

A stack of books is shown from a low angle, with the spines of several books visible. The books have various colors, including red, orange, and yellow. A semi-transparent red and orange gradient bar is overlaid on the right side of the image, containing the title and author's name.

# RESPIRATORY TRACT INFECTIONS

Dr. Tanmay Mehta



## Learning objectives

At the end of the session, the students will be able to

- Classify and define of respiratory tract infections
- Describe aetiopathogenesis
- Describe laboratory diagnosis and treatment of respiratory tract infections



## RESPIRATORY TRACT INFECTIONS

- **Upper Respiratory Tract Infections**
- Infections of airway above glottis or vocal cords
- Tonsillitis, pharyngitis, laryngitis, sinusitis, otitis media, and rhinitis
- Symptoms - cough, sore throat, running nose, nasal congestion, headache, low-grade fever, facial pressure and sneezing



## Rhinitis or common cold

- **Mostly caused by viruses:**
- Rhinovirus
- Coronavirus
- Adenovirus
- Influenza virus
- Parainfluenza virus
- Human metapneumovirus
- Respiratory syncytial virus



## Sinusitis

- **Symptoms:** Headache/facial pain, nasal mucus, Plugged nose
- **Agents of acute sinusitis:**
- Viruses (most common cause): Rhinoviruses, Influenza viruses, Parainfluenza viruses
- **Bacterial agents:** *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, *Pseudomonas* and other gram- neg- ative bacilli (nosocomial sinusitis)
- **Agents of chronic sinusitis:** Obligate anaerobes, *Staphylococcus aureus*



## Pharyngitis (sore throat), and tonsillitis

- **Symptoms:**
- Pharynx and/or tonsils become inflamed, red, swollen, and show exudate, and sometimes a membrane is formed
- **Viruses:** (most common cause) Influenza virus, Parainfluenza virus, Coxsackievirus A, Rhinovirus, Coronavirus, Epstein-Barr virus, Adenoviruses



## Pharyngitis (sore throat), and tonsillitis

- **Bacteria:** *Streptococcus pyogenes* (most common bacterial cause), *Streptococcus* groups C and G, *Arcanobacterium* species, *Corynebacterium diphtheriae* and *C. ulcerans*, *Mycoplasma pneumoniae*
- Vincent angina - *Treponema vincentii* & *Leptotrichia buccalis*
- **Fungal:** *Candida albicans*



## Laryngitis

- **Symptoms:** Hoarseness of voice, Lowering and deepening of voice
- **Mostly viral agents:** Influenza virus, Parainfluenza virus, Rhinovirus, Adenovirus, Coronavirus, Human metapneumovirus
- **If membrane or exudate present:** *Streptococcus pyogenes*, *C. diphtheriae*, Epstein-Barr virus





## Laryngotracheobronchitis (or croup)

- Age—Children, <3 years age
- **Symptoms:**
  - Inspiratory stridor, Hoarseness, Fever
  - Cough (harsh, barking non-productive )
- **Agents:**
  - Parainfluenza virus (most common)
  - Influenza virus
  - Respiratory syncytial virus
  - Adenoviruses



## Epiglottitis

- Edema and inflammation of epiglottis and soft tissue above vocal cords
- **Age:** children 2–6 years
- **Symptoms:** Fever, Difficulty in swallowing, Inspiratory stridor
- **Most common agent:** *Haemophilus influenzae* type b



## Lower Respiratory Tract Infection

- ***Pneumonia***
- Inflammation of lungs
  1. Community acquired—patients acquire the organisms in the community
  2. Hospital acquired— patients acquire the organisms in the hospital setting.

## Community-acquired Pneumonia (CAP)

- **Agents:** *Streptococcus pneumoniae* followed by *Mycoplasma pneumoniae*
- CURB65 scoring system - To predict prognosis of CAP
- Score  $>1$   $\rightarrow$  patient should be hospitalized
- Else the treatment can be given on outpatient basis



## Agents of Community-acquired Pneumonia (CAP)

- **No co-morbidity:**
- *Streptococcus pneumoniae* (most common)
- **Atypical pathogens:**
  - *Chlamydophila pneumoniae* and *C. psittaci*
  - *Legionella* and *Mycoplasma*
  - *Coxiella burnetii* (Q fever)
  - Viral pneumonia (influenza, adenovirus, parainfluenza, RSV)

## Agents of Community-acquired Pneumonia (CAP)

- **Associated with Co-morbidity:**
- Alcoholism: *S. pneumoniae*, *H. influenzae*
- COPD: *H. influenzae*, *M. catarrhalis*, *S. pneumoniae*
- Post-CVA-aspiration: *S. pneumoniae*
- Post-obstruction of bronchi: *pneumoniae*, anaerobes
- Post-influenza: *S. pneumoniae*, *S.aureus*

