COMMUNITY ACQUIRED PNEUMONIA

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Community Acquired Pneumonia (CAP)

- One estimate – 915,900 episodes/year in adults ≥ 65 years of age
- Rates of mortality have not significantly decreased since penicillin became routinely available

CAP

- Patients usually in their mid 50's to late 60's
- Peak incidence in midwinter and early spring
- 58% - 89% have one more more chronic underlying diseases or immunosuppression related to malignancy, neutropenia, chronic use of steroids or myelosuppressive agents, or HIV

History

- Consider the diagnosis of pneumonia in a patient with symptoms of cough, sputum, fever, chills, dyspnea, or deterioration of a chronic medical illness. Ask about:
  - Cough
  - Sputum production and color
  - Pleuritic chest pain
  - Dyspnea
  - Chills
  - Fever
  - Duration of symptoms
  - Night sweats
  - Weight loss

History

- Ask about nonrespiratory symptoms in patients who are elderly or who have chronic illnesses:
  - Confusion
  - Weakness
  - Lethargy
  - Falling
  - Poor oral intake
  - Deterioration of a chronic illness, such as congestive heart failure

Collect historical information

- Focus history taking on the presence of chronic illnesses, and the following:
  - Chronic, obstructive pulmonary disease
  - Alcoholism
  - Underlying heart disease
  - Bronchiectasis
  - Aspiration due to gastrointestinal or neurologic disease
  - Poor dentition
  - Injection drug use
  - Need for antibiotic therapy in the past 3 months
  - The presence of risk factors for health care-associated pneumonia, which include:
    - Hospitalization or antibiotic therapy in the past 90 days
    - Residence in a long-term care facility
    - Chronic dialysis
    - Outpatient wound care or home infusion therapy

History

- Ask about travel history to the southwestern U.S. (endemic fungi) or Southeast Asia or China (melioidosis, SARS).
- Ask about environmental exposures to birds, bats, farm animals, and rabbits.
- Obtain epidemiologic information from the patient's residence, including whether it is influenza season, and whether the patient resides in a nursing home with a respiratory infection outbreak, including epidemic *Legionella*

Physical Examination

- Fever (68% - 78%) – less common in older patients
- Tachypnea with a respiratory rate of 24 – 30 in 45% - 69%
- Tachycardia with a pulse greater than 100 beats/minute in 45%
- Rales in 78% - more common in older adults

Physical Examination

- Examine the patient for signs of pneumonia including crackles, bronchial breath sounds, and evidence of pleural effusion.
- Elicit specific findings associated with an increased likelihood of a poor outcome:
  - Respiratory rate >30/min
  - Diastolic BP <60 mmHg
  - Systolic BP <90 mmHg
  - Heart rate >125/min
  - Temperature <35°C or >40°C

Laboratory Testing

- Limit laboratory testing in outpatients with CAP. Assess disease severity in outpatients by clinical exam.
- Confirm the presence of pneumonia with a chest x-ray
- Assess oxygenation by pulse oximetry but defer other testing if outpatient therapy is contemplated.
- Consider more diagnostic testing if an outpatient is being considered for admission

Chest X-Ray

- Obtain a chest x-ray if the diagnosis is uncertain or if complicated illness is suspected in an outpatient suspected of having CAP.
- Obtain a chest x-ray in all hospitalized patients suspected of having CAP, and follow-up with decubitus films or a CT chest scan if pleural effusion is suspected

Clinical Indications for more Extensive Diagnostic Testing.

Indication	Blood Culture	Sputum Culture	*Legionella UAT*	Pneumococcal UAT	Other
Intensive care unit admission	X	X	X	X	X
Failure of outpatient antibiotic therapy		X	X	X	
Cavitary infiltrates	X	X			X
Leukopenia	X			X	
Active alcohol abuse	X	X	X	X	
Chronic sever liver disease	X			X	
Severe obstructive/structural lung disease		X			
Aspleria (anatomic or functional)	X			X	
Recent travel (within past 2 weeks)			X		X
Positive *Legionella UAT* result		X	NA		
Positive pneumococcal UAT result	X	X		NA	
Pleural effusion	X	X	X	X	X

