Community-Acquired Pneumonia

Assoc. Prof. Mehmet GÜL
Department of Emergency Medicine
University of Necmettin Erbakan
Konya-TURKEY
Community-Acquired Pneumonia (CAP)

The IDSA, ATS, ERS, BTS, The Canadian guidelines.

(Infectious Diseases Society of America and American Thoracic Society)
Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults

Lionel A. Mandell,1,∗ Richard G. Wunderink,2,∗ Antonio Anzueto,3,4 John G. Bartlett,5 G. Douglas Campbell,6 Nathan C. Dean,5,10 Scott F. Dowell,11 Thomas M. File, Jr.12,13 Daniel M. Musher,5,6 Michael S. Niederman,14,15 Antonio Torres,16 and Cynthia G. Whitney11

1McMaster University Medical School, Hamilton, Ontario, Canada; 2Northwestern University Feinberg School of Medicine, Chicago, Illinois; 3University of Texas Health Science Center and 4South Texas Veterans Health Care System, San Antonio, and 5Michael E. DeBakey Veterans Affairs Medical Center and 6Baylor College of Medicine, Houston, Texas; 7Johns Hopkins University School of Medicine, Baltimore, Maryland; 8Division of Pulmonary, Critical Care, and Sleep Medicine, University of Mississippi School of Medicine, Jackson; 9Division of Pulmonary and Critical Care Medicine, LDS Hospital, and 10University of Utah, Salt Lake City, Utah; 11Centers for Disease Control and Prevention, Atlanta, Georgia; 12Northeastern Ohio Universities College of Medicine, Rootstown, and 13Summa Health System, Akron, Ohio; 14State University of New York at Stony Brook, Stony Brook, and 15Department of Medicine, Winthrop University Hospital, Mineola, New York; and 16Cap de Servei de Pneumologia i Àl·lèrgia Respiratòria, Institut Clínic del Tòrax, Hospital Clínic de Barcelona, Facultat de Medicina, Universitat de Barcelona, Institut d’Investigacions Biomèdiques August Pi i Sunyer, CIBER CB06/06/0028, Barcelona, Spain.

Clinical Infectious Diseases 2007;44:S27–72
© 2007 by the Infectious Diseases Society of America. All rights reserved.
1058-4838/2007/4405S2-0001$15.00
DOI: 10.1086/511159
DEFINITION

Pneumonia, inflammation of the lung parenchyma, bacteria or viruses is the most common cause,

- inhalation of chemicals,
- trauma to the chest wall,
- infection by other infectious agents rickettsiae, fungi, ....
The IDSA defines Community-Acquired Pneumonia (CAP) as "an acute infection of the pulmonary parenchyma that is associated with at least some symptoms of acute infection, accompanied by the presence of an acute infiltrate on a chest radiograph or auscultatory findings consistent with pneumonia (such as altered breath sounds and/or localized roles), in a patient not hospitalized or residing in a long-term care facility for more than 14 days before onset of symptoms."

The IDSA: Infectious Diseases Society of America
Epidemiology

Pneumonia is a leading cause of death in the world.

The sixth most common cause of death in the USA.

Every year in the USA, 5-10 million cases of CAP
1.1 million hospitalizations
5,000 deaths
Incidence

In Europe, 44 cases per 1,000 populations per year

two- to four-times higher aged over 60 yrs than in those aged 50 yrs

The mortality rate

less than 1% not hospitalized patients with CAP

12% to 14% hospitalized patients with CAP
See 1 citation found using an alternative search:


**Burden of community-acquired pneumonia in North American adults.**

**File TM Jr, Marrie TJ.**

Department of Internal Medicine, Northeastern Ohio University, College of Medicine, Rootstown, OH, USA. filet@summa-health.org

**Abstract**

To determine the burden of community-acquired pneumonia (CAP) affecting adults in North America, a comprehensive literature review was conducted to examine the incidence, morbidity and mortality, etiology, antibiotic resistance, and economic impact of CAP in this population. In the United States, there were approximately 4.2 million ambulatory care visits for pneumonia in 2006. Pneumonia and influenza continue to be a common cause of death in the United States (ranked eighth) and Canada (ranked...
Community-acquired pneumonia in the elderly.

Fung HB, Monteagudo-Chu MO.
Pharmacy Service, James J. Peters Veterans Affairs Medical Center, Bronx, New York, USA.

Abstract

BACKGROUND: Community-acquired pneumonia (CAP) is a frequent cause of hospitalization and death among the elderly.

OBJECTIVE: This article reviews information on CAP among the elderly, including age-related changes, predisposing risk factors, causes, treatment strategies, and prevention.

