

Approach to Internal Medicine

A Resource Book for Clinical
Practice

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Fifth Edition



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Pneumonia

Metlay et al. *AJRCCM* 2019;200(7)

TYPES OF PNEUMONIA

COMMUNITY-ACQUIRED PNEUMONIA

- **BACTERIAL**—*Streptococcus pneumoniae*, *Staphylococcus aureus*, *Haemophilus*, *Moraxella*
- **ATYPICAL**—*Mycoplasma*, *Chlamydia*, *Legionella*, TB, community-acquired MRSA
- **VIRAL**—influenza, parainfluenza, metapneumovirus, RSV, adenovirus, SARS-CoV-2
- **FUNGAL**—blastomycosis, cryptococcus, histoplasmosis

ASPIRATION PNEUMONIA

- **POLYBACTERIAL INCLUDING ANAEROBES**—*Bacteroides*, *Peptostreptococcus*, *Fusobacterium* species and other Gram-positive bacilli
- **CHEMICAL PNEUMONITIS**

PNEUMONIA IN THE IMMUNOCOMPROMISED (see p. 277)

NOSOCOMIAL PNEUMONIA—begins in non-intubated patient within 48 hours of admission

- **POLYBACTERIAL**—*S. aureus*, MRSA, *Pseudomonas aeruginosa*, Enterobacteriaceae (*Klebsiella*, *Escherichia coli*, *Serratia*), *Haemophilus*, *Acinetobacter*
- **VIRAL**—influenza

VENTILATOR-ASSOCIATED PNEUMONIA—begins >48 hours after the patient is intubated (see p. 107)

HEALTHCARE ASSOCIATED PNEUMONIA—pneumonia that (A) occurs within 90 days of hospitalization of 2 days or more, a stay at nursing home, or a visit to an oral puncture care facility, hospital-based clinic or hemodialysis facility; or (B) occurs within 3 days of receiving antibiotics, chemotherapy, or any type of wound care

PATHOPHYSIOLOGY

COMPLICATIONS OF PNEUMONIA

- **PULMONARY**—ARDS, lung abscess ± cavitory formation, parapneumonic effusion/empyema, pleuritis ± hemorrhage
- **EXTRAPULMONARY**—purulent pericarditis, hyponatremia (from SIADH), sepsis

CLINICAL FEATURES

RATIONAL CLINICAL EXAMINATION SERIES: DOES THIS PATIENT HAVE COMMUNITY-ACQUIRED PNEUMONIA?

	LR+	LR−
History		
Cough	1.8	0.31
Sputum	1.3	0.55
Dyspnea	1.4	0.67
Fever	1.7–2.1	0.59–0.71
Asthma	0.1	3.8
Dementia	3.4	0.94
Immunosuppression	2.2	0.85
Physical		
RR >25	1.5–3.4	0.78–0.82
Dullness to percussion	2.2–4.3	0.79–0.93
Decreased breath sounds	2.3–2.5	0.64–0.78
Crackles	1.6–2.7	0.62–0.87
Bronchial breath sounds	3.5	0.9
Egophony	2.0–8.6	0.76–0.96

CLINICAL FEATURES (CONT'D)

PREDICTION RULE—Diehr model (rhinorrhea = -2 points, sore throat = -1 point, night sweats = +1 point, myalgias = +1 point, sputum all day = +1 point, RR >25 = +2 points, temp $\geq 37.8^{\circ}\text{C}$ [$\geq 100^{\circ}\text{F}$] = +2 points. If score ≥ 3 , LR+ 14; if ≥ 1 , LR+ 5.0; if < -1 LR+ 0.22)

APPROACH—individual or combinations of symptoms and signs have inadequate test characteristics to rule in or rule out the diagnosis of pneumonia. "Decision rules that use the presence or absence of several symptoms and signs to modify the probability of pneumonia are available, the simplest of which requires the absence of any vital sign abnormalities to exclude the diagnosis." If diagnostic certainty is required in the management of a patient with suspected pneumonia, then chest radiography (gold standard) should be performed

Metlay et al. JAMA 1997;278(17)

Simel et al. The Rational Clinical Examination. McGraw-Hill, 2009

SURFACE LUNG MARKINGS

- **INFERIOR MARGIN OF THE LUNGS**—level of 6th rib at the mid-clavicular line, level of 8th rib at the mid-axillary line, and level of 10th rib at the mid-scapular line
- **OBLIQUE (MAJOR) FISSURES**—draw a line diagonally from T3 vertebral body posteriorly to the 6th rib anteriorly
- **HORIZONTAL (MINOR) FISSURE**—draw a horizontal line at the level of right anterior 4th rib

Related Topics

Hypoxemia (p. 110)

Parapneumonic Effusion and Empyema (p. 14)

Ventilator-Associated Pneumonia (p. 107)