Testing for Hospitalized Patients

- Obtain a chest x-ray, blood cultures, and routine admission blood studies as otherwise appropriate.
- Assess oxygenation by pulse oximetry in all patients.
- Obtain an arterial blood gas in any patient suspected of retaining carbon dioxide, especially patients with COPD.
- Obtain a sputum culture in any patient at risk for infection with drug-resistant or unusual pathogens, and correlate sputum Gram stain results with sputum culture results.
- Use the results of bacteriologic cultures to simplify initial empiric antibiotic therapy.
- Defer routine serologic testing for *Mycoplasma*, *Legionella*, and viruses.
- Consider testing concentrated urine for pneumococcal antigen using the immunochromatographic membrane test marketed as the BINAX NOW test.
- Consider sampling blood for C-reactive protein in patients with symptoms that suggest pneumonia.
- Do not delay initial therapy for diagnostic testing.

Labs

- WBC 15,000 to 35,000 with increased juvenile forms on differential
- Leukopenia is a poor prognostic sign
- Gram stain of sputum has numerous neutrophils and bacteria
- A microbiologic diagnosis is made only 20% to 70% of the time

Classic Findings in 81% of patients

- Ill for a mean of 6 days
- Cough in 80% - 90%; productive in 60% - 80%
- Chest pain in 30% - 46%
- Chills in 40% - 70%
- Rigors in 15%

Most common etiologies

Outpatient

- Streptococcus Pneumoniae
- Mycoplasma pneumoniae
- Hemophilus influenzae
- Chlamydophilia pneumoniae
- Respiratory viruses (Influenza A and B, adenovirus, RSV, and parainfluenza)

Most common etiologies

In-patient (non-ICU)

- S. pneumoniae
- M. pneumoniae
- C. pneumoniae
- H. influenza
- Legionella species
- Aspiration
- Respiratory viruses

Most common etiologies

Inpatient (ICU)

- S. pneumoniae
- Staphylococcus
- Legionella species
- Gram-negative bacilli
- H. influenza

Criteria for Severe CAP

MINOR CRITERIA

- Respiratory rate 30 breaths.min
- PaO2/FiO2 ratio <250
- Multilobar infiltrates
- Confusion/disorientation
- Uremia (BUN >20 mg/dL)
- Leukopenia (WBC < 4000 cells/mm3)
- Thrombocytopenia (platelet count <100,000 cells/mm3)

Continued

- Hypothermia (core temperature <36degreesC)
- Hypotension requiring aggressive fluid resuscitation

MAJOR CRITERIA

- Invasive mechanical ventilation
- Septic shock with the need for vasopressors

Etiologies

Pneumococcus	**16% - 60%**
Hemophilus influenza	3% - 38%
Staphyloccus aureus	2% - 5%
Aerobic/Anaerobic GNR	7% - 18%
Legionella	2% - 30%
Moraxella catarrhalis	

Pneumococcus

- Leading cause of CAP
- Severe disease associated with splenectomy,abnormal immunoglobulin responses (myeloma, lymphoma, HIV)
- Functional asplenia due to SLE or marrow transplant

