Ventilator Associated Pneumonia

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Dynamics of Critical Care 2009
CACCN, Fredericton,
New Brunswick
Disclosure

- Nothing to disclose
Goals & Objectives

- By the end of this presentation participants will:
  - Understand how to prevent Ventilator-Associated Pneumonia (VAP) by implementing the four components of care called the: “VAP bundle”.
  - Understand how implementation of the VAP bundle decreases the rate of VAP in ventilated patients.
About St. Mary’s Hospital

- Hospital is situated in Montreal
- 313 beds
- 11 Critical care beds (7 ICU, 4 CCU)
VAP: Definition

- “VAP (Ventilator-Associated Pneumonia) is defined as a pneumonia occurring in patients requiring a device intermittently or continuously to assist respiration through a tracheostomy or endotracheal tube.”

- “Further, the device must have been in place within the 48 hour period before onset of infection and for at least 2 consecutive days.”
Why is it important

- 10-20% of patients requiring mechanical ventilation will develop VAP.\(^7\)
- The risk is higher during the first 5 days of MV.
- 4.4-15.2 cases of VAP are found per 1000 ventilator days in adult population.\(^8\)
- VAP is associated with 15% of all nosocomial infections and 25% of the deaths associated with nosocomial infections.\(^9\)
Why is it important

- ICU LOS can be ↑ by 4-6 days (mean 4.3 days) and hospital LOS from 4-9 days (up to 17 days).\textsuperscript{10}
- Often LOS is doubled in patients who have VAP.\textsuperscript{10}
- Mortality rate is very high.(close to 50%)
Diagnostic Criteria for VAP

- Diagnostic Criteria as per Safer Health Care Now (SHCN)
  - New, worsening or persistent infiltrate consolidation or cavitation on CXR compatible with pneumonia and 1 of:
    - WBC $\geq 12,000$ or $< 4,000$
    - $T^\circ > 38^\circ C$ with no other recognized cause
    - Altered mental status with no other cause, in $> 70$ year old.
Diagnostic Criteria for VAP

- At least 2 of the following:
  - New onset of purulent sputum, or change in character of sputum, or increase in respiratory secretions or increase in suctioning requirements
  - Altered mental status with no other cause, in the > 70 year old.
  - Inspiratory crackles or bronchial breath sounds on auscultation
  - Worsening gas exchange (e.g. O\textsubscript{2} desaturation, PaO\textsubscript{2}/FiO\textsubscript{2} < 240, an increase in O\textsubscript{2} requirements or an increase in minute ventilation).
VAP Criteria

- CXR
## Diagnostic Criteria

### Ventilator Associated Pneumonia (VAP) & Central Line Infection (CLI) Project Data

Please collect information daily.

<table>
<thead>
<tr>
<th>Date</th>
<th>Pt. Chart # (List All Pts in ICU)</th>
<th>ON Ventilator - VAP Bundle: check all that apply</th>
<th>NOT on Ventilator</th>
<th>VAP</th>
<th>If YES check all that apply</th>
<th>Comments / Special Circumstances (including surgical pt with NG tube/ trach/ vent, etc)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Head of bed 30°-45°</td>
<td><em>Oropharyngeal</em> orogastric feeding</td>
<td>EVAC tubes in trachea/ stomach</td>
<td>Spontaneous Breathing Trial</td>
<td>Too Sicks to Try</td>
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</table>

*Oropharyngeal* orogastric feeding: Pts receiving enteral feeding via *specially designed small bore nutrition tubes* placed nasally are deemed in compliance with the VAP prevention strategy. (Safer Health Care Now Campaign, How-to-Guide: Prevent Ventilator-Associated Pneumonia, p.20)
Difficulties encountered

- VAP needs to be diagnosed according to set criteria. MDs need to be aware of them.
- Since we are a small ICU we compiled data on a daily basis. Larger ICU’s sample a volume of ventilated patients of approximately 10%.
- Search of information: data may not be documented (HOB, SBT, oral tubes, EVAC)
- We therefore added the 4 components of the bundle to our documentation tools.
Difficulties encountered

