Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

Question: “What is the quality of the evidence concerning the prediction and prevention of hospital-acquired pneumonia (HAP) in the acute care hospital setting?”

Results: There is conflicting evidence surrounding the board topic of HAP, which focused mainly on mechanically ventilated patients, post-operative patients, and patients at risk of aspiration (6,8,10,11). The risk factors vary from each group, as do the specific recommendations for HAP prevention (1,2,3,4,5,6,7,8,9,10,11,12). The contradictory results may represent evolving research surrounding innovative technologies, patient care procedures, and pharmacological strategies (1,2,5,6,7,8,9,11). Clinical expertise, coupled with organization-supported evidence-based practices and new technologies, is needed to ensure the continuation of quality patient care while also reducing HAP rates (1,2,9,11).

Based on the reviewed evidence, the following recommendations are offered for consideration:

Physicians (MD)
• Become proficient in physician focused evidence-based HAP practices and participate in their implementation in the clinical setting (9,11)
• Know the factors associated with patients at high-risk of ventilator associated pneumonia (VAP) and other types of HAP (1,2,3,4,5,6,7,8,9,10,11,12)
• Understand the risks and benefits of proton-pump inhibitor use and its association with aspiration pneumonia (6)
• Consider orotracheal intubation with a subglottic drainage endotracheal tube (SSD ETT) (9,12)
• Consider twice-daily oral hygiene with tooth brushing followed by chlorhexidine (CHG) application for patients at risk of VAP (1,2,9)
• Search for post-operative infections in patients developing new onset atrial fibrillation or other supraventricular tachyarrhythmias (3)

Staff Nurses (RN)
• Become proficient in RN focused evidence-based HAP practices and participate in their implementation in the practice setting (9,11)
• Know the factors associated with patients at high-risk of VAP and other types of HAP (1,2,3,4,5,6,7,8,9,10,11,12)
• Monitor patients receiving proton-pump inhibitor medications who are at risk of aspiration pneumonia (6)
• Routinely remove oral secretions prior to position change in non-SSD ETT patients (2)
• Elevate the head of bed as near to 45 degrees as possible for all patients at risk of HAP (7,9)
• Implement twice-daily oral hygiene with tooth brushing followed CHG application for patients at risk of VAP (1,2,9)
• Report signs and symptoms of post-operative infections in patients developing new onset atrial fibrillation or other supraventricular tachyarrhythmias (3)

Respiratory Care Practitioners (RCP)
• Become proficient in RCP focused evidence-based HAP practices for respiratory equipment and pulmonary treatments and participate in their implementation in the practice setting (9,11)
• Know the factors associated with patients at high-risk of VAP and other types of HAP (1,2,3,4,5,6,7,8,9,10,11,12)
• Effectively manage patients who have been orotracheally intubated with SSD ETT (9,12)
• Monitor the routine removal of oral secretions prior to position change in non-SSD ETT patients (2)
• Understand the risks and benefits of bacteria filter use and aerosol therapy in patients at risk of VAP (2,9,11)

Health Care Workers (HCW)
• Become knowledgeable in evidence-based infection control practices for HCW including the role hand-washing plays in disease prevention (10,11)
• Consider the risk and benefits, as well as patient and employee safety issues, for annual HCW influenza vaccination (10,11)
Organizational

- Champion the development of evidence-based HAP monitoring standards, guidelines, protocols, and policies, as led by a group of expert clinicians best able to analyze the conflicting research results, and provide adequate resources to support their implementation in the clinical setting (9,11).
- Educate HCW about organizational infection control procedures for the prevention of HAP (11)
- Maximize the quality of patient care by utilizing innovative technologies and cost reduction strategies for evidence-based procedures and equipment (1,2)
- Implement a comprehensive organizational influenza vaccination program targeting at-risk patients and HCW (10)
  - Target hospitalized patients during September to March (10, 11)
  - Begin HCW vaccination in October (10, 11)
  - Regularly measure and report HCW influenza rates (10)
Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

Introduction: Hospital-acquired pneumonia (HAP), also known as healthcare associated pneumonia (HCAP), has been connected with acute care patients who are mechanically ventilated, patients with gastric aspiration, and as a post-operative complication following surgery (6,8,9,10,11). HCAP negatively contributes to patient pulmonary complications, patient morbidity/mortality, and hospital length of stay, as well as total hospitalization costs (6,8,9,10,11). This integrative review will examine the quality of the evidence for the prediction and prevention of HCAP in the acute care hospital setting.

