Guidelines for Pneumonia

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- **Research Grant:** Bayer/Nektar, Sanofi-Pasteur, Cubist
Why Have Pneumonia Guidelines?

- A single document that can synthesize large amounts of information
- Define the strength of existing data (evidence grading)
- Discuss and define relevant management issues, providing an orderly approach
  - Help guide accurate initial empiric therapy
- Provide a standard against which care can be evaluated
  - Uniform care
  - Quality and cost-effective care
- Point out defects in knowledge base to direct future research
- As a tool to improve patient outcomes
North American CAP Guidelines

• Development of guidelines
  – Canadian guidelines 1993
  – ATS 1993
  – IDSA 1998
  – CDC 2000
  – Canadian (Pulm/ID) guidelines 2000
  – IDSA guidelines 2000
  – ATS guidelines 2001
  – IDSA update 2003
  – ATS/IDSA Joint Guideline 2007
CAP Guidelines Are A Global Effort

- **Europe**: European Respiratory Society (ERS) with the European Society of Clinical Microbiology and Infectious Diseases
  - Germany: pulmonary and infectious diseases societies
  - Spain: pulmonary society
  - United Kingdom: British Thoracic Society (BTS)
  - Portugal: Pulmonary society
  - France: infectious diseases society
  - Sweden: infectious diseases society

- **Middle East** including Saudi Arabia and the Gulf coast countries

- **South America**
  - Latin America: Latin American Thoracic Association
  - Argentina
  - Chile
  - Brazil: pulmonary and infectious diseases societies

- **Africa**
  - South Africa: pulmonary and infectious diseases societies

- **Asia**
  - Japan: pulmonary and infectious diseases societies
WHAT DID WE DO BEFORE CAP GUIDELINES??

- 927 outpatients, 1,328 inpatients in PORT study at 5 clinical sites with same mortality and re-admission rates
- Outpatients: 75% got macrolides; 4-23% got amoxicillin; 1.4-13.9% got TMP/SMX
  - 75%, monotherapy; 11%, 3 agents
  - Mean duration: 12 days
- Inpatients: 41%, macrolides; 44%, 2nd-generation ceph; 9%, 3rd-generation ceph; 28%, aminoglycosides (39% at 1 site); 7%, vancomycin; 5%, quinolones
  - 32%, monotherapy; 28%, 3 agents
  - Mean duration: 14 days (6 in hospital)
  - IMPLICATIONS: too much triple combination therapy; not enough inpatient macrolide or quinolone use; too much aminoglycoside use

### Table 2  Principles of Antibiotic Therapy for CAP in American Guideline Recommendations versus European Recommendations

<table>
<thead>
<tr>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial therapy should be timely and empirical, with limited diagnostic testing, separating health care associated pneumonia from community-acquired pneumonia</td>
</tr>
<tr>
<td><strong>All patients should receive therapy for atypical pathogens</strong></td>
</tr>
<tr>
<td>Intravenous therapy should be used, rather than oral therapy at the time of admission</td>
</tr>
</tbody>
</table>
| Macrolides may have a role  
  Usually with a beta-lactam (part of dual therapy)  
  As monotherapy, but only in selected patients (more outpatient than inpatient)                                                       |
| Certain beta-lactams are not commonly used or recommended (e.g., cefuroxime, penicillin G)                                                |
| Quinolones can be used as first-line therapy and as single agents in non-ICU patients                                                     |
| **No patient with severe CAP treated in the ICU should receive empirical monotherapy, even with a quinolone**                           |
| **Selected patients with severe CAP require empirical therapy for methicillin-resistant *Staphylococcus aureus*, particularly after influenza** |
| Performance measures need to be followed                                                                                               |
| **Importance of time to initial therapy**                                                                                               |
CAP Mortality Worldwide: Relation to Therapy Choices and Risks

