ADVOCATE HEALTH

Clear the Air

Optimizing Pneumonia Treatment

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Disclosures

The planners and speaker have indicated that there are no relevant financial relationships with any ineligible companies to disclose.

Abbreviation Key

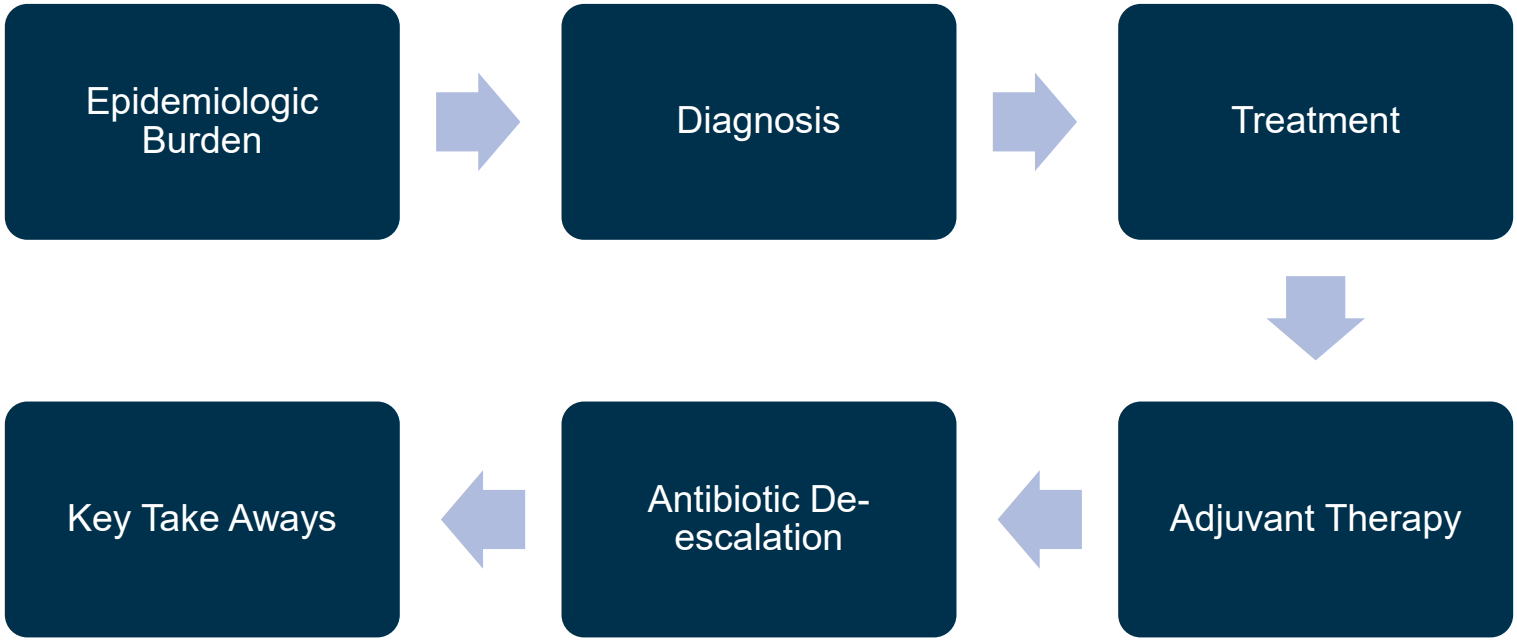
- ATS: American Thoracic Society
- IDSA: Infectious Diseases Society of America
- MRSA: Methicillin resistant Staphylococcus aureus
- CAP: community acquired pneumonia
- HAP: hospital acquired pneumonia
- VAP: ventilator acquired pneumonia
- IMV: Invasive mechanical ventilation
- ICU: Intensive care unit

Learning Objectives

At the end of this session, learners should be able to:

- Identify patient specific factors that affect pneumonia treatment
- Outline the key differences between the 2019 IDSA/ATS guidelines and the 2025 ATS guidelines
- Recognize common workflow gaps in pneumonia diagnosis and management
- Apply evidence-based strategies to determine appropriate duration of therapy for pneumonia in various patient populations