X-Ray of a Patient with Pneumococcal pneumonia

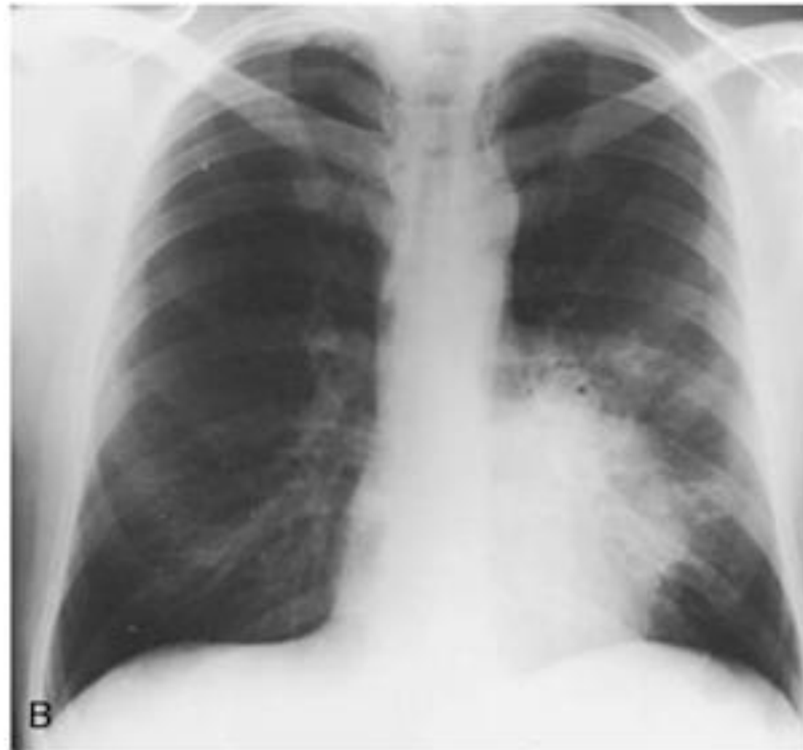

Figure 64-8B A, Normal chest radiograph. **B,** Patchy infiltrate representing bronchopneumonia in a patient with *Streptococcus pneumoniae* infection.

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Gram stain of diplococci from a patient with pneumococcal pneumonia

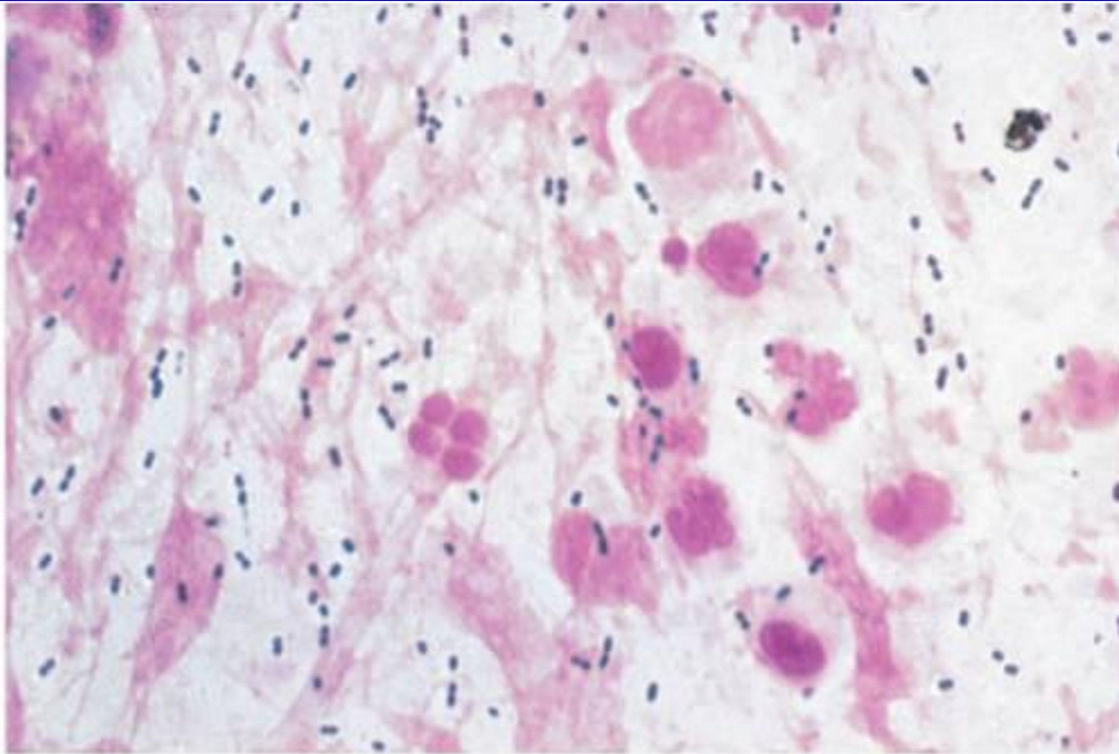

Figure 64-2 Expectorated sputum with gram-positive, lancet-shaped diplococci from a patient with pneumococcal pneumonia.