- CAP mortality varies worldwide and is highest in Latin America. 26.4% in ICU vs 16.3% in US ICUs
- May relate to underutilization of atypical pathogen coverage (53% in LA vs 77% worldwide), with same frequency of atypicals as elsewhere
  - 21% atypicals in LA vs. 22% worldwide
- Arnold FW et al. Am J Respir Crit Care Med 2007; 175:1086-93

Arnold FW, et al. Respiratory Medicine 2013; In press
Improving Survival Of Pneumococcal CAP With Changes in Care

- Practices and outcomes with severe pneumococcal CAP 2000-2013
- 80 matched case controls in different time periods (2000-2002 vs, 2008-2013) (CAPUCI I and II)
- More dual therapy, antibiotics within 3 hours, and lower ICU mortality (incl with shock and MV)
- In multivariate analysis, reduced mortality with dual therapy and early therapy

<table>
<thead>
<tr>
<th>Table 4: characteristics of antibiotic treatment.</th>
<th>Case Group (n: 80)</th>
<th>Control Group (n: 80)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous antibiotic</td>
<td>10 (12.5)</td>
<td>7 (8.8)</td>
<td>0.61</td>
</tr>
<tr>
<td>Monotherapy</td>
<td>10 (12.5)</td>
<td>27 (33.8)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Combined therapy</td>
<td>70 (87.5)</td>
<td>53 (66.2)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>AB initiated 0 to 3 hours</td>
<td>56 (70.0)</td>
<td>22 (27.5)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>AB initiated 4 to 6 hours</td>
<td>16 (20.0)</td>
<td>26 (32.5)</td>
<td>0.11</td>
</tr>
<tr>
<td>AB initiated more than 6 hours</td>
<td>8 (10.0)</td>
<td>32 (40.0)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Adequate according to 2007 IDSA/ATS guidelines</td>
<td>64 (80.0)</td>
<td>38 (47.5)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
Improved Outcome in CAP and Processes of Care

- 142 CAP patients to ICU 1995-200; 175 2005-2010
- From 2005-10, added: sepsis management bundle, dual antibiotic rx (3rd gen ceph + levo), NIV post exubation
- Mortality fell from 43.6% to 30.9% (p<0.02)

### Table 4 Significant prognostic factors derived from univariate analysis

<table>
<thead>
<tr>
<th>Therapeutics interventions</th>
<th>Survivors n = 201</th>
<th>Non survivors n = 116</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vasoactive drugs within 48 hrs of admission, n (%)</td>
<td>88 (43.8)</td>
<td>95 (81.9)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Dobutamine, n (%)</td>
<td>26 (12.9)</td>
<td>37 (31.9)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Dopamine, n (%)</td>
<td>7 (3.5)</td>
<td>11 (9.5)</td>
<td>0.02</td>
</tr>
<tr>
<td>Norepinephrine, n (%)</td>
<td>66 (32.8)</td>
<td>54 (46.5)</td>
<td>0.01</td>
</tr>
<tr>
<td>Epinephrine, n (%)</td>
<td>7 (3.5)</td>
<td>24 (20.7)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Combination of a 3rdGC and levofoxacin, n (%)</td>
<td>84 (41.8)</td>
<td>31 (26.7)</td>
<td>0.007</td>
</tr>
<tr>
<td>Mean tidal volume, mL/kg</td>
<td>7.14 ± 1</td>
<td>7.56 ± 1.41</td>
<td>0.008</td>
</tr>
<tr>
<td>Low-dose steroid administration, n (%)</td>
<td>47 (23.3)</td>
<td>42 (36.2)</td>
<td>0.01</td>
</tr>
<tr>
<td>Transfusion, n (%)</td>
<td>48 (23.9)</td>
<td>54 (46.5)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Systematic post extubation NIMV, n (%)</td>
<td>21 (10.4)</td>
<td>7 (6)</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Criteria for Severe CAP: 2007 IDSA/ATS Guidelines

- Maybe OTHER MINOR CRITERIA

- Hyponatremia
  - On admit: 28% of 342 CAP patients with hyponatremia ( < 136 mEq/L). 4.1% < 130 mEq/L.
  - Hyponatremia on admit with increased mortality and increased length of stay.
  - 10.5% developed in hospital, unrelated to severity of illness on admit.