Outline



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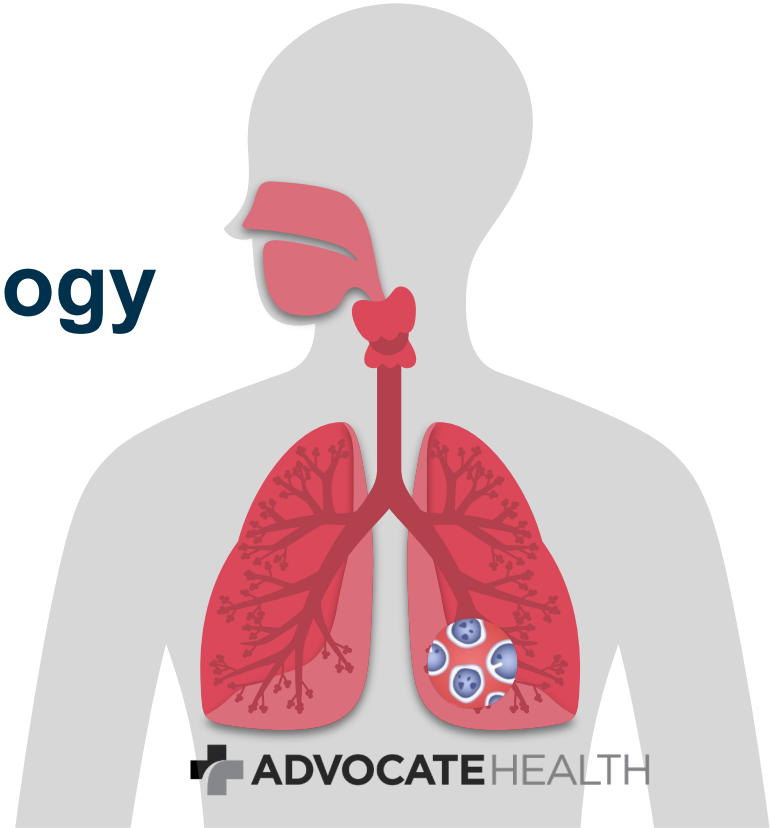
Epidemiology



Epidemiology

- Leading cause of hospitalization and death
- > 1 million in-hospital deaths/year
- In-hospital mortality rates range from 7% to 13%
- 1-year mortality rates post hospitalization ~18%
- Cost per pneumonia hospitalization ~ $10,000–$19,000

Shi et al., The Journal of Infectious Diseases, 2020
Mohanty et al., The Journal of Infectious Diseases, 2024

Risk Factors

The presence of two or more chronic conditions substantially increases pneumonia risk

Immunocompromising conditions:	• HIV infection • Hematological malignancies • Immunodeficiency syndromes
Other chronic conditions	• Chronic kidney disease • Liver disease • Heart failure • Diabetes • Neurological disease

Ochoa-Gondar et al., BMC Pulmonary Medicine, 2023
Almirall et al., Respiration, 2017

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Classifications

Hospital acquired:

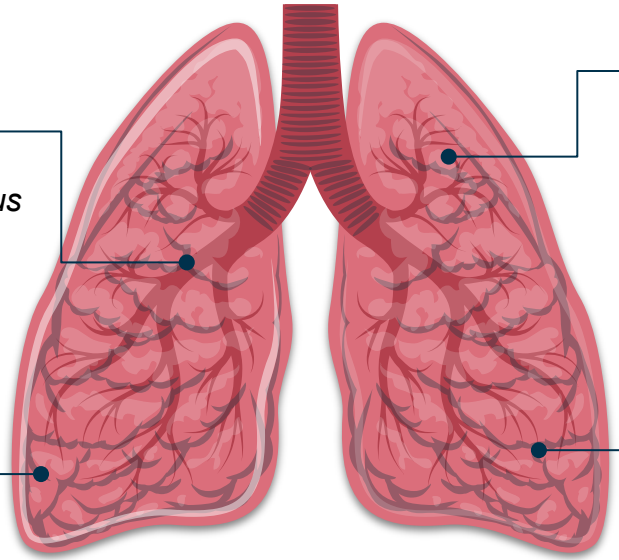
Pneumonia that develops >48 hours after hospital admission

Pseudomonas aeruginosa, Klebsiella, E. coli, Staphylococcus aureus

Ventilation acquired:

Subset of HAP that occurs ≥48–72 hours after endotracheal intubation/mechanical ventilation

Pseudomonas aeruginosa, Klebsiella, E. coli, Staphylococcus aureus



Community acquired:

Pneumonia in patients who have not been recently hospitalized or had significant healthcare exposure

Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis, Legionella, Mycoplasma, Chlamydia pneumoniae

Aspiration:

Pneumonia caused by inhalation of oropharyngeal or gastric contents into the lower respiratory tract

