



# Lecture 6: Treatment of bacterial respiratory infections 2

Respiratory system

Second year

Medical school

Hashemite University

2<sup>nd</sup> semester 23/24

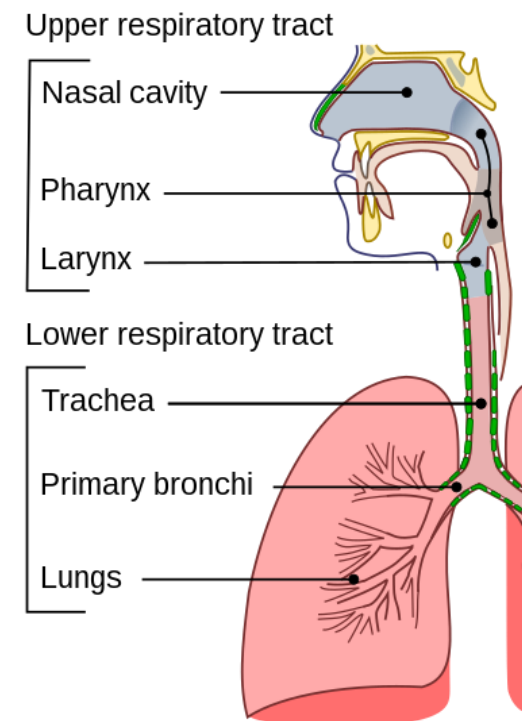
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# Respiratory tract infections

- Divided to:

- I. Upper Respiratory tract Infection (URTI)  
(common cold, pharyngitis, epiglottitis, & otitis media etc.)
- II. Lower Respiratory tract Infection (LRTI)  
(bronchitis, bronchiolitis & pneumonia)





# Lower respiratory tract infection (LRTI)

- A group of disease effect the respiratory system below the throat
- Pneumonia, lung abscess, bronchiolitis and bronchitis.
- Symptoms include shortness of breath, weakness, fever, coughing and fatigue

## Antibiotics:

- the first line treatment for pneumonia
- NOT effective and NOT indicated for parasitic or viral infections.
- Acute bronchitis typically resolves on its own with time.
- Vaccines available for many pathogens

## UPPER RESPIRATORY TRACT VERSUS LOWER RESPIRATORY TRACT

Upper respiratory tract is the uppermost section of the respiratory tract, which is mainly involved in the conduction of air	Lower respiratory tract is the lowermost section of the respiratory tract, which is mainly involved in the gas exchange
Consists of the upper parts of the respiratory tract above the lung	Consists of the lower parts of the respiratory tract that occur inside the lung
Composed of nose, sinus, throat, larynx, and trachea	Composed of bronchi, bronchioles, and alveoli
Lined by the pseudostratified epithelium	Alveoli and bronchioles are lined by the simple squamous epithelium
Main function is to conduct air to the bottom part of the respiratory tract	Conduction of air and gas exchange are the main functions
Flu, common cold, laryngitis, sinusitis, and tonsillitis are infections of the upper respiratory tract	Pneumonia, tuberculosis, bronchitis, and bronchiolitis are infections of the lower respiratory tract

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# Lower respiratory tract infection: **bronchitis**

- Bronchitis: inflammation of the bronchi (medium and large airways)

## **Acute bronchitis:**

- cough that lasts around three weeks, wheezing, shortness of breath, chest pain.
- primarily viral (parainfluenza and influenza), could be bacterial infection (Mycoplasma)
- Paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs)
- Antibiotics should generally not be used

## **Chronic bronchitis (COPD)**



# Lower respiratory tract infection: **bronchiolitis**

- acute inflammatory injury of the bronchioles (small airways)
- Mainly viral (RSV).
- any age, but severe and more common <2 years
- Fever, cough, runny nose, wheezing, and breathing problems.
- Complications: dehydration and aspiration pneumonia
- No diagnostic test are required
- No specific treatment, home care is sufficient
- Hospital admission for oxygen, support with feeding, or intravenous fluids
- No clear evidence for antibiotics, antivirals, bronchodilators, or nebulized epinephrine?!