- Thrombocytosis. Thrombocytosis (>400 K) added to mortality (OR 2.7), but biphasic relationship, with low platelets ( < 100 K) also a risk.
  - Prina E, et al. Chest 2013;143:767-75

- Abnormal arterial CO2. Higher mortality with hypocapnia (13.4%) and hypercapnia (20%) vs, normal (5.3%).

<table>
<thead>
<tr>
<th>Minor criteria</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory rate</td>
<td>≥30 breaths/min</td>
</tr>
<tr>
<td>PaO₂/FiO₂ ratio</td>
<td>≤250</td>
</tr>
<tr>
<td>Multilobar infiltrates</td>
<td></td>
</tr>
<tr>
<td>Confusion/disorientation</td>
<td></td>
</tr>
<tr>
<td>Uremia (BUN level, ≥20 mg/dL)</td>
<td></td>
</tr>
<tr>
<td>Leukopenia (WBC count, &lt;4000 cells/mm³)</td>
<td></td>
</tr>
<tr>
<td>Thrombocytopenia (platelet count, &lt;100,000 cells/mm³)</td>
<td></td>
</tr>
<tr>
<td>Hypothermia (core temperature, &lt;36°C)</td>
<td></td>
</tr>
<tr>
<td>Hypotension requiring aggressive fluid resuscitation</td>
<td></td>
</tr>
</tbody>
</table>

Need 1 MAJOR or 3 MINOR

Validation of IDSA/ATS Severity Criteria

- 379/2413 with CAP admitted to ICU. 4 positive minor criteria may be a better prediction of ICU need. Outperformed SMART-COP, CURB-65 and CURXO-80.
  
GUIDELINES FOR NOSOCOMIAL PNEUMONIA 2005

• Prepared jointly by ATS and IDSA
• Sections
  – Epidemiology and pathogenesis
    • Includes HAP, HCAP, and VAP
    • Modifiable risk factors (vs. prevention)
  – Bacteriology (mostly VAP, little on non-intubated patients)
    • MDR pathogens emphasized: P. aeruginosa, Acinetobacter spp., MRSA
  – Diagnosis: accept either a clinical or bacteriologic strategy
  – Therapy:
    • Only 2 groups; emphasis on de-escalation
    • Appropriate and adequate therapy: emphasize dosing
  – Non-resolving pneumonia
• Am J Respir Crit Care Med 2005; 171:388-416
Pseudomonal VAP: Outcome and Mortality Risk Factors

- 110 patients with ICU *P. aeruginosa* pneumonia: 71 VAP, 28 HAP, 11 HCAP.
- 81 ICU-AP, 29 not ICU-AP
- 38% with MDR pathogens
- 59% monotherapy.
- 50.9% got IIAT
  - Sig less if combination rx.
- ICU mortality risks: IIAT, diabetes, higher SAPS II, older age, no empiric combination rx.
- IIAT and MDR pathogens increase duration MV

Fig. 3 Days of mechanical ventilation after *P. aeruginosa* pneumonia onset in ICU survivors: significantly longer ventilation periods were associated with inadequate initial antibiotic treatment (*P* < 0.001) and PA isolates with multi-drug resistant (MDR) phenotypes (*P* = 0.01). Boxes represent interquartile ranges (lower
Proven Benefits of Guidelines Require an Implementation Strategy

• With implementation, physicians will use antibiotics correctly and in a timely manner. More likely to use guideline-recommended antibiotics
• Physicians make better site of care decisions (ICU vs. inpatient ward vs. home)
• Physicians better recognize clinical stability, and this promotes a safe early discharge and avoids readmission
• Physician and nurse education can improve immunization rates
• Patient education can enhance satisfaction about care given and reduce duration of antibiotic therapy
• **BUT**, NEED AN IMPLEMENTATION STRATEGY With Education AND Educational adjuncts to improve patient outcomes: physician performance auditing, pre-printed order sets, prospective case management, possibly formulary restriction (?) if valuable
  – Must customize to each individual care setting
Education and Pathway Development Alone Did Not Have An Impact on CAP Quality of Care

