Community-Acquired Pneumonia (CAP)

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William Osler

1. In 1898, William Osler described community-acquired pneumonia as:
   a. An ailment that often leads to suffocation and death.
   b. A friend of the aged.
   c. A common and mortal disease which can be diagnosed by simple observation and percussion of the chest.

"Pneumonia may well be called the friend of the aged. Taken off by it in an acute, short, not often painful illness, the old man escapes those 'cold gradations of decay' so distressing of himself and to his friends."

— William Osler, M.D., 1898

“Brad, pneumonia sucks.”
— Mr. L. Washington
Inpatient November 2006

Update in CAP
Specific Goals:

- Describe the most common causes of community-acquired pneumonia in the outpatient setting
- Order appropriate diagnostic tests for CAP
- Utilize the PORT (Pneumonia Severity Index) score effectively in the admission decision
- Initiate appropriate antibiotics in the treatment of outpatient community-acquired pneumonia (CAP)
- State the benefits and need for preventative treatments for CAP

Sources

- Guidelines for Community-Acquired Pneumonia
  - IDSA/ATS Consensus Guidelines 2007
  (IDSA = Infectious Disease Society of America)
  (ATS = American Thoracic Society)
  - BTS: British Thoracic Society
- Updated Literature Review

Roadmap

- Background
- Etiology
- Diagnosis
- Admission
- Treatment
- Prevention

CAP: Background

- 5 million cases/year in the U.S.
- 80% of CAP is treated outpatient
- Sixth leading cause of death
- Inpatient mortality 10-35%
- Outpatient mortality < 1%
- Evidence/Guidelines

Cough 90%*
Dyspnea 66%
Sputum 66%
Pleuritic chest pain 50%

* Yet, only 4% of all visits for cough are pneumonia

Community-Acquired Pneumonia

**Roadmap**
- Background
- Etiology
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**“Typical” vs. “Atypical”**

- **Typical organisms**
  - *S. pneumococcus*, *H. influenzae*, *M. catarrhalis*, etc.

- **Atypical organisms**
  - *M. pneumoniae*, *C. pneumoniae*, *Legionella spp.*, etc.

**Etiology of CAP**

<table>
<thead>
<tr>
<th>Outpatients (mild)</th>
<th>Non-ICU inpatients</th>
<th>ICU inpatient</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S. pneumoniae</em></td>
<td><em>S. pneumoniae</em></td>
<td><em>S. pneumoniae</em></td>
</tr>
<tr>
<td><em>M. pneumoniae</em></td>
<td><em>M. pneumoniae</em></td>
<td><em>Legionella spp.</em></td>
</tr>
<tr>
<td><em>H. influenzae</em></td>
<td><em>H. influenzae</em></td>
<td><em>H. influenzae</em></td>
</tr>
<tr>
<td><em>C. pneumoniae</em></td>
<td><em>Legionella spp.</em></td>
<td><em>GNRs</em></td>
</tr>
<tr>
<td>Resp. viruses</td>
<td>Resp. viruses</td>
<td><em>S. aureus</em></td>
</tr>
</tbody>
</table>


**“Typical” vs. “Atypical”**

- Classic teaching is just plain wrong
- No history, exam, laboratory, or radiographic features predict organism
  - “Walking pneumonia”
  - “Classic lobar pneumonia”
Community-Acquired Pneumonia

Etiology of CAP

- *Mycoplasma pneumoniae* causes up to 1/3 of CAP in outpatient setting
- Respiratory viruses common in outpatient CAP
  - 10-30% depending on the study

Outpatients (mild)
- *S pneumoniae*
- *M pneumoniae*
- *H influenzae*
- *C pneumoniae*
- Resp. viruses

Non-ICU inpatients
- *S pneumoniae*
- *M pneumoniae*
- *C pneumoniae*
- *H influenzae*
- Legionella spp
- Resp. viruses

ICU inpatient
- *S pneumoniae*
- *Legionella spp*
- *H influenzae*
- *GNRs*
- *S aureus*


MRSA Nightmare...