Disease	Symptoms	Pathogens (common)	Pharmacotherapy
bronchitis	<p><b>Acute:</b> cough (<math>\leq 3</math> weeks (Sputum?), wheezing, shortness of breath, chest pain.</p> <p><b>Chronic:</b> productive cough that lasts for three months or more per year for at least two years. <b>(remember COPD)</b></p>	primarily viral (parainfluenza and influenza), could be bacterial infection (Mycoplasma)	<p><b>Acute:</b> Paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs) Antibiotics should generally not be used</p> <p><b>Chronic:</b> Quit smoking, vaccinations, rehabilitation, and inhaled bronchodilators and steroids</p>
bronchiolitis	Fever, cough, runny nose, wheezing, and breathing problems. Complications: dehydration and aspiration pneumonia	Mainly viral (RSV)	No diagnostic test are required No specific treatment, home care is sufficient Hospital admission for oxygen, support with feeding, or intravenous fluids No clear evidence for antibiotics, antivirals, bronchodilators, or nebulized epinephrine?!

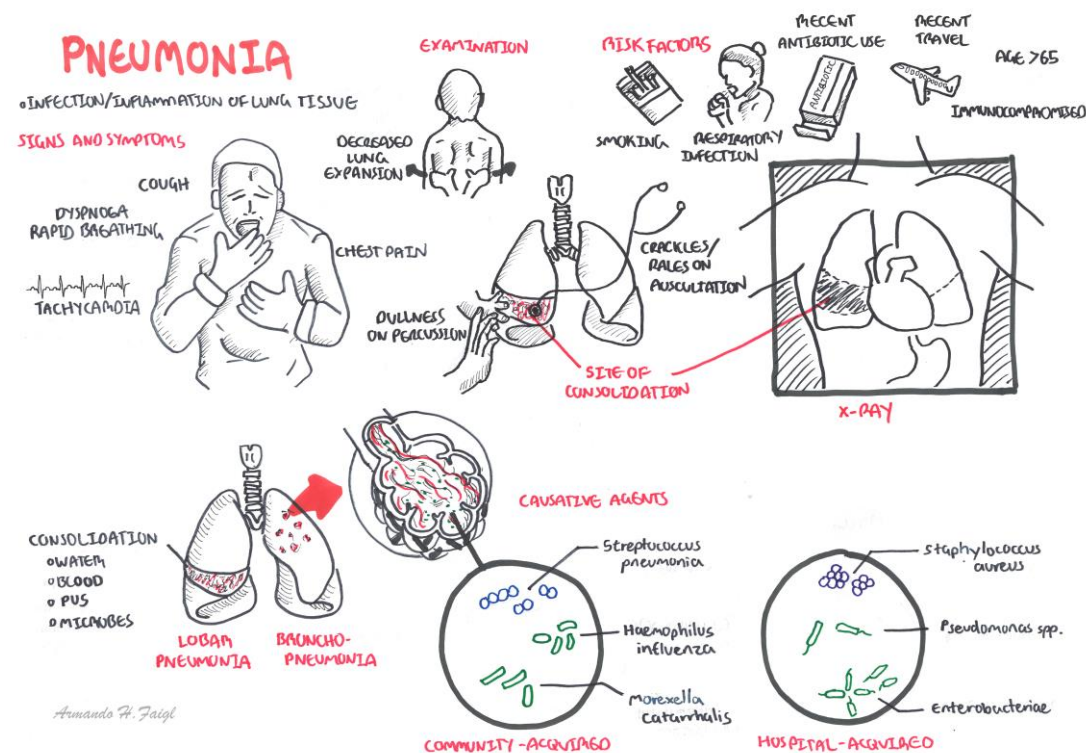


# Pneumonia

- A common **acute** inflammatory respiratory infection that affects the alveoli and distal bronchial tree of the lungs.