Oral flora, gram-negatives

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

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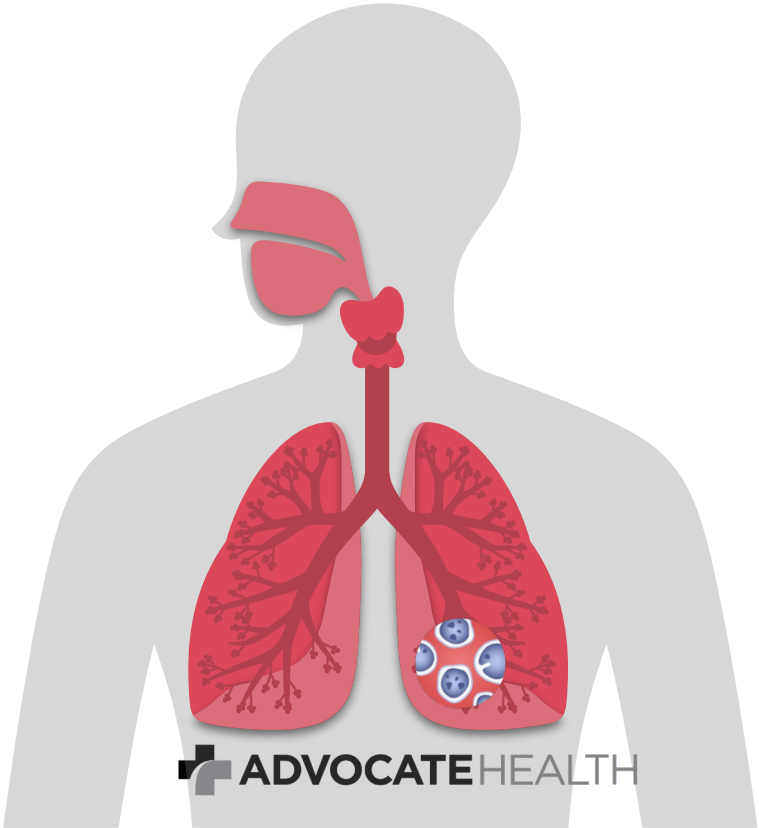
Diagnosis



Diagnosis of Pneumonia

- Physical findings can vary and are influenced by the severity of lung consolidation, the type of organism, the extent of the infection, and host factors
- The presence of pulmonary infiltrates are considered a gold standard for diagnosis when supported by laboratory and clinical features

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

Diagnosis of Pneumonia

2019 IDSA/ATS

- CT scan is the most accurate diagnostic
- Radiographic imaging as an alternative

2025 ATS

- Lung ultrasounds are as accurate as chest x-ray in confirming a clinical suspicion of pneumonia

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

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Sputum and Blood Cultures

- Not recommended in the outpatient setting
- May be considered for hospitalized patients who meet the following criteria:
  - Severe pneumonia
  - Empirically treated for MRSA or *Pseudomonas aeruginosa*
  - Previous respiratory tract infection with confirmed MRSA of *Pseudomonas aeruginosa*
  - Hospitalized or received IV antibiotics in the past 90 days

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Utility of Sputum Cultures

Pros

- Potential antibiotic de-escalation

Cons

- Low Yield
- Detect Colonization

Musher et al., NEJM, 2014
Vaughn et al., JAMA, 2024

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Utility of Blood Cultures

Pros

- Potential for antibiotic de-escalation
- May reveal alternative infectious source

Cons

- Rarely change empiric therapy
- High contamination rate
- Increased cost a resource utilization

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Zhang et al., American Journal of Medicine, 2020

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Urinary Antigens

Non-culture-based tests that detect antigen shed from pathogens excreted in the urine

Simple, rapid, and non-invasive diagnostic tool

Unaffected by prior antibiotic administration

Most common bacteria detected by urinary antigen tests are *Streptococcus pneumoniae* and *Legionella pneumophila*

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Kim et al., Infection and Drug Resistance, 2022

Legionella Testing

- Only detects one type of *Legionella*
- Possible benefit in severe cases and in outbreak settings
- Legionnaires' disease outbreaks are associated with:
  - Healthcare settings: Hospitals, long-term care facilities
  - Travel: Hotels, resorts, cruise ships
- No statistical differences seen in death, clinical relapse, ICU admission, length of stay or length of antibiotic treatment

