB/CLEAN/MOISTURIZE**
- **SUCTION**
- **All of the above**

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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 performed Murray TM et al. AACN Advanced Critical Care. 2007;18(2):190-199
- Dickinson S et al. SCCM Critical Connections, Feb 2008

![Graph showing VAP rates and oral care interventions](image)

ORAL SUCTIONING WITH POSITION CHANGE

- Prospective time sequenced non-randomized study
  - 237 control (observation phase 9 months)
  - 227 Interventional (7 months interventional)

- Difference in nursing protocol was oral suctioning prior to position change (11 additional suctionings)
- All other nursing care the same

- Results:
  - VAP: 6.51 to 2.04 per 1000 ventilator days (p<0.002)
  - Vent days: 28.8 ± 17.2 vs. 20.2 ± 4.0 (p<0.009)
  - ICU LOS: 27.6 ± 17 vs. 20.3 ± 4.0 (p<0.012)
  - Suctioning before positional change only independent factor responsible for VAP decrease (p=0.003)


DOES COMPLIANCE MAKE A DIFFERENCE?

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

![Graph showing VAP rates and compliance](image)


SUBGLOTTIC SECRETION DRAINAGE/ BUNDLE ELEMENT

5 level 2 trials conclude that subglottic secretion drainage is associated with a reduction in VAP

![Graph showing outcomes and mortality](image)


ENTERAL FEEDING WITHIN 24-48HRS BUNDLE ELEMENT

- Early EN vs Late EN
  - Decrease in infectious complications
  - Reduced LOS
  - Reduced mortality

- How to Make it Happen
  - Large bore in the mouth/small bore in the nose
  - Confirmation of the tube site and mark it
  - Address issues of intolerance but do not hold feeding until residuals > 500cc’s
  - Continuous administration
  - Use of a protocol to drive early EN

![Graph showing enteral feeding rates](image)


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SSCM NUTRITIONAL GUIDELINES (2009)

- Targeted for ICU pts > 2-3 day LOS
- ARDS/Severe ALI=EN formula with anti-inflammatory lipid profile (Grade A)
- Nutritional therapy in form of EN should be initiated in patients unable to maintain voluntary intake (Grade C)
- EN preferred route (Grade B), EN start 24-48hrs (Grade C), advance towards goal over next 48-72hrs (Grade E)
- EN withheld until unstable patient fully resuscitated (Grade E)
- Neither presence or absence of bowel sounds, or passage of flatus or stool required before initiation (Grade B)
- Either gastric or small bowel feeding acceptable. If at high risk feed via small bowel (Grade C)
- Hold for gastric residuals > 500 ml in absence of other signs of intolerance (Grade B)


ADDITIONAL CARE PRACTICES TO IMPACT VAP

VENTILATOR CIRCUIT CHANGE

Continuously rotating therapy (CLRT) reduces VAP.

CLRT TO PREVENT VAP

Methodology

- Prospective randomized controlled trial, 3 medical ICUs at a single center
- Eligible if ventilated < 48 hours & free from pneumonia, ALI or in ARDS
- 150 patients with 75 in each group
- 35 CLRT patients allocated to undergo percussion before suctioning
- Measures to prevent VAP were standardized for both groups including HOB

Results: CLRT vs. Control

- VAP: 11% vs. 23% p = .048
- Ventilation duration: 8 ± 5 days vs. 14 ± 23 days, p = .02
- LOS: 25 ± 22 vs. 39 ± 45 days, p = .01
- Mortality: no difference


PROGRESSIVE MOBILITY PROGRAMS

Journey to tolerating upright position, tilt, sitting, standing, and walking can occur quicker through the use of technology
OUTCOMES OF A PROGRESSIVE MOBILITY PROGRAM

- ↓ incidence of skin injury
- ↓ time on the ventilator
- ↓ incidence of VAP
- ↓ days of sedation
- ↓ delirium
- ↑ ambulatory distance
- Improved function

Abroung, F. et al. Critical Care, 2011;15:B6
Schwabacher, W. et al. Amer J. Resp Care, 2010;317:54-62
Wakai, C. et al. CCN, 2010;30:36-60

