Pharmacotherapy 2

Lower Respiratory Tract Infections

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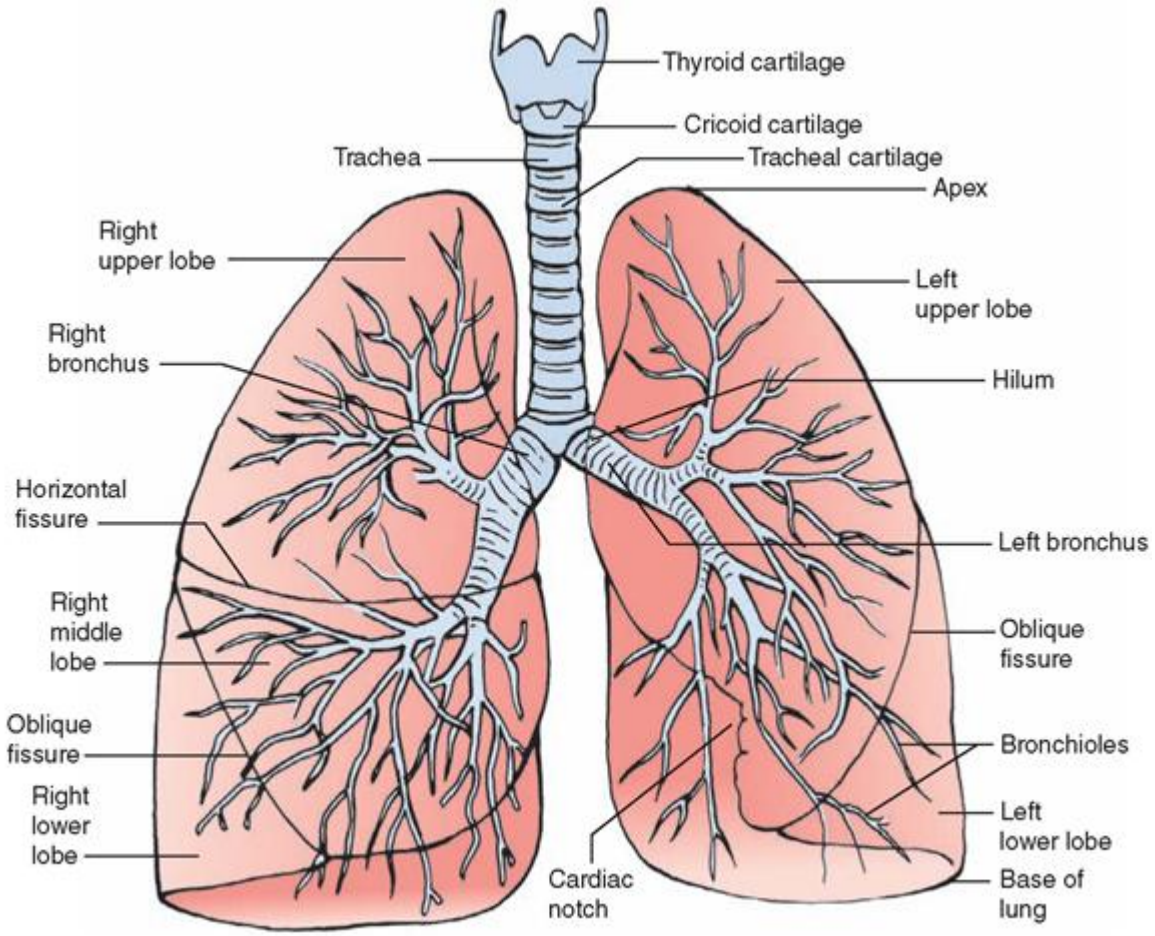
Topic Outline

- Bronchiolitis
- Community-Acquired Pneumonia (CAP)



Bronchiolitis

General principles

Bronchiolitis is an acute viral infection of the lower respiratory tract of infants that affects ~50% of children during the first year of life and 100% by 2 years.

Respiratory syncytial virus is the most common cause of bronchiolitis (up to 75% of all cases).

Diagnosis

The most common clinical signs of bronchiolitis are found in the next Table. (diagnosis based on history and clinical findings).

Clinical presentation of bronchiolitis

Signs and symptoms

- Prodrome with irritability, restlessness, and mild fever
- Cough and coryza
- Vomiting, diarrhea, noisy breathing, and increased respiratory rate as symptoms progress
- Labored breathing with retractions of the chest wall, nasal flaring, and grunting

Physical examination

- Tachycardia and respiratory rate of 40–80/min in hospitalized infants
- Wheezing and inspiratory rales
- Mild conjunctivitis in one third of patients
- Otitis media in 5%–10% of patients

Laboratory tests

- Peripheral white blood cell count normal or slightly elevated
- Abnormal arterial blood gases (hypoxemia and, rarely, hypercarbia)

Treatment

Treatment Bronchiolitis is a self-limiting illness and **usually** requires no therapy other than:

- Reassurance
- Antipyretics
- Adequate oral fluid intake and observed closely for evidence of respiratory deterioration

If the infant is hypoxic or dehydrated (severely affected children), the mainstays of therapy are oxygen therapy and IV fluids.

Because bacteria do not represent primary pathogens in the etiology of bronchiolitis, antibiotics should **not** be routinely administered. However, many clinicians frequently administer antibiotics initially while awaiting culture results because the clinical and radiographic findings in bronchiolitis are often suggestive of a possible bacterial pneumonia.