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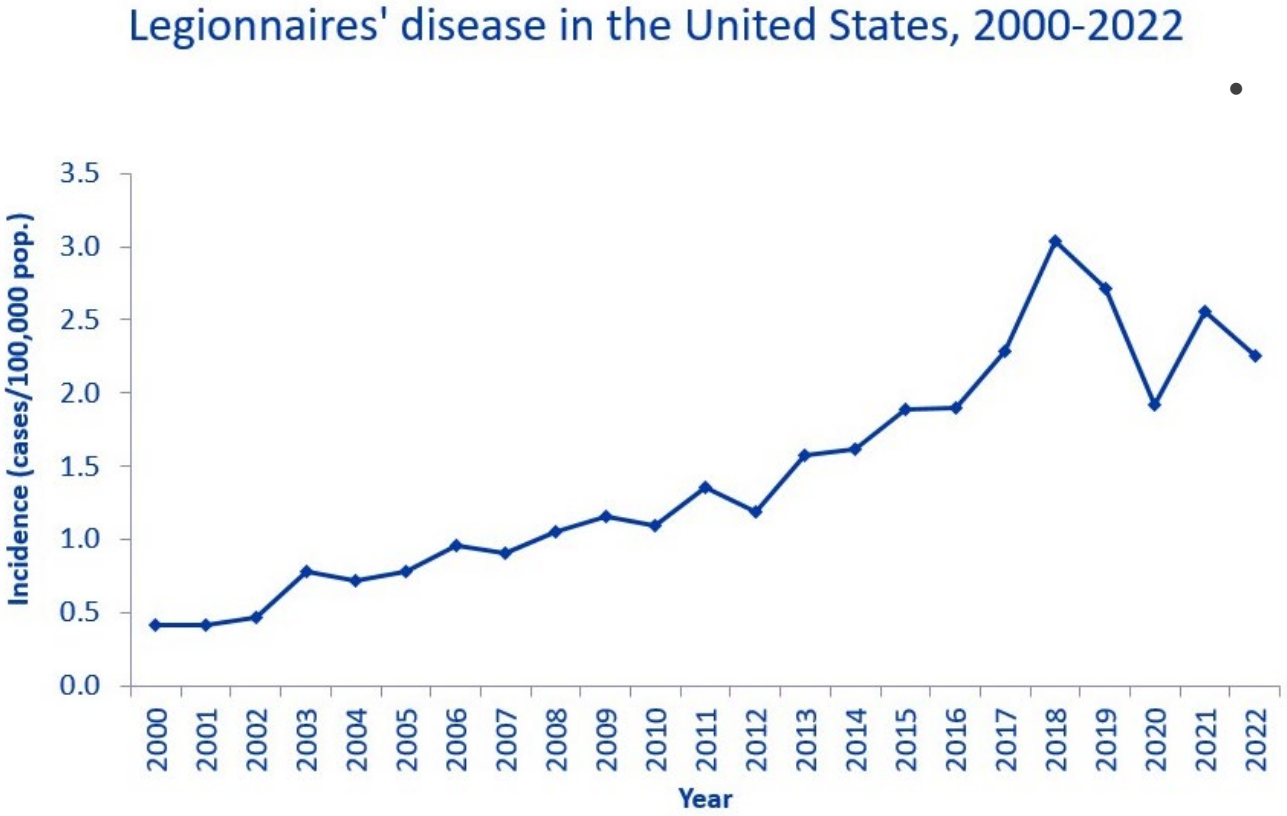
Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Legionella Testing



- Presence of hyponatremia (OR 3.3), diarrhea (OR 2.0), smoking (OR 2.4), and admission during June–October (OR 3.4) are the strongest predictors of a positive Legionella test

CDC, Legionellosis Surveillance and Trends, 2025

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Pneumococcal Testing

Rarely affects outcomes

Low impact on management

Added cost and testing burden

Poor influence on antibiotic de-escalation

Limited role outside of severe disease

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Davis et al., Open Forum Infectious Disease, 2024

Diagnostic Summary

Sputum Cultures	• May be useful for antibiotic de-escalation • Requires high-quality sputum sample
Blood Cultures	• May be useful for antibiotic de-escalation • May uncover alternative source of infection
Legionella pneumophila urinary antigen test	• May be considered in cases of outbreak, recent travel, or recent health-care exposure
Streptococcal pneumonia urinary antigen test	• Poor influence on antibiotic de-escalation

Musher et al., NEJM, 2014
Davis et al., Open Forum Infectious Disease, 2024
Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