- Emerging pathogen
- CDC reports, ’03-’04, ’06-’07 flu seasons
- 25 cases, influenza-associated MRSA

Total of 25 cases, MRSA CAP
- Median age ~ 20 y.o., most (70%) no risk factors
- Rapid-onset, multi-lobar infiltrate
- Mortality near 50%


Roadmap

- Background
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2. A 65-year old man presents to urgent care complaining of subjective fever, chills, and productive cough x 3 days. He reports mild shortness of breath. His temperature is 38.6°C, RR 26, O₂ saturation 95% on RA. He has crackles at the right base on lung exam. You should:

a. Treat for community-acquired pneumonia.
b. Send him for a PA and lateral CXR.
c. Send him for blood and sputum cultures.
d. Prescribe sudafed and robitussin and send him home.
e. Admit him to the hospital
f. B and C
g. B, C, and E
h. B and E

---

1) Select clinical features (e.g., cough, fever, sputum, pleuritic chest pain) AND

2) Infiltrate by CXR or other imaging

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Blood Cultures in CAP

- Limitations
  - Positive in < 10% of cases
  - High percentage of contaminants
  - Cultures change antibiotics in < 5% of patients
  - Costly

- Medicare database of 13,000 patients
- Determined predictors of blood-culture positivity
  - The sicker you are...
**Blood Cultures in CAP**

- In general, blood cultures are not indicated in the management of outpatient CAP

**Sputum for CAP**

- Complicated and Controversial
- Simple, inexpensive, specific for pneumococcus
- Problems include:
  - Up to 30% could not produce adequate sputum
  - Good quality available in only 14%

**Diagnostic Testing**

2. A 65-year old man presents to urgent care complaining of subjective fever, chills, and productive cough x 3 days. He reports mild shortness of breath. His temperature is 38.1°C, RR 26, O2 saturation 95% on RA. He has crackles at the right base on lung exam. You should:

   a. Treat for community-acquired pneumonia.
   b. Send him for a PA and lateral CXR.
   c. Send him for Blood and sputum cultures.
   d. Prescribe suctioning and robitussin and send him home.
   e. Order viral DFA.
   f. B and C
   g. B, C, and E
   h. B and E

**Sputum Cultures in CAP**

- In general, sputum cultures are not indicated in the management of outpatient CAP

**Diagnostic testing for CAP**

- Get the CXR

  - Blood and sputum cultures generally discouraged in outpatient CAP
  - If you’re thinking about cultures, think about admission
**The future in CAP**

- Pneumococcal urinary antigen
- Rapid test, specificity > 90%
- If positive, tx for pneumococcal disease
- No sensitivities...

**The future in CAP - biomarkers**

- Procalcitonin: precursor of calcitonin
  - No hormonal activity
  - Inflammatory marker
  - Increased in sepsis, bacterial infection

**Diagnosing Pneumonia**

Procalcitonin: Bacterial vs. Non-bacterial

![Procalcitonin: Bacterial vs. Non-bacterial](image)

**Procalcitonin: Diagnosis**

**Procalcitonin Based Management**

- Swiss RCT: 300 Inpatients
- PCT at admit, 6-24 hr, day 4,6,8
- Usual care vs. PCT assay (<1 hr)

<table>
<thead>
<tr>
<th>PCT Level</th>
<th>Significance</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0.1 mcg/L</td>
<td>No bacteria</td>
<td>No rx*</td>
</tr>
<tr>
<td>0.1-0.25</td>
<td>viral&gt;bact</td>
<td>no rx</td>
</tr>
<tr>
<td>0.25-0.5</td>
<td>Possible bact</td>
<td>Rx</td>
</tr>
<tr>
<td>&gt; 0.5</td>
<td>Likely bacteria</td>
<td>Rx</td>
</tr>
</tbody>
</table>

* rx= initiation or continuation of abx

25% of patients on admission and 50% at day 4 have PCT levels < 0.25

**Roadmap**

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Community-Acquired Pneumonia

Admission Decision

- Benefit to Patients
  - Able to resume normal activity sooner
  - Up to 80% prefer outpatient treatment
- Cost
  - Inpatient care 25x more expensive
- Patient Safety
  - Hospitals not the safest place to be


Pneumonia Severity Index (PSI)

- Retrospectively studied; prospectively validated
- Scoring system to risk stratify and to identify outpatient vs. inpatient treatment


Pneumonia: Admission Criteria

- Age
- Gender
- Demographic
  - Nursing home
  - Comorbidities
    - Cancer
    - Liver
    - CHF
    - Cerebrovascular
    - Renal
- Exam
  - Mental status
  - Resp rate > 30
  - SBP <90
  - Temp <35, > 40
  - Pulse > 125
- Labs
  - pH < 7.35, pO2 < 60
  - BUN > 30
  - Na < 130
  - Glucose > 250
  - Hct < 30
  - Pleural effusion