Intervention to Decrease VAP
Statewide Collaborative-Keystone ICU

- 112 ICU’s from 72 hospitals reported data
- Examine 550,800 ventilator days
- Implementation of the CUSP/VAP Bundle/checklist

Results: 71% ↓ in VAP rates in MI
- Median rate of VAP per 1000 vent days went 5.5 cases to 0 0 at 16-18 months (p<0.001) & 0 at 28-30 months (p<.001)
- Mean rate of VAP per 1000 vent days went 6.9 to 3.4 at 16-18 month follow up (p<0.001) & 2.4 at 28 to 30 months (<.001)
- Composite compliance measured ↑ from 32% at baseline, 75% at 18 months & 84% at 28 months
- Inclusion of oral care was not measured


WHEN WOULD NOW BE A GOOD TIME TO DO THIS?

A WAKE
B BREATHE
C CHOICE OF SEDATION
D DELIRIUM
E EARLY MOBILITY
F FEEDING

FOUR E’S

- Engage: help staff understand the preventable harm
- Share stories about patients affected
- Estimate number of patients harmed
- Develop a business case
- Educate: ensure staff and senior leaders understand what they need to do to prevent injury and improve teamwork and communication
- Conference calls, webcasts, meetings
- Execute: how given the resources and culture they would ensure that all patients received the evidence
- Share with working, what’s not
- Coaching calls
- Evaluate: project leader monitors that teens are using standardized definitions, report their data and make it transparent at the unit level


IN GOD WE TRUST!

Everyone else please bring data

And a Story
FOUR E’S

- Engage: help staff understand the preventable harm
  - Share stories about patients affected
  - Estimate number of patients harmed
  - Develop a business case
- Educate: ensure staff and senior leaders understand what they need to do to prevent injury and improve teamwork and communication
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- Evaluate: project leader monitors that teens are using standardized definitions, report their data and make it transparent at the unit level

EXECUTE

<table>
<thead>
<tr>
<th>Board/Checklist</th>
<th>Executives/Service Leader Checklist</th>
<th>Projected to Achieve Accessory Evidence</th>
<th>Staff (Hire, Retain)</th>
<th>Staff (Educat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage: help staff understand the preventable harm</td>
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<td></td>
</tr>
</tbody>
</table>

The things included in the measurement becomes relevant, the things omitted are out of sight out of mind

Peter F. Drucker
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**EVALUATE**

It has been...

![Table showing weeks since Unit last VAP](image)

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**POTENTIAL BARRIERS**

- Perception of lack of time or the importance
- Lack of evidence based education...just do it!!!!
- Absence of a define protocol/procedure
- Staff turnover/Replacement staff
- Inaccessibility of needed supplies
- No real clinical lead on the unit
- Lack of feedback on progress
- Lack of accountability/responsibility

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**INTERVENTIONS TO ENSURE PATIENTS RECEIVE EVIDENCE**

- Evidence based education
  - Recognition of value and reinforcement
  - Products/Processes that make it easy for the frontline caregiver to provide the care (make it part of the bundle)
    - Bathing kits
    - Placement on the med record
    - Automated charting with flag reminders
    - Frequent rounding/reinforcement of standard
    - Multidisciplinary rounds/Checklists

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**BE COURAGEOUS**

We all are responsible for the safety of our patients......Own the Issues

- “If not this, then what??”
- “If not now, then when??”
- “If not me, then who??”

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15 August *(Free WHO Teleclass … Europe)* Processing Medical Devices in Settings With Limited Resources
Speaker: Dr. Nizam Damani, Craigavon Area Hospital, Northern Ireland
Sponsored by WHO First Global Patient Safety Challenge – Clean Care is Safer Care

30 August *(Free Teleclass … Broadcast Live from New Zealand MIDC Conference)*
‘Contagion’ … the Movie, How Realistic Is It?
Speaker: Prof. Lance Jennings, University of Otago, New Zealand

5 September *(Free WHO Teleclass … North America)* Successes and Challenges in Developing and Implementing Bundles in Infection Prevention
Speaker: Prof. Don Goldmann, Harvard University School of Public Health
Sponsored by WHO First Global Patient Safety Challenge – Clean Care is Safer Care

13 September *The Hand is Quicker Than a Sneeze in the Spread of Disease*
Speaker: Prof. Chuck Gerba, University of Arizona
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