- **Classification by site of acquisition:**

1. Community-acquired pneumonia (CAP)
2. Hospital-acquired pneumonia (HAP),  
Cut-off point 48 hours
3. Aspiration pneumonia





# Classification by etiology

1. **Atypical** pneumonia: caused by "atypical" bacterial pathogens including **Legionella**, **Mycoplasma pneumoniae** and **Chlamydia pneumoniae**.
2. **Aspiration** pneumonia: adverse pulmonary consequences due to **entry of gastric or oropharyngeal fluids**, which may contain bacteria and/or be of low pH, or exogenous substances (ingested food particles or liquids, mineral oil, salt or fresh water) into the lower airways
3. **Chemical** pneumonitis: Aspiration of substances (acidic gastric fluid) that cause an inflammatory reaction in the lower airways, **independent of bacterial infection**





# Pathogens & Risk factors

- Bacteria or viruses and less commonly by fungi and parasites.
- The causative agent may not be isolated in about half of cases despite careful testing
- Predisposing factors: smoking, immunodeficiency, alcoholism, chronic obstructive pulmonary disease, sickle cell disease (SCD), asthma, chronic kidney disease, liver disease, and biological aging.



# Signs and symptoms

- **Pulmonary:**

Cough (with or without sputum production), dyspnea, and pleuritic chest pain

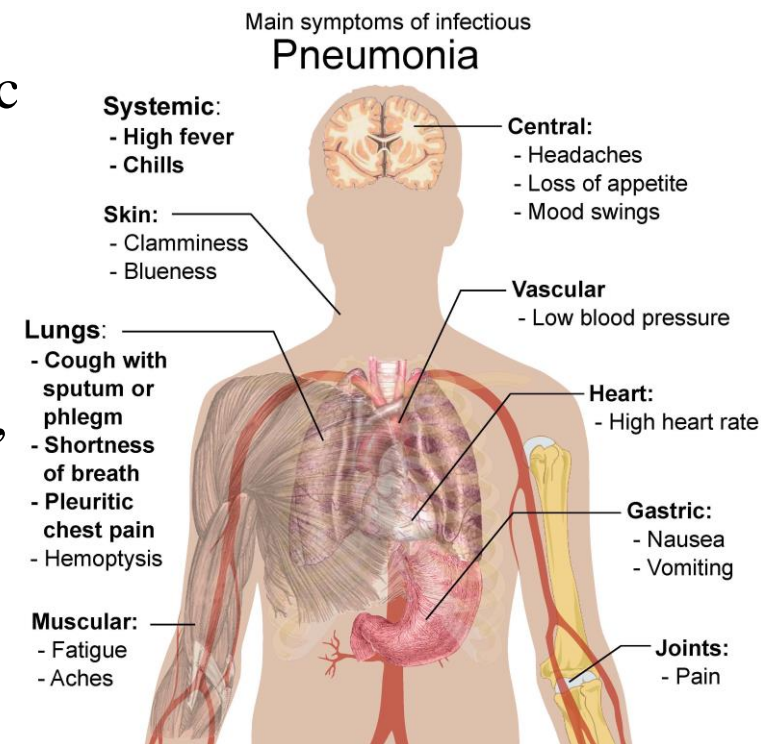
tachypnea, increased work of breathing, and adventitious breath sounds

- **Systemic:**

Fever, chills, fatigue, malaise, chest pain (which may be pleuritic), and anorexia.