Pneumonia Severity Index

<table>
<thead>
<tr>
<th>Class</th>
<th>PSI score</th>
<th>Mortality</th>
<th>Re-admit</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0</td>
<td>0.1</td>
<td>5.1%</td>
</tr>
<tr>
<td>II</td>
<td>&lt;=70</td>
<td>0.7</td>
<td>8.2%</td>
</tr>
<tr>
<td>III</td>
<td>71-90</td>
<td>3%</td>
<td>16.7%</td>
</tr>
<tr>
<td>IV</td>
<td>91-130</td>
<td>8%</td>
<td>20.0%</td>
</tr>
<tr>
<td>V</td>
<td>&gt;130</td>
<td>29%</td>
<td>0.00%</td>
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<table>
<thead>
<tr>
<th>Class</th>
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<th>Treatment</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>0</td>
<td>0.1</td>
<td>Outpatient</td>
</tr>
<tr>
<td>II</td>
<td>&lt;=70</td>
<td>0.7</td>
<td>Outpatient</td>
</tr>
<tr>
<td>III</td>
<td>71-90</td>
<td>3%</td>
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**Admission Decision**

**PSI: An Admission Decision Tool**

  - Discharge classes I, II, III, non-hypoxemic patients
  - Safely reduce low risk admits
  - Multicenter RCT of CAP pathway, 1743 pts
  - Discharge for PSI class I, II, III in pathway hospitals
  - Safely reduced low risk admits
- Fine, et al. (SGIM 2005)
  - > 30 Emergency Departments. Safe and Effective

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**Pneumonia Severity Index (PSI)**

- All expert guidelines recommend:
  - Prognostic models such as the PSI should be used to identify patients with CAP who may be candidates for outpatient treatment.
  - Patients in class I, II, and III should probably be treated as outpatients.

Limitations???

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**Pneumonia: Admission Criteria**

- Age
- Gender
- Demographic
  - Nursing home
- Comorbidities
  - Cancer
  - Liver
  - CHF
  - Cerebrovascular
  - Renal
- Lab
  - pH < 7.35, pO2 < 60
  - BUN > 30
  - Na < 130
  - Glucose > 250
  - Hct < 30
  - Pleural effusion

---

**Admission Decision**

3. A 28 year-old healthy man is evaluated in your clinic because of fever, productive cough, and shortness of breath. His T = 40°C, HR 130 beats/min, RR 28/min, and blood pressure is 120/70 mmHg, 89% on room air. The CXR reveals bilateral infiltrates. His Pneumonia Severity Index (PORT Score) is 63 (risk class II – low to moderate). Which of the following is the most appropriate for this patient?
   a. Treat him as an outpatient with oral therapy.
   b. Treat him as an outpatient with intravenous therapy.
   c. Hospitalize him.
   d. Hospitalize the patient in the intensive care unit.
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### Low Risk Admissions

- 328 pts admitted w/ CAP, 86 low risk (class I-II)
- Most common: other co-morbidity req. hospitalization
- Many because of social needs, oral intolerance

- 1900 low risk (class I-III) without hypoxia
- 45% treated as inpatients
- Most admit because of other co-morbid conditions
- 20% of admitted pts could have been outpatient

### The Admission Decision:2007

**CAP**

- Hypoxia (sat < 90%)
- Active Coexisting Condition
- No oral

- PSI Class IV, V
- Yes
- Yes

- Frail
- Homeless / Unstable home
- “Other”
- No

- Brief stay (23hr)
- SNF
- Home IV
- Home nursing
- Close follow-up

- Yes
- No

- HOME

### Admission Decision

- Use a prognosis score in ALL patients
- Appreciate limitations to PSI/PORT
  - Hypoxia, co-morbidities, no POs, social situation

### Roadmap

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- Prevention

### Treatment of CAP
4. A healthy 48 year-old woman who was recently treated (1 month ago) for cystitis with cipro presents to your clinic with fever, cough, sputum. Her CXR reveals RLL infiltrate and you diagnose community-acquired pneumonia and decide to treat as an outpatient.

Which of the following is the best treatment regimen?