Evidence Search Strategies: An integrative review on the selected clinical question was conducted in June 2009, with a focus on HCAP, and examined ventilator associated pneumonia (VAP), aspiration pneumonia (AP), and surgery related pneumonia (SP). A review of the research evidence from open years and 2004-2009 was conducted via electronic databases (Pub Med, Pub Med Central, Medline, CINAHL, Ovid, Cochrane Library, Joanna Briggs Institute, and Yahoo) using the search terms of “pneumonia”, “prevention”, “hospital acquired pneumonia”, and “adult”, either alone, mixed, or in combination. This review yielded 118 hits and 15 articles were selected as relevant for inclusion. 7 other articles were located via the Centers for Disease Control, contextual links, and a Yahoo web-based search, for a total of 22 articles. After careful examination, 10 articles were eliminated, as they did not answer the clinical question, had an inappropriate patient population, or were studies conducted in the 1990s. The remaining 12 articles pertained to the clinical area of inquiry and were reviewed in detail. The strength of the research evidence evaluated for this integrative review ranges from insufficient to good, with a final grade of fair for the body of the research evidence. Result limitations include a broad search topic, as well as various study methodological discrepancies, such as small sample size and lack of power for statistical significance.

Evidence Search Results: HCAP research evidence is centered around three groups of patients: mechanically ventilated patients, post-operative patients, and patients at risk of aspiration (3,6,8,10,11). The strongest and largest body of evidence concerns VAP, the majority of which is linked to gram negative multi-resistant microorganisms (3, 4, 8). The risk factors associated with VAP include intubation, length of time mechanically ventilated, lack of nutrition support, and possibly acid-suppressive medication use (8, 11). The recommended strategies to prevent VAP involve a combination of physical, positional, and pharmacologic interventions (2, 9, 11, 12). Surgery related pneumonia (SP) risk factors include type of procedure, arterial hypertension, use of blood products and inotropes, age, and pre-existing chronic conditions such as COPD (3,8,11). A key SP prevention strategy involves early post-operative mobilization which encourages deep breathing (11). A SP study revealed that 60% of SP patients underwent direct cardioversion for termination of post operative atrial fibrillation or ventricular arrhythmias before diagnosis of nosocomial infection, with a recommendation for a search for post-operative infections in patients who develop new onset dysrhythmias (3). Aspiration pneumonia (AP) risk factors are focused on head of bed (HOB) lower than 30 degrees, with conflicting evidence regarding the use of acid-suppressive medication (6,8,11). AP prevention measures include elevated HOB, as well as analyzing the risks and benefits of gastric acid inhibitors for patients as risk for AP (6,8,11). Finally, the evidence highlights the role hospital-related influenza outbreaks play in the incidence of HCAP (10,11), with vaccination as the key preventative strategy (10,11).

Conclusions: There is conflicting evidence surrounding the board topic of HCAP and its various differentiated pneumonias (1,2,5,6,7,8,9,11). Although acid-suppressive medication has been implicated in both aspiration and non-aspiration pneumonia, it is significant only for proton-pump inhibitor use (6). These findings contradict earlier studies not supporting the gastro-pulmonary hypothesis of ICU-acquired pneumonia (8,11). Therefore, the risks of gastric acid inhibitors must be weighed with its potential benefits for each patient (6). The use of SSD ETT has also shown benefit in reducing VAP (9,12). However, similar results might be achieved with the routine removal of oral secretions prior to position change, a noninvasive nursing procedure with potential cost savings (2). Oral decontamination with chlorhexidine after tooth brushing is demonstrating reduction in VAP rates (1,2,9). Many clinical experts have not yet endorsed this noninvasive and time saving procedure (11). Another simple yet effective VAP preventative measure is HOB elevated as close to 45 degrees as possible in all at-risk patients (7,9). Although pressure ulcer prevention champions may challenge this intervention, only
the expert bedside clinician can determine the condition for which the patient is more at risk to developing (9). Incentive spirometry (IS) use may be beneficial for patients at high SP risk, but has shown no benefit for low-risk surgical patients undergoing certain surgical procedures (11,5). In fact, patients using IS might have worse pulmonary function and arterial oxygenation as compared to positive pressure breathing techniques (5). Lastly, an aggressive vaccination program targeted to unvaccinated patients and HCW is an organizational strategy all healthcare systems should implement in order to achieve optimal patient and employee health and safety outcomes (10,11).

