UPDATE ON PNEUMONIA

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COMMUNITY ACQUIRED PNEUMONIA - UPDATE

Epidemiology and definitions
Risk factors and mortality
Determining severity
Management

PNEUMONIA

Incidence
1. > 4 million estimated cases in U.S. per year.
2. 7th leading cause of death in U.S.
3. 1st leading cause of death from an infectious disease.
4. Mortality: Overall: 5.1%
    Inpatient: 13.7%
    ICU: 36.5%

Fine et al JAMA 1996; 275:134
PNEUMONIA
Definitions

Community Acquired Pneumonia (CAP)

Nosocomial Pneumonia
• Hospital Acquired Pneumonia (HAP)
• Health-Care-Associated Pneumonia (HCAP)
• Ventilator-Associated Pneumonia (VAP)

COMMUNITY ACQUIRED PNEUMONIA
Determining Empiric Therapy

Four Factors Determine Usual Etiology and Nature of Empiric Therapy:

Need for hospitalization
Severity of illness
Comorbidity
Age

ATS / IDSA TREATMENT GUIDELINES FOR CAP

Empiric therapy determined by clinical setting:
• Outpatient
• Inpatient – not severe
• Inpatient - severe

COMMUNITY ACQUIRED PNEUMONIA
Severe Pneumonia

1. Respiratory rate > 30 bpm.
2. PaO\textsubscript{2} / FiO\textsubscript{2} ratio < 250.
3. Mechanical ventilation.
4. Bilateral or multi-lobar infiltrates on CXR.
5. Shock (systolic B.P. < 90 mmHg and / or diastolic B. P. < 60 mmHg).
6. Requirement for vasopressors > 4 hours.
7. Urine output < 20 cc/hr or acute renal failure.

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RISK FACTORS
SEVERE CAP

Advanced age
Comorbid illness
(Chronic respiratory illness, cardiovascular disease, diabetes mellitus, neurologic disease, renal insufficiency, malignancy)
Cigarette smoking
Alcohol use
No pre-hospital antibiotics
Failure to prevent infection spread
MORTALITY RISK IN CAP

• 170 patients with pneumococcal pneumonia
• 19.4% had at least one major cardiac event
• 7.1% had acute myocardial infarction
• Mortality increased in had cardiac event
  Musher et al: Clin Infect Dis 2007; 45:158

• 500 patients with community acq pneumonia
• 5.8% had acute myocardial infarction
  • 15% with severe CAP, 20% with clinical failure
  • Associated with increased mortality, LOS and time to stability

MORTALITY RISK FACTORS

Male sex  Neoplastic disease
Pleuritic chest pain  Neurologic disease
Hypothermia  Bacteremia
Systolic hypotension  Leukopenia
Tachypnea  Multilobar infiltrates
Diabetes mellitus
MORTALITY RISK FACTORS

- Age >65
- Afebrile
- RR > 30
- Hypotension
- Profound leukopenia
- Profound leukocytosis
- Azotemia
- Inadequate ABX
- Mechanical ventilation
- Hypoalbuminemia
- High risk organism
- ABX delay (4 hours)

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PROGNOSTIC SCORING SYSTEMS

- PORT Pneumonia Severity Index (PSI)
- CURB - 65
- Modified IDSA / ATS
- SMART - COP
PORT PNEUMONIA SEVERITY INDEX (PSI)
Stratifies patients into five classes that predict 30 day mortality and need for hospitalization. Assessment uses a cumulative point system based on 19 variables:
- Age
- Comorbidity
- Physical findings
- Laboratory values

PSI ALGORITHM
Is the patient greater than 50 years of age?
Does the patient have a history of any of the following coexisting conditions?
- Neoplastic Disease
- Congestive Heart Failure
- Cerebrovascular Disease
- Chronic Renal Disease (Cr>2.0)
- Liver Disease (cirrhosis or chronic active hepatitis)
Does the patient have any of the following abnormalities on physical examination?
- Altered mental status
- Pulse ≥ 125 bpm
- Respiratory rate ≥ 30 bpm
- Systolic B.P. < 90 mm Hg
- Temperature <35C or ≥ 40C