INVESTIGATIONS**BASIC**

- **LABS**—CBC, lytes, urea, Cr, troponin/CK, C-reactive protein, AST, ALT, ALP, bilirubin, urinalysis
- **MICROBIOLOGY**—blood C&S, sputum Gram stain/AFB/C&S/fungal, urine C&S
- **IMAGING**—CXR \pm CT chest
- **ABG**—if respiratory distress, and for PSI if deciding on possible hospitalization

SPECIAL

- **BRONCHOSCOPY**
- **NASOPHARYNGEAL SWAB**—if suspect viral infection, check for influenza A/B, parainfluenza, SARS-CoV-2, human metapneumovirus, RSV, adenovirus

INVESTIGATIONS (CONT'D)

enza, SARS-CoV-2, human metapneumovirus, RSV, adenovirus

- **MYCOPLASMA IgM**
- **URINE FOR LEGIONELLA ANTIGEN**

DIAGNOSTIC AND PROGNOSTIC ISSUES**PNEUMONIA SEVERITY OF ILLNESS (PSI) SCORE**

- **SCORING**—age, female (-10), nursing home (+10), cancer (+30), liver disease (+20), heart failure (+10), CVA (+10), renal failure (+10), altered mental status (+20), RR >30 (+20), SBP <90 mmHg (+20), temp $>40^{\circ}\text{C}$ [$>104^{\circ}\text{F}$] (+15), HR >125 (+10), pH <7.35 (+30), BUN >10.7 mmol/L [>30 mg/dL] (+20), Na <130 mmol/L (+20), glucose >13.9 mmol/L [>250 mg/dL] (+10), hematocrit <30% (+10), P_aO_2 <60 mmHg or O_2 saturation <90% on room air (+10), pleural effusion (+10)
- **UTILITY**—originally developed as a prognostic tool. Consider admission if PSI score >90. Clinical judgment more important than PSI in determining admission

INFECTIOUS DISEASES SOCIETY OF AMERICA (IDSA)/AMERICAN THORACIC SOCIETY (ATS) SEVERITY CRITERIA FOR ICU ADMISSION

- **MAJOR CRITERIA**—septic shock requiring vasopressor support, respiratory failure requiring mechanical ventilation
- **MINOR CRITERIA**—altered mental status, hypotension requiring aggressive fluid resuscitation, temperature $<36^{\circ}\text{C}$, respiratory rate ≥ 30 , $\text{PaO}_2/\text{FiO}_2 \leq 250$, blood urea ≥ 7 mmol/L [20 mg/dL], leukocyte count ≤ 4000 cells/ μL , platelets $<100,000/\mu\text{L}$, multilobar infiltrates
- **UTILITY**—severe community-acquired pneumonia is defined as meeting 1 major criteria or ≥ 3 minor criteria

MANAGEMENT

ACUTE—ABC, O_2 , IV, consider **salbutamol** 100 μg MDI 2 puffs q6h + q1h PRN

ANTIBIOTICS

- **COMMUNITY-ACQUIRED PNEUMONIA**—see treatment issues for an approach to selecting the appropriate regimen (remember to adjust for renal function)
 - **TETRACYCLINE**—doxycycline 100 mg PO BID \times 5 days
 - **MACROLIDES**—azithromycin 500 mg PO \times 3 days; clarithromycin 500 mg PO BID \times 5 days

MANAGEMENT (CONT'D)

- **FLUOROQUINOLONES**—levofloxacin 750 mg PO daily \times 5 days, moxifloxacin 400 mg PO daily \times 5 days; avoid if exposed to fluoroquinolone within last 3–6 months
- **β -LACTAMS**—amoxicillin 1 g PO TID, amoxicillin-clavulanate 2 g PO BID, cefuroxime 750 mg IV q8h or 500 mg PO BID, cefotaxime 1 g IV q8h, ceftriaxone 1–2 g IV q24h, usually \times 5 days
- **ANAEROBIC COVERAGE**—if suspect aspiration, add clindamycin 150–450 mg PO q6h or 600–900 mg IV q8h or metronidazole 500 mg PO/IV BID–TID
- **NOSOCOMIAL PNEUMONIA**—see treatment issues for an approach to selecting the appropriate regimen
 - **ANTI-PSEUDOMONAL**—ceftazidime, cefepime, meropenem, ciprofloxacin, aminoglycosides, piperacillin-tazobactam (do not use same class of agent when double covering for *Pseudomonas*)
 - **FURTHER GRAM-NEGATIVE COVERAGE**—ciprofloxacin 500 mg PO BID, gentamicin 6 mg/kg IV q24h, tobramycin 6 mg/kg IV q24h (follow levels to adjust dosing)
 - **ANAEROBIC COVERAGE**—if suspect aspiration, replace gentamicin with clindamycin 150–450 mg PO q6h or 600–900 mg IV q8h or add metronidazole 500 mg PO BID
 - **ANTIBIOTIC COURSE**—7–8 days for most, 14–21 days for *Pseudomonas*, *S. aureus*, *Stenotrophomonas*, *Acinetobacter*
- **ASPIRATION PNEUMONIA**—clindamycin 600 mg IV BID, switch to 300 mg PO QID when stable. May add cefotaxime or ceftriaxone for Gram-positive and Gram-negative coverage
- **TUBERCULOSIS PNEUMONIA**—see p. 267
- **PNEUMOCYSTIS JIROVECI PNEUMONIA**—see p. 278