The contradictory evidence may represent evolving research surrounding innovative technologies, patient care procedures, and pharmacological strategies (1,2,5,6,7,9). The aforementioned conclusions highlight the need for a group of expert clinicians to analyze the conflicting research results and champion the development and implementation of evidence-based HCAP monitoring standards, guidelines, protocols, and policies (9,11). This clinical expertise, coupled with organization-supported evidence-based practices and innovative technologies, would ensure the continuation of quality patient care while also reducing HCAP rates (1,2,9,11).
Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

Key Summary of the Evidence

➢ Health Care Associated Pneumonia (HCAP) (6, 8, 10, 11)
  ➢ Patients At High Risk for Healthcare Related Bacterial Pneumonia: (11)
    • Mechanically ventilated (aspiration risk) (See Ventilator Associated Pneumonia Section and Aspiration Pneumonia Section) (11)
    • Enteral tube (aspiration risk) (See Aspiration Pneumonia Section) (11)
    • Selected Post-operative Patients (See Surgery Related Pneumonia Section) (11)
  ➢ Acid-Suppressive Medication – Conflicting Evidence (6, 8, 11)
    • Some experts have no recommendations for this intervention (11)
    • Gastro-pulmonary hypothesis of ICU-acquired pneumonia is not supported (8)
      o Gastric acid inhibitors did not affect risk (8)
      o Histamine type 2 receptor and proton pump blockers not separated (8)
    • Proton-pump inhibitor or histamine 2 receptor antagonist use was associated with 30% increased odds of HCAP (6)
    • Statistically significant risk only for proton-pump inhibitor use (6)
      o Stronger association in particular with aspiration pneumonia (6)
      o Significant for non-aspiration pneumonia (6)
      o Significant for proton-pump inhibitor use (6)
      o Not significant for histamine 2 receptor antagonists (6)
        ▪ Subgroup analysis not adequately powered to detect significance (6)
      o Acid-suppressive medication benefits for GI bleeding prophylaxis not taken into account with this study (6)
  ➢ Influenza (10, 11)
    • Vaccination is the primary method for preventing influenza and its severe complications, including pneumonia (10, 11)
    • Hospitalized patients at increased risk should be identified and strongly encouraged to receive influenza vaccine before discharge (10, 11)
      o Children 6-23 months (10)
      o Pregnant women (10)
      o 50-64 yrs with an elevated prevalence of certain chronic medical conditions (10)
      o ≥ 65 yrs, particularly among Black and Hispanic patients (10)
      o Any age with certain chronic medical conditions (10)
    • Hospital-based influenza outbreaks occur with unvaccinated HCW (10, 11)
      o HCW vaccination improves prevention of influenza-associated disease, patient safety, and reduces disease burden (10)
      o Influenza rates among HCW should be regularly measured and reported (10)
  ➢ Ventilator Associated Pneumonia (VAP) (1, 2, 3, 4, 7, 8, 9, 11, 12)
    • The use of EBP strategies for VAP may reduce the incidence of this serious nosocomial infection (9)
    • Pneumonia Risk Factors (8, 11)