METHODS: Searches of MEDLINE (January 1990-November 2009), International Pharmaceutical Abstracts (January 1990-November 2009), and Google Scholar were conducted using the terms community-acquired pneumonia, pneumonia, treatment guidelines, and elderly. Additional publications were found by searching the reference lists of the identified articles. Studies that reported diagnostic criteria as well as the treatment outcomes achieved in adult patients with CAP were selected for this review.
Prevalence in the USA

46,237 elderly patients were monitored over a 3-year period,

*CAP* rate, 65-69 years, 18.2 cases per 1000 person-years.

Older than age 85 years, 52.3 cases per 1000 person-years.

Approximately 915,900 *CAP* cases, elderly population, annually in the USA*

CLASSIFICATION

Anatomic or radiologic distribution

- Lobar - known as focal or nonsegmental pneumonia
- Multifocal / lobular (bronchopneumonia)
- Interstitial (focal diffuse)
# Most common etiologies of community-acquired pneumonia

<table>
<thead>
<tr>
<th>Patient type</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outpatient</td>
<td>Streptococcus pneumoniae</td>
</tr>
<tr>
<td></td>
<td>Mycoplasma pneumoniae</td>
</tr>
<tr>
<td></td>
<td>Haemophilus influenza</td>
</tr>
<tr>
<td></td>
<td>Chlamydophila pneumoniae</td>
</tr>
<tr>
<td></td>
<td>Respiratory viruses</td>
</tr>
<tr>
<td>Inpatient (non-ICU)</td>
<td>S. pneumoniae</td>
</tr>
<tr>
<td></td>
<td>M. pneumoniae</td>
</tr>
<tr>
<td></td>
<td>C. pneumoniae</td>
</tr>
<tr>
<td></td>
<td>H. influenza</td>
</tr>
<tr>
<td></td>
<td>Legionella species</td>
</tr>
<tr>
<td></td>
<td>Aspiration</td>
</tr>
<tr>
<td></td>
<td>Respiratory viruses</td>
</tr>
<tr>
<td>Inpatient (ICU)</td>
<td>S. pneumoniae</td>
</tr>
<tr>
<td></td>
<td>Staphylococcus aureus</td>
</tr>
<tr>
<td></td>
<td>Legionella species</td>
</tr>
<tr>
<td></td>
<td>Gram-negative bacilli</td>
</tr>
<tr>
<td></td>
<td>H. influenza</td>
</tr>
</tbody>
</table>
### Identified Pathogens in Community-Acquired Pneumonia

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>20-60</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>3-10</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>3-5</td>
</tr>
<tr>
<td>Gram-negative bacilli</td>
<td>3-10</td>
</tr>
<tr>
<td><em>Legionella species</em></td>
<td>2-8</td>
</tr>
<tr>
<td><em>Mycoplasma pneumoniae</em></td>
<td>1-6</td>
</tr>
<tr>
<td><em>Chlamydia pneumoniae</em></td>
<td>4-6</td>
</tr>
<tr>
<td>Viruses</td>
<td>2-15</td>
</tr>
<tr>
<td>Aspiration</td>
<td>6-10</td>
</tr>
<tr>
<td>Others</td>
<td>3-5</td>
</tr>
</tbody>
</table>


*Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis* (exacerbation of chronic bronchitis)

These 3 pathogens account for approximately **85%** of CAP cases.

Atypical CAP pathogens

Zoonotic atypical CAP pathogens

*Chlamydia psittaci* (psittacosis),

*Francisella tularensis* (tularemia),

*Coxiella burnetii* (Q fever).

Nonzoonotic atypical CAP pathogens

*Legionella* species,

*M pneumoniae,

*Chlamydia pneumoniae.*

These organisms account for approximately 15% of all CAP cases.

Etiology

**ICU (Intensive Care Unit), complex.**

Polymicrobial infection, **11%** of cases.