A. Levofloxacin PO  
B. Azithromycin PO  
C. Ertapenem  
D. Augmentin PO and Azithromycin PO  
E. Doxycycline PO and penicillin PO

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**Etiology of CAP**

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<td>• M pneumoniae</td>
<td>• Legionella spp</td>
</tr>
<tr>
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<td>• H influenzae</td>
<td>• H influenzae</td>
</tr>
<tr>
<td>• C pneumoniae</td>
<td>• C pneumoniae</td>
<td>• Legionella spp</td>
</tr>
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<td>• GNRs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• S aureus</td>
</tr>
</tbody>
</table>


---

**Treatment Principle #1**

Outpatients (mild)

- S pneumoniae
- M pneumoniae
- H influenzae
- C pneumoniae
- Resp. viruses

Must cover all these organisms

**Risk Factors for DRSP**

- Age > 65 years old
- Chronic disease  
  - Heart, lung, renal, liver
- Diabetes mellitus
- Alcoholism
- Malignancy
- Immunosuppression
- Antibiotics in the last 3 months

---

**Treatment Principle #2**

Outpatients (mild)

- S pneumoniae
- M pneumoniae
- H influenzae
- C pneumoniae
- Resp. viruses

“Wimpy” pneumococcus

Drug-resistant S. pneumoniae (DRSP)

Penicillin, erythromycin, macrolides, etc.

**Treatment Principle #2**

Outpatients (mild)

- S pneumoniae
- M pneumoniae
- H influenzae
- C pneumoniae
- Resp. viruses

“Wimpy” pneumococcus

Drug-resistant S. pneumoniae (DRSP)
**Treatment CAP**

**Outpatient, healthy, no DRSP risk factors**

<table>
<thead>
<tr>
<th></th>
<th>Doxycycline or macrolide</th>
</tr>
</thead>
</table>

- Macrolide = azithro, clarithro, erythro

**Outpatient Treatment of CAP**

- Patients with no co-morbidities and not recently exposed to antibacterials:
  - First choice: doxycycline
  - Second choice: azithromycin
  - Third choice: clarithromycin

- "High risk" (DRSP risk factors):
  - First choice: respiratory fluoroquinolone
  - Second choice (maybe first choice): combination β-lactam + macrolide/doxycycline
Community-Acquired Pneumonia

Treatment of CAP

4. A healthy 48 year-old woman who was recently treated (1 month ago) for cystitis with cipro presents to your clinic with fever, cough, sob. Her CXR reveals RLL infiltrate and you diagnose community-acquired pneumonia and decide to treat as an outpatient.

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D. Augmentin PO and Azithromycin PO
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Risk Factors for DRSP

- Age > 65 years old
- Chronic disease (heart, lung, renal, liver)
- Diabetes mellitus
- Alcoholism
- Malignancy
- Immunosuppression
- Antibiotics in the last 3 months

Duration of therapy

- Not substantial data on duration of therapy
- Growing evidence with shorter courses
  - Clinical success with 3-5 d of azithro
  - Small trials w/ single-dose azithro
  - Success with 5 d of high-dose levo (750mg daily)
  - Europe: success w/ 3 vs. 7 d of amoxicillin
Duration of therapy

“Patients with CAP should be treated for a minimum of 5 days (level I evidence)”

--- IDSA/ATS Guidelines

**Roadmap**

- Background
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**Pneumovax**

- Vaccine against *Streptococcus pneumoniae*, most common cause of CAP
- Polysaccharide vaccine with 23 antigens
- Covers 85-95% of serotypes causing invasive disease in U.S.

**Pneumococcal Vaccine: High Risk Pts Effective?**

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>CAP</th>
<th>Invasive Dz Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine 94’</td>
<td>Meta-anal 9 RCTs</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Hutchison 99’</td>
<td>Meta-analysis 13 RCTs</td>
<td>47%</td>
<td>73%</td>
</tr>
<tr>
<td>Moore 00’</td>
<td>Meta-anal 13 RCTs</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Cornu 01’</td>
<td>Meta-Anal 14 RCTs</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Watson 02’</td>
<td>Meta-Anal 16 RCTs</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Holden 03’</td>
<td>Cychane 16 RCTs</td>
<td>No</td>
<td>53%</td>
</tr>
</tbody>
</table>

**Pneumovax - Efficacy**

- Retrospective cohort study, 109 hospitals
- 62,918 adults hospitalized for CAP
- 7,390 (12%) had prior Pneumovax

- Studied in-hospital outcomes – death, complications, and LOS vs. non-vaccinated
Community-Acquired Pneumonia

Pneumovax - Efficacy
- Retrospective cohort study, 109 hospitals
- 62,918 adults hospitalized for CAP
- 7,390 (12%) had prior Pneumovax
- Vaccination reduced complications
- Vaccination reduced LOS

Pneumovax - Efficacy
- Pneumococcal vaccine clearly prevents invasive pneumococcal disease
- Probably reduces death, complications, and LOS in patients hospitalized with CAP