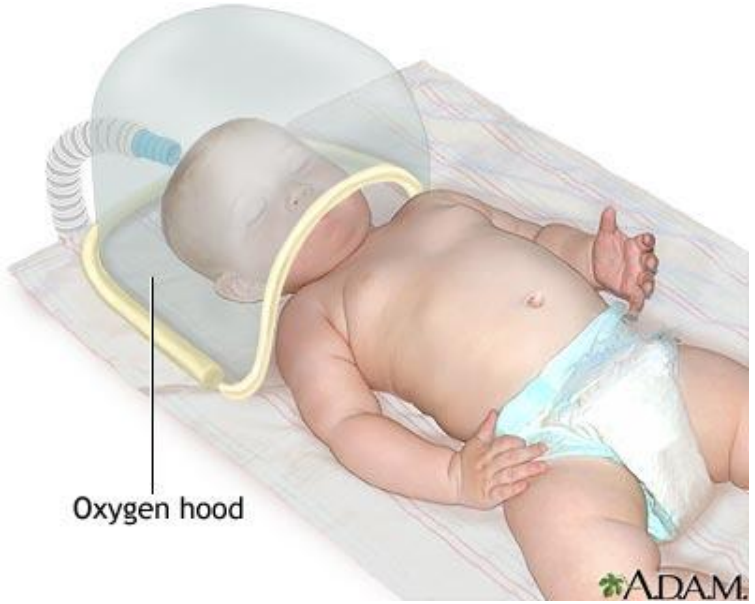
Ribavirin may be considered for bronchiolitis caused by respiratory syncytial virus in a subset of patients; severely ill patients, especially those with:

- Chronic lung disease
- Congenital heart disease
- Prematurity
- Immunodeficiency - especially severe combined immunodeficiency and human HIV infection

Use of the drug requires:

- special equipment (small-particle aerosol generator)
- specifically trained personnel for administration via oxygen hood or mist tent.

Ribavirin Croupette Setup, 5:46 min:
https://www.youtube.com/watch?v=bRMgqAuSv6w



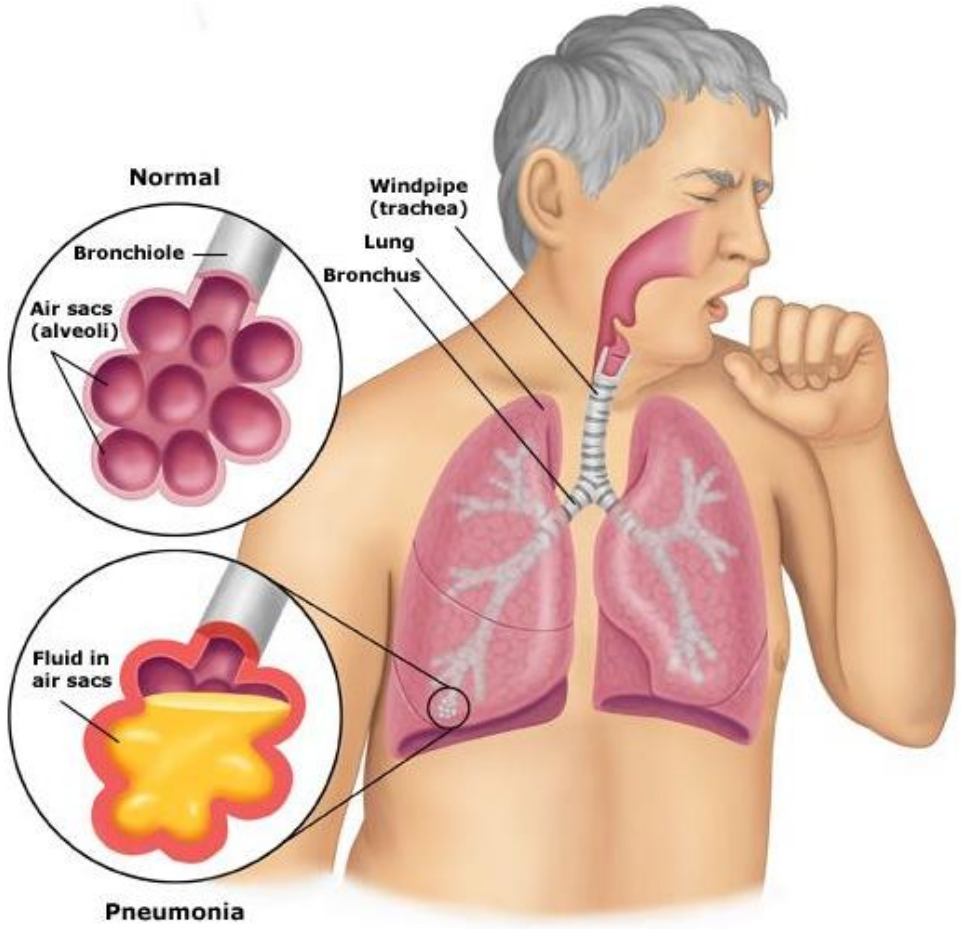
Community-Acquired Pneumonia (CAP)

General Principles

✓ Predominant organism: S. pneumoniae; other bacterial etiologies: H. influenzae & M. catarrhalis.

✓ In Jordan, S. pneumoniae and atypical microorganisms are the most common cause of CAP in previously healthy adults; while in those with associated co morbid illness, gram negative organisms are the likely cause. In children, atypical microorganisms are the most common.

Ref: Al-Ali MK, Batchoun RG, Al-Nour TM. Etiology of community-acquired pneumonia in hospitalized patients in Jordan. Saudi Med J. 2006 Jun;27(6):813-6. PMID: 16758041.



✓ According to the latest WHO data published in 2018 Influenza and Pneumonia Deaths in Jordan reached 1,253 or 3.78% of total deaths.

- ✓ Pneumonia caused by atypical agents, such as Legionella pneumophila, C. pneumoniae, or M. pneumoniae, cannot be reliably distinguished clinically.
- ✓ Community-acquired MRSA is an important cause of severe, necrotizing pneumonia.
- ✓ Patients aged 65 or older, and those with certain medical conditions, should receive the pneumococcal vaccination.
- ✓ Influenza and other respiratory viruses may also cause pneumonia in adults.