- Pre and post intervention evaluation in 4 hospitals
- Intervention: Multi-disciplinary team of opinion leaders developed a pathway of care, then education of doctors, pocket reminder cards, promotion of standardized order sets, development of patient education materials.
- Increased use of guideline antibiotics (78% to 83%, p=0.003), but no significant change in discharge before clinical stability, time to first antibiotic dose, time to oral therapy, time to discharge, LOS, or patient education outcomes

Intensity of Implementation Affects CAP Guideline Success

- Cluster-randomized trial of 32 ED’s and 3219 CAP patients and a guideline implemented with low (n=8), moderate (MI) (n=12) or high (HI) (n=12) intensity.
  - High intensity = real-time reminders, doctor audit and feedback, intense CQI PLUS education
  - More inpatients and outpatients in HI group got all 4 recommended processes (CMS core measures) of care (p<0.001). No mortality differences.


Use of a guideline with tracking of variances and intervention to correct prospectively, reduced LOS by 3 days vs. no guideline, and guideline without variance tracking

Pneumonia Guidelines
CONCERNS ABOUT GUIDELINES

• Management without thought
• Deviations may be basis for discipline
• If experts can’t all agree, how can we have accurate guidelines??
• What do we do if the existing knowledge base is of poor quality?
  – Evidence based medicine, GRADE
• How strong should new data be before changing and updating guidelines?
• Recent issue: conflict of interest and who should author?
Does Severity of Illness Alone Predict MDR Pathogens in ICU- Acquired Pneumonia?

- 343 patients with ICU-AP. 208 VAP, 135 non-vent pneumonia.
- 217 with etiology, 58 were MDR pathogens
- Severity of illness NOT related to MDR pathogens. Related to traditional risk factors.

### TABLE 4. Severity Criteria and Outcomes of Patients According to the Presence or Not of a Multidrug-Resistant Etiologic Agent

<table>
<thead>
<tr>
<th>Variables</th>
<th>No MDR Pathogens (n = 285)</th>
<th>MDR Pathogens (n = 58)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis-related Organ Failure Assessment score at onset of pneumonia</td>
<td>8 ± 3</td>
<td>7 ± 3</td>
<td>0.464</td>
</tr>
<tr>
<td>APACHE-II score at ICU admission</td>
<td>17 ± 6</td>
<td>16 ± 6</td>
<td>0.13</td>
</tr>
<tr>
<td>APACHE-II score at onset of pneumonia</td>
<td>16 ± 5</td>
<td>15 ± 5</td>
<td>0.10</td>
</tr>
<tr>
<td>SAPS-II at admission to ICU</td>
<td>39 ± 13</td>
<td>39 ± 13</td>
<td>0.96</td>
</tr>
<tr>
<td>SAPS-II at onset of pneumonia</td>
<td>40 ± 12</td>
<td>39 ± 11</td>
<td>0.83</td>
</tr>
<tr>
<td>Clinical pulmonary infection score at onset of pneumonia</td>
<td>6.7 ± 1.5</td>
<td>6.7 ± 1.4</td>
<td>0.95</td>
</tr>
</tbody>
</table>
Predicting Resistant Organisms in HAP

- 689 with NP (485 with etiology)
  - 152 early onset, no MDR risks
    - 77 with MDROs
  - 333 with MDR risks
    - 199 with MDROs

- Logistic regression risks for MDRO: severe sepsis/shock (OR 3.7), in center with > 25% MDRO (OR 11.3)


Table 2 Etiologic diagnosis of pneumonia among patients with nosocomial pneumonia according to the 2005 ATS/IDSA guidelines group

