

**CASE:** 57 yo man with history of smoking who lives with his 80 yo mother presents to the ED with one month of shortness of breath and three days of worsening cough productive of green sputum, fever, and left sided pleuritic chest pain. Examination is remarkable for T40.1°C, blood pressure 108/62, HR 114, respirations 28/minute, mildly decreased breath sounds and faint crackles at the left base. The patient is oriented only to self. Chest x-ray shows mildly increased left lower lobe markings. Laboratories are notable for a white cell count of 25,000 with a left shift, sodium of 127, BUN of 28 and creatinine of 1.1. ABG and blood cultures are pending. Does this patient have community-acquired pneumonia? What are the likely pathogens? Does he require hospitalization? What criteria could you use to decide? What is his prognosis? What work-up and treatment would you consider?

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## Community-Acquired Pneumonia (CAP)

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**SCOPE OF THE PROBLEM:** 4 million cases/year US. -20% require admission. 6<sup>th</sup> leading cause of death; most common infectious cause of death.

**Differential Diagnosis:** URI, bronchitis, reactive/obstructive airway disease exacerbation, CHF, pulmonary embolism, malignancy

**Pathogens:** Pathogen identified in 25-50% of inpatients (\*indicates worse prognosis)

- \**Streptococcus pneumoniae* (~67% bacterial pneumonias): bacteremia 20-30%; effusion common; empyema uncommon; most common cause of fatal pneumonia
- “Atypicals” (20-40%): *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, \**Legionella spp*
- *Haemophilus influenzae* (3-10%)
- Gram-negative enteric rods (3-10%) (prior antibiotic use or pulmonary disease)
- \**Pseudomonas aeruginosa* (more common with neutropenia, structural lung disease)
  - \**Staphylococcus aureus* (3-5%) (elderly or post-influenza infection in younger persons)
  - Methicillin resistant *Staphylococcus aureus* (MRSA)
    - Rise in incidence: 2003-2004 17 cases: median age 21; 75% no MRSA risk identified
    - 80% in ICU; 30% fatal: 100% macrolide resistant; 50% fluoroquinolone resistant
- Anaerobes
- Respiratory viruses (influenza A and B, adenovirus, RSV, parainfluenza)
- Less common: *Neisseria meningitidis*, *Moraxella catarrhalis*, *Strep pyogenes* (latter → fulminant PNA; early empyema)

**Risks:** Older age, alcoholism, asthma, immunosuppression, chronic lung/heart disease, dementia, malnutrition, institutionalization. Smoking: strongest independent risk for invasive pneumococcus in immunocompetent, young adults.

**Signs and Symptoms: non-specific**

- **Symptoms:** acute cough (>90%) sputum (~66%), dyspnea (66%), pleuritic chest pain (50%)/fever and rigors 80%
- **Signs:** Egophany (LR 4.1), cachexia (LR 4.0), bronchial breath sounds (LR 3.3), percussion dullness (LR 3.0), diminished breath sounds (LR 2.3), abnormal mental status (LR 2.2), T>37.8°C (LR 2.2), tachypnea (LR 2.0) and crackles (LR 2.0) 80% have fever (less common in elderly), Respiratory Rate > 24 in 45-70% (may be most sensitive sign in elderly)

**Diagnosis:** No gold standard. Clinical diagnosis. Normal HR, temp, respirations reduce pre-test odds of CAP > 5x.

**Laboratory evaluation:**

- WBC 15-30,000 with left shift; WBC > 10.4 +LR3.7; WBC < 4 poor prognosis
- Check blood cultures x 2 (before antibiotics!) if require admission; bacteremia is specific and identifies high-risk patients but < = 10% positive; culture results change management in < 5%.
- Consider diagnostic thoracentesis if effusion.
- Sputum culture controversial. Low sensitivity; moderate specificity. May help (rarely) tailor therapy if organism identified. Consider in patients with sputum production and no prior antibiotics. Consider particularly in ICU when MRSA is a concern.
- Consider urinary Legionella antigen (sensitivity 70%; specificity > 90%); acid-fast stain for TB.
- Consider urinary *Strep pneumo* antigen (sensitivity/specificity > =sputum); still valid after Antibiotics (90%+ positive at 7 days).

**Imaging:** CXR: proxy gold standard if clinical/laboratory evidence supports CAP. Lobar consolidation, interstitial infiltrates, cavitation suggestive. Negative CXR does not rule-out CAP if high pre-test probability. Up to 1/3 of patients with CAP by CT had negative CXR. If moderate/severe illness and negative CXR, consider empiric antibiotics. High-resolution CT more sensitive than CXR. Consider CT if no response to initial therapy or if complications/early failure.