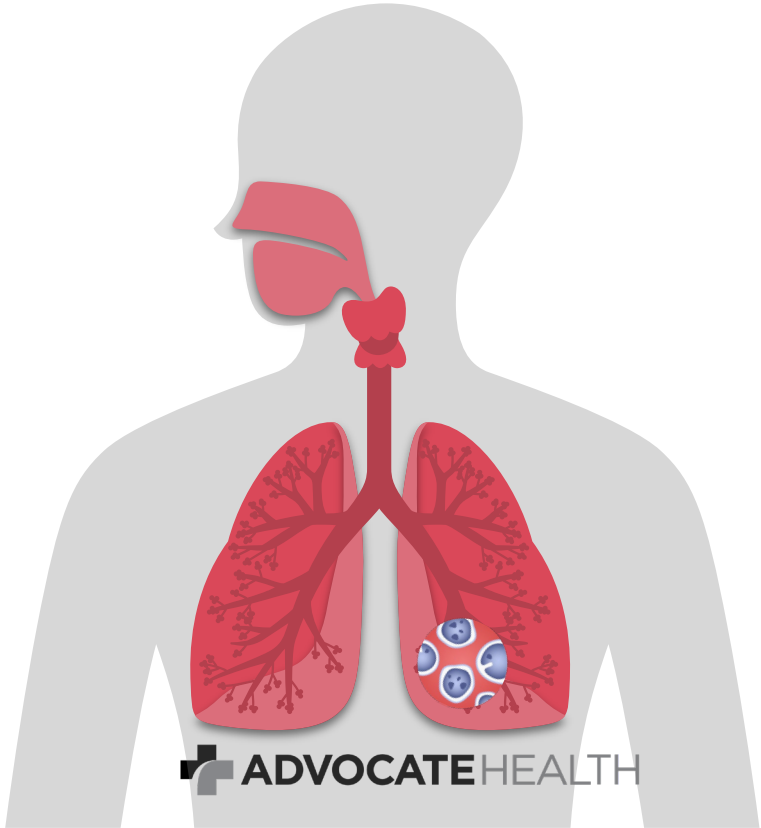
Assessment Question #1

JR is a 67-year-old male with a history of COPD, type 2 diabetes, and hypertension, who presents to the emergency department with a 3-day history of fever, productive cough with yellow sputum, intermittent chest pain, and increased shortness of breath requiring supplemental oxygen. Lung exam reveals crackles, and bronchial breath sounds over the right lower lobe. Vancomycin and piperacillin-tazobactam were initiated. What labs would you consider ordering?

Select all that apply:

A. Blood culture
B. Streptococcus pneumoniae urinary antigen
C. Sputum culture
D. Legionella urine antigen

Treatment



Assessing Severity

The Pneumonia Severity Index (PSI)

Demographic factors Age (in years)

Men
Women -10
Nursing home resident +10

Coexisting illnesses

Neoplastic disease +30
Liver disease +20
CHF +10
CVA +10
Renal disease +10

Findings on physical examination

Altered mental status +20
RR ≧ 30/min +20
SBP <90 mmHg +20
BT <35ºC or ≧ 40ºC +15
HR ≧ 125 beats/min +10

Laboratory and CXR findings

Arterial pH <7.35 +30
BUN ≧ 30 +20
Sodium < 130 +20
Glucose ≧ 250 +10
Hematocrit <30% +10
PaO_2 < 60 mmHg or SpO_2< 90% +10
Pleural effusion +10

PSI Class	Total # points	30-Day mortality	Disposition
I	<51	0.1%	outpatient
II	51-70	0.6%	Outpatient
III	71-90	0.9%	Outpatient vs short stay inpatient
IV	91-130	9.3%	inpatient
V	>130	27.0%	Inpatient ICU

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Assessing Severity

C	Confusion of new onset
U	Urea (BUN) > 7 mmol/L (19mg/dl)
R	Respiratory rate > 30 breathes/min
B	Blood pressure <90/60 mmhg
65	Age >65 years old

Interpretation:

0-1: Treat as outpatient

2: Admit patient

>3: Consider ICU admission

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Classifications

Severe community acquired pneumonia includes either 1 major criterion or ≥ 3 minor criteria:

Major criteria:

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

Minor criteria:

- Hypotension requiring aggressive fluid resuscitation
- Thrombocytopenia (platelet count < 100,000/microL)
- Hypothermia (core temperature < 36°C)
- Uremia (Blood urea nitrogen level ≥ 20 mg/dL)
- Leukopenia (white blood cell count < 4,000 cells/microL)
- Multilobar infiltrates
- Confusion/disorientation
- Respiratory rate ≥ 30 breathes/min

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Treatment

Severity	Standard regimen	Empiric therapy options
Non-severe inpatient pneumonia	β-Lactam + macrolide or fluroquinolone	Ampicillin-sulbactam, cefotaxime, **ceftriaxone**, or ceftaroline + **azithromycin** or clarithromycin or doxycycline levofloxacin or moxifloxacin
Severe inpatient pneumonia	β -Lactam + macrolide or β-lactam + fluroquinolone	Ampicillin-sulbactam, cefotaxime, **ceftriaxone**, or ceftaroline + **azithromycin** or clarithromycin or doxycycline Ampicillin-sulbactam, cefotaxime, ceftriaxone, or ceftaroline + levofloxacin or moxifloxacin

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Treatment

Risk factors for MRSA and *Pseudomonas aeruginosa*:

- Previously infected with MRSA or *P. aeruginosa*
- Hospitalized in the past 90 days
- IV antibiotics in the past 90 days
- Locally validated risk factors

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Treatment

Locally validated risk factors for *Pseudomonas aeruginosa*:

Chronic Structural Lung Disease	Immunosuppression
• Pulmonary Fibrosis • End-Stage COPD	• Congenital or acquired immunodeficiency • Hematologic disease • Receipt of immunosuppressive medications within previous 30 days • Current use of >10 mg/day prednisone or equivalent for >30 days • Neutropenia (<1000 cells/mm^3)

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Treatment

Locally validated risk factors for MRSA:

- MRSA colonization
- IV drug abuse
- Critically ill with recent influenza infection

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Treatment

Risk Factor	Empiric Therapy Options
MRSA	**Vancomycin** or linezolid
Pseudomonas aeruginosa	**Piperacillin-tazobactam**, **cefepime**, ceftazidime, aztreonam, meropenem, or imipenem

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Aspiration Coverage

- Anaerobes are infrequently isolated, even in cases labeled as aspiration pneumonia
- Usually resolves within 24-48 hours with supportive care
- Antibiotics are only recommended if there are radiographic evidence of abscess or empyema

Mandell et al., NEJM, 2019
Bai et al., CHEST, 2024

Assessment Question #2

Which of the following patient-specific factors should prompt consideration of MRSA coverage in pneumonia treatment?