PSI SCORING SYSTEM
DEMографICS
- Age
- Gender if female: -10

COMORBIDITIES
- Congestive Heart Failure +10
- Active Cancer +30
- Liver Disease (Cirrhosis or CAH) +10
- Chronic Renal Insufficiency (Cr>2.0) +10
- Cerebrovascular Disease +10
### PSI SCORING SYSTEM

**PHYSICAL EXAMINATION AT PRESENTATION**

- Systolic Blood Pressure < 90 +20
- Heart Rate > 125 +10
- Respiratory Rate ≥ 30 +20
- Oral Temperature < 95°C or ≥ 104°C +15
- Altered Mental Status +20

**LABORATORY**

- Hematocrit < 30 +10
- Glucose > 250 +10
- Sodium < 130 +20
- BUN > 30 +20
- Arterial pH < 7.35 +30
- PaO2 < 60 torr or O2 sat < 90% +10
- Pleural Effusion on CXR +10

### PSI RISK STRATIFICATION

<table>
<thead>
<tr>
<th>RISK CLASS</th>
<th>SCORE</th>
<th>RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Algorithm</td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>&lt;70</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>71-90</td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>91-130</td>
<td>Moderate</td>
</tr>
<tr>
<td>5</td>
<td>&gt;130</td>
<td>High</td>
</tr>
</tbody>
</table>

### RISK CLASS MORTALITY RATES

<table>
<thead>
<tr>
<th>Risk Class</th>
<th># of Patients</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,034</td>
<td>0.1</td>
</tr>
<tr>
<td>2</td>
<td>5,778</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>6,790</td>
<td>2.8</td>
</tr>
<tr>
<td>4</td>
<td>13,104</td>
<td>8.2</td>
</tr>
<tr>
<td>5</td>
<td>9,333</td>
<td>29.2</td>
</tr>
</tbody>
</table>

CURB - 65

Confusion
Elevated BUN
Respiratory Rate > 30
Low Blood Pressure
(Syst ≤ 90, Diast ≤ 60)
Age ≥ 65
Mortality exceeds 20% if three or more present

PSI VS. CURB - 65

Study of 3161 CAP patients evaluated in ED
Low Risk: PSI I-III, CURB<1, CURB-65<2.
% low risk: 68% by PSI (mortality 1.4%)
51% by CURB (mortality 1.7%)
61% by CURB-65 (mortality 1.7%)
% higher risk: 26% PSI IV (mortality 8.1%)
6% PSI V (mortality 24%)
24% CURB-65 = 2 (mortality 1.7%)
12% CURB-65 = 3 (mortality 13%)
2% CURB-65 = 4 (mortality 17%)
0.2% CURB-65 = 5 (mortality 43%)


ROC Curve for 30 day mortality

Modified IDSA / ATS

<table>
<thead>
<tr>
<th>Major criteria</th>
<th>Minor criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Ventilation</td>
<td>Multilobar disease</td>
</tr>
<tr>
<td>Septic Shock</td>
<td>PaO₂/FiO₂ &lt; 250</td>
</tr>
<tr>
<td></td>
<td>RR &gt; 30</td>
</tr>
<tr>
<td>Severe pneumonia present if</td>
<td>Confusion</td>
</tr>
<tr>
<td>one major or 3 minor are</td>
<td>BUN &gt; 20</td>
</tr>
<tr>
<td>present</td>
<td>Leukopenia</td>
</tr>
<tr>
<td></td>
<td>Thrombocytopenia</td>
</tr>
<tr>
<td></td>
<td>Hypothermia</td>
</tr>
<tr>
<td></td>
<td>Hypotension</td>
</tr>
</tbody>
</table>


SMART-COP

Systolic < 90: +2
Multi-lobar infiltrates: +1
Albumin < 3.5 gm/dl: +1
RR Elevation: +1
Tachycardia: +1
Confusion: +1
Low Oxygen: +2
pH < 7.35: +2

Score > 3 predicted need for intensive or vasopressor support


SMART-COP

Does it predict need for IRVS?