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Staphyloccus Aureus

- Increased importance in older adults and in those with influenza
- Influenza improves and then symptoms suddenly reappear with shaking chills, pleuritic chest pain, and productive cough
- CA-MRSA has mortality rates of 29% - 60% and may develop into ARDS

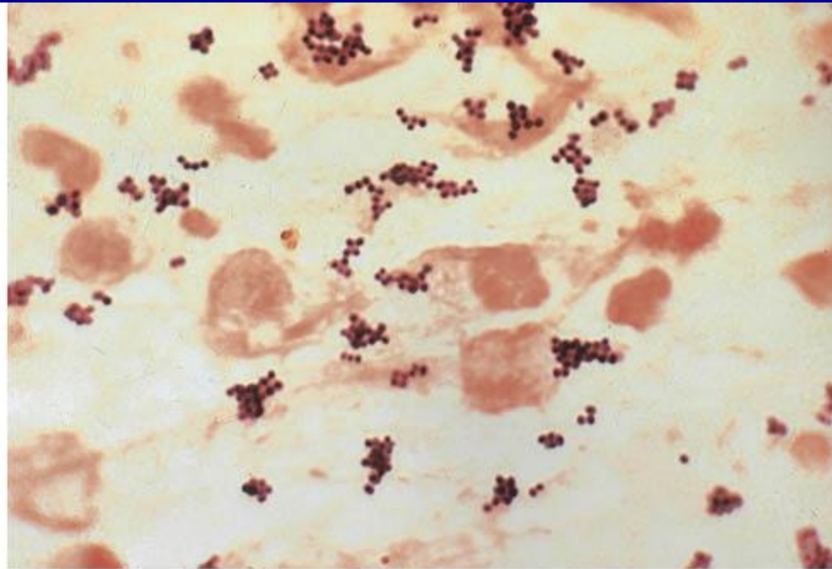

Figure 64-5 Expectorated sputum with clusters of gram-positive cocci in a patient with *Staphylococcus aureus* pneumonia.

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Gram-negative bacilli (excluding H. influenza)

- K. pneumonia, P. aeurginosa, Enterobacter
- Seen in chronic underlying disease, bedridden, and recently hospitalized adults

Current jelly sputum associated with K. pneumonia

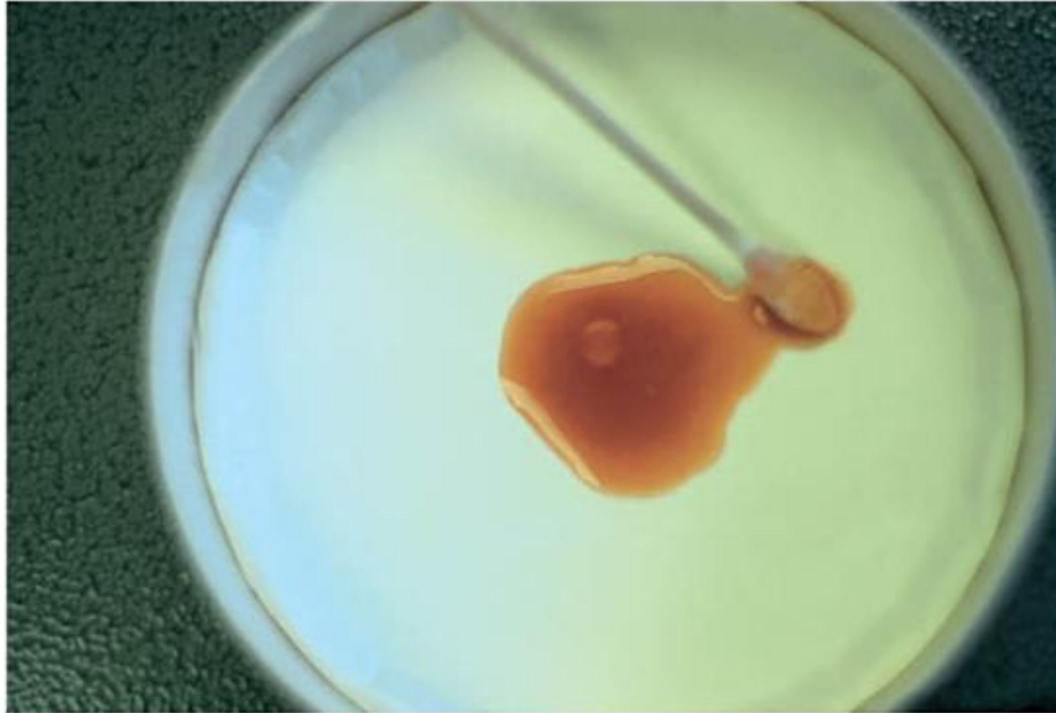

Figure 64-1 “Currant jelly” sputum associated with *Klebsiella pneumoniae* pneumonia.