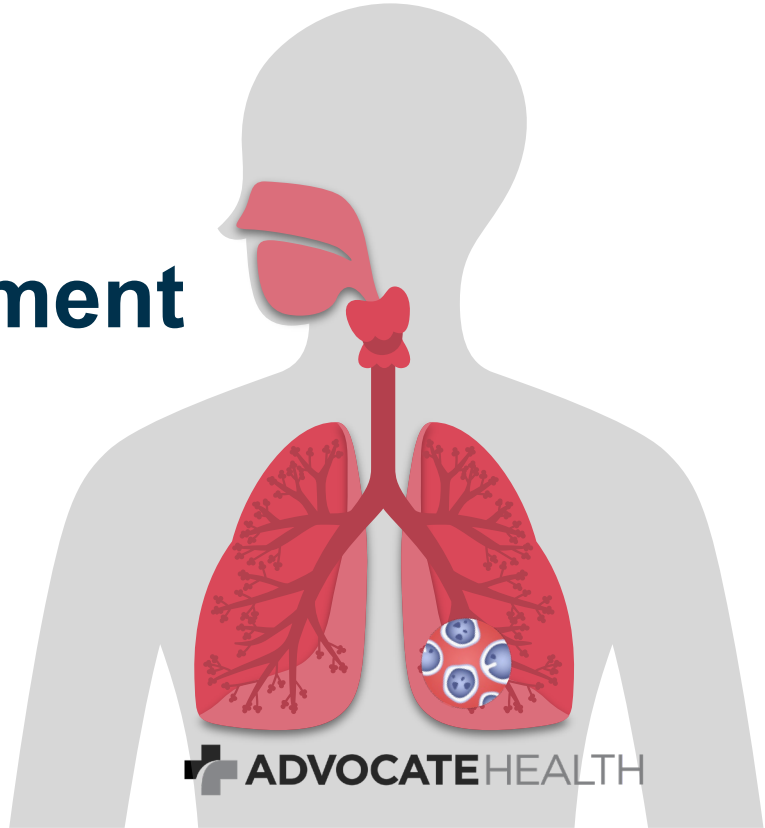
A) Elevated C-reactive protein levels

B) Presence of chronic obstructive pulmonary disease

C) Recent hospitalization with antibiotic therapy within the past 90 days

D) Smoking history greater than 20 pack-years

Adjunctive Treatment



Flu and Concomitant Pneumonia

2019 IDSA/ATS

- If radiographic evidence of pneumonia is present, begin antibiotics

2025 ATS

- For patients being treated outpatient and have no comorbidities, it is not recommended to prescribe empiric antibiotic treatment
- For adult inpatients or those with comorbidities, must weigh 2 important risks:
  - Risks of missed or delayed antibiotic treatment to patients with concomitant bacterial pneumonia
  - Risks of antibiotic use to individual and public health

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

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Flu and Concomitant Pneumonia

Comorbidities that may warrant antibiotic therapy

- Chronic pulmonary disease other than asthma
- End-stage liver disease
- End-stage renal disease
- Cardiovascular disease
- Alcoholism
- Neoplastic disease

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

Corticosteroids

2019 IDSA/ATS

- Generally, not recommended
- May be considered only in cases of refractory shock

2025 ATS

- Non-severe pneumonia: not recommended, the decrease in mortality was not statistically significant
- Severe pneumonia: recommend systemic corticosteroids, excludes patients with severe CAP due to influenza pneumonia

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

Corticosteroids

Corticosteroids in Community-Acquired Bacterial Pneumonia: A Systematic Review

Study Design

- Meta analysis of 30 randomized control trials, including a total of 7519 patients

Study Objective

- Estimate the effect of corticosteroid therapy compared with control on mortality in hospitalized adults