      o Mechanical ventilation (8, 11)
      o Lack of enteral nutriment (8, 11)
      o Length of time at risk (8, 11)
      o Conflicting evidence regarding gastric acid-inhibit medication (See HCAP Section) (8, 11)
    • Gram negative multi-resistant rods account for majority of VAP episodes (3, 4, 8)
1. **Physical Strategies (2, 9, 11, 12)**
   - **Route of Endotracheal Intubation (9)**
     - Orotracheal intubation is associated with a trend in reduced VAP and incidence of sinusitis (9)
   - **Systematic Search for Maxillary Sinusitis (9)**
     - VAP incidence is lower in patients who do not develop sinusitis (9)
     - No evidence supports the practice of systematic search for sinusitis in patients who are endotracheally intubated (9)
   - **Frequency of Ventilator Circuit Changes (9)**
     - Does not influence VAP incidence (9)
     - Cost considerations favor less frequent changes (9)
   - **Airway Humidification: Equipment Type (9)**
     - No difference in VAP incidences between patients whose airways are humidified via heat & moisture changer vs. heated humidifier (9)
   - **Airway Humidification: Frequency of Equipment Changes (9)**
     - Less frequent humidifier may be associated with slightly decreased VAP incidence (9)
     - Reduced equipment changes considered a cost-reduction measure (9)
   - **Suctioning System: Open vs. Closed - Conflicting Evidence (9, 11)**
     - Some experts have no recommendations for this intervention (11)
     - Safety considerations (patient and healthcare worker exposure to aerosolized secretions) favor closed systems (9)
   - **Suctioning System: Frequency of Changes - Conflicting Evidence (9, 11)**
     - Some experts have no recommendations for this intervention (11)
     - Unscheduled changes of closed systems have no effect on VAP (9)
     - Cost considerations favor less frequent changes (9)
   - **Oral Secretion Removal (2)**
     - Removal of oral secretions prior to position change is effective in reducing the incidence of VAP, with minimum cost intervention (2)
       - Consider using less expensive oral secretion removal tubes over more expensive continuous subglottal suction ETT (2)
   - **Subglottic Drainage Endotracheal Tubes (SSD ETT) (9, 12)**
     - Incremental cost of tubes is reasonable, considering the burden of illness associated with VAP (9)
     - SSD ETT reduced incidence of VAP in patients expected to be mechanically ventilated > 72 hours (9, 12)
     - SSD ETT are no more effective than conventional ETT for reducing total mortality for patients expected to be mechanically ventilated > 72 hours (12)
     - SSD ETT are no more effective than conventional ETT for reducing hospital LOS (12)
     - SSD ETT may reduce ICU LOS (12)
     - SSD ETT may reduce duration of mechanical ventilation (12)
     - No direct evidence to determine whether SSD ETT are superior to silver coated ETT for reducing mortality (12)
   - **Timing of Tracheostomy (9)**
     - Early (not defined) and late (not defined) tracheostomy make no difference in VAP incidence (9)
     - There is a higher cost associated with earlier tracheostomy (9)
Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