**Severity of Illness/Prognosis:** Scoring systems for hospital admission and risk assessment have been well validated. See Appendix A.

- *Clinical judgment should always be the deciding factor for hospital admission!*
- *Early empiric antibiotics, smoking cessation, pneumococcal/influenza vaccines and pathway usage improve outcomes.*
- Early empiric antibiotics have been shown to decrease 30-day and in-hospital mortality and length of stay.

**Management Principles:** *Early empiric antibiotics* that cover typical and atypical organisms treatment of choice. North American Guidelines (synthesized from IDSA, Canadian guidelines, CDC, ATS) recommend beta-lactam (ceftriaxone, cefotaxime) plus a macrolide or fluoroquinolone monotherapy for hospitalized (non-ICU) patients. ICU: beta-lactam+macrolide +fluoroquinolone. Cover *Strep pneumoniae*, *Pseudomonas*, *Legionella*. If pathogen known, narrow coverage. Emerging drug resistance may affect empiric therapy. Multinational studies: penicillin/macrolide-resistant *Strep pneumo* ~20%/25%, respectively; however, most studies suggest that current levels of resistance do not result in treatment failures. Worldwide prevalence of fluoroquinolone-resistant *Strep pneumo* <2% but growing. Avoid drug classes that have been used in past three months. Consider adding Vancomycin empirically for patients admitted to MICU.

**Duration/Route of Treatment:** No controlled trials. Most recommend treatment until afebrile for > 72 hours. Trials of newer fluoroquinolones/macrolides show good outcomes with 7-10 or 10-14 days of therapy. No clear advantage of IV versus oral therapy. Most inpatients started on IV; changed to oral when clinically stable. Some studies have shown good efficacy of high-dose levofloxacin (750 mg oral daily) for shorter duration (5 days). Increasingly studies support short-course therapy (5 days/ <7 days).

**Clinical Course/Outcomes:** At 48-72 hours, 18% still febrile. One study 86% had > 1 persisting sx at 30 days. Average 30-day mortality ~14%; 10-35%. Cause of death: respiratory failure (38%), worsening underlying conditions ~50%. 50% greater risk of in-hospital death than 10 next most common conditions

**Discharge Criteria:** Patients with stable vital signs >24 hours, ability to tolerate oral medications/hydration, with baseline mental status and no other active clinical/social/psychiatric issues, can usually be safely discharged.

**Prevention:** Pneumococcal vaccine if age > 65 and/or comorbidities (cardiac/pulmonary disease, alcoholism, asplenia, HIV). One meta analysis of 14 trials: Pneumococcal vaccine prevented pneumonia by 71%; mortality by 32%. Not consistently effective in controlled trials in elderly. Recent Cochrane review found no evidence from randomized trials that vaccine prevented CAP or death; however, evidence from non-randomized trials is convincing and administration of vaccine continues to be recommended. There is NO reason to avoid pneumococcal vaccination before discharge from hospital. Give influenza vaccine between September and November. Avoid acid suppression if possible. Some studies suggest proton pump inhibitor use predisposes patients to CAP.

**Case Follow-Up:** *The patient was diagnosed with CAP based on clinical, laboratory & radiologic findings. He was hospitalized (PORT score 112) with 8-9% (30 day) mortality risk. Empiric IV antibiotics (ceftriaxone + azithromycin) were started after blood cultures drawn. Adequate sputum gram stain/culture could not be obtained. On hospital day #2, the patient remained febrile with a temperature of 39 ° C. He was increasingly tachypneic, tachycardic, hypotensive and hypoxemic requiring intubation and transfer to the ICU. Chest CT +/- contrast showed severe and dense opacity of left lower lobe with hypoperfusion suggestive of necrotizing pneumonia and moderate sized left pleural effusion. What are factors associated with early failure in hospitalized patients with CAP?*

**Early Failure:** 1,383 inpatients with CAP, at 48-72 hours 6% had early failure (worsening clinical/radiologic status or lack of response requiring change in therapy/invasive procedures). Main causes: progressive pneumonia (67%), empyema (16%), lack of response (11%), uncontrolled sepsis (11%). Independent risks: age > 65 (OR .35), multilobar pneumonia (OR 1.81), Severity Index score > 90 (OR 2.75), Legionella or gram-negatives (OR 2.71/4.34), discordant antibiotic therapy (OR 2.51). Early failures had more complications (58% v. 24%,  $p < .001$ ), higher mortality (27% v. 4%,  $p < .001$ ).

#### **Additional Case Follow-up**

*On hospital day #5, patient was successfully extubated and transferred to the general medicine ward. He was discharged to home to complete five more days of antibiotics (cefpodoxime+azithromycin). He received Pneumovax vaccination prior to discharge.*

#### **Clinical Pearls**

- Treat early (within 4-8 hours) with empiric antibiotic therapy (after blood cultures)
- Narrow coverage if pathogen identified
- A negative chest X-ray does not rule out a diagnosis of CAP
- Encourage smoking cessation
- There is no reason to avoid vaccination before discharge from the hospital.