- The more people collecting data, the more inconsistencies or incomplete data.
  - MDs in the ICU collect data for VAP diagnostic criteria
- Assign someone to make sure data is collected daily including weekends.
- We involved a quality analyst to compile and report the data to SHCN.
- Patients with a tracheostomy only count ventilated days.
VAP case study

- 62 year old man with Respiratory failure secondary to neuromuscular disease and narrowed upper airway.
- Vocal cord paralysis after first intubation
- Bilateral pneumonia
# VAP case study

<table>
<thead>
<tr>
<th>Date</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>21</th>
<th>22</th>
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<tbody>
<tr>
<td>T°</td>
<td>37</td>
<td>37.2</td>
<td>39</td>
<td>38.5</td>
<td>38.9</td>
<td>38.6</td>
</tr>
<tr>
<td>WBC</td>
<td>7.0</td>
<td>8.3</td>
<td>10.9</td>
<td>18.9</td>
<td>16.8</td>
<td></td>
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<tr>
<td>Sputum</td>
<td>S/A white clear</td>
<td>S/A white clear</td>
<td>Copious amounts yellow thick</td>
<td>M/A thick beige</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lungs</td>
<td>Crackles at bases</td>
<td>Diffuse Rhonchi</td>
<td>Inspir. Wheezes</td>
<td>Bronchial breathing, ↑insp. wheezes</td>
<td></td>
<td></td>
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## VAP case study ABG (Intubated)

<table>
<thead>
<tr>
<th>Date</th>
<th>PH</th>
<th>PaO₂</th>
<th>PCO₂</th>
<th>HCO₃⁻</th>
<th>SAO₂</th>
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<tbody>
<tr>
<td>18</td>
<td>7.44</td>
<td>80</td>
<td>40</td>
<td>27</td>
<td>.96</td>
</tr>
<tr>
<td>21</td>
<td>7.46</td>
<td>67</td>
<td>35</td>
<td>25</td>
<td>.86</td>
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<tr>
<td>22</td>
<td>7.54</td>
<td>150</td>
<td>29</td>
<td>25</td>
<td>1.00</td>
</tr>
</tbody>
</table>
VAP case study

- CXR for study case

Feb 18: CXR clear
Feb 19: LLL opacity
Feb 21: LLL infiltrate
VAP Bundle

SHCN has defined a “VAP bundle”, a group of evidence-based practices that, when implemented together, should result in dramatic reductions in the incidence of Ventilator-Associated Pneumonia.”

2
VAP Bundle

- The SHCN VAP bundle has 4 key components:
  - HOB between 30-45 °
  - Daily “sedation vacation” and assessment of readiness to extubate by performing a Spontaneous breathing trial (SBT).
  - Use of oral versus nasal tubes for access to trachea or stomach
  - Use of EVAC tubes for the drainage of subglottic secretions
HOB elevation rationale

- HOB > 30-45°

Drakulovic et al.²

- Randomized controlled trial in 86 ventilated patients assigned to semi-recumbent or supine position.
- Trial demonstrated that suspected cases of VAP in supine position has an incidence of 34%, while in semi-recumbent position suspected cases had an incidence of 8% (p=0.003)
HOB elevation rationale

- HOB
- Other benefits:
  - Minimize atelectasis
  - Improve overall patient’s ventilation
HOB elevation implementation

- At St. Mary’s Hospital: (SMHC)
  - HOB documentation is included in the ICU flow sheet and RT flow sheet. (Q1H)
  - We used measuring device on the electric beds
  - Posters at bedside to encourage all staff, family members to maintain HOB elevated
- In-service done with staff May 2007. Reinforced thereafter.
- Communication: Compliance rate with HOB posted in unit Q month.
Sedation Vacation/SBT trial rationale

- Daily sedation vacation and assessment of readiness to extubate by performing SBT:
- Kress et al.;³
- Conducted a randomized controlled trial in 128 adults patients ventilated, randomized to daily interruption of sedation irrespective of clinical state or interruption at the clinician’s discretion
Sedation Vacation/SBT trial rationale