- **Bacterial Filters** – Conflicting Evidence (9, 11)
  - Associated with a trend towards increased mortality (9)
  - Does not influence VAP incidence (9)
  - Does not influence ICU length of stay (9)
  - Does not influence duration of mechanical ventilation (9)
  - Some experts have no recommendations for this intervention (11)

2. **Positional Strategies** (7, 9, 11)
- **Kinetic Bed Therapy: Rotating Beds** - Conflicting Evidence (9)
  - Has associated with decreased VAP incidence (9)
  - Some experts have no recommendations for this intervention (11)
  - Feasibility, safety, and cost are barriers to implementation (9)
- **Semi-Recumbent Positioning: HOB 45 degrees** (7, 9)
  - Clinically relevant trend is associated with a reduction in VAP in patients nursed at HOB 45 degrees (7, 9)
  - Concerns re: feasibility of achieving HOB 45 degrees, which may be uncomfortable for unsedated patients or unsafe for other types of patients (7, 9)
    - HOB as near 45 degrees as possible (7, 9)
    - Low risk, high benefit intervention (7)
- **Prone Positioning** (9)
  - May be associated with reduction in VAP incidence (9)
  - Feasibility and safety are barriers to implementation (9)

3. **Pharmacologic Strategies** (1, 2, 4, 9, 11)
- **Aerosol Therapy** (2)
  - Aerosol therapy in VAP subjects significantly higher than in non-VAP groups (2)
- **Prophylactic Antibiotics: Aerosolized Antibiotics** (9)
  - May decrease incidence of VAP (9)
  - Serious concerns re: possible emergence of resistance to antibiotics (9)
  - No effect on ICU mortality, ICU LOS, or duration of mechanical ventilation (9)
- **Prophylactic Antibiotics: Nasal Mupirocin** (9)
  - Nasal Mupirocin may decrease incidence of VAP due to MRSA (9)
  - No effect on overall incidence of VAP (9)
  - Serious concerns re: possible emergence of resistance to antibiotics (9)
- **Prophylactic Antibiotics: IV Antibiotics Alone** - Conflicting Evidence (9, 11)
  - May decrease incidence of VAP (9)
  - Some experts have no recommendations for this intervention (11)
  - No effect on mortality, ICU or Hospital LOS, or duration of mechanical ventilation (9)
  - Serious concerns re: possible emergence of resistance to antibiotics (9)
- **Prophylactic Antibiotics: Topical/Topical Plus IV Antibiotics** - Conflicting Evidence (9, 11)
  - May decrease incidence of VAP (9)
  - Some experts have no recommendations for this intervention (11)
  - Inconsistent effects on mortality, ICU and Hospital LOS, or mechanical ventilation (9)
  - Serious concerns re: possible emergence of resistance to antibiotics (9)
- **Oral Decontamination: Chlorhexidine** - Conflicting Evidence (1, 2, 4, 9, 11)
  - Use of feasible and effective oral hygiene protocols and antimicrobial products might provide a noninvasive, cost effective method to decrease the incidence of nosocomial pneumonia in the CCU environment (1, 2, 9)
Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

- Routine use of CHG for prevention of HAP has not been established in all postoperative or critically ill patients or other patients at high risk (11)
  - Twice daily oral hygiene care with a suction toothbrush and 0.12% CHG may reduce risk of nosocomial pneumonia in intubated patients within hospital CCUs (1)
  - Gingival and dental plaque antiseptic decontamination significantly decreased the oropharyngeal colonization by aerobic pathogens in ICU ventilated patients (4)
  - Insufficient concentration of CHG gel, combined with lack of mechanical elimination (toothbrushing), and biofilm may explain the lack of efficacy of gingival and dental plaque antiseptic decontamination in reducing the incidence of respiratory infections due to multiresistant bacteria (4)
- **Oral Decontamination: Povidone-Iodine (9)**
  - In patients with severe head injuries, use of povidone-iodine as an oral antiseptic decreases incidence of VAP (9)
  - Safety, feasibility, cost considerations for this intervention are all very favorable (9)
  - Insufficient data to make recommendation in critically ill patients other than severe head injury (9)
- **Oral Decontamination: Iseganan (9)**
  - No effect on incidence of VAP (9)
- **Prevention of Maxillary Sinusitis: Xylometazoline Nasal Drops & Budesonide Spray (9)**
  - Intervention decreases the incidence of maxillary sinusitis WITHOUT decreasing the incidence of VAP (9)

❖ **Aspiration Pneumonia (AP) - Conflicting Evidence (See HCAP) (6, 11)**
- Acid-suppressive medication use (proton-pump inhibitor or histamine₂ receptor antagonist) is associated with increased odds of hospital-acquired pneumonia (6)
  - Statistically significant risk was demonstrated only for proton-pump inhibitor use (6)
    - Stronger association in particular with aspiration pneumonia (6)
    - Significant for non-aspiration pneumonia (6)
    - Significant for proton-pump inhibitor use (6)
    - Not significant for histamine₂ receptor antagonists (6)
  - Subgroup analysis not adequately powered (6)
- Unless contraindicated, elevate HOB 30-45 degrees for patients at high risk of aspiration (11)
Surgery Related Pneumonia (SP) (3, 5, 8, 11)
- **Independent risk factors** associated with the development of post operative infection, including pneumonia, may help in the development of clinical strategies for the prevention, early diagnosis, and treatment of these infections (3, 5, 8, 11)