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Legionella

- Water-related
- Increased incidence on the East coast
- Ages 45 – 64 at greatest risk
- Risk factors: cigarette smoking, chronic lung disease, immunosuppression

Legionella pneumophilia

- Mental status changes
- Loose stools or diarrhea
- Headache
- Bradycardia
- Elevation of hepatic enzyme levels

Legionella pneumophilia

- Hypophosphatemia
- Hyponatremia
- Elevated serum lactate dehydrogenase level
- Elevated serum creatinine level

Older Adults

- Specific etiologic diagnosis made less frequently
- Viral agents are important and may be 15% to 29% of hospitalized patients

Viruses that cause influenza in older adults

- RSV
- Human metapneumovirus
- Parainfluenza
- Enterovirus
- Coronavirus

Pneumonia in the Nursing Home

- Highest mortality of any infection
- Risk factors: Silent aspiration, poor functional status, poor oral hygiene, nasogastric feeding, swallowing difficulties, confusion, COPD, presence of a tracheostomy, advancing age

Mycoplasma pneumoniae

- 10% - 30% of CAP
- Most likely in children > 5 years, adolescents, and young adults
- 10 days of symptoms prior to presentation
- Sore throat is often the initial finding
- Fever, malaise, coryza, headache, cough are major findings
- Sputum production is variable
- Unilateral or bilateral lower lobe patchy infiltrates

Chlamydophilia pneumoniae

- 6% - 20% of CAP
- May be a co-pathogen with S. pneumoniae
- Sore throat, hoarseness herald onset
- Has been associated with exacerbation of COPD and asthma

Management

- Assessment if pneumonia is present
- Assess if hospitalization is needed
- 18% - 30% require hospitalization
- Assessment score: PORT score or Pneumonia Severity Index: uses 20 clinical parameters in categories of age, presence of co-morbidities, vital sign abnormality, laboratory abnormality, and radiologic findings

Outpatient Empiric Treatment

Outpatient

Previously Healthy

- No recent antibiotic therapy: Oral-based β-lactam, macrolide, or doxycycline
- Recent antibiotic therapy: A respiratory fluoroquinolone alone, an advanced macrolide plus high-dose amoxicillin, or an advanced macrolide plus high-dose amoxicillin-clavulanate

Empiric Outpatient Treatment

- ***Co-morbidities (COPD, Diabetes, Renal Failure or Congestive Heart Failure, or Malignancy)***
- No recent antibiotic therapy: An advanced macrolide plus β-lactam or a respiratory fluoroquinolone
- Recent antibiotic therapy: A respiratory fluoroquinolone alone or an advanced macrolide plus a β-lactam
- Suspected aspiration with infection: Amoxicillin-clavulanate or clindamycin
- Influenza with bacterial superinfection: Vancomycin, linezolid, or other coverage for MRSA or CA-MRSA

Empiric Treatment
Inpatient – Medical Ward

- No recent antibiotic therapy: A respiratory fluoroquinolone alone or an advanced macrolide plus a β-lactam
- Recent antibiotic therapy: An advanced macrolide plus a β-lactam, or a respiratory quinolone alone (regimen selected will depend on nature of recent antibiotic therapy)

Empiric Treatment
ICU

- A β-lactam (cefotaxime, ceftriaxone, or ampicillin-sulbactam) **plus** either azithromycin (level II evidence) or a respiratory fluoroquinolone (level I evidence) (strong recommendation)
- (for penicillin-allergic patients, a respiratory fluoroquinolone and aztreonam are recommended)

Special Concerns

If *Pseudomonas is a consideration*

- An antipneumococcal, antipseudomonal b-lactam (piperacillintazobactam, cefepime, imipenem, or meropenem)

plus

- either ciprofloxacin or levofloxacin (750 mg)

or

- The above β-lactam plus an aminoglycoside and azithromycin

or

- The above β-lactam plus an aminoglycoside and an antipneumococcal fluoroquinolone (for penicillin-allergic patients, substitute aztreonam for above b-lactam)
- (moderate recommendation; level III evidence)
- If CA-MRSA is a consideration, add vancomycin or linezolid
- (moderate recommendation; level III evidence)