- 882 patients with CAP
- IRVS (intensive respiratory or vasopressor support) included MV, NIPPV, pressors.
- 10.3% received IRVS
- SMART-COP score > 3 identified 92% of patients needing IRVS
  - better than both CURB-65 and PSI
  - of 91/118 ICU patients required IRVS
SMART-COP
Does it predict need for IRVS?


<table>
<thead>
<tr>
<th>SCORING SYSTEM</th>
<th>ADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI</td>
<td>Accurate (for 30 day mort)</td>
</tr>
<tr>
<td></td>
<td>Identifies low risk pts</td>
</tr>
<tr>
<td></td>
<td>Well validated</td>
</tr>
<tr>
<td>CURB-65</td>
<td>Simple</td>
</tr>
<tr>
<td></td>
<td>Uses clinical exam</td>
</tr>
<tr>
<td></td>
<td>Validated</td>
</tr>
<tr>
<td></td>
<td>Identifies severe patients</td>
</tr>
<tr>
<td>SMART-COP</td>
<td>Identifies IRVS</td>
</tr>
<tr>
<td></td>
<td>Somewhat validated</td>
</tr>
<tr>
<td>IDSA/ATS</td>
<td>Partially validated for predicting ICU need</td>
</tr>
<tr>
<td></td>
<td>Niederman: Respirology 2009; 14:327</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCORING SYSTEM</th>
<th>DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSI</td>
<td>Complex</td>
</tr>
<tr>
<td></td>
<td>Not always accurate for hosp or ICU</td>
</tr>
<tr>
<td></td>
<td>Overestimates severity in elderly</td>
</tr>
<tr>
<td></td>
<td>Underestimates severity in young</td>
</tr>
<tr>
<td></td>
<td>Does not consider social factors</td>
</tr>
<tr>
<td>CURB-65</td>
<td>Does not consider social factors</td>
</tr>
<tr>
<td>SMART-COP</td>
<td>Needs more validation</td>
</tr>
<tr>
<td></td>
<td>Does not predict mortality</td>
</tr>
<tr>
<td></td>
<td>May not work in young patients</td>
</tr>
<tr>
<td></td>
<td>Limited to sever CAP</td>
</tr>
<tr>
<td>IDSA/ATS</td>
<td>Needs more validation</td>
</tr>
<tr>
<td></td>
<td>Only partially weights clinical variables</td>
</tr>
<tr>
<td></td>
<td>Limited to sever CAP</td>
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ICU USE IN CAP

- 172 ICUs with 17,889 cases of CAP
- 29% admitted days 0-2, 21.5% admitted days 3-7, 19.5% after day 7.
- 55% ventilated on admission to ICU
- Mortality:
  - 46.3% if admitted by day 2
  - 50.4% if admitted day 3-7
  - 57.6% if admitted after day 7

Woodhead et al: Critical Care 2006; 10:S1

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**OUTCOME IN SEVERE CAP**

**Effective Antibiotic Therapy**

- 299 patients
- 50% were mechanically ventilated
- 194 received effective initial therapy
- 33% received ineffective initial therapy
- Overall mortality 28.5%


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**OUTCOME IN SEVERE CAP**

**Effective Antibiotic Therapy**

![Mortality Graph]

**EFFECTIVE INEFFECTIVE**


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**FOUR HOUR ANTIBIOTIC RULE**

**Adverse Consequences**

Misdiagnosis and overtreatment of CAP:
Kanwar compared diagnosis and treatment of CAP before and after institution of 4 hr abx guideline.
- Dx of CAP with normal CXR increased from 20 to 28%
- Discharge dx of CAP fell 76 to 59%
- More blood cultures and total abx were given

Kanwar et al: Chest 2007; 131:1865

C difficile colitis from misdiagnosis and overtreatment:
- 6 of 15 patients who developed C difficile colitis following treatment for CAP did not have CAP

Polgreen et al: ICHE 2007; 28:212
FOUR HOUR ANTIBIOTIC RULE
Adverse Consequences

OVERDIAGNOSIS OF CAP

Retrospective analysis of 548 patients with CAP treated using a guideline of 4 vs. 8 hrs to initiation of abx:

- 255 patients treated under 8 hr guideline
- 293 patients treated under 4 hr guideline
- Discharge diagnosis of CAP was 74.5% under 8 hr guideline but only 66.9% with 4 hr guideline


BACTERIOLOGY OF CAP
Hospitalized Patients

- S. pneumoniae
- H. influenzae
- K. pneumoniae (and other gram-negative bacilli)
- L. pneumophila
- S. aureus
- C. pneumoniae
- Others: M. catarrhalis, M. pneumoniae

ATS / IDSA TREATMENT GUIDELINES FOR CAP

Hospitalized patients - general medical ward

Generally preferred: β-lactam* +/- a macrolide†

or a fluoroquinolone‡ (alone)

*Cefotaxime, ceftriaxone, or a β-lactam/β-lactamase inhibitor
†Azithromycin, clarithromycin, or erythromycin
‡Levofloxacin, sparfloxacin, grepafloxacin, or another fluoroquinolone with enhanced activity against S. pneumoniae
ETIOLOGY OF SEVERE CAP


VIRUSES IN SEVERE CAP

Review of etiology of 338 patients with severe CAP

61 had viral infection based on initial / convalescent serology:

- 37 influenza
- 11 parainfluenza
- 5 respiratory syncytial virus
- 5 adenovirus

Likelihood of viral cause higher in patients with CHF and dry cough

De Roux et al: 2004; 125:1343

You think your nine year old child could learn responsibility by being personally responsible for a new pet. Which of the following would be the safest pet for your child?

1. A purple breasted rooster from Indonesia.
2. A Vietnamese pot bellied pig purchased through a discount importer / exporter located in Mexico City.
3. A cute Chinese Guandongian civet.
4. A turtle.
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H1N1 INFLUENZA

H1N1 is a Type A human influenza with swine genetic components – cannot be transmitted from pigs.
As of 8/30, 1380 hospitalizations in US with 196 deaths.
GI complaints more severe than seasonal flu
  Occur in 60% of patients
  All age groups, not just children
Younger populations at increased risk of infection
May be increased risk of thrombo-embolic disease
Complications occur in the usual risk groups
Rapid influenza antigen screen is only 38-53% sensitive
  (If negative follow up with H1N1 PCR or culture)

ATS / IDSA TREATMENT GUIDELINES FOR SEVERE CAP

- Hospitalized patients - severely ill (I.C.U.)
  Erythromycin, azithromycin or a fluoroquinolone‡
  plus
  cefotaxime, ceftriaxone or a β-lactam / β-lactamase inhibitor

CA-MRSA IN CAP

Frequently complicates preceding viral illness
Distinct clinical illness compared to HAP-MRSA
- Necrotizing, severe pneumonia
- Panton valentine leukocidin (PVL) exotoxin causes necrosis.
- Antibiotics that decrease exotoxin production may be beneficial

Micek reported 3 cases of CAP from PVL producing MRSA that failed initial therapy with vancomycin but responded to either addition of clindamycin or switch to linezolid.

Micek et al: Chest 2005; 128:2732

CA-MRSA CAP

FLUOUROQUINOLONE MONOTHERAPY IN SEVERE CAP

398 severe CAP patients treated in MICU
Prospective trial comparing levofloxacin to cefotaxime/ofloxacin.
Excluded patients in septic shock
Overall efficacy was equal but trend to less cure with levofloxacin monotherapy if mechanically ventilated.
Do not use in septic shock or mech ventilation

Leroy et al: Chest 2005; 128:171
FLUOROQUINOLONE MONOTHERAPY IN SEVERE CAP

Do not use in fluoroquinolone monotherapy in septic shock or mechanical ventilation

Leroy et al: Chest 2005; 128:171

FLUOROQUINOLONE MONOTHERAPY IN SEVERE CAP

515 patients with severe CAP
Prospective trial comparing beta-lactam/macrolide vs fluoroquinolone alone
30 day mortality in PSI V patients:
18.4% in beta-lactam/macrolide group
36.6% in fluoroquinolone group