## Community-acquired Pneumonia (CAP)

- **CURB-65score**
  - **C** (Confusion) = 1 point
  - **U** (blood urea nitrogen >19 mg/dL) = 1 point
  - **R** (respiratory rate >30 min) = 1 point
  - **B** (BP <90/60) = 1 point
  - **65** (Age ≥65 years) = 1 point
- Higher the score, greater is the mortality
- If the score ≤1, outpatient therapy is indicated If the score >1, patient should be hospitalized



## Hospital-acquired Pneumonia (hAP)

- Hospitalized patients have increased risk of developing pneumonia; most of which are ventilator-associated pneumonia
- VAP can be clinically diagnosed by Clinical Pulmonary Infection (CPIS)
- Likelihood of VAP is higher when total CPIS is  $>6$



## Clinical Pulmonary Infection Score (CPIS)

Parameter(s)	Score 0
Temperature (°C)	$\geq 36.5^{\circ}\text{C}$ and $\leq 38.4^{\circ}\text{C}$
Leukocytosis	$\geq 4000$ and $\leq 11,000$
Tracheal aspirate	None
Oxygenation (PaO <sub>2</sub> /FiO <sub>2</sub> mm Hg)	>250 or ARDS
Chest radiograph	No opacity
Progressive radiological progression	No radiological progression
Culture of tracheal aspirate	Pathogenic bacteria Light or no growth
Culture-gram stain correlation	Different morphology than Gram stain

# Clinical Pulmonary Infection Score (CPIS)

Score 1	Score 2
$\geq 38.5^{\circ}\text{C}$ and $\leq 38.9^{\circ}\text{C}$	$\geq 39.0^{\circ}\text{C}$ and $\leq 36.4^{\circ}\text{C}$
$< 4000$ and $> 12000$	
Non-purulent	Purulent
	$\leq 250$ and no ARDS
Diffuse (patchy) opacity	Localized opacity
	Radiological progression
Pathogenic bacteria Moderate or heavy growth	
Same morphology as Gram stain	



## Hospital-acquired Pneumonia (hAP)

- **Bacterial agents:**
- Gram-negative bacilli (most common)
  - MDR non-fermenters (*Pseudomonas* and *Acinetobacter*)
  - MDR Enterobacteriaceae (*E. coli*, *Klebsiella* and *Enterobacter*)
- *Staphylococcus aureus* (both MRSA and MSSA)
- *S. pneumoniae* (rarely, in early stage)
- **Viral agents:**
- Influenza, adenovirus, parainfluenza, RSV



## Clinical Manifestations of Pneumonia

- Fever, chills, chest pain and cough
- Based on area of lungs involved, and type of cough produced
- **Lobar pneumonia** infecting lung parenchyma (alveoli)
- Consolidation and productive cough with purulent sputum
- Mostly caused by pyogenic organisms :
  - Pneumococcus
  - *Haemophilus influenzae*
  - *Staphylococcus aureus*
  - Gram-negative bacilli.



## Interstitial or atypical pneumonia

- Infection occurs in interstitial space of lungs
- Cough is characteristically non-productive
- **Caused by :**
  - *Chlamydophila pneumoniae*
  - *Mycoplasma pneumoniae*
  - Viral pneumonia
  - *Legionella* species



## Bronchitis

- Inflammation of bronchus, which occurs either as an extension of upper respiratory tract infection such as influenza or may be caused directly by bacterial agents such as *Bordetella*.
- **Common symptoms** - fever, cough, sputum production, and rarely croup- like features



## Bronchitis

- **Bacterial agents:**
  - *B. pertussis*
  - *B. parapertussis*
  - *Mycoplasma pneumoniae*
  - *Chlamydia pneumoniae*
- **Viral agents:**
  - Influenza viruses
  - Adenoviruses
  - Rhinoviruses
  - Coronaviruses



## Bronchiolitis

- Inflammation of the smaller airways (bronchioles)
- It presents as an acute viral infection that primarily occurs in children **less than 2 year**
- **Symptoms:** Acute onset of wheeze, dyspnea, cough, rhinorrhea, and respiratory distress
- Respiratory syncytial viruses account for 40–80%





## Bronchiolitis

- **Viral agents:**
- Respiratory syncytial viruses
- Parainfluenza viruses
- Rhinoviruses
- Influenza viruses
- Adenoviruses
- Enterovirus
- Human metapneumovirus

The background of the slide features a blurred image of laboratory glassware, including a white beaker and a glass pipette, set against a warm, orange-to-red gradient. The text is overlaid on this background.

## Laboratory Diagnosis

- **Specimen Collection**
- **For URTI:**
  - Throat swab: Two swabs should be collected, one for direct examination, other one for culture
  - A part of the membrane, if present
  - Nasopharyngeal aspirate for viral diagnosis or for *B.pertussis*
- **For LRTI:** Sputum, induced sputum, tracheal aspirate, bronchoalveolar lavage (BAL)

A background image showing a laboratory setting with a microscope slide and a pipette tip. The slide is held by a hand, and a pipette tip is positioned above it. The background is a gradient of orange and red.