*S pneumoniae*, respiratory viruses, and *P aeruginosa.*

Other gram-negative pathogens

*Enterobacter species,*

*Serratia species,*

*Stenotrophomonas maltophilia,*

*Burkholderia cepacia* rarely

---

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em></td>
<td>60 (8.2)</td>
<td>613 (17.4)</td>
<td>70 (38)</td>
<td>23 (18.3)</td>
<td>114 (11.9)</td>
</tr>
<tr>
<td><em>Klebsiella pneumoniae</em></td>
<td>7 (1.0)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>60 (6.3)</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>19 (2.6)</td>
<td>70 (2.0)</td>
<td>9 (4.9)</td>
<td>0</td>
<td>59 (6.2)</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>20 (2.7)</td>
<td>50 (1.4)</td>
<td>0</td>
<td>0</td>
<td>26 (2.7)</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>37 (5.0)</td>
<td>25 (0.7)</td>
<td>4 (2.2)</td>
<td>0</td>
<td>19 (2.0)</td>
</tr>
<tr>
<td><em>Mycobacterium tuberculosis</em></td>
<td>0</td>
<td>0</td>
<td>2 (1.1)</td>
<td>0</td>
<td>13 (1.4)</td>
</tr>
<tr>
<td><em>Moraxella catarrhalis</em></td>
<td>0</td>
<td>5 (0.1)</td>
<td>7 (3.8)</td>
<td>0</td>
<td>12 (1.3)</td>
</tr>
<tr>
<td><em>Mycoplasma pneumoniae</em></td>
<td>◆</td>
<td>65 (1.8)Δ</td>
<td>15 (8.2)Δ</td>
<td>23 (18.3)Δ</td>
<td>61/556 (11.0)Δ</td>
</tr>
<tr>
<td><em>Chlamydophila pneumoniae</em></td>
<td>◆</td>
<td>50 (1.4)Δ</td>
<td>0Δ</td>
<td>26 (20.6)Δ</td>
<td>55/411 (13.4)Δ</td>
</tr>
<tr>
<td><em>Legionella pneumophila</em></td>
<td>0</td>
<td>118 (3.3)Δ</td>
<td>3 (1.6)</td>
<td>9 (7.1)</td>
<td>7/648 (1.1)</td>
</tr>
<tr>
<td><em>Coxiella burnetii</em></td>
<td>30 (0.8)Δ</td>
<td>0</td>
<td>8 (6.3)Δ</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gram-negative enteric bacilli</td>
<td>12 (1.6)</td>
<td>27 (0.8)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Polymicrobial (&gt;1 pathogen identified)</td>
<td>13 (1.8)</td>
<td>208 (5.9)Δ</td>
<td>46 (25.0)Δ</td>
<td>43 (34.1)Δ</td>
<td>60 (6.3)Δ</td>
</tr>
</tbody>
</table>
## Pathogenetic Mechanisms in Pneumonia

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation of infectious particles</td>
<td>Common</td>
</tr>
<tr>
<td>Aspiration of oropharyngeal or gastric contents</td>
<td>Common</td>
</tr>
<tr>
<td>Hematogenous deposition</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Invasion from infection in contiguous structures</td>
<td>Rare</td>
</tr>
<tr>
<td>Direct inoculation</td>
<td>Less common</td>
</tr>
<tr>
<td>Reactivation</td>
<td>More common in immunocompromised hosts</td>
</tr>
<tr>
<td>History</td>
<td>Associated Organisms</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Alcoholism</td>
<td><em>Streptococcus pneumoniae</em>, oral anaerobes, <em>Mycobacterium tuberculosis</em></td>
</tr>
<tr>
<td>Exposure to bat or bird droppings, construction sites, caves</td>
<td><em>Histoplasma capsulatum</em></td>
</tr>
<tr>
<td>Exposure to birds</td>
<td><em>Chlamydia psittaci</em></td>
</tr>
<tr>
<td>Exposure to rabbits</td>
<td><em>Francisella tularensis</em></td>
</tr>
<tr>
<td>Travel to desert, southwest United States</td>
<td><em>Coccidioides</em> spp., Hantavirus (Sin Nombre virus)</td>
</tr>
<tr>
<td>Farm exposure</td>
<td><em>Coxiella burnetii</em> (animals), <em>Aspergillus</em> spp. (barns, hay)</td>
</tr>
<tr>
<td>Postinfluenza</td>
<td><em>S. pneumoniae</em>, <em>S. aureus</em>, <em>Streptococcus pyogenes</em>, <em>H. influenzae</em></td>
</tr>
<tr>
<td>Aspiration</td>
<td>Mixed aerobic, anaerobic</td>
</tr>
<tr>
<td>Marijuana smoking</td>
<td><em>Aspergillus</em> spp.</td>
</tr>
<tr>
<td>Anatomic abnormality of lung parenchyma, e.g., bronchiectasis, cystic fibrosis</td>
<td><em>Pseudomonas aeruginosa</em>, <em>Burkholderia cepacia</em>, <em>S. aureus</em></td>
</tr>
<tr>
<td>Injection drug use</td>
<td><em>S. aureus</em>, anaerobes, <em>M. tuberculosis</em>, and <em>S. pneumoniae</em></td>
</tr>
<tr>
<td>Obstruction of large airway</td>
<td>Anaerobes, <em>S. pneumoniae</em>, <em>H. influenzae</em>, <em>S. aureus</em></td>
</tr>
<tr>
<td>Incarceration</td>
<td><em>M. tuberculosis</em></td>
</tr>
<tr>
<td>Neutropenia</td>
<td><em>Aspergillus</em> spp., <em>Zygomycetes</em></td>
</tr>
<tr>
<td>Asplenia</td>
<td><em>S. pneumoniae</em>, <em>H. influenzae</em></td>
</tr>
<tr>
<td>Chest Radiographic Pattern</td>
<td>Pathogen</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Focal; large pleural effusion</td>
<td>Usually bacteria</td>
</tr>
<tr>
<td>Cavitary</td>
<td>Bacterial abscess, fungi, acid-fast bacilli, Nocardia</td>
</tr>
<tr>
<td>Miliary</td>
<td>Acid-fast bacilli, fungi</td>
</tr>
<tr>
<td>Rapid progression/multifocal</td>
<td>Legionella spp., Pneumococcus, Staphylococcus</td>
</tr>
<tr>
<td>Interstitial</td>
<td>Viruses, Pneumocystis jiroveci, Mycoplasma, Chlamydia psittaci</td>
</tr>
<tr>
<td>Mediastinal widening without infiltrate</td>
<td>Inhalation anthrax</td>
</tr>
</tbody>
</table>
Radiograph of pulmonary infiltrates in influenza pneumonia.
The CURB-65 is a simple scoring system easily used in the outpatient office or emergency room setting, which assigns 1 point for each of 5 clinical features:

