COMMUNITY ACQUIRED PNEUMONIA

Community-Acquired Pneumonia (CAP) *is an acute infection of the pulmonary parenchyma that occurs in individuals outside of hospital or healthcare settings or within 48 hours of admission to a hospital. It is defined by the presence of clinical symptoms such as fever, cough (with or without sputum production), dyspnea, pleuritic chest pain, and abnormal findings on physical examination (such as rales, decreased breath sounds) or radiologic imaging, particularly consolidation on chest X-ray or CT scan.*

Etiology of Community-Acquired Pneumonia (CAP)

The etiology of CAP includes a wide variety of bacterial, viral, and atypical pathogens. The specific causative agents often vary depending on patient age, comorbidities, geographic region, and the presence of risk factors like smoking, chronic lung disease, and immunosuppression.

Common Etiological Agents in CAP

Pathogen Type	***Specific Pathogens***
Bacterial Pathogens	*Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*
Atypical Bacteria	*Mycoplasma pneumoniae, Chlamydia pneumoniae, Legionella pneumophila*
Viral Pathogens	*Influenza A and B, Respiratory syncytial virus (RSV), SARS-CoV-2, Human metapneumovirus, Adenovirus*
Gram-Negative Bacilli	*Klebsiella pneumoniae, Pseudomonas aeruginosa (in patients with structural lung diseases)*
Fungal Pathogens	*Histoplasma capsulatum, Coccidioides immitis, Cryptococcus neoformans (typically in immunocompromised patients)*

Pathogenesis of CAP

The pathogenesis of CAP involves the invasion of lung parenchyma by microbial pathogens, leading to an inflammatory response within the alveoli and interstitial tissues. The mechanisms of disease progression include:

1. ***Colonization of the Upper Respiratory Tract****:*
    - *Pathogens such as Streptococcus pneumoniae colonize the nasopharynx without causing disease in healthy individuals. In patients with impaired host defenses (e.g., smokers, the elderly, or immunocompromised), these pathogens can bypass local barriers.*
2. ***Aspiration/Inhalation of Pathogens****:*
    - *The pathogens are inhaled into the lower respiratory tract or aspirated from the oropharyngeal region. Host defense mechanisms, such as mucociliary clearance, are overwhelmed or impaired.*
3. ***Impaired Host Defense Mechanisms****:*
    - *The immune system's first line of defense (alveolar macrophages and mucociliary clearance) is compromised in the elderly, smokers, or those with chronic lung diseases. Viral infections like influenza or SARS-CoV-2 can disrupt epithelial barriers, predisposing patients to bacterial superinfection.*
4. ***Alveolar Invasion and Inflammation****:*
    - *Once in the lower respiratory tract, pathogens trigger an inflammatory response. Proinflammatory cytokines (e.g., IL-1, TNF-alpha) are released by alveolar macrophages, leading to neutrophil recruitment. This inflammatory cascade results in alveolar filling with exudate, red blood cells, and fibrin, impairing gas exchange.*

5. ***Pneumonia Pathophysiology**:*
    - *The inflammatory response causes alveolar consolidation, reducing lung compliance and causing hypoxemia due to impaired gas exchange.*
    - *The bacteria may invade the bloodstream, causing bacteremia, septicemia, and sometimes metastatic infection in other organs.*

Risk Factors for Pathogen-Specific CAP

Risk Factor	***Common Pathogens***
Chronic obstructive pulmonary disease	*Haemophilus influenzae, Moraxella catarrhalis, Pseudomonas aeruginosa*
Alcoholism	*Streptococcus pneumoniae, Klebsiella pneumoniae*
Aspiration	*Anaerobes, Gram-negative enteric organisms*
Structural lung disease (e.g., bronchiectasis)	*Pseudomonas aeruginosa, Staphylococcus aureus*
Elderly or immunocompromised patients	*Legionella pneumophila, Respiratory viruses, Pneumocystis jirovecii (in HIV/AIDS)*
Post-influenza infection	*Staphylococcus aureus, Streptococcus pneumoniae*
HIV/AIDS	*Pneumocystis jirovecii, Cryptococcus neoformans*

Host-Pathogen Interaction

The balance between pathogen virulence and host defense determines the outcome of CAP. Key host defense mechanisms include:

- ***Alveolar macrophages**: First line of defense against microbial invasion.*
- ***Neutrophils**: Recruited to the alveoli to phagocytose and kill pathogens.*
- ***Cytokines and chemokines**: These modulate the inflammatory response but can also contribute to tissue damage and alveolar fluid accumulation.*

However, in severe cases or with highly virulent pathogens (e.g., Legionella), the host inflammatory response may be exaggerated, leading to widespread alveolar damage, capillary leakage, and severe hypoxemia (acute respiratory distress syndrome, ARDS).