- SBT
  - Daily interruption resulted in a marked and highly significant reduction in time on mechanical ventilation.
  - Duration of MV ↓ from 7.3 days to 4.9 days (p=0.004)
Sedation Vacation/SBT trial rationale

- SBT
  - Risk of sedation vacation:
    - self-extubation
    - Pain & anxiety associated with lightening sedation
SBT implementation

- At St. Mary’s Hospital:
  - Standardized the performance of SBTs with ventilated patients. Done by RT before 09:00a.m. if patient not too sick
  - Results shared at medical rounds
  - Use of Ramsay score to avoid over-sedation
  - SBT compliance posted monthly on bulletin board.
Orogastric tubes rationale

- Use of oral versus nasal tubes for trachea or stomach access
- Rationale: Reduces the frequency of nosocomial sinusitis and possibly VAP
- Holzapfel L$^4$ and colleagues randomized 300 patients between nasal and oral endotracheal intubation.
  - Sinusitis was observed in 78 patients. (45 from nasal group and 33 from oral group.)
  - Nosocomial pneumonia was observed in 26 patients. 17 in the nasal group and 9 in the oral group
Oral tubes Implementation

- At St. Mary’s:
  - We insert oral tubes for all patients mechanically ventilated in the ICU
  - We asked ER and OR to adopt our policy when possible.
  - Some exceptions have been made with OR patients.
  - If the tube is not in right place we change it.
  - Nutritionists are on board
  - Communication: Results posted on bulletin board
EVAC rationale

- EVAC tubes.
  - The accumulation of contaminated oropharyngeal secretions above the endotracheal tube cuff is a risk of aspiration.
  - If the subglottic region is suctioned to remove these secretions this may reduce the risk of aspiration and VAP.
  - EVAC tubes allow subglottic aspiration. It contains a separate lumen that opens into the subglottic region.
**EVAC tubes**

- A recent meta-analysis\(^5\) of 5 studies including a total of 896 patients showed that subglottic secretion drainage reduced the incidence of VAP by nearly half by reducing early onset pneumonia.

- **Cost difference:**
  - EVAC: $7.74 \pm $ each
  - Regular tube: $1.96 \pm $ each

- Available in all sizes

- 0.8 mm larger in outer diameter.
EVAC tube

- EVAC tube implementation
  - Purchased in May 2007.
  - Installed on all crash cart in ICU, CCU, ER
  - Instructed OR that for all expected cases to go to the ICU an EVAC tube must be used
  - Education program done for staff in May 2007
  - Communication: Compliance rate with EVAC tubes posted in ICU bulletin board monthly.
Other

- Oral decontamination
  - SMHC purchased the oral decontamination kit in January 2008.
  - Staff in-services done in February 2008.
  - New implementation protocol for use of oral decontamination products to be established in October 2009 to standardize practice.
Where to start

- First Form a team
  - Our team is composed of:
    - Head Nurse
    - MD ICU Director
    - Clinical Nurse Educator
    - ICU nurses
    - Respiratory Therapist
    - Nutritionist
    - Pharmacist
    - QA analyst
    - OT/PT
    - Infection Control Nurse
Assess where you stand presently.

- In May 2006
  - Pilot study of 56 patients was observed over 10 days by nursing students.
  - 36/56 patients were intubated
- Compliance Results
  - HOB > 30°: 64 %
  - SBT: 30%
  - Oro-gastric intubation: 5%
  - EVAC: 0%
Set a Goal

As per SHCN
First set your VAP rate:

Total # VAP cases $\times$ 1000 = VAP rate
# ventilation days
VAP rate what it means

- Represents the total number of cases of VAP for a particular time period.
- Needs to take into consideration the total number of days that patients are on a ventilator.
- Example:
  - 7 cases of VAP for June
  - Total Mechanically ventilation days for each patient total 168
  - \( \frac{7}{168} \times 1000 = 41.6 \)
SMHC VAP rate

- We calculated our VAP rate for a 3 month period in 2007 (per 1000 ventilation days)
  - February 2007 VAP = 10.42%
  - March 2007 VAP = 29.4%
  - April 2007 VAP = 17.9%

