Community Acquired Pneumonia (CAP) Clinical Pathway Overview

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Need for a Guideline Implementation Tool

- Respiratory Tract Infections (RTIs) are a major driver of hospital antibiotic use and are often the leading indication for antibiotics in hospitals.
- Studies have shown that prescribing for community acquired RTIs can be improved through a variety of interventions, with a growing evidence base supporting the use of clinical pathways in this area.
- Guideline implementation tools are needed to help stewardship programs reduce unwarranted practice variability and improve prescribing in this area.

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Overview of CAP Algorithm

- *INTENDED AUDIENCE*:

  All medical practitioners involved in treatment decision-making for patients with CAP are the intended audience of the guidance. These include but not limited to stewardship teams, clinical infectious diseases physicians, hospitalists, ED providers, pharmacists, and others.

- *EXCLUSIONS*: Immunocompromised patients defined as "inherited or acquired immune deficiency or drug-induced neutropenia, including patients actively receiving cancer chemotherapy, patients infected with HIV with suppressed CD4 counts, and solid organ or bone marrow transplant recipients"

Development Process

- Developed with funding from CDC.
- Multidisciplinary development group consisted of a twelve individuals selected for their clinical expertise in antimicrobial stewardship and infectious diseases.
- All group members served as uncompensated volunteers.
- Development began in June 2021.
- Pathway algorithm based on 2019 ATS/IDSA CAP Guideline[1] with some enhancements
- After completion of the first draft of the clinical pathway, IDSA staff conducted 15 interviews with stewardship directors in CoE and non-CoE clinical settings to understand the perceived feasibility and usability of the tool and collect feedback on the clinical content of the pathway.
- Following additional revisions, the pathway was pilot-tested for feasibility of implementation in nine clinical settings for a 4-month period.
- Pathway was finalized in Sept 2023.

[1] Metlay JP. et al. Diagnosis and Treatment of Adults with Community-acquired Pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med. 2019 Oct 1;200(7):e45-e67

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Diagnosis and Admission

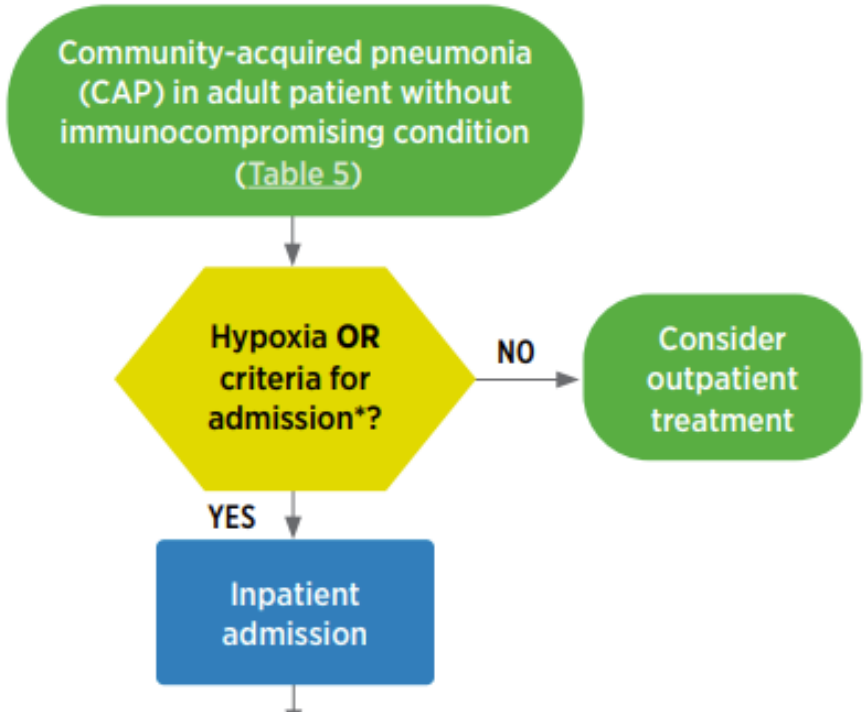

TABLE 1: Diagnosis of Community-acquired Pneumonia in Adults (≥ 18 years) Without Immunocompromising Conditions[1]*

Newly recognized pulmonary infiltrate(s) on chest imaging† **AND** at least one respiratory symptom **AND** at least one other symptom/sign or finding (see below)
Respiratory Symptoms (at least one)
New or increased cough
New or increased sputum production
Dyspnea
Pleuritic chest pain
Other Signs or Findings (at least one)
Abnormal lung sounds (rhonchi or rales)
Fever (≥100.4 °F)
Leukocytosis or unexplained bandemia (above normal limits for laboratory)
Hypoxia (< 90%)

*Immunocompromising conditions include inherited or acquired immune deficiency or drug-induced neutropenia, including patients actively receiving cancer chemotherapy, patients infected with HIV with suppressed CD4 counts, and solid organ or bone marrow transplant recipients.