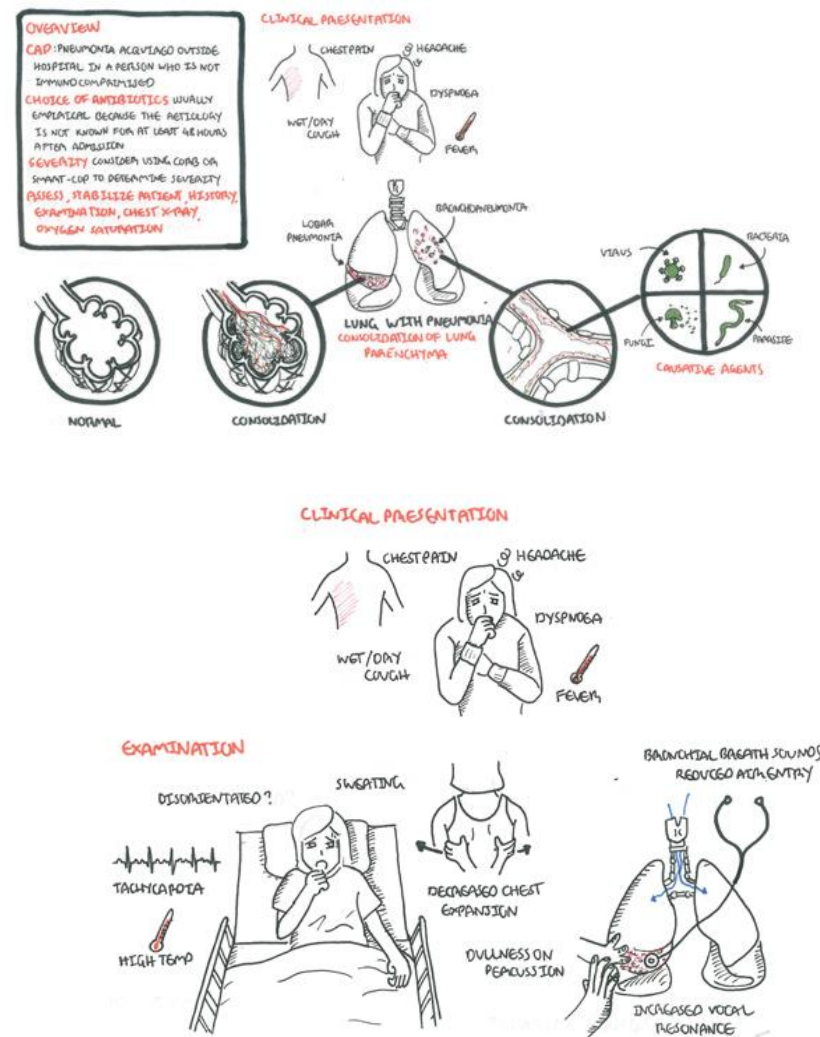
Tachycardia, leukocytosis or leukopenia are also findings that are mediated by the systemic inflammatory response.

Inflammatory markers, such as the erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and procalcitonin may rise, though the latter is largely specific to bacterial infections.



# Community-acquired pneumonia (CAP)

- WHO estimates that lower respiratory tract infection is the most common infectious cause of death in the world.
- Signs and Symptoms:
  1. Fever or hypothermia
  2. Sweats, rigors or chills
  3. Cough, sputum production
  4. Pulmonary lesions observed on radiographic examination
  5. Nonspecific symptoms are common, including loss of appetite, fatigue, and confusion.
- **Choice of antibiotics are usually empirical.**





# Community-acquired pneumonia (CAP)

- CAP: *Streptococcus pneumoniae*, respiratory viruses, *Haemophilus influenzae* and *Mycoplasma pneumoniae*
- Management:
  1. Oxygen
  2. Analgesia for chest pain
  3. **Antibiotics (IV or oral)**
  4. Steroids (could be considered in severe pneumonia)



# Community-acquired pneumonia (CAP)

- ❖ Empirical therapy should start ASAP with broad-spectrum than definitive therapy with narrow and target antibiotics ‘de-escalation’ of therapy
- ❖ 7-10 days, but increasing evidence suggests that shorter courses (3–5 days) may be effective for certain types of pneumonia and may reduce the risk of antibiotic resistance.



# Community-acquired pneumonia (CAP)

❖ In general, adjunctive corticosteroid therapy might benefit those with severe CAP and a high inflammatory response

❖ **First line:**

Amoxicillin **OR** macrolide (azithromycin or clarithromycin) **OR**

Doxycycline



# Community-acquired pneumonia (CAP)

➤ Patients >65, with **comorbidities** such as chronic heart, lung, liver, or renal disease; diabetes mellitus; alcoholism; malignancy; asplenia; immunosuppression, prior antibiotics within 90 days:

**First: amoxicillin/clavulanate + macrolide OR doxycycline**

**Alternative: cefuroxime + macrolide OR doxycycline**

Duration of therapy:

minimum of 5 days, should be afebrile for at least 48 hours, clinically improving (based on symptoms and vital signs).

Patients with documented MRSA or *Pseudomonas aeruginosa* should receive a **minimum of 7** days treatment.