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n = 152)</th>
<th>Group 2 (n = 333)</th>
<th>Overall (n = 485)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymicrobial, n (%)</td>
<td>51 (23.5)</td>
<td>109 (23.1)</td>
<td>160 (23.2)</td>
<td>0.9</td>
</tr>
<tr>
<td>Patients with potentially resistant microorganisms, n (%)</td>
<td>77 (50.7)</td>
<td>199 (59.8)</td>
<td>276 (56.9)</td>
<td>0.07</td>
</tr>
<tr>
<td>Potentially resistant microorganisms, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>33 (21.7)</td>
<td>82 (24.6)</td>
<td>115 (23.7)</td>
<td>0.5</td>
</tr>
<tr>
<td>Stenotrophomonas maltophilia</td>
<td>2 (1.3)</td>
<td>14 (4.2)</td>
<td>16 (3.3)</td>
<td>0.1</td>
</tr>
<tr>
<td>Methicillin-resistant Staphylococcus aureus</td>
<td>24 (15.8)</td>
<td>58 (17.4)</td>
<td>82 (16.9)</td>
<td>0.6</td>
</tr>
<tr>
<td>Acinetobacter baumannii</td>
<td>24 (15.8)</td>
<td>77 (23.1)</td>
<td>101 (20.8)</td>
<td>0.07</td>
</tr>
</tbody>
</table>
HCAPO Now a Part of Nosocomial Pneumonia Guidelines

• Inclusion of healthcare related pneumonia
  – Hospitalized in the preceding 90 days
  – Nursing home/extended care facility residence
  – Home infusion therapy (including antibiotics)
  – Chronic dialysis
  – Home wound care
  – Family member with multidrug-resistant pathogen

• Treat for MDR pathogens, regardless of when in hospital stay pneumonia begins

The HCAP Care Gap: Need a More Believable Algorithm for Therapy

- Survey of 855 doctors comparing treatment of CAP and HCAP in patient scenarios vs. knowledge of guidelines
- Select guideline compliant rx for CAP, 78% of the time vs. 9% of the time for HCAP scenarios. Often no MRSA coverage (72% of incorrect answers)
- 71% were aware of HCAP guidelines, 79% said they agree with guidelines and that they follow them.
Resistance Risk Factors in CAP and HCAP: Japan

- 1413 pneumonia patients, 10 hospitals in Japan
  - 887 CAP, 526 HCAP
- Not sensitive to CAP rx regimens (CAP-DRPs): 8.6% CAP, 26.6% HCAP.
- CAP-DRP risks same in CAP and HCAP: prior admit (OR 2.06), immune suppression (OR 2.3), prev antibiotics (OR 2.45), acid suppressive rx (OR 2.22), feeding tube (OR 2.43), non-ambulatory (OR 2.45)
  - Risk increases with number of risk factors
  - Shindo et al. Am J Respir Crit Care Med 2013; 188:985-995
Resistance Risk Factors in CAP and HCAP: Japan

- **CAP-DRP**
  - Risk increases with number of risk factors (all weighted equally)
  - Shindo et al. Am J Respir Crit Care Med 2013; 188:985-995
Proposed Algorithm for HCAP Therapy

HCAP Is Present
(from a nursing home, home infusion therapy, home wound care, dialysis center, hospitalized in past 90 days)

Assess Severity of Illness (ICU or mechanical ventilation) and MDR Risks (recent antibiotic therapy, poor functional status, recent hospitalization, immune suppression)

Severe Illness

0–1 MDR Risks:
- Treat for common CAP pathogens (consider oral Rx)
  - Quinolone,
  - β-lactam/Macrolide

≥ 2 MDR Risks:
Consider hospital admit
Treat for MDR pathogens with HAP recommendations

0 MDR Risks:
Consider IV therapy
with β-lactam
PLUS Macrolide or Quinolone

≥ 1 MDR Risks:
Treat for MDR pathogens
with HAP recommendations
Need 3 drugs

Using an Algorithm To Avoid Antibiotic Overuse in HCAP

- Prospective Use of Algorithm in 445 pneumonia patients, including 321 with HCAP
- With algorithm, only 53% got broad spectrum rx with 93% appropriate rx
- 27% high risk patients with MDR pathogens
- HCAP mortality related to risk factors and failure of initial therapy, but not to inappropriate therapy (which was uncommon)
Using an Algorithm To Identify MDR Pathogens in HCAP