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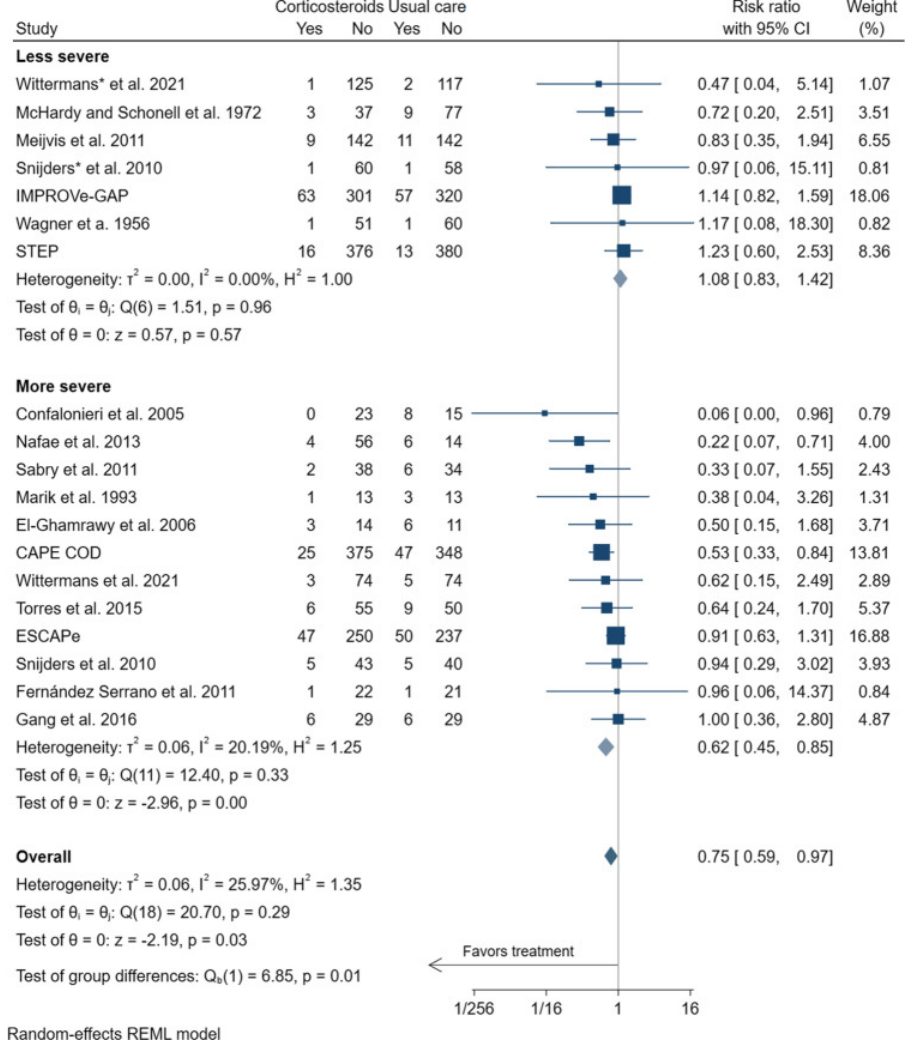
Pitre et al., Journal of General Internal Medicine, 2023

Corticosteroids in Community-Acquired Bacterial Pneumonia: A Systematic Review



Pitre et al., Journal of General Internal Medicine, 2023

Conclusions:
Corticosteroids reduce mortality in patients with more severe CAP, the need for invasive mechanical ventilation, and ICU admission

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Assessment Question #3

How do the 2025 ATS guideline address the use of corticosteroids in severe pneumonia compared to the 2019 IDSA/ATS guidelines?

A. The 2025 guidelines strongly encourage the routine use of corticosteroids for severe CAP, while the 2019 guidelines suggest their use in select cases

B. The 2025 guidelines advise against the use of corticosteroids in any severe pneumonia cases, whereas the 2019 guidelines recommend them for patients with high inflammatory markers

C. The 2025 guidelines recommend corticosteroids for patients with CAP who fail to respond to initial antibiotic therapy, while the 2019 guidelines focus more on early antibiotic de-escalation

D. The 2025 guidelines focus on corticosteroid therapy for viral pneumonia, whereas the 2019 guidelines only support their use for bacterial pneumonia

Antibiotic De-escalation

- Clinical improvement is typically observed within 48 to 72 hours after initiation of antibacterial therapy
- Deescalate when the patient demonstrates clinical improvement, is hemodynamically stable, and can tolerate oral medications

Criteria for Clinical Stability	
Temperature < 100.4°F (37.8°C)	RR ≤24 breaths/minute
Heart rate ≤100 beats/minute	Systolic Blood Pressure ≥90 mmHg
Ability to eat	Normal mentation
O_2 Saturation ≥90% on room air OR pO_2 > 60 mmHg on room air OR return to baseline O_2 needs	

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Utility of Procalcitonin

- Procalcitonin is a marker of systemic response to bacterial infection
- Noninfectious causes for rise in procalcitonin include major trauma, recent surgery, severe burns, severe cardiogenic shock and chronic kidney disease
- Certain medications, such as immunomodulatory therapies, can also cause elevated procalcitonin

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Procalcitonin Interpretation

- Procalcitonin should not be used in isolation to guide antimicrobial therapy initiation
- Insufficient sensitivity, specificity and lack of mortality benefit
- Can help guide the discontinuation of antibiotics, especially when procalcitonin levels fall below 0.5 µg/L or decrease by ≥80% from peak values

