Community-acquired pneumonia (CAP)

Microbiology

- Respiratory viruses (eg, influenza A and B, adenovirus, RSV, parainfluenza virus)
- *S. pneumoniae* most common bacteria, *H. influenza* less common
- Atypical organisms (*Mycoplasma pneumoniae*, *Chlamydophila pneumoniae*, *Legionella*)
- *Staphylococcus aureus* is rare in CAP except in the setting of necrotizing pneumonia, or pneumonia complicating influenza

Diagnosis

The diagnosis of pneumonia is based on suggestive clinical features (cough, fever, sputum production, pleuritic chest pain, dyspnea) **AND** a new chest x-ray infiltrate.

Procalcitonin:

- Procalcitonin-guided therapy is effective in reducing unnecessary antibiotic use for non-bacterial pneumonia, with no adverse impact on mortality, length-of-stay, or readmission rates.
- Procalcitonin is a tool to support, not supplant, clinician judgment. Interpretation should be made in light of the clinical picture and severity of illness. Procalcitonin can be used in those on corticosteroids, but has not been validated in patients with higher degrees of immunosuppression.

Procalcitonin Level	Diagnostic Implications	Antimicrobial Guidance
>0.5 µg/L	Bacterial pneumonia very likely	Antibiotics strongly encouraged
0.25-0.5 µg/L	Bacterial pneumonia likely	Antibiotics encouraged
0.1-0.25 µg/L	Bacterial pneumonia unlikely	Antibiotics discouraged
<0.1 µg/L	Bacterial pneumonia very unlikely	Antibiotics strongly discouraged

- Follow-up testing: antibiotic therapy can be discontinued when procalcitonin drops to below 0.25 µg/L **OR** ≥80% decrease.

Investigations:

- Not all patients admitted with CAP require extensive microbiologic workup. Blood and sputum cultures should be reserved for patients with severe presentations, suspected resistant organisms, recent antimicrobial exposure, or failure of therapy.
- During respiratory virus season, consider a nasopharyngeal swab for respiratory virus testing.
    - If positive → consider discontinuation of antibacterial agents
    - If negative → discontinue antiviral agent (if started)
- Rarely, patients admitted with pneumonia may have a negative initial chest x-ray. If clinical features are highly suggestive, it may be reasonable to treat presumptively and repeat imaging after 24-48 hrs. Lack of infiltrate after 48 hrs suggests an alternative diagnosis other than bacterial CAP and may allow early discontinuation of antimicrobials.

EMPIRIC TREATMENT

CRB-65 Score	*One point for each of:* **C**onfusion (new disorientation in person, place, or time) **R**espiratory rate ≥ 30 breaths/minute **B**lood pressure (systolic <90 mmHg or diastolic ≤60 mmHg) Age ≥**65** years Note: CRB-65 is a tool to support, not supplant, clinician judgment.

Risk Stratification			**Duration (days)**
Low Severity CRB-65 = 0 *Consider outpatient treatment*	amoxicillin 1000 mg PO TID *If penicillin allergy:* cefuroxime 500 mg PO BID *If severe beta-lactam allergy:* moxifloxacin 400 mg PO daily If unable to take oral antibiotics: ceftriaxone 1000 mg IV q24h *If severe beta-lactam allergy:* moxifloxacin 400 mg IV daily **Notes** • If patient requires admission for comorbidities or social reasons, oral therapy is still appropriate • Addition of atypical coverage is not routinely recommended for low severity CAP		**5**
Moderate Severity CRB-65 = 1-2 *Consider medical ward admission*	amoxicillin-clavulanate 875-125 mg one tab PO BID **OR** ceftriaxone 1000 mg IV q24h **PLUS EITHER** doxycycline 100 mg PO BID **OR** azithromycin 500 mg PO/IV q24h[1] *If severe beta-lactam allergy:* moxifloxacin 400 mg PO daily		**5**
High Severity CRB-65 ≥ 3 ***OR*** respiratory failure ***OR*** requiring ICU admission	MRSA or *Pseudomonas* unlikely	ceftriaxone 1000 mg IV q24h **PLUS EITHER** doxycycline 100 mg PO BID **OR** azithromycin 500 mg PO/IV q24h[1] *If severe beta-lactam allergy:* moxifloxacin 400 mg PO/IV daily	**7**
	Potential *Pseudomonas* • COPD with FEV_1<50% • Structural lung disease • Recent broad-spectrum antibiotics • From nursing home or recent hospitalization	piperacillin-tazobactam 4500 mg IV q6h **PLUS EITHER** doxycycline 100 mg PO BID **OR** azithromycin 500 mg PO/IV q24h[1] *If severe beta-lactam allergy:* meropenem 500 mg IV q6h **OR** moxifloxacin 400 mg PO/IV daily **PLUS** gentamicin[2] **OR** levofloxacin 750 mg PO daily	**7**
	Potential MRSA • Necrotizing pneumonia • Recent influenza • Injection drug use	ceftriaxone 1000 mg IV q24h **PLUS** vancomycin[3] **PLUS EITHER** doxycycline 100 mg PO BID **OR** azithromycin 500 mg PO/IV q24h[1] *If severe beta-lactam allergy:* moxifloxacin 400 mg PO/IV daily **PLUS** vancomycin[3]	**7**

