Pneumonia: Types,Causes, Symptom, Diagnosis and Treatment

Pneumonia is an acute or chronic infection of the lung parenchyma, characterized by inflammation of the alveoli and/or interstitial tissue, leading to impaired gas exchange. It may involve alveolar consolidation, bronchioles, or the interstitium.

Etiology and Causative Agents

Pneumonia may be caused by:

- **Infectious agents** :
  - **Bacteria** : *Streptococcus pneumoniae* , *Haemophilus influenzae* , *Mycoplasma pneumoniae* , *Legionella pneumophila* , *Chlamydophila pneumoniae*
  - **Viruses** : Influenza virus, RSV, Parainfluenza virus, Adenovirus, SARS-CoV-2
  - **Fungi** : *Pneumocystis jirovecii* , *Histoplasma capsulatum* , *Aspergillus* spp.
- **Non-infectious agents** : Gastric acid aspiration, toxic inhalants (smoke, chemical fumes)

? **High-Yield Note** :

- *S. pneumoniae* is the leading cause of **community-acquired pneumonia (CAP)** .
- **Aspiration pneumonia** is common in stroke, elderly, or sedated patients.
- **Ventilator-associated pneumonia (VAP)** is linked to *Pseudomonas* , *Acinetobacter* , *MRSA* .

Classification of Pneumonia

A. By Anatomic Pattern of Involvement

1. **Lobar Pneumonia**
   - Consolidation of an entire lobe
   - Typically caused by *S. pneumoniae*
2. **Bronchopneumonia**
   - Patchy consolidation centered around bronchi
   - Common in elderly or debilitated individuals
3. **Interstitial (Atypical) Pneumonia**
   - Involves alveolar walls and interstitium
   - Often viral or caused by *Mycoplasma*
4. **Miliary Pneumonia**
   - Hematogenous spread leading to diffuse micronodular infiltrates
   - Associated with TB, fungal, or disseminated infections

B. By Clinical Setting

Classification	Description	Common Pathogens
Community-Acquired (CAP)	Acquired outside hospitals	*S. pneumoniae* , *H. influenzae* , *M. pneumoniae* , respiratory viruses
Hospital-Acquired (HAP)	Onset ?48h after admission	*P. aeruginosa* , *Klebsiella* , *MRSA* , *Enterobacter*
Ventilator-Associated (VAP)	Occurs ?48h after intubation	Similar to HAP but more resistant organisms
Healthcare-Associated (HCAP)	Exposure to healthcare settings (dialysis, nursing homes)	Similar to HAP organisms

? **High-Yield Tip** :
Hospital-acquired organisms often show **multidrug resistance (MDR)** . Empiric therapy should consider local antibiogram data.

C. By Causative Agent

1. **Typical Pneumonia**
   - Extracellular bacteria (e.g. *S. pneumoniae*)
   - Presents with productive cough, high fever, lobar consolidation
2. **Atypical Pneumonia**
   - Caused by *Mycoplasma* , *Chlamydia* , viruses
   - Dry cough, milder symptoms, diffuse interstitial infiltrates
3. **Aspiration Pneumonia**
   - Inhalation of gastric contents
   - Common in impaired consciousness, poor gag reflex
   - Affects right lower lobe most commonly
4. **Opportunistic Pneumonia**
   - Occurs in immunocompromised patients (e.g. AIDS, transplant)
   - Caused by *Pneumocystis jirovecii* , *Aspergillus* , *CMV*
5. **Cryptogenic Organizing Pneumonia (COP)**
   - Non-infectious, inflammatory disorder resembling pneumonia
   - Patchy subpleural consolidation, responds to steroids
6. **Legionnaire's Disease**
   - Caused by *Legionella pneumophila*
   - Found in water systems, presents with GI symptoms, hyponatremia, confusion

Risk Factors

- Extremes of age (<5 years, >65 years)
- Smoking, COPD, asthma
- Immunosuppression (HIV/AIDS, chemotherapy)
- Neurological disease (stroke, Parkinson’s)
- Recent hospitalization or surgery
- Mechanical ventilation (VAP)
- Dysphagia, GERD, sedation

Pathophysiology

1. **Invasion of lung parenchyma** by pathogen
2. **Inflammatory response** triggers cytokine release (e.g., IL-1, TNF-?)
3. **Alveolar exudation** causes consolidation and impaired oxygenation
4. **Resolution** or progression to complications (e.g., abscess, ARDS)

Clinical Manifestations

Typical Pneumonia	Atypical Pneumonia
Sudden onset	Insidious onset
High-grade fever	Low-grade fever
Productive cough with purulent sputum	Dry cough
Pleuritic chest pain	Mild/no chest pain
Dyspnea	Mild or absent dyspnea
Lobar consolidation on CXR	Diffuse, patchy infiltrates

Diagnostic Evaluation

- **History and physical exam**
- **Chest X-ray (CXR)** : Lobar vs interstitial infiltrates
- **Sputum culture & Gram stain**
- **Blood cultures**
- **Pulse oximetry/ABG** : Assess oxygenation
- **CBC** : Leukocytosis in bacterial infections
- **CRP, Procalcitonin** : Help differentiate bacterial vs viral causes

? **USMLE Tip** :

- *Legionella* requires urine antigen test
- *P. jirovecii* needs special stains (e.g., silver stain) or PCR
- Look for **hypoxia out of proportion** in interstitial pneumonia

Management

1. Empiric Antibiotic Therapy (Adults)

Setting	First-Line
Outpatient (no comorbidity)	Amoxicillin, Doxycycline, Macrolide (if resistance <25%)
Outpatient (comorbid)	Amoxicillin-clavulanate + Macrolide or Doxycycline
Inpatient (non-ICU)	IV Beta-lactam + Macrolide or Fluoroquinolone
ICU	Beta-lactam + Azithromycin or Fluoroquinolone ± MRSA/Pseudomonas coverage

? **High-Yield** :

- *Macrolides* are preferred in atypical pneumonia.
- *Vancomycin or Linezolid* added if MRSA is suspected.
- *Piperacillin-tazobactam* for HAP/VAP with Pseudomonas risk.

2. Supportive Care

- Oxygen therapy
- IV fluids
- Antipyretics
- Chest physiotherapy (selected patients)

Complications

- Lung abscess
- Pleural effusion/empyema
- ARDS (acute respiratory distress syndrome)
- Sepsis
- Respiratory failure

Prevention

- **Vaccination** :
  - Pneumococcal vaccine (PCV13/PPSV23)
  - Influenza vaccine annually
  - COVID-19 vaccine
- **Hand hygiene**
- **Smoking cessation**
- **Head elevation in tube-fed or sedated patients**

High-Yield Summary for NCLEX & USMLE

Feature	Typical Pneumonia	Atypical Pneumonia
Causative agent	*S. pneumoniae* , *Klebsiella*	*Mycoplasma* , *Chlamydia* , viruses
Onset	Sudden	Gradual
Sputum	Purulent	Scant or absent
WBC	Elevated	Normal/slightly elevated
CXR	Lobar consolidation	Diffuse interstitial
Response to ?-lactams	Good	Poor (needs macrolide/tetracycline)