- Abdominal aortic aneurysm repair (11)
- Previous vascular surgery (3)
- Thoracic, CABG, or emergency surgery (3, 5, 11)
  - Nosocomial pneumonia occurs on average 8 days after cardiac surgery per literature citation (5)
- Off-pump coronary artery bypass grafting (OPCAB) (3)
  - Age, obesity, diabetes mellitus were NOT found to be independently associated with nosocomial infections after OPCAB (3)
- General anesthesia (11)
- Fresh frozen plasma (FFP) during ICU stay (3)
- Received >4 units blood before surgery (11)
  - Conflicting Evidence: Some findings do not support blood transfusions as increasing the risk of ICU-acquired nosocomial infections (8)
- Number of inotropes used during & after surgery (3)
- Arterial hypertension (3)
- Post operative atrial fibrillation (3)
  - 60% of pneumonia patients & 29% of bacteremia patients underwent direct cardioversion for termination of post operative atrial fibrillation or ventricular arrhythmias before diagnosis of nosocomial infection (3)
- >60 yrs (11)
- Totally dependent function status (11)
- Weight loss > 10% (11)
- Steroid use for chronic conditions (11)
- Recent history of alcohol (11)
- History of COPD or smoking during preceding year (11)
- Impaired sensorium (11)
- History of CVA with residual neurologic deficit (11)
- Low (<8mg/dL) or high (>22mg/dL) BUN (11)
- Positive culture of gram negative microbes (3)
- ICU stay until infection development (3)

**Incentive Spirometry (IS) (5, 11)**
- Use IS with postop patient at high risk for HAP (11)
- For low risk surgical patients undergoing CABG, there is no evidence of benefit from IS in (5):
  - reducing pulmonary complications (atelectasis and pneumonia) (5)
  - decreasing the negative effects of pulmonary function (5)
  - improving lung function (5)
  - shortening hospital LOS (5)
- No significant difference in pulmonary complications between IS and positive pressure breathing techniques (continuous positive airway pressure [CPAP], bi-level positive airway pressure [BiPAP] and intermittent positive pressure breathing [IPPB]) or preoperative patient education (5)
- Patient treated with IS had worse pulmonary function and arterial oxygenation, compared with positive pressure breathing techniques (5)

**Prevention of Post Surgical Pneumonia (11)**
- Encourage all post surgical patients to take deep breaths, move about the bed, and ambulate unless medically contraindicated (11)
- Develop a comprehensive oral hygiene program that might include use of an antiseptic agent for patients at high risk of HAP (11)
  - Use oral 0.12% chlorhexidine gluconate rinse during the peri-operative period on adult patients undergoing cardiac surgery (11)
Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

Physicians Focused Implications (3, 9, 12)
- Consider implementing EBP guidelines for prevention of VAP (9)
  - For areas lacking formal evidence-based recommendations, use the judgment and expert opinions of clinical specialists’ for guidance in clinical practice and safe patient care (9)
- Use identified risk factors to develop clinical strategies for prevention, early diagnosis, and treatment of infections associated with OPCAB (3)
- Consider intubating patients with a subglottic drainage endotracheal tube (SSD ETT) via the orotracheal route (9,12)
- Post operative atrial fibrillation or new onset of other types of supraventricular tachyarrhythmia in an otherwise stable patient should prompt a search for post operative infection (3)

Staff Nurse Focused Implications (1, 2, 3, 5, 7, 9)
- Consider implementing EBP guidelines for prevention of VAP (9)
  - For areas lacking formal evidence-based recommendations, use the judgment and expert opinions of clinical specialists’ for guidance in clinical practice and safe patient care (9)
- Use identified risk factors to develop clinical strategies for prevention, early diagnosis, and treatment of infections associated with OPCAB (3)
- Post operative atrial fibrillation or new onset of other types of supraventricular tachyarrhythmia in an otherwise stable patient should prompt a search for post operative infection (3)
- For low risk surgical patients undergoing CABG, there is no evidence of benefit from IS (5)
- Constant and careful measurement is required to implement this angle of bed elevation, as nurses tend to overestimate the degree of bed head elevation (7)
  - HOB elevation in excess of 30 degrees may be less acceptable to the patient who is not heavily sedated and may hamper positioning the patient on their side (7)
- Twice daily CHG application combined with suctioning toothbrush saved nursing time and oral care supplies, while possibly decreasing the rate of nosocomial pneumonia (1)
  - Intervention was easy & less time consuming than standard oral care protocol (1)
- Removal of oral secretions prior to position change via oral suction tubes is an easy and cost effective nursing intervention that reduces the incidence of VAP (1, 2)