## Microscopy

- **Albert staining** - metachromatic granules in the ends of the bacilli → of *C. diphtheriae*
- **Gram staining**
  - Detect the quality of the sputum
  - Pus cells >25/low power field and epithelial cells <5/low power field → good quality sputum
- **Acid fast staining** - *M. tuberculosis*
- **GMS stain** - *Pneumocystis jirovecii*
- **Immunofluorescence microscopy** of nasopharyngeal aspirate



## Culture

- **For bacteriological culture:** Blood agar, chocolate agar and MacConkey agar
- **For isolation of *C. diphtheriae*:** Loeffler's serum slope and potassium tellurite agar
- **For *M. tuberculosis*:** LJ medium and incubated for up to 6–8 weeks
- **For fungal pathogen isolation:** Sabouraud dextrose agar
- **Viral - Appropriate cell lines**

# Identification of agents of Lobar Pneumonia

Agents of pneumonia	Direct demonstration in sputum	Culture identification
<i>Streptococcus pneumoniae</i>	Pus cells >25/LPF and epithelial cells <5/LPF gram-positive cocci in pair, lanceolate shaped	Alfa hemolytic, draughtsman-shaped colonies on blood agar Sensitive to optochin Bile soluble, ferments inulin
<i>Haemophilus influenzae</i>	Pus cells >25/LPF and epithelial cells <5/LPF Pleomorphic gram-negative bacilli	Satellitism on blood agar with <i>S. aureus</i> streak line

# Identification of agents of Lobar Pneumonia

Agents of pneumonia	Direct demonstration in sputum	Culture identification
<i>Staphylococcus aureus</i>	Pus cells >25/LPF and epithelial cells <5/LPF gram-positive cocci in clusters	BA- golden yellow hemolytic colonies Catalase positive, coagulase positive
<i>Gram-negative bacilli</i> <i>E. coli, Klebsiella, Pseudomonas, etc.</i> )	Pus cells >25/LPF and epithelial cells <5/LPF gram-negative bacilli	Identification is based on: <ul style="list-style-type: none"> <li>• Growth on MacConkey agar (LF or NLF colonies) and</li> <li>• Biochemical reactions (ICUT: indole, citrate, urease, TSI)</li> </ul>

## Identification of agents of Interstitial Pneumonia

Agents of pneumonia	Direct demonstration in sputum	Culture identification
<i>Chlamydophila pneumoniae</i>	Direct immunofluorescence test Antigen detection by enzyme immunoassay Nucleic acid amplification test (NAAT) detecting specific genes	Serology-antibody detection by - CFT using LPS antigen - ELISA using recombinant LPS antigen - Micro-IF test using outer membrane protein antigen
<i>Legionella pneumophila</i>	Pus cells >25/LPF and epithelial cells <5/LPF Detection of specific antigen in sputum, urine	Growth on BCYE medium

## Identification of agents of Interstitial Pneumonia

Agents of pneumonia	Direct demonstration in sputum	Culture identification
<i>Mycoplasma pneumoniae</i>	Direct immunofluorescence test Capture ELISA-detecting antigen (P1 adhesin) PCR targeting P1 adhesin gene	Culture-fried egg colonies on PPLO agar Antibody detection - Non-specific test (cold agglutination test) - Specific test (e.g. ELISA)
Viral pneumonia	Detection of specific viral antigen in sputum Detection of specific viral genes in sputum (PCR)	



The background of the slide features a blurred image of laboratory glassware, including a white pipette tip and a glass vial, set against a warm, orange-to-red gradient. The word "Identification" is prominently displayed in white text on a dark red rectangular background in the upper right corner.


## Identification

- **Serology:**
- Detection of antibodies:
- ***Mycoplasma***: Cold agglutination test, complement fixation test (CFT) and ELISA formats are available
- **Chlamydial antibodies in serum:** Micro-IF and CFT
- **Molecular Test**



## TREATMENT

- **Community-acquired pneumonia (CAP)**
- Empiric regimen is determined by presence of co-morbidity and prediction of prognosis by CURB-65 scoring system
- **CAP, hospitalized (if CURB65 score >1):**
  - IV ceftriaxone plus azithromycin or
  - IV levofloxacin
  - Add vancomycin if CA-MRSA suspected

- 
- **CAP, outpatient (if CURB-65 score  $\leq 1$ ):**
    - If no comorbidity present: Oral azithromycin or azithromycin plus amoxycylav.
    - If comorbidity present: Oral levofloxacin
  - **Hospital-acquired pneumonia (HAP)**
  - **Empirical therapy:** comprises of both gram-negative (e.g. piperacillin-tazobactam or meropenem) *plus* gram-positive coverage (e.g. vancomycin).
  - **Definitive therapy:** The empirical treatment should be tailored based on the organism isolated and its