Clinical Stages of Pneumonia (Histopathological Stages)

Stage	***Description***
Congestion	*Hyperemia of the pulmonary capillaries and alveolar exudation containing mostly serous fluid.*
Red Hepatization	*Alveoli filled with neutrophils, red blood cells, and fibrin; lung tissue appears firm and red.*
Gray Hepatization	*Breakdown of red blood cells, and alveoli filled with fibrinous exudate; lung tissue appears grayish.*
Resolution	*Gradual resorption of exudate, with restoration of normal lung architecture.*

Key Pathogens and Their Clinical Characteristics

Pathogen	***Typical Clinical Presentation***
Streptococcus pneumoniae	*Acute onset, productive cough with rusty sputum, fever, pleuritic chest pain.*

Pathogen	Typical Clinical Presentation
Mycoplasma pneumoniae	Gradual onset, dry cough, low-grade fever, often in young adults ("walking pneumonia").
Legionella pneumophila	High fever, GI symptoms (diarrhea), hyponatremia, confusion, often in smokers.
Influenza virus	Abrupt onset of fever, myalgia, headache, followed by cough and dyspnea.
Chlamydia pneumoniae	Gradual onset, dry cough, pharyngitis, sinusitis, often in elderly.

Clinical Features of Community-Acquired Pneumonia (CAP)

The clinical presentation of CAP can vary depending on the causative organism, the patient's age, and underlying comorbidities. CAP typically presents with the following symptoms:

Typical Symptoms:

- ***Fever*** *(with or without chills)*
- ***Cough****: May be productive or non-productive*
    - *Productive cough: Sputum may be purulent or blood-tinged (rusty-colored sputum in Streptococcus pneumoniae infection).*
- ***Pleuritic chest pain****: Sharp pain that worsens with deep breathing or coughing.*
- ***Dyspnea*** *(shortness of breath): Varies from mild to severe.*
- ***Tachypnea****: Increased respiratory rate.*

Atypical Symptoms:

- ***Fatigue****,* ***malaise****, and* ***weakness****: More common in elderly patients.*
- ***Confusion or altered mental status****: Particularly in the elderly and severe cases.*
- ***Diarrhea, nausea, vomiting****: Can occur in certain pathogens such as Legionella pneumophila.*
- ***Myalgia****,* ***arthralgia****, and* ***headache****: Often associated with viral or atypical pneumonia (Mycoplasma pneumoniae, Chlamydia pneumoniae).*

Physical Examination Findings:

- ***Tachypnea****,* ***tachycardia****, and* ***hypoxia*** *(in severe cases).*
- ***Crackles*** *(rales) on auscultation: Indicative of alveolar fluid.*
- ***Dullness to percussion****: Suggestive of consolidation or pleural effusion.*
- ***Bronchial breath sounds*** *over areas of consolidation.*
- ***Increased tactile fremitus*** *over the affected areas.*
- ***Pleural rub****: May be present in cases with pleuritic involvement.*

CURB-65 Score: Severity Assessment for CAP

The ***CURB-65 score*** *is a clinical tool used to assess the severity of CAP and guide decisions regarding hospital admission. Each of the 5 factors below is given 1 point, and the total score helps predict mortality risk.*

CURB-65 Components:

Criteria	Points
Confusion (new onset)**	1
Urea > 7 mmol/L (20 mg/dL)	1
Respiratory rate ≥ 30 breaths/min	1
Blood pressure < 90 mmHg systolic or ≤ 60 mmHg diastolic	1
Age ≥ **65** years	1

CURB-65 Score Interpretation:

Score	Mortality Risk	Management Recommendations
0-1	Low (<1.5%)	Outpatient management.
2	Intermediate (9.2%)	Consider short inpatient stay or close outpatient follow-up.
3-5	High (>22%)	Severe pneumonia; hospital admission or ICU care is indicated.