Timing of antibiotics

- 1997 Retrospective review of over 14,000 Medicare patients hospitalized with pneumonia suggested that antibiotics given within 8 hours of presentation associated with decreased mortality
- 2004 study suggested antibiotics must be given within 4 hours to be associated with decreased mortality
- JC/CMS hold hospitals responsible for 4 hours for time to give antibiotics

Duration of antibiotics

- 3 – 7 days for mild to moderate pneumonia
- Change from IV to po antibiotics after clinical stability

Epidemiologic Conditions

- Alcoholism: *Streptococcus pneumoniae, oral anaerobes, Klebsiella pneumoniae, Acinetobacter species, Mycobacterium Tuberculosis*
- COPD and/or smoking: *Haemophilus influenzae, Pseudomonas aeruginosa, Legionella species, S. pneumoniae, Moraxella cararrhalis, Chlamydophila pneumoniae*
- Aspiration: Gram-negative enteric pathogens, oral anaerobes
- Lung abscess: CA-MRSA, oral anaerobes, endemic fungal pneumonia, *M. tuberculosis, atypical mycobacteria*
- Exposure to bat or bird droppings: *Histoplasma capsulatum*

Epidemiologic conditions (cont)

- Exposure to birds: *Chlamydophila psittaci (if poultry: avian influenza)*
- Exposure to rabbits: *Francisella tularensis*
- Exposure to farm animals or parturient cats: *Coxiella burnetti (Q fever)*
- HIV infection (early): *S. pneumoniae, H. influenzae, M. tuberculosis*
- HIV infection (late): The pathogens listed for early infection plus *Pneumocystis jirovecii, Cryptococcus, Histoplasma, Aspergillus,* atypical mycobacteria (especially *Mycobacterium kansasii), P. aeruginosa, H. influenzae*

Epidemiologic conditions (cont)

- Hotel or cruise ship stay in previous 2 weeks: *Legionella species*
- Travel to or residence in southwestern United States: *Coccidioides species, Hantavirus*
- Travel to or residence in Southeast and East Asia: *Burkholderia pseudomallei, avian influenza, SARS*
- Influenza active in community: Influenza, *S. pneumoniae, Staphylococcus aureus, H. influenzae*
- Cough 12 weeks with whoop or posttussive vomiting: *Bordetella pertussis*

Epidemiologic conditions (cont)

- Structural lung disease (e.g., bronchiectasis): p*seudomonas aeruginosa, Burkholderia cepacia, S. aureus*
- Injection drug use: *S. aureus, anaerobes, M. tuberculosis, S. pneumoniae*
- Endobronchial obstruction: Anaerobes, *S. pneumoniae, H. influenzae, S. aureus*
- In context of bioterrorism: *Bacillus anthracis (anthrax), Yersinia pestis (plague), Francisella tularensis (tularemia*

Pneumonia: Etiology Suggested by Environmental History

Infectious Agent	Environmental History
Anthrax	Exposure to cattle, swine, horses, goat hair, raw wool, animal hides Possible agent of bioterrorism
Brucellosis	Exposure to cattle, goats, pigs; ingestion of unpasteurized dairy products; employment as abattoir worker or veterinarian
Melioidosis	Travel to West Indies, Australia, Guam, Southeast Asia, South and Central America
Plague	Exposure to ground squirrels, chipmunks, rabbits, prairie dogs, rats Possible agent of bioterrorism
Tularemia	Exposure to tissue or body fluids of infected animals during trapping, hunting, or skinning (rabbits, hares, foxes, squirrels) or to bites of an infected arthropod (flies, ticks) Possible agent of bioterrorism

Infectious Agent	Environmental History
Psittacosis	Exposure to birds (parrots, budgerigars, cockatoos, pigeons, turkeys)
Leptospirosis	Exposure to wild rodents, dogs, cats, pigs, cattle, or horses, or exposure to water contaminated with animal urine
Coccidioidmycosis	Residence in or travel to San Joaquin Valley, southern California, southwestern Texas, southern Arizona, New Mexico
Histoplasmosis	Exposure to bat droppings or dust from soil enriched with bird droppings
Q Fever	Exposure to infected goats, cattle, sheep, domestic animals, and their secretions (milk, amniotic fluid, placenta, feces)
Legionnaires' disease	Exposure to contaminated aerosols (e.g., air coolers, hospital water supply)
Pasteurella Multocida	Exposure to infected dogs and cats
Hantavirus	Exposure to rodent droppings, urine, saliva
SARS	Travel to area of outbreak