†If clinical suspicion for community-acquired pneumonia is high despite negative chest radiograph, consider a CT scan of the chest.[2]

*e.g. CURB-65, PSI

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Severity Assessment

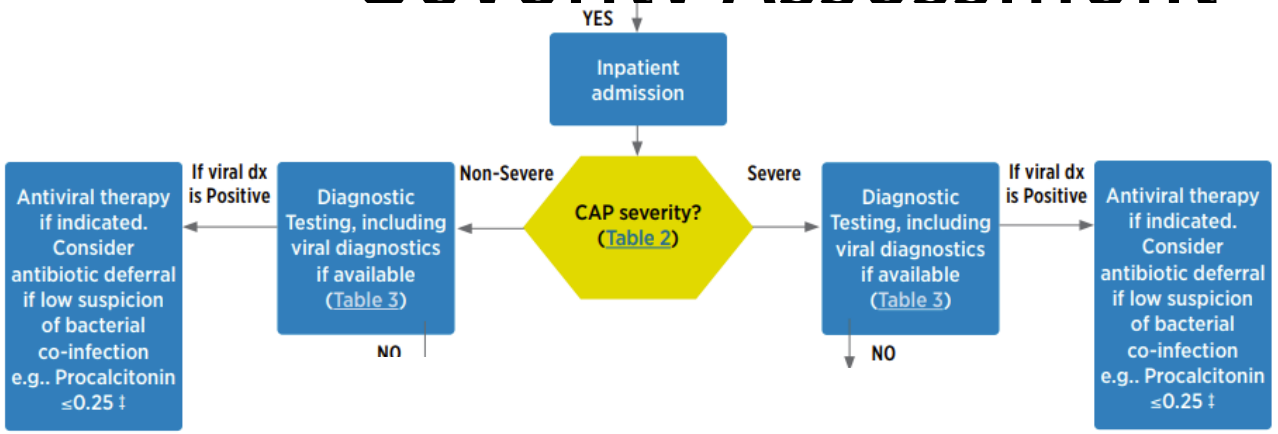

TABLE 2: Criteria for Defining Severe Community-acquired Pneumonia[1]

One major criterion **OR** three or more minor criteria	
Major Criteria	Septic shock with need for vasopressors
	Respiratory failure requiring mechanical ventilation
Minor Criteria	Respiratory rate ≥ 30 breaths/min
	PaO_2/FIO_2 ratio ≤ 250*
	Multilobar (i.e., ≥ 2) infiltrates
	Confusion/disorientation
	Uremia (blood urea nitrogen level ≥ 20 mg/dl)
	Leukopenia (white blood cell count < 4,000 cells/µl)†
	Thrombocytopenia (platelet count < 100,000/µl)
	Hypothermia (core temperature < 36°C)
	Hypotension requiring aggressive fluid resuscitation

* PaO_2/FiO_2 ratio is the ratio of patient's oxygen in arterial blood (PaO_2) to the fraction of the oxygen in the inspired air (FiO_2).[3]

† Due to infection alone (i.e., not chemotherapy)

TABLE 3: Diagnostic Testing for Community-acquired Pneumonia (CAP) by Disease Severity[†]

	Non-severe CAP*	Severe CAP*
Blood		
Blood culture	Not routinely recommended[†]	Yes
Procalcitonin[‡]	Consider if available and recommended by hospital guidelines	Yes, if available and recommended by hospital guidelines
Respiratory		
Respiratory culture	Not routinely recommended unless: • hospitalization and parenteral antibiotics in the last 90 days OR • anti-MRSA or anti – *P. aeruginosa* coverage is intiated OR • advanced structural lung disease[§]	Yes
Molecular testing for bacterial pathogens[‡]	Not routinely recommended[†]	Yes, if available and recommended by hospital guidelines
MRSA nasal swab (marker of MRSA colonization)*	Yes, if: • hospitalization and parenteral antibiotics in the last 90 days OR • anti-MRSA coverage is intiated	Yes, if • hospitalization and parenteral antibiotics in the last 90 days OR • history of MRSA colonization or infection at any site within 1 year OR • anti-MRSA coverage is intiated
Viruses		
Influenza testing	Yes, if presence of virus in community, travel risk or potential exposure	Yes, if presence of virus in community, travel risk or potential exposure
COVID-19 testing[‡]	Yes, if presence of virus in community, travel risk or potential exposure	Yes, if presence of virus in community, travel risk or potential exposure
Expanded viral molecular panel (e.g., rhinovirus, enterovirus, RSV)[‡]	Consider if available[†]	Yes, if available[†]
Urine		
Legionella urine antigen test	Yes, if recent outbreak, travel or other epidemiological factors	Yes
Pneumococcus urine antigen test	Not routinely recommended[†]	Yes