<table>
<thead>
<tr>
<th>Clinical Factor</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>C Confusion</td>
<td>1</td>
</tr>
<tr>
<td>U Blood urea nitrogen &gt; or = 20 mg/dL</td>
<td>1</td>
</tr>
<tr>
<td>R Respiratory rate &gt; or = 30 breaths/min</td>
<td>1</td>
</tr>
<tr>
<td>B Systolic BP &lt; 90 mm Hg or Diastolic BP &lt; or = 60 mm Hg</td>
<td>1</td>
</tr>
<tr>
<td>65 Age &gt; or = 65</td>
<td>1</td>
</tr>
<tr>
<td>Total Score</td>
<td>Mortality %</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>0</td>
<td>0.6%</td>
</tr>
<tr>
<td>1</td>
<td>2.7%</td>
</tr>
<tr>
<td>2</td>
<td>6.8%</td>
</tr>
<tr>
<td>3</td>
<td>14.0%</td>
</tr>
<tr>
<td>4 or 5</td>
<td>27.8%</td>
</tr>
</tbody>
</table>
Pneumonia Severity Index (PSI)

- Risk stratification
- Identifying CAP patients (outpatient antibiotics).
- A variety of clinical and laboratory parameters.
- The PSI involves calculating a score, one of 5 risk classes.

Risk classes IV and V: high risk for death, hospitalized
<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Point Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>Age (in yr)</td>
</tr>
<tr>
<td>Women</td>
<td>Age (in yr) - 10</td>
</tr>
<tr>
<td>Nursing home resident</td>
<td>+10</td>
</tr>
<tr>
<td><strong>Comorbid Illnesses</strong></td>
<td></td>
</tr>
<tr>
<td>Neoplastic disease</td>
<td>+30</td>
</tr>
<tr>
<td>Liver disease</td>
<td>+20</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>+10</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>+10</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>+10</td>
</tr>
<tr>
<td><strong>Physical Findings</strong></td>
<td></td>
</tr>
<tr>
<td>Altered mentation</td>
<td>+20</td>
</tr>
<tr>
<td>Tachypnea (&gt;30 breaths/min)</td>
<td>+20</td>
</tr>
<tr>
<td>Systolic hypotension (&lt;90 mm Hg)</td>
<td>+20</td>
</tr>
<tr>
<td>Body temperature (&lt;35° or &gt;40° C)</td>
<td>+15</td>
</tr>
<tr>
<td>Heart rate &gt;125 beats/min</td>
<td>+10</td>
</tr>
<tr>
<td><strong>Laboratory and Radiographic Findings</strong></td>
<td></td>
</tr>
<tr>
<td>Blood pH (arterial) &lt;7.35</td>
<td>+30</td>
</tr>
<tr>
<td>Hypoxemia (arterial $P_{O_2}$&lt;60 mm Hg or $O_2$ saturation &lt;90%)</td>
<td>+10</td>
</tr>
<tr>
<td>Serum urea nitrogen (BUN) &gt;30 mg/dL</td>
<td>+20</td>
</tr>
<tr>
<td>Na &lt;130 mEq/L</td>
<td>+20</td>
</tr>
<tr>
<td>Blood sugar &gt;250 mg/dL</td>
<td>+10</td>
</tr>
<tr>
<td>Anemia (hematocrit &lt;30%)</td>
<td>+10</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Class</th>
<th>Point Score</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No points assigned</td>
<td>0.1</td>
</tr>
<tr>
<td>II</td>
<td>&lt;70</td>
<td>0.6</td>
</tr>
<tr>
<td>III</td>
<td>71-90</td>
<td>2.8</td>
</tr>
<tr>
<td>IV</td>
<td>91-130</td>
<td>8.2</td>
</tr>
<tr>
<td>V</td>
<td>&gt;130</td>
<td>29.2</td>
</tr>
</tbody>
</table>

Patient with community-acquired pneumonia

Is the patient more than 50 years of age?