Table 4. Causative Microorganisms

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>CAP (n = 124)</th>
<th>All HCAP (n = 321)</th>
<th>Group 1 in HCAP (n = 110)</th>
<th>Group 2 in HCAP (n = 92)</th>
<th>Group 3 in HCAP (n = 41)</th>
<th>Group 4 in HCAP (n = 78)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>31 (25)</td>
<td>106 (33)</td>
<td>42 (38.2)</td>
<td>24 (26.1)</td>
<td>17 (41.5)</td>
<td>23 (29.5)</td>
<td>.1</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>1 (0.8)</td>
<td>37 (11.5)</td>
<td>4 (3.6)</td>
<td>14 (15.2)</td>
<td>3 (7.3)</td>
<td>16 (20.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MRSA</td>
<td>0</td>
<td>22 (6.9)</td>
<td>0</td>
<td>11 (10)</td>
<td>0</td>
<td>11 (14.1)</td>
<td>.003</td>
</tr>
</tbody>
</table>

Table 5. Causative Microorganisms in Each Healthcare-Associated Pneumonia Group Classified by Risk of Multidrug Resistance

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>HCAP With 0–1 MDR Risk Factor (n = 151)</th>
<th>HCAP With ≥2 MDR Risk Factors (n = 170)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>59 (39.1)</td>
<td>47 (27.6)</td>
<td>.03</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>7 (4.6)</td>
<td>30 (17.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MRSA</td>
<td>0</td>
<td>22 (12.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Enterobacteriaceae</td>
<td>4 (2.6)</td>
<td>21 (12.4)</td>
<td>.001</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>3 (2)</td>
<td>19 (11.2)</td>
<td>.001</td>
</tr>
</tbody>
</table>
How The Era of “Zero VAP” Makes New Definitions Necessary

• In the US, IHI has promoted the idea of achievable “Zero VAP”
  – Presumes that VAP is a medical error
  – Assumes that hospital quality can be reflected by VAP rates
    • VAP rates should be able to be reduced to ZERO in good patient care centers
  – Public reporting of VAP rates and maybe tie to reimbursement

• Pressure of public reporting promotes under-reporting of VAP rates
  – May be reluctant to test aggressively for VAP
  – Hospitals with (falsely) low rates may be lulled into thinking things are fine
  – Hospitals with (falsely) high rates may get penalized in “pay for performance” atmosphere

Prevention Efforts Reduce VAP Rates, BUT NOT TO ZERO

- Compare incidence of VAP (quantitative culture dx) in 45 month baseline period (n=856) to 30 month multi-modality intervention period (n=835). All MV > 48 hours.
- VAP rates reduced by 43% (22.6 to 13.1 episodes /1000 vent days) BUT even with high compliance to prevention, did not drop to zero.

Interventions: HOB elevation, hand hygiene, ETT cuff pressure > 20 cm water, OG tube, oral chlorhexidine, minimal tracheal suctioning.
A National Approach to VAE Surveillance

- CDC project, with representatives from ATS, ACCP, SCCM, SHEA, IDSA
- Define VAC, IVAC, possible and probable VAP
- Does not define pneumonia alone: VAP, pulmonary edema, ARDS, atelectasis
- Unclear if current prevention tools will prevent these events
- Want surveillance to be automated, not manual
A National Approach to VAE Surveillance


Patient has a baseline period of stability or improvement on the ventilator, defined by ≥ 2 calendar days of stable or decreasing daily minimum FiO₂ or PEEP values. The baseline period is defined as the two calendar days immediately preceding the first day of increased daily minimum PEEP or FiO₂.