Pneumonia Severity Index (PSI): Risk Stratification Tool

*The **Pneumonia Severity Index (PSI)** or **PORT score** is another widely used tool for determining the severity of CAP and guiding treatment decisions, particularly to assess the need for hospitalization or intensive care. PSI classifies patients into five risk classes based on mortality prediction. It uses a more comprehensive set of criteria compared to CURB-65, which includes demographic, clinical, and laboratory data.*

PSI Scoring System:

Factor	Points
Demographics	
Age	Age in years (male)
Age	Age in years - 10 (female)
Nursing home resident	+10
Comorbidities	
Neoplastic disease	+30
Liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Renal disease	+10
Physical Examination Findings	
Altered mental status	+20
Respiratory rate ≥ 30 breaths/min	+20

Factor	Points
Systolic blood pressure < 90 mmHg	+20
Temperature < 35°C or ≥ 40°C	+15
Pulse ≥ 125 beats/min	+10
Laboratory Findings	
Arterial pH < 7.35	+30
Blood urea nitrogen ≥ 30 mg/dL	+20
Sodium < 130 mEq/L	+20
Glucose ≥ 250 mg/dL	+10
Hematocrit < 30%	+10
Partial pressure of oxygen (PaO2) < 60 mmHg or oxygen saturation < 90%	+10
Pleural effusion (on chest X-ray)	+10

PSI Risk Classification:

PSI Class	Total Points	Mortality (%)	Management
Class I	< 51	0.1%	Outpatient care
Class II	51–70	0.6%	Outpatient care
Class III	71–90	0.9%	Consider outpatient or short inpatient stay
Class IV	91–130	9.3%	Inpatient care recommended
Class V	> 130	27%	Inpatient care, ICU if required

Comparison Between CURB-65 and PSI:

Aspect	CURB-65	PSI (PORT Score)
Simplicity	Simple, quick (5 variables)	More complex (20 variables)
Factors Assessed	Limited to clinical and laboratory markers	Includes demographics, comorbidities, clinical, and laboratory markers
Use	Easy to use in emergency settings	More comprehensive for detailed risk stratification
Outcome Predicted	30-day mortality	30-day mortality
Utility	Guides hospitalization decisions quickly	Provides detailed prognosis and guides hospitalization vs outpatient management

Clinical Application of CURB-65 and PSI:

Both CURB-65 and PSI are useful for predicting the severity and mortality risk of CAP, but they are used in slightly different clinical settings:

- ***CURB-65*** *is preferred in emergency settings for its simplicity and ease of use.*
- ***PSI*** *is used for more comprehensive risk stratification, especially when considering comorbidities and long-term outcomes, to determine whether outpatient care is feasible.*

Diagnosis of Community-Acquired Pneumonia (CAP)

According to the latest ***Infectious Diseases Society of America (IDSA) and American Thoracic Society (ATS)*** *guidelines (2019), the diagnosis of CAP should be based on a combination of clinical, laboratory, and imaging findings.*

1. Clinical Diagnosis

The diagnosis of CAP is initially based on clinical features, including:

- ***History of acute onset respiratory symptoms*** *(e.g., cough, sputum production, dyspnea, pleuritic chest pain, fever, chills).*
- ***Physical examination findings*** *suggestive of pneumonia (e.g., crackles, diminished breath sounds, dullness to percussion).*
- ***Presence of risk factors*** *for CAP (e.g., smoking, advanced age, chronic lung disease, immunocompromised state).*

However, clinical symptoms alone are not sufficient for a definitive diagnosis, as they can overlap with other respiratory conditions such as bronchitis or asthma. Therefore, clinical diagnosis should be supported by imaging and laboratory investigations.

2. Laboratory Investigations

To confirm the presence of infection and assess the severity of disease, the following tests are recommended:

- ***Complete blood count (CBC)****: Elevated white blood cell count (leukocytosis) with a left shift (increased neutrophils) is common.*
- ***C-reactive protein (CRP)*** *or* ***procalcitonin****: These biomarkers may help differentiate bacterial from viral pneumonia.*
- ***Blood cultures****: Recommended in patients with severe CAP or those being admitted to the hospital, especially to detect bacteremia caused by Streptococcus pneumoniae or Staphylococcus aureus.*
- ***Sputum culture and Gram stain****: Especially useful in hospitalized patients to identify the causative pathogen.*
- ***Urinary antigen tests****: For rapid detection of Streptococcus pneumoniae and Legionella pneumophila in severe CAP cases.*
- ***Nasal or throat swabs****: For PCR testing to identify respiratory viruses, especially during influenza season or in cases of suspected viral pneumonia (e.g., SARS-CoV-2, RSV, or influenza).*