TABLE 125-5 Pneumonia Classifications and Risk Factors

Type of Pneumonia	Definition	Risk Factors
Community-acquired pneumonia (CAP)	Pneumonia developing outside the hospital or<48 hours after hospital admission	• Age >65 years • Diabetes mellitus • Asplenia • Chronic cardiovascular, pulmonary, renal, and/or liver disease • Smoking and/or alcohol abuse
Hospital-acquired pneumonia (HAP)	Pneumonia developing >48 hours after hospital admission	• Witnessed aspiration • COPD, ARDS, or coma • Administration of antacids, H_2-antagonists, or proton pump inhibitor • Supine position • Enteral nutrition, nasogastric tube • Reintubation, tracheostomy, or patient transport • Head trauma, ICP monitoring • Age >60 years • MDR risk (eg, MRSA, MDR *Pseudomonas*) if IV antibiotic use within 90 days
Ventilator-associated pneumonia (VAP)	Pneumonia developing >48 hours after endotracheal intubation	• Same as hospital acquired • MDR risk with IV antibiotics in past 90 days, septic shock, ARDS preceding VAP, acute renal replacement therapy preceding VAP, or 5 + days of hospitalization preceding VAP

ARDS, acute respiratory distress syndrome; CAP, community-acquired pneumonia; COPD, chronic obstructive pulmonary disease; HAP, hospital-acquired pneumonia; ICP, intracranial pressure; MDR, multidrug-resistant; MRSA, methicillin-resistant *S. aureus;* VAP, ventilator-associated pneumonia.

Diagnosis

✓ Clinical Presentation:

- The presentation of CAP is extremely variable.
- Fever and respiratory symptoms, including cough with sputum production, dyspnea, and pleuritic chest pain, are common in immunocompetent patients.
- Signs include tachypnea, rales, or evidence of consolidation on auscultation.
- CAP presents acutely, over a matter of hours to days.
- The clinical manifestations are most severe in the very young, the elderly & the chronically ill.

TABLE 125-7 Clinical Presentation of Pneumonia

Signs and symptoms

- Abrupt onset of fever, chills, dyspnea, and productive cough
- Rust-colored sputum or hemoptysis
- Pleuritic chest pain
- Dyspnea

Physical examination

- Tachypnea and tachycardia
- Dullness to percussion
- Increased tactile fremitus, whisper pectoriloquy, and egophony
- Chest wall retractions and grunting respirations
- Diminished breath sounds over affected area
- Inspiratory crackles during lung expansion

Chest radiograph

- Dense lobar or segmental infiltrate

Laboratory tests

- Leukocytosis with predominance of polymorphonuclear cells
- Low oxygen saturation on arterial blood gas or pulse oximetry

✓ Diagnostic Testing:

- Sputum Gram stain and culture of an adequate sputum sample and blood cultures before antibiotic therapy should be obtained in all patients who are going to be hospitalized, and, if disease is severe.
- Urinary antigen tests for S. pneumoniae and L. pneumophila
- Nasopharyngeal swab for influenza or other virus detection by PCR, and respiratory samples for atypical pathogens should be sent in selected cases.
- Chest radiography should be performed.

Treatment

- ✓ All patients should be assessed for hospitalization & evaluated for comorbid factors, oxygenation & severity of illness using validated severity scales as the Pneumonia Severity Index or CURB-65.
- ✓ For CURB-65, patients receive 1 point for each criterion present: **C**onfusion, **U**remia (BUN > 20 mg/dL [7.1 mmol/L]), **R**espiratory rate ≥ 30 breaths/min, **B**lood pressure (systolic < 90 mm Hg, diastolic ≤ 60 mm Hg), age ≥ 65 years.
- ✓ Patients with CURB-65 or CRB-65 scores < 2 are generally candidates for outpatient treatment.
- ✓ Patients with a score of 2 are typically admitted to the general ward of the hospital with ICU admission considered for patients with scores ≥ 3.
- ✓ Empiric treatment regimens target the most likely pathogens within specific risk groups.
- ✓ Antibiotics should be given as soon as CAP is diagnosed, ideally within 4 hours of arrival to the hospital, as delays lead to higher mortality.

- ✓ Antibiotic therapy should be narrowed once a specific microbiologic etiology has been identified.
- ✓ Immunocompetent outpatients with no recent antibiotic exposure and no comorbidities should receive amoxicillin, or doxycycline 100 mg every 12h for at least 5 days.
- ✓ Outpatients with recent antibiotic exposure or comorbidities should receive respiratory fluoroquinolone (e.g., moxifloxacin) monotherapy or a macrolide (azithromycin or clarithromycin) with high-dose amoxicillin 1 g PO every 8h for at least 5 days.
- ✓ Hospitalized patients should be treated with ceftriaxone 1 g IV every day or cefotaxime 1 g IV every 8h PLUS a macrolide (azithromycin or clarithromycin), OR monotherapy with a respiratory fluoroquinolone.
- ✓
- ✓ Duration of therapy should be at least 5 days for low severity pneumonia, provided that the patient has been afebrile for > 48 hours and has demonstrated clinical improvement.
- ✓ For severe pneumonia, duration of therapy is 7 days (longer courses may be indicated)

- ✓ In critically ill patients, the addition of azithromycin or a respiratory fluoroquinolone to a β-lactam (ceftriaxone, cefotaxime, ampicillin-sulbactam) is necessary to provide coverage for L. pneumophila.

- ✓ MRSA coverage with vancomycin or linezolid should also be considered.

- ✓ If P. aeruginosa is a concern, an antipseudomonal β-lactam (cefepime, piperacillin-tazobactam, meropenem, imipenem) in combination with an antipseudomonal fluoroquinolone (ciprofloxacin, levofloxacin) is recommended.

- ✓ Once Pseudomonas has been isolated and antibiotic susceptibilities are available, monotherapy is an option.