# Community-acquired pneumonia (CAP)

hospitalized patient

Ampicillin/sulbactam OR ceftriaxone + azithromycin or doxycycline

Fluoroquinolone (Levofloxacin or Moxifloxacin)





# Hospital-acquired pneumonia (HAP)

- Bacteria > virus.
- NO MDR: Piperacillin-tazobactam
- MDR: Meropenem
  
- MDR:
- Ventilatory support for HAP
- Septic shock
- Intravenous (IV) antibiotic use within the previous 90 days



# Atypical pneumonia

- Any type of pneumonia not caused by one of the pathogens most commonly associated with the disease. (belongs mainly CAP)
- No response to common antibiotics such as beta-lactams (penicillin)
- No signs and symptoms of lobar consolidation (infection is restricted to small areas, rather than involving a whole lobe).
- Absence of leukocytosis.

What is the difference between typical and atypical community-acquired pneumonia?

Variable	Typical	Atypical
Etiology	S.pneumoniae, H.influenza	Mycoplasma pneumoniae, chlamydoiphila pneumoniae , legionella, TB, viral or fungal
Clinical presentation	Sudden onset of fever, chill, productive cough, shortness of breath and chest pain	Gradual onset headache, sore throat and body ache
Diagnosis Gram Stain	Useful	Useless (no cell wall)
Radiography	Lobar infiltrate	Dramatic changes: patchy or interstitial
Treatment with penicillin	Sensitive	Resistant

- ***Mycoplasma pneumoniae***: doxycycline, macrolide
- ***Chlamydoiphila pneumoniae***: doxycycline, macrolide, fluoroquinolones.
- ***Legionella spp.***: macrolide +/- rifampicin.



# Aspiration pneumonia

- Relatively large amount of material inhaled from the stomach or mouth entering the lungs
- Fever, cough, increased respiratory rate, foul-smelling sputum, hemoptysis
- Risk factors: decreased level of consciousness, problems with swallowing, alcoholism, tube feeding, and poor oral health.

- Treatment depends on the setting in which aspiration occurred (CAP or HAP):

CAP: ampicillin-sulbactam or fluroquinolone (high risk: add clindamycin)

HAP: : vancomycin + piperacillin-tazobactam



# Viral pneumonia

- No specific antiviral medications are recommended for community acquired viral pneumonias including SARS coronavirus, adenovirus, hantavirus, and parainfluenza virus.
- Influenza A may be treated with rimantadine or amantadine, while influenza A or B may be treated with oseltamivir, zanamivir or peramivir.
- These are of most benefit if they are started within 48 hours of the onset of symptoms
- The use of antibiotics in viral pneumonia is recommended by some experts, as it is impossible to rule out a complicating bacterial infection.



CAP	<ul style="list-style-type: none"><li>❖ Patients without comorbidities: Amoxicillin <b>OR</b> A macrolide (azithromycin or clarithromycin) <b>OR</b> Doxycycline</li><li>❖ Patients with comorbidities: amoxicillin/clavulanate + macrolide or doxycycline ^^&gt; <b>Alternative:</b> cefuroxime + macrolide <b>OR</b> doxycycline</li><li>❖ <u>hospitalized patient</u> : Ampicillin/sulbactam <b>OR</b> ceftriaxone + azithromycin or doxycycline <b>Alternative:</b> Fluoroquinolone (Levofloxacin or Moxifloxacin)</li></ul>
HAP	<ul style="list-style-type: none"><li>• <b>NO MDR:</b> Piperacillin-tazobactam</li><li>• <b>MDR:</b> Meropenem</li></ul>
Atypical	<ul style="list-style-type: none"><li>➤ Mycoplasma : doxycycline or macrolide</li><li>➤ Chlamydothila : doxycycline, macrolide, fluoroquinolones.</li><li>➤ Legionella: macrolide +/- rifampicin.</li></ul>
Aspiration	Depends on the setting in which aspiration occurred: CAP: ampicillin-sulbactam or fluoroquinolone (high risk: add clindamycin) HAP: : vancomycin + piperacillin-tazobactam
Viral	No specific antiviral medications are recommended Influenza A: rimantadine or amantadine Influenza A or B may be treated with oseltamivir, zanamivir or peramivir.