3. Imaging in CAP Diagnosis

Chest imaging *is essential for confirming the diagnosis of CAP. The latest IDSA/ATS guidelines emphasize the importance of chest radiography or, in some cases, chest CT for establishing the presence of pneumonia.*

Chest Radiography (X-ray)

- ***Standard chest X-ray*** *remains the cornerstone of CAP diagnosis.*
- *It should be obtained in all patients with suspected CAP to confirm the presence of* ***pulmonary infiltrates*** *(e.g., lobar consolidation, interstitial infiltrates, or cavitation).*
- ***Findings****: The presence of new or progressive infiltrates supports the diagnosis of pneumonia.*

Common radiographic patterns include:

  - ***Lobar consolidation****: Common in bacterial pneumonia, especially Streptococcus pneumoniae.*
  - ***Interstitial infiltrates****: More typical of viral or atypical pathogens (e.g., Mycoplasma pneumoniae, Legionella).*

- ***Cavitation**: Suggests necrotizing pneumonia, often caused by Staphylococcus aureus or gram-negative pathogens.*
- ***Pleural effusion**: Seen in more severe cases, can indicate complicated pneumonia.*

***Note**: A normal chest X-ray does not completely rule out pneumonia, particularly in early stages, immunocompromised patients, or dehydrated individuals. A repeat X-ray may be needed if clinical suspicion remains high.*

Chest Computed Tomography (CT)

- ***Chest CT** is not routinely recommended for all patients but can be helpful in cases where:*
  - *The diagnosis is uncertain (e.g., equivocal chest X-ray findings).*
  - *There is suspicion of complications (e.g., abscess, empyema, or necrotizing pneumonia).*
  - *Atypical pathogens or unusual presentations are suspected.*

***CT findings** include:*

- *More detailed visualization of lung parenchyma, useful in identifying small or early infiltrates.*
- *Detection of cavitation or lymphadenopathy.*

Ultrasound

- *Lung **ultrasound** may be used in certain settings, especially in critically ill patients or those who cannot undergo a chest X-ray. It is helpful in identifying **consolidations** and **pleural effusions**, although it is less commonly used compared to chest X-ray or CT in the initial evaluation of CAP.*

Summary of Diagnostic Imaging

Imaging Modality	***Usefulness***	***Indications***
Chest X-ray	*- Gold standard for initial diagnosis of CAP.*	*- All patients with suspected CAP.*
Chest CT	*- More sensitive for detecting small infiltrates, cavitation, and complications (e.g., abscess).*	*- When the diagnosis is unclear or in severe/complicated CAP.*
Lung ultrasound	*- Useful for pleural effusions and in settings where X-ray/CT is not feasible.*	*- Critically ill patients or those unable to undergo X-ray/CT.*

IDSA/ATS 2019 Guidelines on Imaging for CAP

*The 2019 guidelines from IDSA/ATS recommend the use of **chest radiography** for all patients with suspected CAP to confirm the diagnosis and rule out other potential causes of respiratory symptoms. **Chest CT** is reserved for complicated or unclear cases, while lung ultrasound may be used in critically ill patients where X-ray is not feasible.*

In terms of follow-up imaging, routine repeat chest X-rays are not required in uncomplicated CAP but may be indicated in patients who fail to improve clinically or if there is suspicion of complications such as empyema or abscess formation.

Treatment of Community-Acquired Pneumonia (CAP)

*The treatment of CAP is guided by the severity of the disease, the patient's age, comorbid conditions, and local pathogen resistance patterns. The **2019 IDSA/ATS Guidelines** recommend stratifying treatment into **outpatient**, **inpatient (non-ICU)**, and **inpatient (ICU)** settings, based on severity scores like **CURB-65** or **Pneumonia Severity Index (PSI)**.*

1. Outpatient Management

Outpatient treatment is appropriate for patients with mild CAP who have low severity scores (e.g., CURB-65 score of 0 or 1, or PSI class I or II).