NON-PHARMACOLOGIC TREATMENTS

- **VACCINATIONS**—influenza vaccine annually and pneumococcal vaccine booster every 5 years
- **CHEST PHYSIOTHERAPY**

TREATMENT ISSUES

IMPORTANT NOTE—avoid using the same antibiotic class if given within 3 months. Consider vancomycin or linezolid if MRSA suspected; emergence of community-acquired MRSA associated with serious necrotizing infections

OUTPATIENT ANTIBIOTICS CHOICE

- **PREVIOUSLY HEALTHY**—macrolide (azithromycin, clarithromycin, or doxycycline). Other antibiotic choices include fluoroquinolone, macrolide plus amoxicillin \pm clavulanate

TREATMENT ISSUES (CONT'D)

- **COMORBIDITIES** (COPD, diabetes, renal failure, HF, malignancy)—macrolide or fluoroquinolone
- **SUSPECTED ASPIRATION WITH INFECTION**—amoxicillin-clavulanate or clindamycin
- **INFLUENZA WITH BACTERIAL SUPERINFECTION**— β -lactam or fluoroquinolone

INPATIENT ANTIBIOTIC CHOICE—second-third-generation β -lactam plus macrolide or respiratory fluoroquinolone

ICU ANTIBIOTICS CHOICE

- **PSEUDOMONAS UNLIKELY**—macrolide plus β -lactam or fluoroquinolone plus β -lactam
- **PSEUDOMONAS UNLIKELY BUT β -LACTAM ALLERGY**—fluoroquinolone with or without clindamycin
- **PSEUDOMONAS LIKELY**—double coverage with agents that are effective against *Pseudomonas* (different classes)
- **PSEUDOMONAS LIKELY BUT β -LACTAM ALLERGY**—aztreonam plus levofloxacin or aztreonam plus moxifloxacin, with or without aminoglycoside

NURSING HOME ANTIBIOTICS CHOICE

- **TREATMENT IN NURSING HOME**—fluoroquinolone or macrolide plus amoxicillin-clavulanate

DISCHARGE DECISION—clinical stabilization usually takes 2–3 days. When symptoms have significantly improved, vital signs normalized, and patient has defervesced, patients at low risk may be safely discharged on the day of switching to oral therapy without adverse consequences. Time to radiographic resolution is variable, with up to 5 months for pneumococcal pneumonia associated with bacteremia

SPECIFIC ENTITIES

CAUSES OF NON-RESOLVING PNEUMONIA—**non-infectious** (malignancy especially bronchoalveolar carcinoma or lymphoma, cryptogenic organizing pneumonia, hemorrhage), **non-bacterial** (viral, fungal), **immunocompromised host**, **antibiotic resistance**, **pneumonia complications** (abscess, empyema, ARDS)

CAUSES OF RECURRENT PNEUMONIA

- **IMMUNOCOMPROMISED** ★ **SADDIST** ★—Suppressants (steroids, chemotherapy, transplant medications, alcohol), **AIDS**, **Diabetes**, **Decreased nutrition**, **Immunoglobulin** (hypogammaglobulinemia), **Solid organ failure** (renal, liver, splenectomy), **Tumors**
- **PULMONARY**—bronchiectasis, COPD, cystic fibrosis, abnormal anatomy
- **GI**—aspiration

SPECIFIC ENTITIES (CONT'D)

LUNG ABSCESS

- **CAUSES—anaerobes** (*Peptostreptococcus*, *Prevotella*, *Bacteroides*, *Fusobacterium*), **Gram-positive** (*Streptococcus milleri*, microaerophilic streptococcus, *S. aureus*), **Gram-negative** (*Klebsiella*, *Haemophilus*, *Legionella*). *Nocardia* and actinomycosis can rarely cause lung abscess

SPECIFIC ENTITIES (CONT'D)

- **TREATMENTS**—antibiotics with anaerobic coverage until radiographic improvement and stabilization (usually several weeks to months, can be completed with oral antibiotics once patient is stable). No need for percutaneous drainage. If complicated abscess, consider thoracic surgery consult for consideration of VATS/ lung resection