Average for 3 month VAP rate = 19
Aim set at 50% reduction = VAP rate ↓ to 9.5
Difficulties encountered

- We could not do a retrospective study to evaluated the number of VAPs due to Medico system.
- We decided to take a 3 month sample in a year.
- Our goal was then set from this sample.
Set a Goal

As per SHCN!
- Second set your VAP bundle compliance

# receiving ALL 4 components of VAP bundle= Bundle compliance
# on ventilators for the day of the sample

Target for SHCN is 95%
VAP Bundle Compliance
what it means

- On a given day, select all ventilated patients and assess them for compliance with the VAP bundle
  - HOB > 30°
  - EVAC tubes
  - Orogastric tubes
  - SBT/Sedation vacation
Difficulties encountered

- If you do not have compliance with one element of the bundle for example SBT then your overall compliance will be affected.
- You cannot choose to implement only one component of the bundle but you must implement all 4 to be compliant and effective to ↓ overall VAP rate.
- Surgical patients: for surgical reasons gastric tubes may not be able to be inserted in the mouth.
- EVAC tubes: Not all patients admitted from OR have the EVAC tube- unexpected crashing patient.
Difficulties encountered

- Transfers from ER may not comply with EVAC or orogastric tubes.
- Risk or discomfort caused to patients if EVAC tubes or nasogastric tubes have to be changed.
- EVAC tracheostomy tubes were not purchased and available then.
- There was some reluctance of doctors to do SBT due to severity of patient illness but we are now allowed to say patients are too sick to try SBT and still count as compliant with the bundle.
Difficulties encountered

- Difficulty in benchmarking amongst institutions. If there is good medical reason why not to do part/all of the bundle the patient is considered compliant as per SHCN criteria.
## VAP rate results

Our target 9.5 (50% reduction)

<table>
<thead>
<tr>
<th>Year</th>
<th>VAP Rate</th>
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</thead>
<tbody>
<tr>
<td>February, March, April 2007</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1-March 31, 2007-8</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1-March 31, 2008-9</td>
<td>8.7</td>
<td></td>
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</tr>
</tbody>
</table>
VAP rate results

![Bar chart showing VAP rate results from 2007 to 2008-9.](chart.png)
## Results Bundle Compliance

<table>
<thead>
<tr>
<th>Bundle component</th>
<th>2006 Pilot</th>
<th>2007-8</th>
<th>2008-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOB &gt; 30°</td>
<td>64%</td>
<td>95.8%</td>
<td>98.8%</td>
</tr>
<tr>
<td>SBT</td>
<td>30%</td>
<td>61.1%</td>
<td>95.3%</td>
</tr>
<tr>
<td>EVAC</td>
<td>0%</td>
<td>80.7%</td>
<td>99%</td>
</tr>
<tr>
<td>Orogastric tubes</td>
<td>5%</td>
<td>91.1%</td>
<td>98.3%</td>
</tr>
<tr>
<td>Overall</td>
<td>51%</td>
<td>94%</td>
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Accomplishments

- Over the last 6 months we have had 100% compliance with the 4 components of the Bundle compliance.
- We have managed to decrease our VAP rate by 50%
- Decrease overall mortality and LOS
Accomplishments / Future Goals

- Project adopted for life!
- After 6 months of compliance reached for bundle compliance and VAP rate aim reached, SHCN only ask that we do spot check 4 times a year but we continue daily data collection.
- Documentation tool changed to integrate bundle compliance elements to facilitate data collection (RT sheets)
- Integrated in daily routine (MD do data collection on rounds)
Accomplishments / Future Goals

- Oral decontamination incorporated with VAP protocol.
- Hand Hygiene reinforced.

- Other SHCN initiatives in process:
  - Central line infection
  - Sepsis bundle.
  - Acute MI
Thank you
Questions?
References:


References


References


7. SafdarN and al. The pathogenesis of ventilator-associated pneumonia; its relevance to developing effective strategies for prevention. Respir Care 2005;50; 725-39
References


References