# Respiratory System Module
# 2022-2023

## Bacterial Respiratory Tract Infections
## *(Streptococcus pneumonia)*

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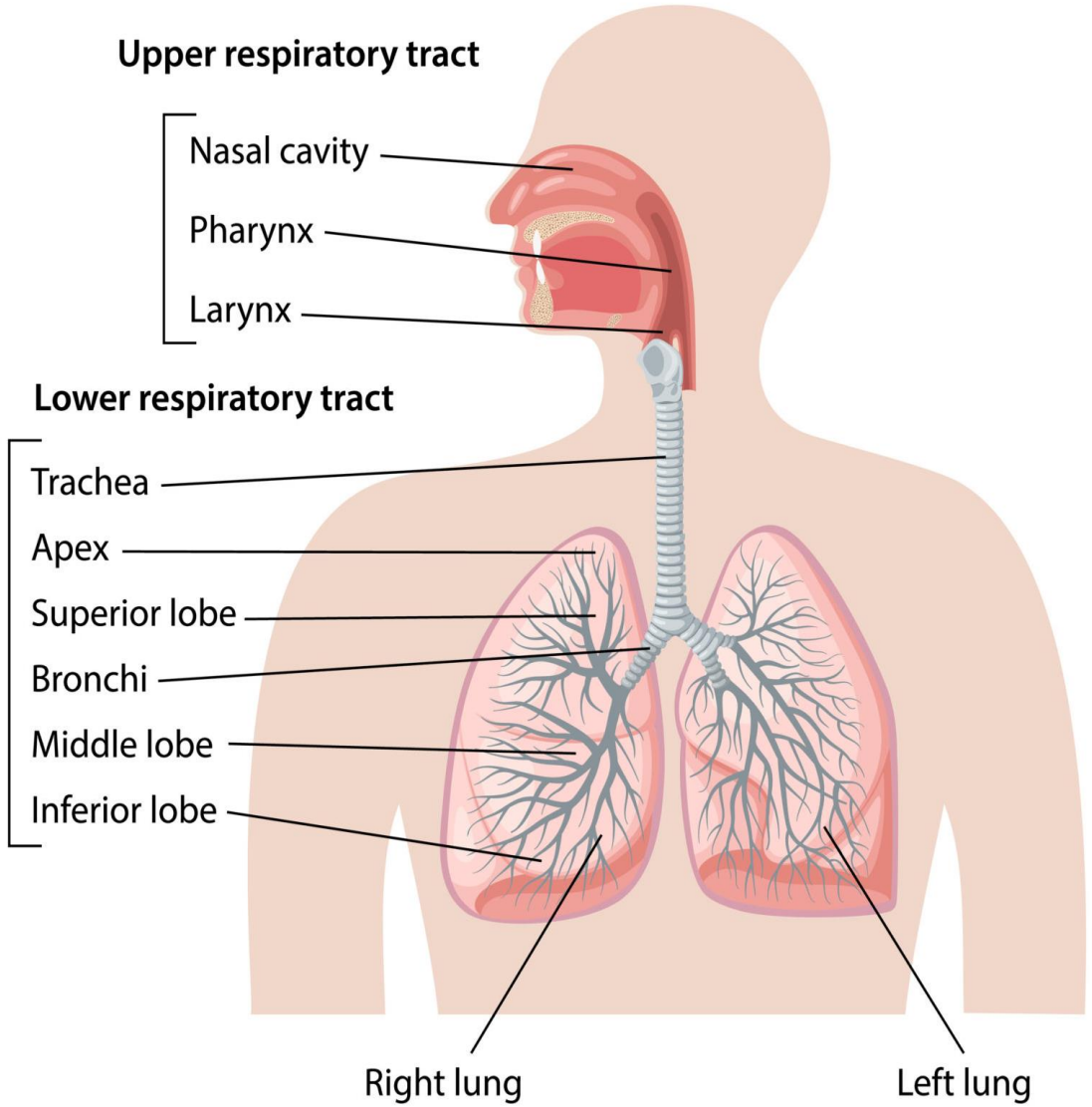
# Aims

- To be familiar with the types of the respiratory tract infections
- The causative agent of the upper and lower respiratory tract infections
- The clinical picture of the bacterial and viral infections of the respiratory tract