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Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019

Duration of Therapy

2019 IDSA/ATS

- No less than 5 days for non-severe pneumonia
- Pneumonia due to MRSA or pseudomonas, no less than 7 days

2025 ATS

- Non-Severe: 3-5 days
  - Clinical cure rate 3 to 4 weeks after treatment was similar among patients who received less than 5 days of antibiotics versus those who received 5 or more days
- Severe: 5 or more days

Metlay et al., American Journal of Respiratory and Critical Care Medicine, 2019
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

Duration of Therapy

Study	Design	Results
El Moussaoui et al	After 3 days treatment with IV amoxicillin, patients were randomly assigned to oral amoxicillin (n = 63) or placebo (n = 56) three times daily for 5 days	The clinical success rate: • Day 10: 93% for both (difference 0.1%, 95% CI -9% to 10%) • Day 28: 90% compared with 88% (difference 2%, 95% CI -9% to 15%)
Dinh et al	After 3 days of treatment with β-lactam therapy, patients were randomly assigned to receive placebo (n = 157) or continued β-lactam therapy (n = 153) for 5 extra days	Cure at day 15: • 77% of participants in the placebo group • 68% of participants in the β-lactam group (between-group difference of 9.42%, 95% CI -0.38 to 20.04)

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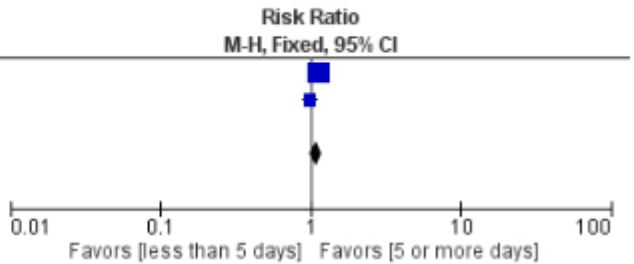
Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

Duration of Therapy

E) Sub-analysis #2.3: Clinical cure – short follow-up: inpatient only

Study or Subgroup	Less than 5 days Events	Total	5 or more days Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Dinh - 2021	113	145	100	146	65.3%	1.14 [0.99, 1.31]
Moussaoui - 2006	50	54	56	60	34.7%	0.99 [0.90, 1.10]
Total (95% CI)		**199**		**206**	**100.0%**	**1.09 [0.98, 1.20]**
Total events	163		156			

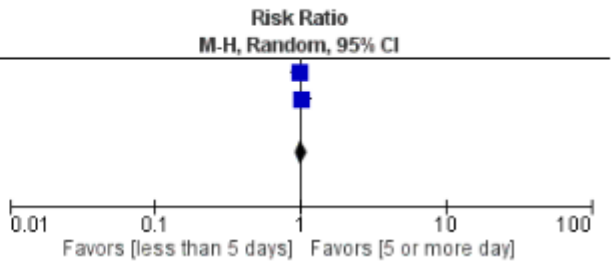
Heterogeneity: $Chi^2 = 3.54$, df = 1 (P = 0.06); $I^2 = 72\%$
Test for overall effect: Z = 1.65 (P = 0.10)



M) Sub-analysis #3.3: Clinical cure – long follow-up: inpatient only

Study or Subgroup	Less than 5 days Events	Total	5 or more days Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Dinh - 2021	105	141	107	141	49.5%	0.98 [0.86, 1.12]
Moussaoui - 2006	47	52	49	56	50.5%	1.03 [0.90, 1.18]
Total (95% CI)		**193**		**197**	**100.0%**	**1.01 [0.92, 1.11]**
Total events	152		156			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.33$, df = 1 (P = 0.57); $I^2 = 0\%$
Test for overall effect: Z = 0.15 (P = 0.88)



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Jones et al., American Journal of Respiratory and Critical Care Medicine, 2025

Assessment Question #4

MK was initiated on IV ceftriaxone and azithromycin 2 days ago. Blood cultures, sputum cultures, and urine antigen tests were negative. He has been afebrile for 48 hours, his oxygenation has improved, and he is considered to be clinically stable.

Which of the following is the most appropriate next step regarding his antibiotic therapy?

A. Continue IV ceftriaxone for a total of 5 days
B. Stop antibiotics since his S. pneumoniae urine antigen test was negative
C. Switch to oral amoxicillin & azithromycin for a total treatment duration of 3 days
D. Switch to oral azithromycin monotherapy for a total of 7 days

Key Take Aways

- Avoid unnecessary testing and treatment in patients with non-severe pneumonia
- In cases of influenza and concomitant pneumonia, weight the risk vs benefits of initiating antibiotics
- Assess MRSA and Pseudomonal risk when initiating empiric therapy
- Corticosteroid use is recommended in patients with severe CAP
- The recommended duration of therapy for pneumonia is now 3-5 days for non-severe CAP and 5 or more days for severe CAP

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Questions?

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