* See table 3 for criteria for defining severe CAP

† Can be considered in select cases where timely pathogen determination may allow a more directed therapy or discontinuation of unnecessary antibiotics

‡ This is a clinical practice enhancement to the ATS/IDSA CAP clinical practice guideline

§ Patients with advanced structural lung disease defined as "bronchiectasis, post-obstruction, advanced chronic obstructive pulmonary disease or cystic fibrosis"

* See detailed note in Table 5[4]

Treatment Selection

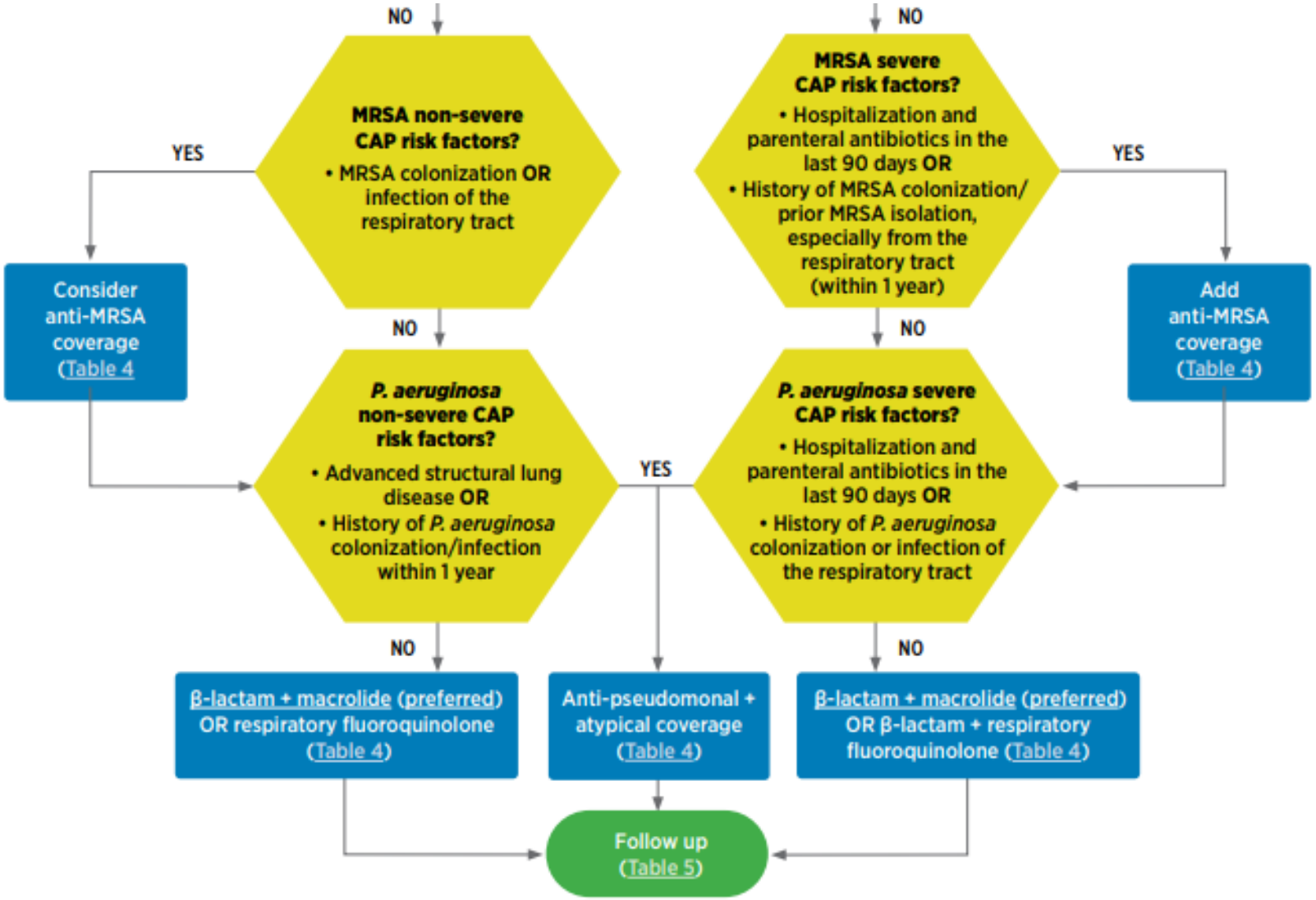

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TABLE 4: Initial Treatment for Hospitalized Patients with Community-Acquired Pneumonia (CAP) Stratified by Disease Severity and Risk for Antibiotic Resistant Pathogens[1]