Respiratory Care Practitioners (RCP) Implications (2, 3, 5, 9, 12)
- Consider implementing EBP guidelines for prevention of VAP (9)
  - For areas lacking formal evidence-based recommendations, use the judgment and expert opinions of clinical specialists’ for guidance in clinical practice and safe patient care (9)
- Manage the intubation of patients with a subglottic drainage endotracheal tube (SSD ETT) via the orotracheal route (9,12)
- Bacterial filter use and aerosol therapy in VAP subjects was significantly higher than in non-VAP groups (2, 9)
- Use identified risk factors to develop clinical strategies for prevention, early diagnosis, and treatment of infections associated with OPCAB (3)
- For low risk surgical patients undergoing CABG, there is no evidence of benefit from IS (5)

Financial Considerations (1, 2)
- Twice daily 0.12% CHG with suctioning toothbrush saved personnel time and oral care supplies, while possibly decreasing the rate of nosocomial pneumonia (1)
- Removal of oral secretions prior to position change is an effective low cost, low risk, high patient benefit intervention in reducing the incidence of VAP (2)
  - Subglottal suctioning: $14.00 more than traditional ETT, invasive intervention (2)
  - Oral suctioning: < $0.1 for saliva ejection tube, noninvasive intervention taking less than 10 seconds (2)
Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

- **Staff Education (11)**
  - Educate HCW about epidemiology and infection control procedures for the prevention of HAP (11)
    - Use performance-improvement tools and techniques to ensure HCW competency according to level of responsibility (11)

- **Suggested Further Research (1, 2, 4, 5, 6, 7, 9)**
  - 0.12% CHG with suctioning toothbrush vs. CHG without suctioning toothbrush intervention (1)
  - Oral secretions removal prior to position change with a larger sample size, with concurrent randomized patient allocation, and multiple sites may be required to confirm the effect of the nursing intervention on VAP management (2)
  - Whether antiseptic decontamination can decrease the rate of nosocomial infections in critically ill patients (4)
  - An adequately powered trial of high methodological rigor to determine those patients who may derive benefit from IS following CABG (5)
  - Large scale RCT to assess benefits of IS with and without standard postsurgical physical therapy compared with standard postsurgical physical therapy, and compared with absence of physical therapy (pre-operative education only) in patient undergoing CABG (5)
  - Further scrutiny regarding inpatient prescribing practices of acid-suppressive medications (6)
  - Adequately powered study to assess the effect of different degrees of bed head elevation on VAP rates, mortality, and patient comfort (7)
  - Long term impact of VAP prevention practices on microbial ecology of ICUs and antibiotic resistance patterns (9)
  - Use of oral decontamination for VAP prevention with povidone-iodine in critically ill patients without severe head injury (9)
### Key Search Terms (Open to 2009)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia, prevention, hospital acquired pneumonia, adult</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>78</td>
<td>30</td>
<td>118</td>
<td>15</td>
</tr>
</tbody>
</table>