Evidence-Based Empirical Antimicrobial Therapy for Pneumonia in Adults[a]

Clinical Setting and/or Patient Characteristics	Usual Pathogens	Empirical Therapy
Outpatient/Community-Acquired		
No at-risk comorbidity (diabetes, heart/lung/liver/renal disease, alcoholism, malignancy, asplenia)	*S. pneumoniae, M. pneumoniae, H. influenzae, C. pneumoniae, M. catarrhalis*	Amoxicillin (preferred) OR Doxycycline (2nd preferred) OR Macrolide[b] (non-preferred)
At-risk comorbidity (diabetes, heart/lung/liver/renal disease, alcoholism, malignancy, asplenia) OR immunosuppressive condition/drugs	*S. pneumoniae (including drug-resistant), M. pneumoniae, H. influenzae, C. pneumoniae, M. catarrhalis*	Antipneumococcal fluoroquinolone[c] OR β-lactam[d] + EITHER macrolide[b] OR doxycycline

Inpatient/Community-Acquired		
Non-severe CAP	*S. pneumoniae*, *H. influenzae*, *M. pneumoniae*, *C. pneumoniae*, *Legionella* sp. If prior respiratory MRSA (1 year) If prior respiratory *P. aeruginosa* (1 year) If prior hospitalization AND IV antibiotic (90 days) OR locally validated risk factor	β-lactam[e] + EITHER macrolide[b] OR doxycycline OR Antipneumococcal fluoroquinolone[c] ADD vancomycin OR linezolid AND obtain cultures, de-escalate in 48 hr if MRSA negative and clinically improving ADD[f] cefepime, piperacillin-tazobactam, ceftazidime, imipenem, meropenem, OR aztreonam AND obtain cultures, de-escalate in 48 hr if *P. aeruginosa* negative and clinically improving Obtain cultures, escalate if needed based on results
Severe CAP	*S. pneumoniae*, *H. influenzae*, *M. pneumoniae*, *C. pneumoniae*, *Legionella* sp. If prior respiratory MRSA (1 year) If prior respiratory *P. aeruginosa* (1 year) If prior hospitalization AND IV antibiotic (90 days)	β-lactam[e] + EITHER macrolide[b] OR antipneumococcal fluoroquinolone[c] ADD vancomycin OR linezolid AND obtain cultures, de-escalate in 48 hr if MRSA negative and clinically improving ADD[f] cefepime, piperacillin-tazobactam, ceftazidime, imipenem, meropenem, OR aztreonam AND obtain cultures, de-escalate in 48 hr if *P. aeruginosa* negative and clinically improving ADD vancomycin OR Linezolid AND ADD[e] cefepime, ceftazidime, imipenem, meropenem, piperacillin-tazobactam, OR aztreonam AND obtain cultures, de-escalate if MRSA/*P. aeruginosa*-negative and clinically improving

a See the section Selection of Antimicrobial Agents.

b Macrolide: erythromycin, clarithromycin, and azithromycin.

c Antipneumococcal fluoroquinolone: levofloxacin and moxifloxacin.

d Infectious Diseases Society of America recommended outpatient β-lactams: High dose amoxicillin or amoxicillin/clavulanate preferred, cefpodoxime, cefuroxime, ceftriaxone (intramuscular) alternatives.

e Infectious Diseases Society of America recommended inpatient β-lactams: ceftriaxone (intravenous), cefotaxime, ampicillin, ampicillin-sulbactam, ceftaroline.

f If β-lactam-based CAP regimen selected, substitute antipseudomonal β-lactam for standard CAP β-lactam, unless ceftazidime or aztreonam chosen.

Empirical Antimicrobial Therapy for Pneumonia in Pediatric Patients (1/3)

Clinical Setting and/or Patient Characteristics	Usual Pathogen(s)	Empirical Therapy
Outpatient/Community-Acquired		
<1 month	Group B *Streptococcus*, *H. influenzae* (nontypable), *E. coli*, *S. aureus*, *Listeria* CMV, RSV, adenovirus	Ampicillin-sulbactam, cephalosporin,[b] carbapenem[c] Ribavirin for RSV[d]
1-3 months	*C. pneumoniae*, possibly *Ureaplasma*, CMV, *Pneumocystis carinii* (afebrile pneumonia syndrome) *S. pneumoniae*, *S. aureus*	Macrolide/azalide,[e] trimethoprim–sulfamethoxazole Semisynthetic penicillin[f] OR cephalosporin[g]
Preschool-aged children	Viral (rhinovirus, RSV, influenza A and B, parainfluenzae, adenovirus, human metapneumovirus, coronavirus)	Antimicrobial therapy not routinely required
Previously healthy, fully immunized infants and preschool children with suspected mild-to-moderate bacterial CAP	*S. pneumonia* *M. pneumoniae*, other atypical	Amoxicillin, cephalosporin[b,g] Macrolide/azalide or fluoroquinolone
Previously healthy, fully immunized school-aged children and adolescents with mild-to-moderate CAP	*S. pneumonia* *M. pneumoniae*, other atypical	Amoxicillin, cephalosporin,[b,g] or fluoroquinolone Macrolide/azalide, fluoroquinolone, or tetracycline

Empirical Antimicrobial Therapy for Pneumonia in Pediatric Patients (2/3)

Clinical Setting and/or Patient Characteristics	Usual Pathogen(s)	Empirical Therapy
Moderate-to-severe CAP during influenza virus outbreak	Influenza A and B, other viruses	Oseltamivir or zanamivir
Inpatient/Community-Acquired		
Fully immunized infants and school-aged children	*S. pneumonia* CA-MRSA *M. pneumoniae*, *C. pneumoniae*	Ampicillin, penicillin G, cephalosporin[b] β-Lactam + vancomycin/clindamycin β-Lactam + macrolide/fluoroquinolone/doxycycline
Not fully immunized infants and children; regions with invasive penicillin-resistant pneumococcal strains; patients with life-threatening infections	*S. pneumoniae*, PCN-resistant MRSA *M. pneumoniae*, other atypical pathogens	Cephalosporin[b] Add vancomycin/clindamycin Macrolide/azalide[e] + β-lactam/doxycycline/fluoroquinolone

Empirical Antimicrobial Therapy for Pneumonia in Pediatric Patients (3/3)

a See the section Selection of Antimicrobial Agents.

b Third-generation cephalosporin: ceftriaxone and cefotaxime. Note that cephalosporins are not active against Listeria.

c Carbapenem: imipenem–cilastatin and meropenem.

d See text for details regarding possible ribavirin treatment for RSV infection.

e Macrolide/azalide: erythromycin and clarithromycin/azithromycin.

f Semisynthetic penicillin: nafcillin and oxacillin.

g Second-generation cephalosporin: cefuroxime and cefprozil.