Doses may require adjustment for renal insufficiency

1. *Azithromycin duration is 500 mg for 3 days, or 500 mg once followed by 250 mg for 4 days. Longer durations only indicated in Legionella infection.*
2. *For aminoglycoside dosing, refer to dosing reference (such as Lexicomp) or discuss with clinical pharmacist*
3. *For vancomycin dosing, refer to "Vancomycin Dosing and Therapeutic Monitoring" in the ASP Handbook*

Oral Step-Down

Patients on IV therapy can be switched safely to oral therapy once:

1. Hemodynamically stable
2. Improving clinically
3. Afebrile for 24 hours
4. Can ingest medications and have a functioning GI tract

Guided by microbiology results (See "Pathogen-Directed Therapy for Pneumonia")

In the absence of positive microbiology, recommended oral step-down if on initial intravenous therapy:

Intravenous	**Oral Step-Down Option**
azithromycin	same
ceftriaxone	amoxicillin 500-1000 mg PO TID *If penicillin allergy:* cefuroxime 500 mg PO BID
moxifloxacin	same
piperacillin-tazobactam	amoxicillin-clavulanate 875-125 mg one tab PO BID

Note: Complete concurrent course of doxycycline or azithromycin as appropriate

Duration

- Patients should be afebrile for 48hrs prior to stopping antibiotics. The majority of CAP can be treated with a total of 5 days of antibiotics.
- Cough and chest x-ray abnormalities may take several weeks to resolve. If the patient is otherwise improving and afebrile, extension of antibiotic course is NOT necessary.
    - Repeated chest x-rays to document resolution of opacities should not be performed sooner than 6 weeks, unless patient's condition is worsening.
    - Repeat chest x-rays are warranted if concerned about underlying malignancy (higher risk in smokers and those over 50 years old)
- Azithromycin dosing (due to long tissue half-life):
    - azithromycin 500 mg daily x 3 days
      OR azithromycin 500 mg once, then 250 mg daily x 4 days
    - Treatment of CAP due to *Legionella* is the only indication for prolonged azithromycin
- Uncomplicated CAP with *S. pneumoniae* bacteremia includes patients who become afebrile within 72 hours, and have no evidence of necrotizing pneumonia, lung abscess, empyema, or extra-pulmonary disease. The presence of bacteremia alone does NOT require a prolonged course of parenteral antibiotics. Treat as per usual CAP duration above.
- Pneumonia due to *S. aureus*, *Pseudomonas*, or *Legionella* are exceptions and may require 14 days of antibiotics. Infectious Diseases consultation recommended.
- Necrotizing pneumonia, lung abscess, or empyema will require prolonged therapy. Respirology and/or Infectious Diseases consultation recommended.

Pathogen-Directed Therapy in Pneumonia

Where a pathogen is microbiologically identified, directed antimicrobial therapy should be used.
Note: Doses may require adjustment in renal insufficiency.

Organism	Preferred Agent	Alternative/Severe allergy
Streptococcus pneumoniae Penicillin MIC <4 ug/mL Penicillin MIC ≥4 ug/mL	 penicillin G 2 million units IV q4h **OR** amoxicillin 500-1000 mg PO TID *Based on susceptibility results* ceftriaxone 1 g IV q24h **OR** moxifloxacin 400 mg IV/PO daily	 azithromycin[1] **OR** doxycycline 100 mg PO BID **OR** moxifloxacin 400 mg PO/IV daily
Haemophilus influenzae Amoxicillin-susceptible Amoxicillin-resistant	 amoxicillin 500 mg PO TID amoxicillin-clavulanate 875 mg PO BID	 azithromycin[1] **OR** doxycycline 100 mg PO BID
Mycoplasma pneumonia *Chlamydophila pneumoniae*	azithromycin[1]	doxycycline 100 mg PO BID
Staphylococcus aureus MSSA MRSA	 cloxacillin 2 g IV q4h vancomycin[2]	 clindamycin 450 mg PO TID **OR** vancomycin[2] linezolid 600 mg PO/IV BID
Pseudomonas aeruginosa	piperacillin-tazobactam 4.5 g IV q6h *If susceptibility confirmed:* ceftazidime 2 g IV q8h **OR** ciprofloxacin 750 mg PO BID	aminoglycoside[3] **OR** ciprofloxacin 750 mg PO BID
Gram-negative enteric bacilli	ceftriaxone 1 g IV q24h *If ESBL:* meropenem 500 mg IV q6h *If susceptibility confirmed:* ciprofloxacin 500 mg PO BID **OR** cotrimoxazole DS 1-2 tabs PO BID	aminoglycoside[3] *If susceptibility confirmed:* ciprofloxacin 500 mg PO BID **OR** cotrimoxazole DS 1-2 tabs PO BID
Legionella	moxifloxacin 400 mg PO/IV daily	azithromycin 500 mg PO/IV q24h[1]

Doses may require adjustment for renal insufficiency

1. *Azithromycin duration is 500 mg for 3 days, or 500 mg once followed by 250 mg for 4 days. Longer durations only indicated in Legionella infection.*
2. *For vancomycin dosing, refer to "Vancomycin Dosing and Therapeutic Monitoring" in the ASP Handbook*
3. *For aminoglycoside dosing, refer to dosing reference (such as Lexicomp) or discuss with clinical pharmacist*