Empiric Antibiotic Therapy (Outpatient)

- ***Previously healthy patients with no comorbidities or recent antibiotic use**:*
    - ***First-line:***
        - ***Amoxicillin**: 1 g PO three times daily (high-dose to cover resistant S. pneumoniae).*
        - ***Doxycycline**: 100 mg PO twice daily (alternative if penicillin allergy or suspected atypical pathogens).*
    - ***Alternative for atypical pathogens** (e.g., Mycoplasma pneumoniae, Chlamydia pneumoniae):*
        - ***Azithromycin**: 500 mg PO on day 1, then 250 mg PO daily on days 2–5.*
        - ***Clarithromycin**: 500 mg PO twice daily for 5–7 days (note increased resistance in some areas).*
- ***Patients with comorbidities (chronic heart, lung, liver, or renal disease; diabetes; alcoholism; malignancy) or recent antibiotic use**:*
    - ***First-line (combination therapy)**:*
        - ***Amoxicillin-clavulanate**: 875 mg/125 mg PO twice daily **or** 500 mg/125 mg PO three times daily **or***
        - ***Cefuroxime**: 500 mg PO twice daily, PLUS*
        - ***Azithromycin**: 500 mg PO on day 1, then 250 mg PO daily on days 2–5, or*
        - ***Doxycycline**: 100 mg PO twice daily.*
    - ***Alternative monotherapy**:*
        - ***Levofloxacin**: 750 mg PO daily for 5 days (covers both typical and atypical organisms).*
        - ***Moxifloxacin**: 400 mg PO daily for 5 days.*

2. Inpatient Management (Non-ICU)

Patients with moderate CAP (e.g., CURB-65 score of 2, or PSI class III or IV) who do not require ICU admission should be hospitalized.

Empiric Antibiotic Therapy (Inpatient, Non-ICU)

- ***Combination Therapy** (Preferred):*
    - ***Beta-lactam + macrolide**:*
        - ***Ceftriaxone**: 1–2 g IV once daily, PLUS*
        - ***Azithromycin**: 500 mg IV/PO once daily.*

***Alternative Beta-lactams**:*

- ***Cefotaxime**: 1–2 g IV every 8 hours, OR*
- ***Ampicillin-sulbactam**: 1.5–3 g IV every 6 hours.*

- ***Monotherapy (for penicillin-allergic patients)**:*
    - ***Levofloxacin**: 750 mg IV/PO once daily, or*
    - ***Moxifloxacin**: 400 mg IV/PO once daily.*

Considerations for Specific Pathogens:

- ***Legionella pneumonia**: Empiric coverage with **macrolide (azithromycin)** or **fluoroquinolone (levofloxacin)**.*
- ***MRSA** suspected (e.g., recent influenza or risk factors for MRSA):*
    - *Add **Vancomycin**: 15–20 mg/kg IV every 8–12 hours (target trough: 15–20 mg/L) or*

- ***Linezolid**: 600 mg IV/PO twice daily.*

- ***Pseudomonas aeruginosa** suspected (e.g., structural lung disease):*
  - *Use **Piperacillin-tazobactam**: 4.5 g IV every 6 hours, or*
  - ***Cefepime**: 2 g IV every 8 hours, PLUS*
  - ***Levofloxacin**: 750 mg IV daily or an aminoglycoside (e.g., tobramycin).*

3. Inpatient Management (ICU)

Patients with severe CAP (e.g., CURB-65 score ≥ 3, or PSI class V) who require intensive care due to respiratory failure, sepsis, or shock need aggressive treatment.

Empiric Antibiotic Therapy (Inpatient, ICU)

- ***Combination Therapy (Preferred)**:*
  - ***Beta-lactam + macrolide**:*
    - ***Ceftriaxone**: 1–2 g IV once daily, or*
    - ***Cefotaxime**: 1–2 g IV every 8 hours, or*
    - ***Ampicillin-sulbactam**: 3 g IV every 6 hours, PLUS*
    - ***Azithromycin**: 500 mg IV once daily.*

***Alternative Combination**:*

- ***Beta-lactam + fluoroquinolone**:*
  - ***Ceftriaxone or Cefotaxime** (as above), PLUS*
  - ***Levofloxacin**: 750 mg IV once daily, or*
  - ***Moxifloxacin**: 400 mg IV once daily.*

Special Considerations (ICU):

- ***MRSA coverage**: Add **Vancomycin** or **Linezolid** if Staphylococcus aureus is suspected.*
- ***Pseudomonas coverage**: In patients at risk for Pseudomonas infection, use:*
  - ***Piperacillin-tazobactam**: 4.5 g IV every 6 hours, or*
  - ***Cefepime**: 2 g IV every 8 hours, PLUS*
  - ***Levofloxacin**: 750 mg IV daily or an aminoglycoside.*