CAP, community-acquired pneumonia; CMV, cytomegalovirus; MRSA, methicillin resistant Staphylococcus aureus; RSV, respiratory syncytial virus.

Data from Reference 5.

TABLE 125-10 Antibiotic Doses for Treatment of Bacterial Pneumonia

Antibiotic Class	Antibiotic	Antibiotic Dose[a]	
		Pediatric	Usual Adult Dose
Penicillin	Ampicillin ± sulbactam	150–200 mg/kg/day IV	2 g IV every 4–6 h (6 h if ampicillin/sulbactam)
	Amoxicillin ± clavulanate[b]	45–100 mg/kg/day orally	875–2,000 mg orally twice daily
	Piperacillin-tazobactam	200–300 mg/kg/day IV	3.375–4.5 g IV every 6–8 h
	Penicillin	100,000–250,000 units/kg/day IV	12–24 million units/day in divided doses IV every 4–6 h
Extended-spectrum cephalosporins	Ceftriaxone	50–75 mg/kg/day IV	1–2 g IV daily
	Cefotaxime	150 mg/kg/day IV	1–2 g IV every 8 h
	Ceftazidime	90–150 mg/kg/day IV	1–2 g IV every 8 h
	Cefepime	100–150 mg/kg/day IV	1–2 g IV every 6–8 h
	Ceftolozane-tazobactam	–	3 g IV every 8 h
	Ceftazidime-avibactam	–	2.5 g IV every 8 h
Monobactam	Aztreonam	90–120 mg/kg/day IV	1–2 g IV every 8 h
Macrolide/azalide	Clarithromycin	15 orally mg/kg/day	0.5–1 g orally once or twice daily
	Erythromycin	30–50 IV or orally mg/kg/day	500 mg IV or orally every 6 to 8 h
	Azithromycin	10 mg/kg × 1 day (× 2 days if parenteral), and then 5 mg/kg days 2–5 IV or orally	500 mg × 1 day (× 2 days if parenteral), and then 250 mg days 2–5 IV or orally
Fluoroquinolones[c]	Moxifloxacin	–	400 mg IV or orally daily
	Levofloxacin	8–20 mg/kg/day IV or orally	750 mg IV or orally daily
	Ciprofloxacin	30 mg/kg/day IV or orally	400 mg IV every 8 h / 750 mg orally twice daily
Tetracycline[d]	Doxycycline	2–5 mg/kg/day IV or orally	100 mg IV or orally twice daily
	Tetracycline HCl	25–50 mg/kg/day orally	–
Aminoglycosides	Gentamicin	7.5–10 mg/kg/day IV	7.5 mg/kg IV daily
	Tobramycin	7.5–10 mg/kg/day IV	7.5 mg/kg IV daily
	Amikacin	15–20 mg/kg/day IV	15–20 mg/kg IV daily

Table 125-10 continued

Carbapenems	Imipenem	60–100 mg/kg/day IV	500–1000 mg IV every 6 to 8 h
	Meropenem	30–60 mg/kg/day IV	500–2000 mg IV every 6 to 8 h
	Meropenem-vaborbactam		2 g/2 g IV every 8 h
Polymyxins	Colistin	2.5–5 mg/kg/day IV	IV: 300 mg × 1, then 150 mg daily/ Neb: 150 mg every 8 h
	Polymyxin B	15,000–30,000 units/kg/day IV	IV: 2–2.5 mg/kg × 1, then 1.25–1.5 mg/kg every 12 h
Other	Vancomycin	45–60 mg/kg/day IV	15–20 mg/kg IV every 8–12 h
	Linezolid	20–30 mg/kg/day IV or orally	600 mg IV or orally every 12 h
	Clindamycin	30–40 mg/kg/day IV or orally	600 mg IV or orally every 8 h or 450 mg orally every 6 h

a Doses can be increased for more severe disease and may require modification for patients with organ dysfunction.
b Higher-dose amoxicillin and amoxicillin/clavulanate (eg, 90 mg/kg/day) are used for penicillin-resistant S. pneumoniae .
c Fluoroquinolones have been avoided for pediatric patients because of the potential for cartilage damage; however, they have been used for MDR bacterial infection safely and effectively in infants and children.
d Tetracyclines are rarely used in pediatric patients, particularly in those younger than 8 years because of tetracycline-induced permanent tooth discoloration.