Yes

Does the patient have a history of any of the following coexisting conditions?
- Neoplastic disease
- Liver disease
- Congestive heart failure
- Cerebrovascular disease
- Renal disease

Yes

Does the patient have any of the following abnormalities on physical examination?
- Altered mental status
- Respiratory rate: $\geq 30$/min
- Systolic blood pressure: $< 90$ mm Hg
- Temperature: $< 35^\circ$C or $\geq 40^\circ$C
- Pulse: $\geq 125$ beats/min

No

Assign patient to risk class I

Assign patient to risk class II, III, IV, or V according to total score using the prediction rule
CRB65 severity score: 1 point for each feature present:
- Confusion
- Respiratory rate = 30/min
- Blood pressure (SBP < 90 or DBP = 60mmHg)
- Age = 65 years

Treat according to clinical judgment and CRB65 severity score

- 0 Low severity: Likely suitable for home treatment. Antibiotics as per table 5.
- 1-2 Moderate severity: Consider hospital referral.
- 3-4 High severity: Urgent hospital Admission. Empirical antibiotics if life-threatening.

Consider social circumstances and home support when deciding on whether to refer to hospital or manage in the community.
Risk Factors

Patients with co-existing illnesses like

- COPD,
- Diabetes Mellitus,
- Renal failure,
- Congestive Heart Failure,
- Coronary Artery disease,
- Malignancy,
- Chronic Neurological disease and
- Chronic liver disease

have increased incidence of CAP
Patients with CAP and certain co-morbidities have increased mortality. These risk factors include:

- Diabetes mellitus,
- Coronary artery disease,
- CHF,
- Immunosuppression,
- Neurologic disease,
- Active malignancies,
- Alcohol consumption,
- Increasing age,
- Bacteremia,
- Leukopenia,
- Hypotension,
- Altered mental status,
- Tachypnea,
- Hypoxemia,
- Aspiration pneumonia,
- Gram-negative infections
Clinical presentation

Temperature greater than 38°C (100.4°F)
Cough with or without sputum,
Hemoptysis
Pleuritic chest pain
Myalgia
Gastrointestinal symptoms
Dyspnea
Malaise, fatigue
Rales, rhonchi, wheezing
Egophony, bronchial breath sounds
Dullness to percussion
Atypical symptoms in older patients
<table>
<thead>
<tr>
<th>Common Signs and Symptoms of CAP (%) frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever (80%)</td>
</tr>
<tr>
<td>Cough (90%)</td>
</tr>
<tr>
<td>Dyspnea (66%)</td>
</tr>
<tr>
<td>Tachypnea (70%)</td>
</tr>
<tr>
<td>Sputum Production (66%)</td>
</tr>
<tr>
<td>Pleuritic Chest Pain (50%)</td>
</tr>
</tbody>
</table>

*Signs and symptoms may present differently among the elderly.
Source: References 12-15.*
Patient History

Typical bacterial CAP: pulmonary symptoms,
fever,
productive cough
pleuritic chest pain.

Atypical CAP: a variety of pulmonary and extrapulmonary findings
(eg, CAP plus diarrhea), often subacute.

*Legionella pneumonia*: productive or nonproductive cough, pleuritic chest pain

*M pneumoniae* or *Chlamydophila pneumoniae* usually nonproductive cough.
Diagnostic Testing for Community-Acquired Pneumonia

All patients with suspected pneumonia

- Chest radiography
- Complete blood count
- Complete metabolic profile
- Blood gases or pulse oximetry

Severely ill or immunocompromised patients, patients with anatomic lung disease

- Sputum Gram stain and culture
- Blood cultures: two sets before antibiotics
- *Legionella* serology, urinary antigen, direct fluorescent antibody testing
- Pneumococcal urinary antigen testing

Inpatients with appropriate history or physical findings

- HIV serology
- *Mycoplasma* serology
- *Chlamydia* serology
- Fungal serology
- SARS-associated coronavirus serology or PCR
- Stains or cultures for fungi, mycobacteria, *Pneumocystis jiroveci*
- Analysis or cultures of pleural or cerebrospinal fluid
- Nasopharyngeal swab for viral direct fluorescent antibody or other rapid technique
- Tuberculin skin testing

Deteriorating patient without definitive diagnosis of cause

- Bronchoscopy (bronchoalveolar lavage, protected catheter, transbronchial biopsy)
- Thoracoscopic or open-lung biopsy
- Radiographically guided transthoracic aspirate
- *Legionella, Chlamydia, Mycoplasma* serology
- Fungal serology
- Evaluation for congestive heart failure, pulmonary embolus, neoplasm, connective tissue disease

PCR, polymerase chain reaction; PORT, Patient Outcomes Research Team; SARS, severe acute respiratory syndrome.
© 2004 The Cleveland Clinic Foundation.
(H) the heart, (L) lungs, (v) vertebrae, and (C) collarbone can be seen.
The differentiation of viral pneumonias from nonviral pneumonias.