(Note: Modify per hospital formulary and/or preferred antibiotics)

Allergy Alert‡: Use evidence-based validated risk strategies for evaluating β-lactam allergy and cross-reactivity to other β-lactams (add references). Patients with mild to moderate penicillin reactions[5] can typically tolerate non-pencillin β-lactams. Obtain a detailed history as these patients may be de-labled based on tolerated penicillin-class agents since the initial reaction[6]. Patients with immediate penicillin reactions (e.g., urticaria, angioedema, anaphylaxis) within 1 hour of β-lactam penicillin exposure may tolerate 3rd/4th generation cephalosporins or carbapenems[7]. Avoid β-lactams in patients with severe delayed cutaneous reactions (e.g., Stevens-Johnson syndrome, toxic epidermal necrolysis)[8].

	Standard Regimen		Recent hospitalization and parenteral antibiotics in the last 90 days			History of MRSA colonization or infection at any site within 1 year OR MRSA nasal PCR positive	History of P. aeruginosa colonization or infection at any site within 1 year OR Advanced structural lung disease	
Non-severe CAP	**β-lactam PLUS Atypical Coverage (Preferred)**		**β-lactam PLUS Atypical Coverage (same as standard regimen)**			**MRSA Coverage**	**β-lactam PLUS Atypical Coverage**	
	Choose One: Ampicillin/ sulbactam *1.5-3g IV q6h* Ceftriaxone *1-2g IV q24h (2g if >80kg)*[9,10] Cefotaxime *1-2g IV q8h*	*Choose One:* Azithromycin *500mg IV/PO q24h** Clarithromycin *500mg IV/PO q12h* Doxycycline *100mg IV/PO q12h***				*Choose One:* Vancomycin *per hospital guidelines* Linezolid *600 mg IV/PO*	*Choose One:* Piperacillin/ tazobactam *4.5g IV q6h* Cefepime *2g IV q8h* Ceftazidime 2g IV q8h Imipenem *500mg IV q6h* Meropenem *1000mg IV q8h*	*Choose One:* Azithromycin *500mg IV/PO q24h** Clarithromycin *500mg IV/PO q12h* Doxycycline 100mg IV/PO q12** Levofloxacin *750mg IV/PO q24h* Moxifloxacin *400mg*
	Monotherapy (alternative if above regimen is not tolerated)							
	Choose One: Levofloxacin *750mg IV/PO q24h* Moxifloxacin 400mg *IV/PO q24h*							
Severe CAP	**β-lactam PLUS Atypical Coverage**		**MRSA Coverage**	**β-lactam PLUS Atypical Coverage**		**MRSA Coverage**	**β-lactam PLUS Atypical Coverage**	
	Choose One: Ampicillin/ sulbactam *1.5-3g IV q6h* Ceftriaxone *2g IV q24h*[11,12]‡ Cefotaxime *1-2g IV q8h*	*Choose One:* Azithromycin *500mg IV/PO q24h** Clarithromycin *500mg IV/PO q12h* Doxycycline *100mg IV/PO q12h*** Levofloxacin *750mg IV/PO q24h* Moxifloxacin *400mg IV/PO q24h*	*Choose One:* Vancomycin *per hospital guidelines* Linezolid *600 mg IV/PO q12h*	*Choose One:* Piperacillin/ tazobactam *4.5g IV q6h* Cefepime *2g IV q8h* Ceftazidime *2g IV q8h* Imipenem *500mg IV q6h* Meropenem *1000mg IV q8h*	*Choose One:* Azithromycin *500mg IV/PO q24h** Clarithromycin *500mg IV/PO q12h* Doxycycline *100mg IV/PO q12*** Levofloxacin *750mg IV/PO q24h* Moxifloxacin *400mg IV/PO q24h*	*Choose One:* Vancomycin *per hospital guidelines* Linezolid *600 mg IV/PO q12h*	*Choose One:* Piperacillin/ tazobactam *4.5g IV q6h* Cefepime *2g IV q8h* Ceftazidime *2g IV q8h* Imipenem *500mg IV q6h* Meropenem *1000mg IV q8h*	*Choose One:* Azithromycin *500mg IV/PO q24h** Clarithromycin *500mg IV/PO q12h* Doxycycline *100mg IV/PO q12*** Levofloxacin *750mg IV/PO q24h* Moxifloxacin *400mg IV/PO q24h*