4. Duration of Therapy

- *The duration of antibiotic therapy depends on the clinical response:*
  - ***Outpatients**: 5 days of therapy is typically sufficient if the patient shows clinical improvement (afebrile for 48–72 hours and stable vitals).*
  - ***Inpatients (non-ICU)**: 5–7 days of therapy, tailored to clinical response.*
  - ***ICU patients**: 7–10 days of therapy is generally recommended, especially if the clinical course is complicated by bacteremia or other factors.*
  - ***Atypical pathogens (e.g., Legionella, Mycoplasma)** may require extended therapy (up to 10–14 days).*

Adjunctive Therapy

- ***Corticosteroids**: Not routinely recommended in non-severe CAP but may be considered in select cases of severe CAP or refractory septic shock.*

- ***Oxygen therapy**: Supplemental oxygen should be provided as needed to maintain oxygen saturation ≥92%.*
- ***Mechanical ventilation**: In cases of respiratory failure, invasive or non-invasive mechanical ventilation may be required.*

Monitoring and Follow-up

- *Clinical response should be assessed within **48–72 hours** of initiating therapy. Failure to improve may prompt further investigation (e.g., repeat cultures, chest imaging) and consideration of complications (e.g., pleural effusion, abscess).*
- *Routine follow-up chest X-rays are not required in uncomplicated cases but may be performed after several weeks in patients with slow clinical recovery or suspicion of underlying malignancy..*

Summary of CAP Treatment Based on 2019 IDSA/ATS Guidelines

Category	***First-line Antibiotics***	***Alternative Antibiotics***	***Duration***
Outpatient - Healthy, No Comorbidities	*- **Amoxicillin**: 1 g PO three times daily*	*- **Doxycycline**: 100 mg PO twice daily*	*5 days if clinically stable*
		*- **Azithromycin**: 500 mg PO on day 1, then 250 mg PO daily (if low resistance)*	
Outpatient - With Comorbidities (chronic heart/lung/renal disease, diabetes, alcoholism, etc.)	*- **Amoxicillin-clavulanate**: 875 mg/125 mg PO twice daily or **Cefuroxime**: 500 mg PO twice daily*	*- **Levofloxacin**: 750 mg PO once daily*	*5–7 days*
	*PLUS **Azithromycin**: 500 mg PO on day 1, then 250 mg PO daily*	*- **Moxifloxacin**: 400 mg PO once daily*	
	***OR Doxycycline**: 100 mg PO twice daily*		
Inpatient (Non-ICU)	*- **Ceftriaxone**: 1–2 g IV once daily **or** **Cefotaxime**: 1–2 g IV every 8 hours*	*- **Levofloxacin**: 750 mg IV/PO once daily*	*5–7 days depending on clinical response*
	*PLUS **Azithromycin**: 500 mg IV once daily*	*- **Moxifloxacin**: 400 mg IV/PO once daily*	
	***OR Ampicillin-sulbactam**: 3 g IV every 6 hours*		
Inpatient (ICU)	*- **Ceftriaxone**: 1–2 g IV once daily **or** **Cefotaxime**: 1–2 g IV every 8 hours*	*- **Levofloxacin**: 750 mg IV daily **or Moxifloxacin**: 400 mg IV daily*	*7–10 days*
	*PLUS **Azithromycin**: 500 mg IV once daily*	*- **Vancomycin** or **Linezolid** for MRSA coverage (if suspected)*	
	***OR Ampicillin-sulbactam**: 3 g IV every 6 hours*	*- **Piperacillin-tazobactam** or **Cefepime** for Pseudomonas coverage*	
MRSA Coverage (If Suspected)	*- **Vancomycin**: 15–20 mg/kg IV every 8–12 hours (target trough: 15–20 mg/L)*	*- **Linezolid**: 600 mg IV/PO twice daily*	*Depends on clinical response*

Category	*First-line Antibiotics*	*Alternative Antibiotics*	*Duration*
Pseudomonas Coverage (If Suspected)	*- **Piperacillin-tazobactam**: 4.5 g IV every 6 hours*	*- **Cefepime**: 2 g IV every 8 hours*	*Depends on clinical response*
	*PLUS **Levofloxacin**: 750 mg IV daily*		

Key Notes:

- ***Duration**: Antibiotic therapy is typically 5 days for outpatients, but can be extended to 7–10 days for hospitalized patients based on clinical response.*
- ***Special Pathogen Considerations**:*
  - *For suspected **Legionella**, a macrolide or fluoroquinolone is preferred.*
  - *In cases of **MRSA**, **vancomycin** or **linezolid** should be added.*
  - ***Pseudomonas** coverage is required in patients with structural lung disease or other risk factors.*