Viral pneumonias display few or no infiltrates,
but when infiltrates are present, they are almost always
- bilateral,
- perihilar,
- symmetric, - interstitial.
Sputum Studies and Blood Culture

**Gram stain and/or culture.**

Reliable and diagnostic if performed on a well-collected specimen without many squamous epithelial cells (saliva/contamination) and a predominant organism is present.

Keep in mind !!!

**Elderly persons**, adequate suitable sputum sample.
Studies in CAP Patients with HIV

**CD4 count** (a normal or slightly decreased)

**Chest radiographic appearance** (focal infiltrates)

Nonfocal infiltrates and hypoxemia $\rightarrow$ *Pneumocystis (carinii) jiroveci* pneumonia (PCP)?

HIV infection $\leftrightarrow$ focal infiltrates $\rightarrow$ *tuberculosis* ?

(acid-fast bacillus (AFB) smears of sputum)

HIV infection $\leftrightarrow$ *S pneumoniae* CAP? $\rightarrow$ **urinary antigen testing** may be useful.
Chest radiograph demonstrating diffuse bilateral infiltrates in a patient with Pneumocystis carinii pneumonia.
Other Laboratory Tests

Extrapulmonary findings → atypical CAP
Transaminase levels → psittacosis,
    Q fever, or
    Legionella pneumonia ??

Phosphorous levels
    hypophosphatemia or microscopic hematuria → Legionnaires disease
urinalysis,
Ferritin,
creatine phosphokinase (CPK),
C-reactive protein (CRP),
cold agglutinin titers.
FNA, TTA, and Bronchoscopy With BAL
Pneumococcal pneumonia produces consolidation in the right upper lobe with multiple air bronchograms (black branching structures) present since the spaces surrounding the air-filled bronchi normally contain air but now are filled with inflammatory exudate.
CAP-associated complications

Empyema (Str. pneumoniae, Kleb. pneumoniae, group A strept.)

Cavitation K pneumoniae infections.

Myocardial infarction, due to fever

Pneumococcal sepsis, 12-24 h, mortality
Morbidity and mortality

Highest in elderly patients and in immunocompromised hosts.

- Comorbidities,
- Increased respiratory rate,
- Hypotension,
- Fever,
- Multilobar involvement,
- Anemia,
- Hypoxia.*

Mortalité & Étken

- *P. aeruginosa* % 41
- *Klebsiella* % 32
- *E. coli* % 12-15
- *Streptococcus pneumoniae* % 12-15
- *Chlamydia pneumoniae* % 1.4

Negative prognostic factors

- preexisting lung disease,
- underlying cardiac disease,
- poor splenic function,
- advanced age,
- multilobar involvement,
- delayed initiation of appropriate antimicrobial therapy.

Pleural effusion

Usually due to *H influenzae* infection,

Pleural effusion $\leftrightarrow$ CAP $\leftrightarrow$ extrapulmonary manifestations $\rightarrow$ *Legionella* inf. ??

Pleural effusion $\leftrightarrow$ appropriate epidemiologic history findings (such as contact with a rabbit or deer), $\rightarrow$ tularemia ??

CAP $\leftrightarrow$ large pleural effusion (serosanguineous) $\rightarrow$ group A streptococci

**Empyema**

*Klebsiella*,

group A streptococci,

*S pneumoniae.*
**Differential Diagnosis**

*Acute bronchitis
*Myocardial infarction
*Congestive heart failure and pulmonary edema
*Pulmonary fibrosis
*Sarcoidosis
*SLE pneumonitis
*Pulmonary drug hypersensitivity reactions (nitrofurantoin)
*Drug-induced pulmonary disease
*Pulmonary embolus or infarction
*Bronchogenic carcinomas
*Radiation pneumonitis
*Wegener granulomatosis
*Lymphomas
*Tracheobronchitis
Hospital Care

Mild CAP may be treated in an ambulatory setting,

Moderately to severely ill patients with CAP should be hospitalized.

Severe CAP - oxygen and/or ventilatory support
- require invasive ventilation
- nonpermanent artificial airway,
- require admission to an intensive care unit (ICU).
Severe CAP underlying severe cardiopulmonary disease,

Direct medical efforts:
- supporting cardiopulmonary function
- administering antibiotics for CAP.