Severe CAP with allergy to β-lactams: Consider levofloxacin 750mg IV/PO q24h ± aztreonam 2g IV q8h +/- MRSA coverage

* Azithromycin 500mg q24 hours x 3 doses for 1500mg total to treat atypical pneumonia[13,14]

** Macrolide intolerance or QTc prolongation.

‡ This is a clinical practice enhancement to the ATS/IDSA CAP clinical practice guideline

Notes:

- Antibiotic selections should be driven by local antibiograms
- Patients with septic shock should receive therapy per hospital sepsis guidelines
- Antibiotic dosing should be adjusted according to hospital guidelines and renal/liver insufficiency
- The following FDA-approved agents may be considered in non-severe CAP patients who are not candidates for β-lactams, macrolides or FQs: lefamulin 150 mg IV q 12 hours (600 mg orally q 12 h) or omadacycline 200 mg IV on day one followed by 100mg IV daily (300 mg orally q 12 h on day one, followed by 300 mg orally once daily)

TABLE 5: Daily Follow-up Stewardship Considerations for Hospitalized Patients with Community-acquired Pneumonia (CAP)‡

Assessment	Action
Confirm CAP diagnosis and assess clinical improvement	Review clinical progression to confirm CAP (viral or bacterial) diagnosis vs. non-infectious etiology
	Evaluate documented penicillin allergy as recommended by hospital guidelines. The evaluation may include history and physical examination, allergy consultation, challenge doses, or skin testing (refer to top of Table 4).
	Assess for clinical stability[15], at least 5 clinical stability criteria (or return to baseline) below: • Tmax ≤38°C • HR ≤100 • RR ≤24 • Arterial O_2 saturation ≥90% or pO_2 >60mmHg • Baseline mental status • SBP ≥90 mmHg
	Assess for CAP complications if no clinical improvement (secondary bacteremia, lung abscess, or empyema)
Diagnostic Testing	Determine pathogen-directed therapy based on sputum culture (if sputum can be readily produced) and other diagnostic testing
	Viral diagnostics: Consider discontinuing antibiotic therapy if, viral diagnostics are positive, Procalcitonin <0.25 (or 80% reduction on repeat testing in 72 hours), WBC < 10,000 cells/µl, and low suspicion for bacterial co-infection
	MRSA nasal swab: • If negative, discontinue MRSA coverage (>95% negative predictive value in CAP) • If positive, may not be indicative of MRSA pneumonia (<40% positive predictive value); continue assessment of other MRSA risk factors and consider anti-MRSA therapy discontinuation if no risk factors
Treatment Considerations	Try to minimize broad spectrum antibiotics when possible
	Assess for adverse drug events
Discharge Considerations	Assess for clinical stability; patient afebrile with at least 5 signs of CAP stability criteria listed above or return to baseline
	Assess for ability to tolerate oral therapy, oral de-escalation options: • No MDRO risk factors (choose one): » Amoxicillin (500mg) + clavulanate (125mg) PO TID, or Amoxicillin (875 mg or 2000mg) + clavulanate (125mg) PO BID » Cefpodoxime 200mg PO BID » Cefuroxime 500mg PO BID • MDRO Risk Factors: » Levofloxacin 750mg PO q24h » If Legionella-negative or alternative etiology identified, discontinue azithromycin after 1500mg total.
	Consider duration of antibiotics administered (no more than 3-5 days total in the ED and inpatient) if clinically stable by day 3.[16]‡
	Ensure post-discharge follow-up including insurance coverage and availability at outpatient pharmacy
	Consider vaccination (pneumococcal, influenza, COVID-19, and RSV [in eligible populations]). If relevant, provide smoking cessation counselling/medications and ensure patient is on proper therapy to enhance control of chronic conditions (e.g., COPD, CHF)"
	Educate patients and caregivers[17]: • Planned antibiotic course (if needed) and instructions for follow-up medical care • Signs and symptoms of worsening infection, and sepsis • Signs and symptoms of antibiotic-associated adverse events, including *Clostridioides difficile* infection

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Examples of strategies for implementation

Pocket cards

Order sets

App-based implementation

Education (webinars, grand rounds)

- Keep messaging simple (2-3 teaching points)

- Emphasize duration and allergy assessments

Audit and Feedback

Quality improvement initiatives

THANK YOU!

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