Pneumovax - Who
- Patients > 65 years old
- Patients < 65 with chronic medical conditions
  - Respiratory: COPD, asthma
  - Cardiovascular disease
  - Metabolic diseases: diabetes, renal failure, liver failure
- Immunocompromised (HIV, malignancy, etc.)
- Residing in long-term care facilities

Influenza Vaccine - Efficacy
- Adults aged < 65 years
  - Prevents influenza illness in ~ 70-90%
- Adults aged > 65 years
  - Prevents influenza illness in ~ 30-70%
**Influenza Vaccine - Efficacy**

<table>
<thead>
<tr>
<th>Hospitalization</th>
<th>Risk Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resp. Illness</td>
<td>56%*</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>50%*</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>53%*</td>
</tr>
<tr>
<td>All cause death</td>
<td>68%* (NNT = 118)</td>
</tr>
</tbody>
</table>

*All p values < 0.001


---

**Influenza Vaccine – Who?**

- All adults ≥ 65 years old
- Adults of any age with chronic medical conditions
  - Respiratory: COPD, asthma
  - Cardiovascular disease
  - Metabolic diseases: diabetes, renal failure, liver failure
- Residents of chronic care facilities
- Immunosuppressed patients
- Health-care employees
- All adults aged 50-64 (offered)

CDC Recs. MMWR 2004;53:1.

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**Smoking Cessation Counseling**

- Should provide it to all of our patients that smoke
- Some evidence that tobacco is a risk factor for pneumonia

---

**Prevention**

**Smoking and Invasive Pneumococcus**

<table>
<thead>
<tr>
<th>Cigs / d</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Smokers</td>
<td></td>
</tr>
<tr>
<td>1 - 14</td>
<td>2.3</td>
</tr>
<tr>
<td>15 - 24</td>
<td>3.7</td>
</tr>
<tr>
<td>≥ 25</td>
<td>5.5</td>
</tr>
<tr>
<td>All</td>
<td>4.1 (2.4-7.3)</td>
</tr>
<tr>
<td>Hrs / d</td>
<td>OR</td>
</tr>
<tr>
<td>Passive Smokers</td>
<td></td>
</tr>
<tr>
<td>≤ 4</td>
<td>2.4</td>
</tr>
<tr>
<td>&gt; 4</td>
<td>3.9</td>
</tr>
<tr>
<td>All</td>
<td>2.5 (1.2-5.1)</td>
</tr>
</tbody>
</table>

Nuorti, NEJM, 2000

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**Avoid Overuse of Acid-Suppressive Rx**

- Netherlands; Large Primary Care Database
- 365,000 pts; 5500 cases of CAP

<table>
<thead>
<tr>
<th>Pt Population</th>
<th>Risk for CAP: OR(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current PPI</td>
<td>1.9 (1.4-2.6)</td>
</tr>
<tr>
<td>Current H2RA</td>
<td>1.6 (1.1-2.5)</td>
</tr>
<tr>
<td>&gt; 1 daily dose</td>
<td>2.3 (1.3-4.1)</td>
</tr>
</tbody>
</table>

- Risk is 1 case of CAP for 225 pts with PPI

Laheij, et al. JAMA 2004
Community-Acquired Pneumonia

Roadmap

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Take-Home Points

- **Etiology:** 1) *S. pneumoniae*; 2) mycoplasma in outpatient CAP
- **Diagnosis:** Patients with suspected CAP should have a PA & lateral CXR
- **Diagnosis:** Do not routinely get blood or sputum cultures in outpatient CAP
- **Admission:** Use the PSI/PORT score to make the admission decision

Take-home Points

- **Admission:** appreciate the limitations to the PSI/PORT score
- **Treatment:** doxycycline or macrolide for healthy outpatient with no DRSP risk-factors
- **Treatment:** fluoroquinolone or β-lactam + macrolide/doxy for outpatient with DRSP risk factors
- **Prevention:** pneumovax, flu vax, smoking, avoid PPIs

Community-Acquired Pneumonia

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Alternatives to Admission

Prospective trial of "Hospital at Home" for elderly (>65 yo) pts
Initial 8-24 hr RN, then daily RN and daily MD visit, O2, IVs, CXR
60% chose home hospital
Home vs. Hosp; LOS 3.2d vs 4.9; Cost: 5k vs 7.5 k;
Similar outcomes, but less delirium, procedures, devices

Richards, et al. *MJA.* 2005
55 pts, mild-mod CAP randomized to home care vs. hospital
IV abx in ED, then admitted vs. home
Home vs Hospital; LOS 4 vs 2;
Home less costly, more satisfaction