Specific pathogen therapy

Organism	Preferred antimicrobial(s)	Alternative antimicrobial(s)
Streptococcus pneumoniae		
Peniciliin nonresistant; MIC <2 µg/mL	Penicillin G, amoxicillin	Macrodie, cephalosporins, (oral [cefpodoxime, cefprozil, cefuroxime, cefdinir, cefditoren] or parenteral [cefuroxime, ceftriaxone, cefotamime]) clindamycin, doxycyline, respiratory fluoroquinolone
Penicillin resistant; MIC ≥ 2 µg/mL	Agents chosen on the basis of susceptibility, including cefotaxime, ceftriaxone, fluoroquinolone	Vancomycin, linezolid, high-dose amoxicillin (3 g/day with penicillin MIC ≤ 4µg/mL)
Haemophilus influenzae		
Non-β-lactamase producing	Amoxicillin	Fluoroquinolone, doxcycline, azithromycin, clarithromycin
β-lactamase producing	Second- or third-generation cephalosporin, amoxicillin-clavulanate	Fluoroquinolone, doxcycline, azithromycin, clarithromycin

Organism	Preferred antimicrobial(s)	Alternative antimicrobial(s)
Mycoplama pneumoniae/Chamydophila pneumoniae	Macrolide, a tetracycline	Fluroquinolone
Legionella species	Fluoroquinolone, azithromycin	Doxycyline
Chlamydophila psittaci	A tetracycline	Macrolide
Coxiella burnetii	A tetracycline	Macrolide
Francisella tularensis	Doxycycline	Getamicin, streptomycin
Yersinisa pestis	Streptomycin, gentamicin	Doxycyline, fluoroquinolone
Bacillun anthracis (inhalation)	Ciprogloxacin, levvofloxacin, doxycycline, (usually with second agent)	Other fluoroquinolones; β-lactam, if susceptible; rifampin, clindamycin; chloramphenicol
Enterobacteriaceae	Third-generation cephalosporin, carbapenem (drug of choice if extended-specitrum β-lactamase producer	B-Lactam/β-lactamase inhibitor, fluoroquinolone

Organism	Preferred antimicrobial(s)	Alternative antimicrobial(s)
Pseudomonas aeruginosa	Antipseudomonal β-lactam **plus** (ciprofloxacin or levofloxacin or aminoglycoside)	Aminoglycoside **plus** (ciprofloxacin or levofloxacin)
Burkholderia pseudomallei	Carbapenem, ceftazadime	Fluoroquinolone, TMP-SMX
Acinetobacter species	Carbapenem	Cephalosporin-aminoglycoside, ampicillin-sulbactam, colistin
Staphlococcus aureus		
Methicillin susceptible	Antistaphylococcal penicillin	Cefazolin, clindamycin
Methicillin resistant	Vancomycin or linezolid	TMP-SMX
Bordetella pertussis	Macrolide	TMP-SMX
Anaerobe (aspiration)	B-Lactam/β-lactamase inhibitor, clindamycin	Carbapenem

Organism	Preferred antimicrobial(s)	Alternative antimicrobial(s)
Influenza virus	Oseltamivir or zanamivir	
Mycrobacterium tuberculosis	Isoniazid plus rifampin plus ethambutol plus pyrazinamide	Refer to [243] for specific recommendations
Coccidioides Species	For uncomplicated infection in a normal host, no therapy generally recommended; for therapy, itraconazole fluconazole	Amphotericin B
Histoplasmosis	Itraconazole	Amphotericin B
Blastomycosis	Itraconazole	Amphotericin B

Criteria for Clinical Stability

- Temperature 37.8C
- Heart rate 100 beats/min
- Respiratory rate 24 breaths/min
- Systolic blood pressure 90 mm Hg
- Arterial oxygen saturation 90% or pO2 60 mm Hg on room air
- Ability to maintain oral intake
- Normal mental status

Factors Associated with Nonresponders

Failure to improve
Early (<72 h of treatment)
Normal response
Delayed
Resistant microorganism
Uncovered pathogen
Inappropriate by sensitivity
Parapneumonic effusion/empyema
Nosocomial superinfection
Nosocomial pneumonia
Extrapulmonary
Noninfectious
Complication of pneumonia (e.g., BOOP)
Misdiagnosis: PE, CHF, vasculitis
Drug fever