After a period of stability or improvement on the ventilator, the patient has at least one of the following indicators of worsening oxygenation:
1) Minimum daily FiO₂ values increase ≥ 0.20 (20 points) over the daily minimum FiO₂ in the preceding 2 calendar days (the baseline period), for ≥ 2 calendar days
2) Minimum daily PEEP values increase ≥ 3 cmH₂O over the daily minimum PEEP in the preceding 2 calendar days (the baseline period), for ≥ 2 calendar days

Ventilator-Associated Condition (VAC)

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, the patient meets both of the following criteria:
1) Temperature > 38 °C or < 36°C, OR white blood cell count ≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³
AND
2) A new antimicrobial agent(s)* is started, and is continued for ≥ 4 calendar days
*See VAE surveillance protocol (available at: http://www.cdc.gov/nhsn/acute-care-hospital/vae/index.html) for eligible agents

Infection-related Ventilator-Associated Complication (IVAC)
A National Approach to VAE Surveillance


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**Infection-related Ventilator-Associated Complication (IVAC)**

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, **ONE** of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections)
   - Defined as secretions from the lungs, bronchi, or trachea that contain ≥25 neutrophils and ≤10 squamous epithelial cells per low power field [×10, ×100] (or corresponding semi-quantitative results)

2) Positive culture (qualitative, semi-quantitative or quantitative) of sputum*, endotracheal aspirate*, bronchoalveolar lavage*, lung tissue, or protected specimen brushing*

*Excludes the following:
- Normal respiratory/oral flora, mixed respiratory/oral flora or equivalent
- *Candida* species or yeast not otherwise specified
- Coagulase-negative *Staphylococcus* species
- *Enterococcus* species

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**Possible Ventilator-Associated Pneumonia**

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**Probable Ventilator-Associated Pneumonia**

On or after calendar day 3 of mechanical ventilation and within 2 calendar days before or after the onset of worsening oxygenation, **ONE** of the following criteria is met:

1) Purulent respiratory secretions (from one or more specimen collections)—and defined as for possible VAP
   AND one of the following:
   - Positive culture of endotracheal aspirate*, ≥10^5 CFU/ml or equivalent semi-quantitative result
   - Positive culture of bronchoalveolar lavage*, ≥10^6 CFU/ml or equivalent semi-quantitative result
   - Positive culture of lung tissue, ≥10^4 CFU/g or equivalent semi-quantitative result
   - Positive culture of protected specimen brush*, ≥10^3 CFU/ml or equivalent semi-quantitative result

*Some organism exclusions as noted for Possible VAP.

2) One of the following (without requirement for purulent respiratory secretions):
   - Positive pleural fluid culture (where specimen was obtained during thoracentesis or initial placement of chest tube and NOT from an indwelling chest tube)
   - Positive lung histopathology
   - Positive diagnostic test for *Legionella* spp.
   - Positive diagnostic test on respiratory secretions for influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, rhinovirus, human metapneumovirus, coronavirus
Are VAC and IVAC the Same as VAP?

- Retrospective application of VAC and IVAC to 1320 ventilated patients in Canada
- Low agreement of VAC and VAP, IVAC and VAP
Can We Prevent VAC and IVAC?

- Following VAP prevention guidelines reduced VAC, VAP and not iVAC.
Problems with VAC and IVAC: Is This Progress??

- VAC is more common than VAP
  - How do VAC and IVAC correlate with the presence of specific respiratory infections?
    - IVAC: Is this VAP + VAT+ a lot of other things (not pneumonia)?
    - If it is VAT, will this push us to treat or not treat it? Treat=IVAC
  - What is the false negative rate? VAP can exist without meeting the oxygenation criteria of VAC.

- Still need to show that these diseases can be modified by current prevention strategies
- Need to show that VAC correlates with quality of care, or why monitor?
Future Challenges

- Updating guidelines
  - By whom?
  - How often?
- Improving outcome thru guidelines
- Effective implementation
- A unified algorithm for all pneumonia?
  - Where does HCAP belong?
- Use of biomarkers
- Prevention of CAP and HAP
- Believing that VAP still exists. Validating new definitions
Guidelines for Pneumonia: The Good, The Bad and The Ugly

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Pneumonia Guidelines