Severe CAP and hypotension or shock
- Pulmonary embolism ??
- Acute myocardial infarction ??
- Diminished or absent splenic function ??
# Empirical Antimicrobial Therapy for Community-Acquired Pneumonia In Immunocompetent Adults

<table>
<thead>
<tr>
<th>Patient, Setting</th>
<th>Common Pathogens</th>
<th>Empirical Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outpatients</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| <60 yr           | Streptococcus pneumoniae  
|                  | Mycoplasma pneumoniae  
|                  | Chlamydia pneumoniae  
|                  | Haemophilus influenzae  
|                  | Viruses               | Macrolide or doxycycline |
| No comorbid      | S. pneumoniae (drug-  
| disease or       | resistant)           
| antibiotic       | M. pneumoniae        
| therapy within   | C. pneumoniae        
| last 3 mo        | H. influenzae        
|                  | Viruses               | Macrolide or doxycycline fluoroquinolone†  
|                  | Gram-negative bacilli† | Beta-lactam¶ and macrolide |
|                  | S. aureus ‡         |                   |

| **Inpatients**   |                  |                   |
| Not severely ill | S. pneumoniae    | Macrolide and cefotaxime or ceftriaxone, or beta-  
|                  | H. influenzae    | lactam or beta-lactamase inhibitor¶; fluoroquinolone‡  
|                  | Polymicrobial    | alone                                                      |
|                  | Anaerobes        |                                                               |
|                  | S. aureus        |                                                               |
|                  | C. pneumoniae    |                                                               |

| Severely ill     | S. pneumoniae § 
| Legionella spp.  | Azithromycin, or fluoroquinolone‡ and cefotaxime,  
|                  | Gram-negative bacilli | ceftriaxone, or beta-lactam or beta-lactamase  
|                  | M. pneumoniae       | inhibitor¶  
|                  | Viruses             | If P. aeruginosa possible—IV macrolide or  
|                  | S. aureus           | fluoroquinolone and aminoglycoside IV, or  
|                  |                     | antipseudomonal quinolone and antipseudomonal  
|                  |                     | beta-lactam  
|                  |                     | If MRSA possible, add vancomycin or linezolid |

†In the outpatient setting, many authorities prefer to reserve fluoroquinolones (levofloxacin, gatifloxacin, moxifloxacin, gemifloxacin) for patients with comorbid diseases or risk factors.
‡In most cases, patients with pneumonias caused by these organisms should be hospitalized.
¶Levofloxacin, gatifloxacin, moxifloxacin.
§Critically ill patients in areas with significant rates of high-level pneumococcal resistance and a suggestive sputum Gram stain should receive vancomycin or newer quinolone pending microbiologic diagnosis.
<table>
<thead>
<tr>
<th>Organism</th>
<th>Primary Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Streptococcus pneumoniae</em>, penicillin-</td>
<td>Penicillin G; amoxicillin</td>
</tr>
<tr>
<td>susceptible</td>
<td></td>
</tr>
<tr>
<td><em>S. pneumoniae</em>, penicillin-resistant</td>
<td>Cefotaxime, ceftriaxone, fluoroquinolone, vancomycin, others, based on</td>
</tr>
<tr>
<td></td>
<td>susceptibility studies</td>
</tr>
<tr>
<td><em>Haemophilus influenzae</em></td>
<td>Second- or third-generation cephalosporin, doxycycline, beta-lactam or</td>
</tr>
<tr>
<td></td>
<td>beta-lactamase inhibitor, azithromycin, TMP-SMX</td>
</tr>
<tr>
<td><em>Moraxella catarrhalis</em></td>
<td>Second- or third-generation cephalosporin, TMP-SMX macrolide, beta-</td>
</tr>
<tr>
<td></td>
<td>lactam or beta-lactamase inhibitor</td>
</tr>
<tr>
<td><em>Legionella spp.</em></td>
<td>Macrolide, tetracycline, fluoroquinolone alone</td>
</tr>
<tr>
<td><em>Mycoplasma pneumoniae</em></td>
<td>Doxycycline, macrolide</td>
</tr>
<tr>
<td><em>Chlamydia pneumoniae</em></td>
<td>Doxycycline, macrolide</td>
</tr>
<tr>
<td>Anaerobes</td>
<td>Beta-lactam or beta-lactamase inhibitor, clindamycin</td>
</tr>
<tr>
<td><em>Enteric gram-negative bacilli</em></td>
<td>Third-generation cephalosporin ± aminoglycoside; carbapenem</td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>Aminoglycoside + ticarcillin, piperacillin, mezlocillin, ceftazidime,</td>
</tr>
<tr>
<td></td>
<td>cefepime, aztreonam, or carbapenem</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em>, methicillin-</td>
<td>Nafcillin or oxacillin</td>
</tr>
<tr>
<td>susceptible</td>
<td></td>
</tr>
<tr>
<td><em>S. aureus</em>, methicillin-resistant</td>
<td>Vancomycin or linezolid</td>
</tr>
<tr>
<td><em>Bacillus anthracis</em></td>
<td>Ciprofloxacin or doxycycline + two of the following: rifampin, vancomycin,</td>
</tr>
<tr>
<td></td>
<td>penicillin, ampicillin, chloramphenicol, imipenem, clindamycin, clarithromycin</td>
</tr>
<tr>
<td>Influenza A, within 48 hr of symptom onset</td>
<td>Amantadine, rimantadine, oseltamivir, zanamivir</td>
</tr>
<tr>
<td>or immunocompromised host</td>
<td></td>
</tr>
<tr>
<td>Influenza B, within 48 hr of symptom onset</td>
<td>Oseltamivir, zanamivir</td>
</tr>
<tr>
<td>or immunocompromised host</td>
<td></td>
</tr>
</tbody>
</table>