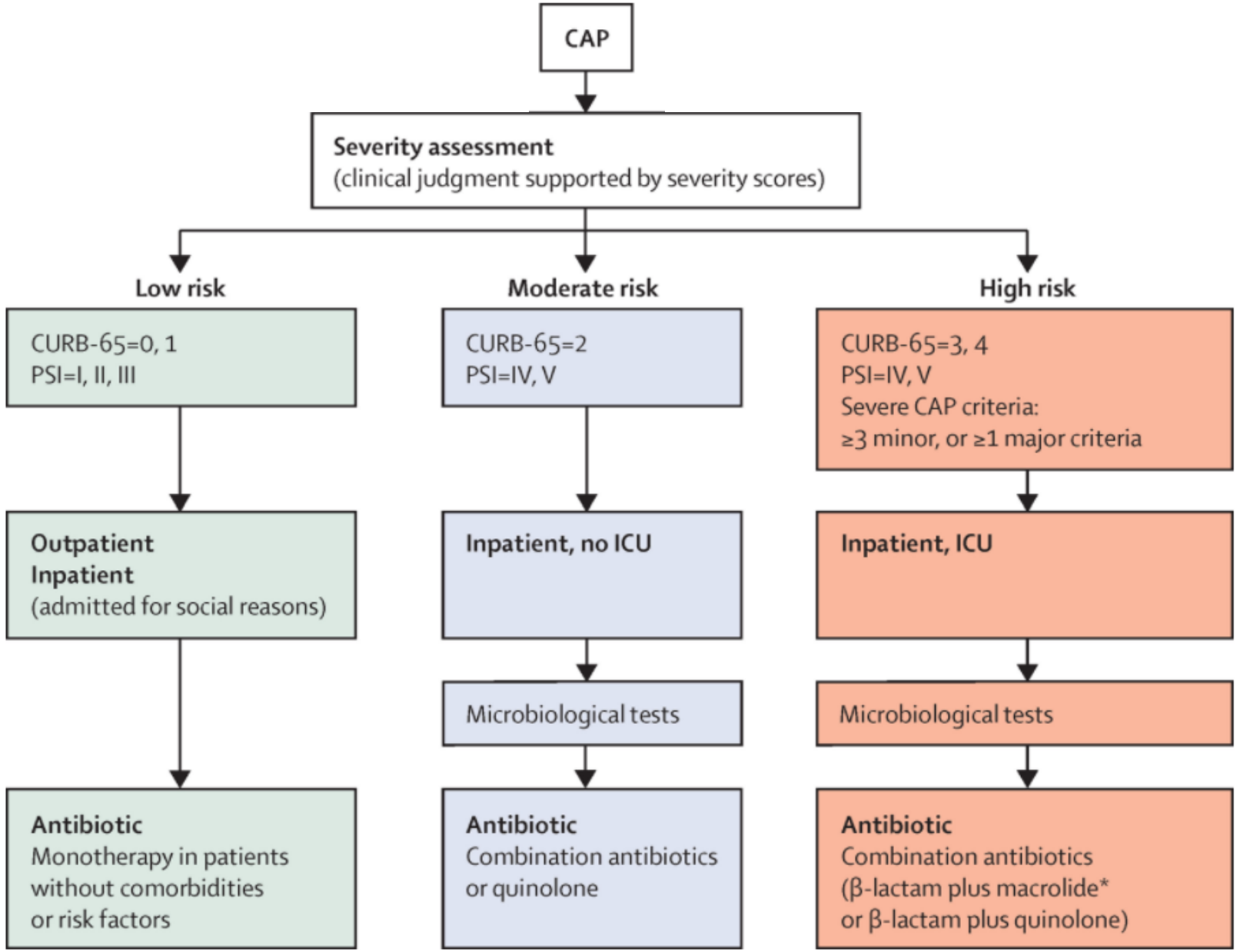
TABLE 125-11 Directed Antimicrobial Therapy for Common Pneumonia Pathogens in Adult Patients

Pathogen	Preferred Antibiotic Therapy	Alternative Antibiotic Therapy
Penicillin-susceptible *S. pneumoniae* (MIC ≤ 2 mg/L)	Ampicillin, amoxicillin, penicillin G	Ceftriaxone, cefotaxime, macrolide, levofloxacin, moxifloxacin, doxycycline, clindamycin, vancomycin
Penicillin-resistant *S. pneumoniae* (MIC > 2 mg/L)	Ceftriaxone, cefotaxime, levofloxacin, moxifloxacin	High-dose amoxicillin (3 g/day), linezolid, clindamycin, vancomycin
Non-β-lactamase-producing *H. influenzae*	Ampicillin (IV), amoxicillin	Fluoroquinolone, doxycycline, azithromycin, clarithromycin
β-Lactamase-producing *H. influenzae*	Ceftriaxone, cefotaxime, ampicillin-sulbactam, amoxicillin-clavulanate	Fluoroquinolone, doxycycline, azithromycin, clarithromycin
Mycoplasma pneumoniae	Macrolide, doxycycline	Fluoroquinolone
Chlamydophila pneumoniae	Macrolide, doxycycline	Fluoroquinolone
Legionella pneumophila	Fluoroquinolone or azithromycin	Doxycycline
MSSA	Cefazolin, antistaphylococcal penicillin	Clindamycin, vancomycin
MRSA	Vancomycin, linezolid	Telavancin, ceftaroline, quinupristin/dalfopristin, clindamycin, sulfamethoxazole/trimethoprim
P. aeruginosa	Antipseudomonal β-lactam[a] or fluoroquinolone[b] based on antimicrobial susceptibility testing results. Can consider adding aminoglycoside if patient in septic shock or at high mortality risk	IV colistin or polymyxin B + inhaled colistin for isolates resistant to all preferred therapies
Acinetobacter spp.	Carbapenem OR ampicillin-sulbactam based on antimicrobial susceptibility testing results	IV colistin or polymyxin B + inhaled colistin for isolates resistant to all preferred therapies
Extended-spectrum β-lactamase-producing gram-negative bacilli	Carbapenem	Piperacillin-tazobactam or cefepime potential options depending on susceptibility/adequate dosing

Table 125-11 continued

Carbapenem-resistant organisms	New β-lactam/β-lactamase inhibitors[c] based on antimicrobial susceptibility testing OR IV colistin or polymyxin B + inhaled colistin

a Antipseudomonal β-lactam: piperacillin/tazobactam, cefepime, ceftazidime, meropenem, imipenem/cilastatin, doripenem, aztreonam.
b Antipseudomonal fluoroquinolone: ciprofloxacin and levofloxacin
c New β-lactam/ β-lactamase inhibitors: ceftazidime/avibactam, meropenem/vaborbactam, ceftolozane/tazobactam.
MIC, minimum inhibitory concentration; MRSA, methicillin-resistant Staphylococcus aureus ; MSSA, methicillin-sensitive Staphylococcus aureus ; PCN, penicillin.