**Quality of the Evidence - Appendix A**

**Other resources via CDC, Yahoo Searches, or Contextual Links:** 7

**Total Relevant Articles Reviewed:** 22

**Total Relevant Articles Included in Review:** 12

<table>
<thead>
<tr>
<th>SCORE</th>
<th>LEVELS OF STUDIES</th>
<th>RELEVANT ARTICLES</th>
<th>ARTICLE NUMBER (Revised numbering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Systematic Review or Meta-Analysis of Randomized Controlled Trials</td>
<td>3</td>
<td>#5, #9, #12</td>
</tr>
<tr>
<td>9</td>
<td>Large Sample Randomized Controlled Trials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Small Sample Randomized Controlled Trials</td>
<td>3</td>
<td>#2, #4, #7</td>
</tr>
<tr>
<td>7</td>
<td>Non-random, Controlled Prospective Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Non-random, Controlled Retrospective Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Cohort Studies</td>
<td>2</td>
<td>#3, #6</td>
</tr>
<tr>
<td>4</td>
<td>Case-Controlled Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Non-Controlled, Clinical, Descriptive Studies</td>
<td>2</td>
<td>#1, #8</td>
</tr>
<tr>
<td>2</td>
<td>Case Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Expert Consensus, Manufacturers Recommendations (Literature Reviews)</td>
<td>2</td>
<td>#10, #11</td>
</tr>
<tr>
<td>0</td>
<td>Anecdotes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>12</strong></td>
<td></td>
</tr>
</tbody>
</table>
Hospital-Acquired Pneumonia in the Acute Care Setting
An Integrative Review of the Evidence
June 2009

Appendix B – Bibliography


Created June 30, 2009 by Cecelia L. Crawford, RN, MSN; ©Kaiser Permanente SCAL Nursing Research Program

Purpose/intended Audience

Because we want everyone in our communities to have the healthiest lives possible, we are making our evidence reviews available to the communities we serve to help Californians and others lead healthier lives.

Integrative reviews and evidence summaries are provided as a community service for reference purposes only, and must be used only as specified in this disclaimer. These documents are intended for use by clinicians. If you are not a clinician and are reading these documents, you should understand that the information presented is intended and designed for use by those with experience and training in managing healthcare conditions. If you have questions about them, you should seek assistance from your clinician. The information contained in the evidence reviews is not intended to constitute the practice of medicine or nursing, including telemedicine or advice nursing.

Limitations On Use

These documents have been developed to assist clinicians by providing an analytical framework for the effective evaluation and treatment of selected common problems encountered in patients. These documents are not intended to establish a protocol for all patients with a particular condition. While evidence reviews provide one approach to evaluating a problem, clinical conditions may vary significantly from individual to individual. Therefore, clinicians must exercise independent professional judgment and make decisions based upon the situation presented.

Kaiser Permanente’s documents were created using an evidence-based process; however, the strength of the evidence supporting these documents differs. Because there may be differing yet reasonable interpretations of the same evidence, it is likely that more than one viewpoint on any given healthcare condition exists. Many reviews will include a range of recommendations consistent with the existing state of the evidence.

All of the Kaiser Permanente integrative reviews and evidence summaries were developed from published research and non-research evidence and do not necessarily represent the views of all clinicians in Kaiser Permanente. These documents may also include recommendations that differ from certain federal or state health care mandates.

Intellectual Property Rights

Unless stated otherwise, all of these materials are protected by copyright and should not be reproduced or altered without express written permission from Kaiser Permanente. Permission is granted to view and use these documents on single personal computers for private use within your hospital or hospital system. No portion of these materials in any form may be distributed, licensed, sold or otherwise transferred to others.

The organizations within Kaiser Permanente retain all worldwide rights, title and interest in and to the documents provided (including, but not limited to, ownership of all copyrights and other intellectual property rights therein), as well as all rights, title and interest in and to their trademarks, service marks and trade names worldwide, including any goodwill associated therewith.
No Endorsement or Promotional Use

Any reference in these documents to a specific commercial product, process, or service by trade name, trademark, or manufacturer, does not constitute or imply an endorsement or recommendation by Kaiser Permanente. The views and opinions expressed in these documents may not be used for any advertising, promotional, or product endorsement purposes.

Disclaimer of All Warranties and Liabilities

Finally, although Kaiser Permanente believes that all of the information provided in its documents is accurate, specific recommendations derive from combining the best available evidence. Although we have sought to ensure that the documents accurately and fully reflect our view of the appropriate combination of evidence at the time of initial publication, we cannot anticipate changes and take no responsibility or assume any legal liability for the continued currency of the information or for the manner in which any person who references them may apply them to any particular patient. Kaiser Permanente does not assume any legal liability or responsibility for the completeness, clinical efficacy or value of any apparatus, product, or process described or referenced in the documents. We make no warranties regarding errors or omissions and assume no responsibility or liability for loss or damage resulting from the use of these documents.