*For community-acquired methicillin-resistant *S. aureus*, some clinicians add agents that inhibit toxin production, such as clindamycin, when susceptibility patterns allow.


© 2003 The Cleveland Clinic Foundation.
Duration of Therapy

10 to 14 days

Longer courses

tissue necrosis

- Legionella spp.,
- S. aureus,
- Pseudomonas aeruginosa

live intracellularly

- C. pneumoniae

Comorbidities

local (COPD) or systemic
(hematologic malignancy) immunity.
Failure to Respond to Initial Therapy

- cancers,
- pulmonary edema,
- pulmonary embolus,
- pulmonary hemorrhage,
- connective tissue diseases,
- drug toxicity
- fungi, mycobacterial, P. Jiroveci, Pseudomonas aeruginosa
- a secondary infection, such as postinfluenza staph. pneumonia,
- poor adherence, poor drug absorption, or drug interaction.
- immunodeficiency (HIV, hematologic malignancy)
- anatomic derangement (COPD, bronchiectasis, neoplasm)
Discharge Criteria

Candidates for discharge should have no more than one of the following poor prognostic indicators:

- temperature higher than 37.8° C,
- pulse higher than 100 beats/min,
- respiratory rate higher than 24/min,
- systolic blood pressure lower than 90 mm Hg,
- oxygen saturation lower than 90%, and
- inability to maintain oral intake.
Vaccination

Pneumococcal vaccines prevent pneumococcal bacteremia but not necessarily pneumococcal pneumonia.

Two pneumococcal vaccines are approved in the USA.

Prevnar 13, a pneumococcal 13-valent conjugate vaccine is approved for children aged 6 weeks to 5 years and adults aged 50 years or older.

The 23-valent vaccine (Pneumovax 23) is approved for adults aged 50 years or older and persons aged 2 years or older who are at increased risk for pneumococcal disease.
On October 12, 2012, the Advisory Committee on Immunization Practices (ACIP) published updated recommendations for pneumococcal vaccination of high-risk adults.

The committee now recommends routine use of Prevnar 13 in addition to the previously recommended Pneumovax 23 for

- adults aged 19 years and older with immunocompromising conditions (eg, HIV, cancer, renal disease),

- functional or anatomic asplenia,

- cerebrospinal fluid leaks,

- cochlear implants.
Algorithm for the management of CAP

**CAP diagnosis**

- Comorbidities present
  - Yes
    - Assign a risk class (see Table 3)
      - Moderate risk class IV and high-risk class V
        - Treat as inpatient
          - Preferred antibiotics
            - Intravenous beta-lactam (cefotaxime [Claforan] or ceftriaxone [Rocephin]) plus a macrolide (level A) or a fluoroquinolone alone (level A)
  - No
    - Low risk class II and III
      - Preferred antibiotics
        - Macrolides (level A)
        - Fluoroquinolones (level A)
        - Doxycycline (Vibramycin)
    - Preferred antibiotics
      - Amoxicillin/clavulanate (Augmentin) (level A)
      - Beta-lactam (cefpodoxime [Vantin], cefprozil [Cefzil], cefuroxime [Ceftin]) (level A)

**Preferred antibiotics**
- Macrolides (level A)
- Fluoroquinolones (level A)
- Doxycycline (Vibramycin)

**Alternative antibiotics**
- Amoxicillin/clavulanate (Augmentin) (level A)
- Beta-lactam (cefpodoxime [Vantin], cefprozil [Cefzil], cefuroxime [Ceftin]) (level A)
Summary

* Antibiotic therapy for CAP should always be selected with patient characteristics, place of acquisition, severity of disease, and local resistance patterns in mind.

* Antimicrobial therapy should be narrowed whenever a pathogen is identified.

* Most pneumonias, with some exceptions, can be cured with 10 to 14 days of antibiotic therapy.

* Failure to respond to initial therapy should raise questions of diagnosis, treatment adherence, and antimicrobial resistance.
THANK YOU!