CAP
Severity assessment
(clinical judgment supported by severity scores)
Low risk
Moderate risk
High risk
CURB-65=0, 1
PSI=I, II, III
CURB-65=2
PSI=IV, V
CURB-65=3, 4
PSI=IV, V
Severe CAP criteria:
≥3 minor, or ≥1 major criteria
Outpatient
Inpatient
(admitted for social reasons)
Inpatient, no ICU
Inpatient, ICU
Microbiological tests
Microbiological tests
Antibiotic
Monotherapy in patients
without comorbidities
or risk factors
Antibiotic
Combination antibiotics
or quinolone
Antibiotic
Combination antibiotics
(β-lactam plus macrolide*
or β-lactam plus quinolone)

Severe pneumonia = one major criterion or 3+ minor criteria

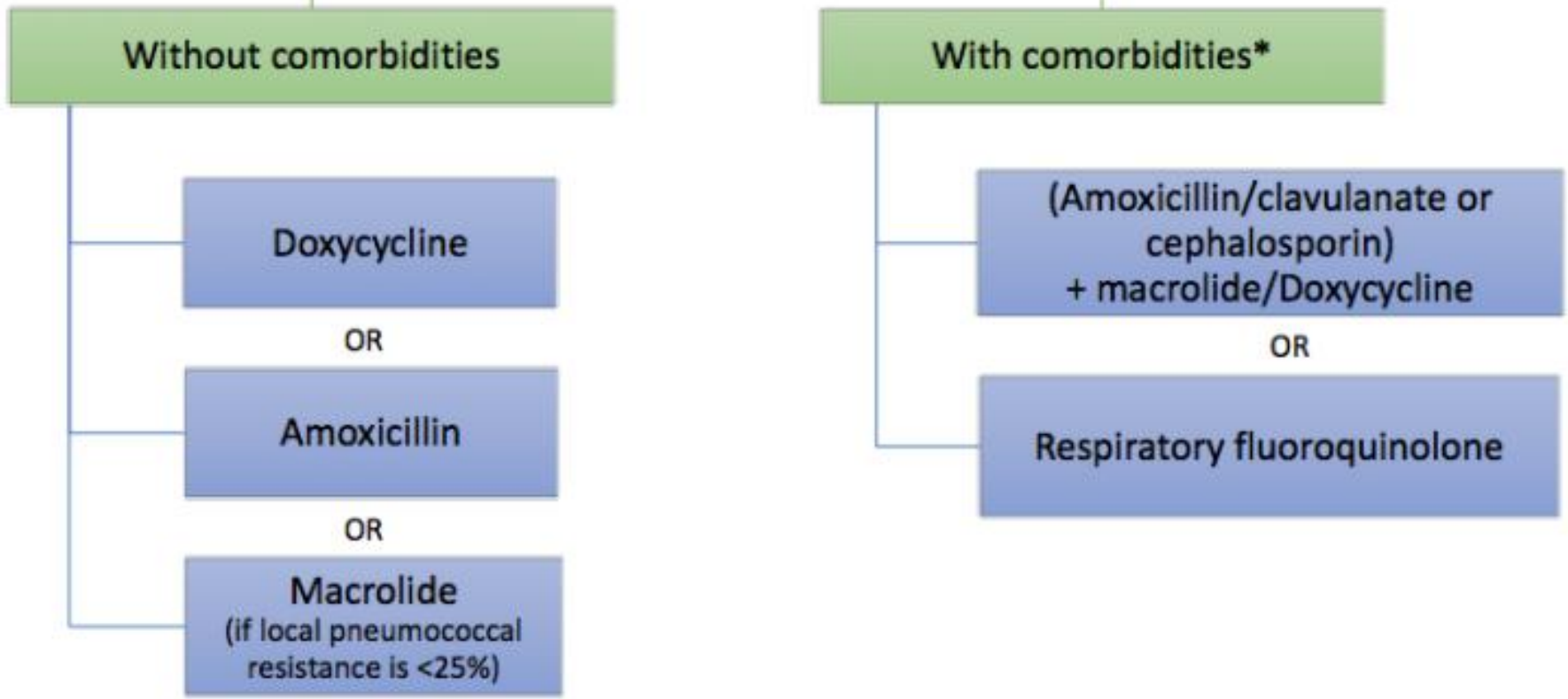
Major criteria

- Septic shock, with need for vasopressors
- Respiratory failure requiring mechanical ventilation

Minor criteria

- Respiratory rate ≥ 30 breaths/min
- PaO2/FiO2 ratio ≤250
- Multilobar infiltrates
- Confusion/disorientation
- Uremia (BUN ≥20mg/dL)
- Leukopenia (WBC <4,000 cells/microL)
- Thrombocytopenia (platelet <100,000/microL)
- Hypothermia (T<36C)
- Hypotension that requires aggressive fluid resuscitation