#### **References**

1. Baik I, et al. A prospective study of age and lifestyle factors in relation to community-acquired pneumonia in US men and women. Arch Intern Med 2000 Nov 13;160(2):3082-8.
2. Cochrane Database Syst Rev 2003(4):CD 000422.
3. Dunbar LM, et al. High-dose, short-course levofloxacin for community-acquired pneumonia: a new treatment paradigm. CID 2003;37:752-60.
4. File TM. Community-acquired pneumonia. Lancet 2003 Dec 13; 362(9400):1991-2001.
5. Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low risk patients with community-acquired pneumonia. N Engl J Med 1997;336:243.

6. Greci LS et al. Vaccinations in pneumonia (VIP): pneumococcal and influenza vaccination patterns among patients hospitalized for pneumonia. *Prev Med* 2005;40(4):384-8.
7. Halm EA, Teirstein AS. Management of community-acquired pneumonia. *NEJM* 2002 Dec 19;347(25):2039-2045.
8. Halm EA, et al. Time to clinical stability in patients hospitalized with community acquired pneumonia. *JAMA* 1998;279:1452-7.
9. Houck PM, et al. Timing of antibiotic administration and outcomes for Medicare patients hospitalized with community-acquired pneumonia. *Arch Intern Med* 2004;164:637-44.
10. Laheij RJ, et al. Risk of community-acquired pneumonia and use of gastric acid-suppressive drugs. *JAMA* 2004;292(16):1955-60.
11. Mandell LA, et al. update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. *Clin Infect Dis* 2003;37:1405-1433.
12. McGee, S. Evidence-based Physical Diagnosis. Saunders Philadelphia: 2001.
13. Metersky ML, et al. Predicting bacteremia in patients with community acquired pneumonia. *Am J Resp Crit Care* 2004; 169(3):342-8.
14. Metlay JP, Fine MJ. Testing strategies in the initial management of patients with community-acquired pneumonia. *Ann Intern Med* 2003 Jan 21;138(2);109-118.
15. Niederman MS, et al. Guidelines for the management of adults with community-acquired pneumonia. Diagnosis, assessment and severity, antimicrobial therapy and prevention. *Am J Respir Crit Care Med* 2001;163:1730-54.
16. Roson B, Carratala J, Fernandez-Sabe N, et al. Causes and factors associated with early failure in hospitalized patients with community-acquired pneumonia. *Arch Intern Med* 2004 Mar 8;164(5):502-8.
17. Shorr AF. Preventing pneumonia: The role for pneumococcal and influenza vaccines. *Clin Chest Med* 2005;26:123-34.

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### **Appendix A. Point Scoring System for Hospital Admission**

(Modified from pneumonia Patient Outcomes Research Team (PORT), modified from Fine 1997)

*Pneumonia Severity Index Score (PSI score)*

		Points
Demographics	Age – Men	Age in years
	Age – Women	Age in years – 10

Co-morbidity	Nursing home residence	+ 10
	Malignancy	+ 30
	Liver disease	+ 20
	Congestive heart failure	+ 10
	Cerebrovascular disease	+ 10
Physical examination findings	Renal disease	+ 10
	Altered mental status	+ 20
	Respiratory rate $\geq$ 30 per minute	+ 20
	Systolic blood pressure $<$ 90 mmHg	+ 10
	Temperature $<$ 35°C or $\geq$ 40°C	+ 15
Laboratory/radiographic findings	Heart rate $\geq$ 125 beats per minute	+ 10
	Arterial pH $<$ 7.35	+ 30
	Blood urea nitrogen $>$ 30 mg/dL	+ 20
	Sodium $<$ 130 mmol/L	+ 20
	Glucose $\geq$ 250 mg/dL	+ 10
	Hematocrit $<$ 30%	+ 10
PaO <sub>2</sub> $<$ 60 mm Hg	+ 10	
	Pleural effusion	+ 10
<b>Mortality Risk:</b> < 70 points – Class II: 0.6-0.7% 71-90 points – Class III: 0.9-2.8% 91-130 points – Class IV: 8.2-9.3% > 130 points – Class V: 27-31%	<b>Recommendations:</b> Class I and II: consider outpatient therapy Class III: consider brief inpatient observation Class IV and V: admit	

Class I if age  $<$  50 and none of the above. Otherwise, assign risk as noted. Consider social/psychiatric factors that may compromise home care, compliance, ability to take pills, substance use, cognitive impairment, baseline functional status.