Factors associated with nonresponders

Deterioration or progression
Early (<72 h of treatment)
Severity of illness at presetation
Resistant microorganism
Uncovered pathogen
Inappropriate by sensitivity
Metastatic infection
Empyema/paraneumonic
Endocarditis, meningitis, arthritis
Inaccurate diagnosis
PE, aspiration, ARDS
Vasculitis (e.g., SLE)

Factors associated with nonresponders

Delayed
Nosocomial superinfection
Nosocomial pneumonia
Extrapulmonary
Exacerbation of comorbid illness
Intercurrent noninfectious disease
PE
Myocardial infarction
Renal failure

Unusual Pathogens or complications for nonresponders within 4-72 hours

Consider unusual pathogens or complications of infection in patients who do not respond to empiric therapy within 48 to 72 hours. Collect historical data corroborating the possibility of infection with unusual bacteria, fungi, and viruses, such as:

- *Mycobacterium tuberculosis*
- *Coxiella burnetii*
- *Burkholderia pseudomallei*
- *Chlamydophilia psittaci*
- Paragonimiasis
- Endemic fungi (histoplasmosis, coccidioidomycosis, blastomycosis)
- *Pasteurella multocida*
- *Bacillus anthracis*
- *Actinomyces israeli*
- *Francisella tularensis*
- *Leptospira* spp
- *Nocardia* spp
- *Rhodococcus equi*
- *Yersinia pestis* (plague)
- Hantavirus
- MRSA

Unusual Pathogens or complications for nonresponders within 4-72 hours

- Evaluate radiographic data to exclude empyema or lung abscess.
- Evaluate laboratory data to rule out metastatic infectious complications, such as endocarditis.
- Repeat blood and sputum cultures and consider bronchoscopy if infection with an unusual pathogen is suspected

Nonresponders

- Consider inflammatory lung disease, neoplastic lung disease, and other noninfectious processes, especially if the patient has an unusual clinical presentation.
- Consider additional diagnostic testing in such cases, including:
  - CT scan of the chest
  - Serologic testing (antinuclear cytoplasmic antibody for Wegener's granulomatosis)
  - Spiral CT scan of the chest
  - Pulmonary angiography
  - Bronchoscopy with biopsy
  - Open lung biopsy

S. pneumoniae resistance to antibiotics

Antibiotic	% Resistance
Penicillin, amoxicillin-clavulanic acid	10
Cefuroxine axetil	20
Ceftriaxone	5
Trimethoprim-sulfamethoxazole	35
Azithromycin	15-25
Clarithromycin	18-25
Doxycycline	29
Imipenem	5
Meropenem	5
Respiratory tract quinolones (levofloxacin, moxifloxacin, etc.)	1-5
Quinupristin/dalfopristin	1
Linezolid	1

Recommendations for influenza vaccination

- Now recommended for all people over age 6 months unless they have a previous contraindication (allergy to the vaccine or eggs; history of Guillain-Barre syndrome)
- Live intranasal spray may be used in healthy persons 5-49 years of age, including health care workers and household contacts of high-risk persons
- Avoid live intranasal spray in high-risk persons

Specific high-risk indications for influenza vaccination

- Chronic cardiovascular or pulmonary disease (including asthma)
- Chronic metabolic disease (including DM)
- Renal dysfunction
- Hemoglobinopathies
- Immunocompromising conditions/meds
- Compromised respiratory function
- Pregnancy
- Residence in a long-term care facility
- Aspirin therapy in persons < 18 years of age

Recommendations for pneumococcal vaccination

- Recommended for all persons ≥65 years of age, high-risk persons 2-64 years of age, current smokers.

- Revaccinate after 5 years for adults ≥65 years of age, if the first dose is received before 65 years, persons with asplenia, and immunocompromised persons

High-risk indications for pneumococcal vaccination

- Chronic cardiovascular, pulmonary, renal, or liver disease
- Diabetes mellitus
- Cerebrospinal fluid leaks
- Alcoholism
- Asplenia
- Immunocompromising conditions/medications
- Long-term care facility residents

Native Americans

Alaska natives