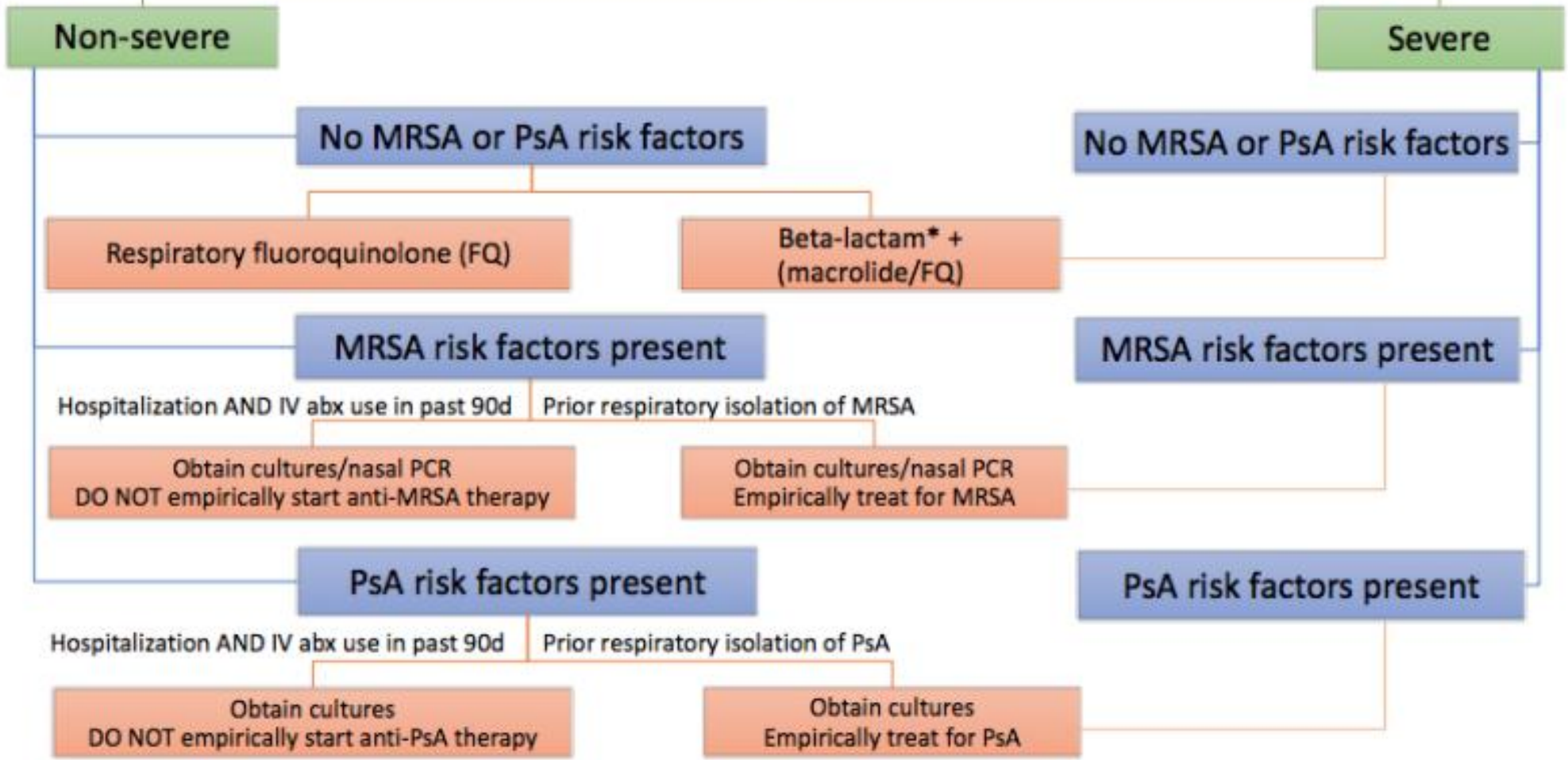
Community-acquired pneumonia treatment algorithm (outpatient)



*Comorbidities: chronic heart, lung, liver, or kidney disease; diabetes mellitus; alcoholism; malignancy; or asplenia

Adapted from Metlay et al. 2019

Community-acquired pneumonia treatment algorithm (inpatient)



*Beta-lactam: ampicillin-sulbactam, cefotaxime, ceftriaxone, or ceftaroline

Adapted from Metlay et al. 2019

Patient Care Process for Pneumonia (1/4)

Patient Care Process for Pneumonia (2/4)

Collect

- Patient characteristics (eg, age, sex, pregnancy, drug allergies)
- Patient medical history including comorbid conditions, previous infections, previous hospitalization, and current or recent residence in a nursing facility
- Social history (including tobacco/ethanol/drug use)
- Current and past medications, particularly antimicrobials, immune suppressants, and chemotherapy
- Subjective data
  - Patient-reported risk factors for pneumonia (Table 129-5)
  - Patient-reported pneumonia signs/symptoms (Table 129-6)
  - Timing/location of symptom onset (ie, community vs hospital; time since onset)
- Objective data
  - Temperature, blood pressure (BP), heart rate (HR), respiratory rate (RR), height, weight, O_2-saturation, ventilator settings if applicable
  - Pertinent respiratory physical exam findings (Table 129-6)
  - Diagnostic procedures (such as chest imaging)
  - Labs including CBC and differential, basic metabolic panel, blood gases, and lactate (if sepsis suspected)
  - Current and previous microbiology results including antimicrobial susceptibility when available

Patient Care Process for Pneumonia (3/4)

Assess

- Likelihood of pneumonia based on history of present illness, physical exam, imaging, and laboratory and microbiologic data
- Severity of illness and mortality risk based on hemodynamics, respiratory status, presence of organ failure, severity score(s) if CAP
- Most likely pathogens and potential for antimicrobial resistance based on age, comorbidities, clinical presentation and diagnostics, pneumonia type (ie, CAP vs HAP vs VAP vs aspiration—Table 129-5), local epidemiology and antimicrobial resistance patterns, previous infections and antibiotic exposure

Plan

- Empiric antimicrobial regimen based on likely pathogen(s) and mortality risk
    - Include drug(s), route of administration, dose, frequency, and duration (Tables 129-8 to 129-10)
- Appropriate monitoring parameters for efficacy, toxicity, and potential modification of therapy (ie cultures or other tests for etiology when indicated)
    - Include timing (cultures preferably obtained before antimicrobials administered) and frequency
- Provider education including rationale and evidence for recommendation
- Patient education including counseling points/monitoring for efficacy and safety

Patient Care Process for Pneumonia (4/4)

Implement*

- Clearly and professionally communicate recommendations to prescribers, healthcare team, and/or patient
- Determine consensus treatment plan as an interdisciplinary team
- Follow-up to ensure accurate/appropriate implementation of consensus treatment plan (antimicrobial therapy, diagnostics, and monitoring)

Follow-Up: Monitor and Evaluate

- Efficacy monitoring including improvement/resolution of signs/symptoms, physiologic and laboratory data with focus on indicators of infection (temperature, WBC, etc.), respiratory status (RR, oxygenation, ventilator settings), and organ failure/sepsis
- Safety monitoring (including SCr and urine output for nephrotoxicity, etc.)
- Microbiologic cultures and diagnostic tests for etiology
- Assess whether therapy can be narrowed, should be broadened, or requires change based on above monitoring considerations
- When possible, change empiric therapy to pathogen-directed therapy (Table 129-11)
- Design and implement new plan and continual monitoring as needed/appropriate

**Collaborate with patient, caregivers, and other healthcare professionals.*

Thank You!