# Bacterial Respiratory tract infections




**Sinusitis**

Streptococcus pneumoniae
Haemophilus influenzae

**Upper respiratory tract infections**

Streptococcus pyogenes
Haemophilus influenzae

**Tracheitis**

Staphylococcus aureus

**Bronchitis**

Mycoplasma pneumoniae
Streptococcus pneumoniae
Haemophilus influenzae
Mycoplasma catarrhalis

**Pneumonia**

Streptococcus pneumoniae
Haemophilus influenzae
Staphylococcus aureus

**Atypical Pneumonia**

Mycoplasma pneumoniae
Chlamydia pneumoniae
Legionella pneumonia

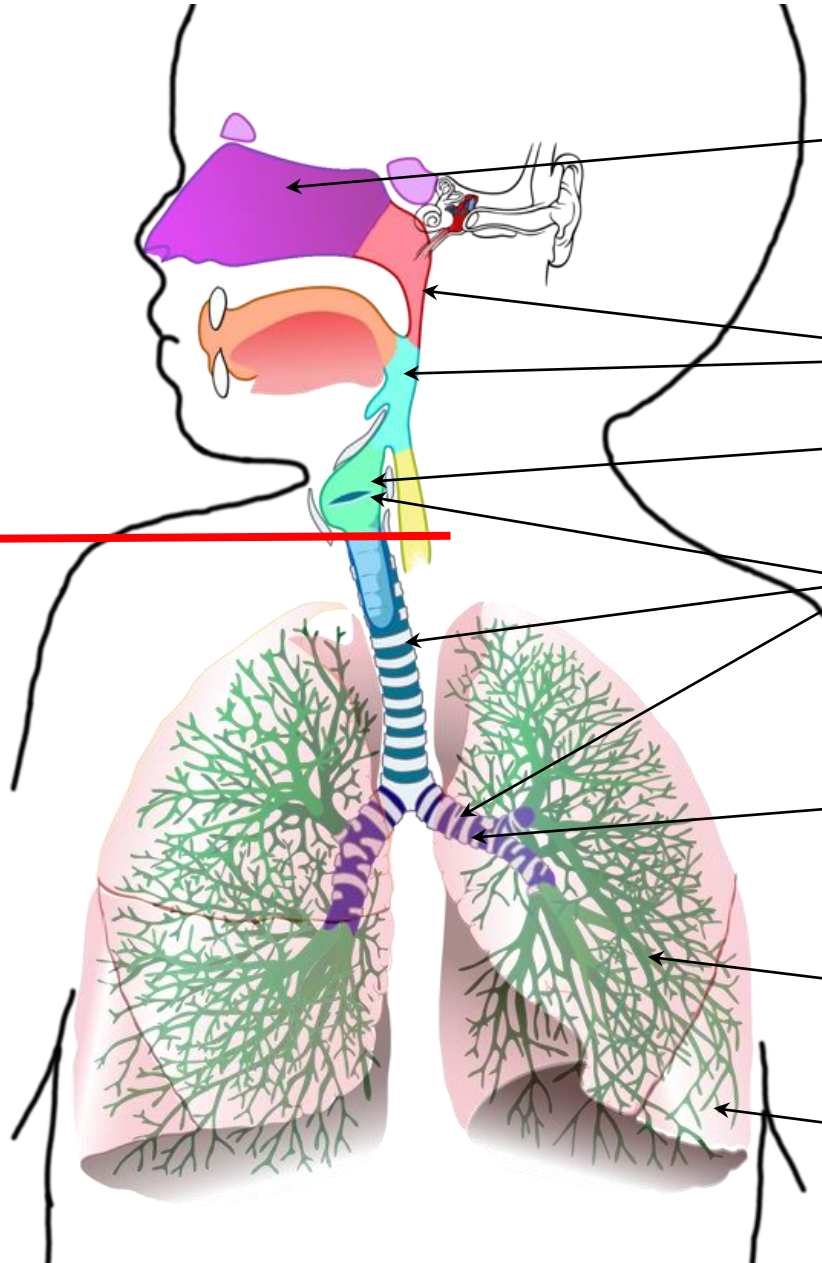
**Tuberculosis**

Mycobacterium tuberculosis

# Anatomical Location of Viral Syndromes

## Upper Tract

Nasal Cavity
Nasopharynx
Oropharynx
Larynx

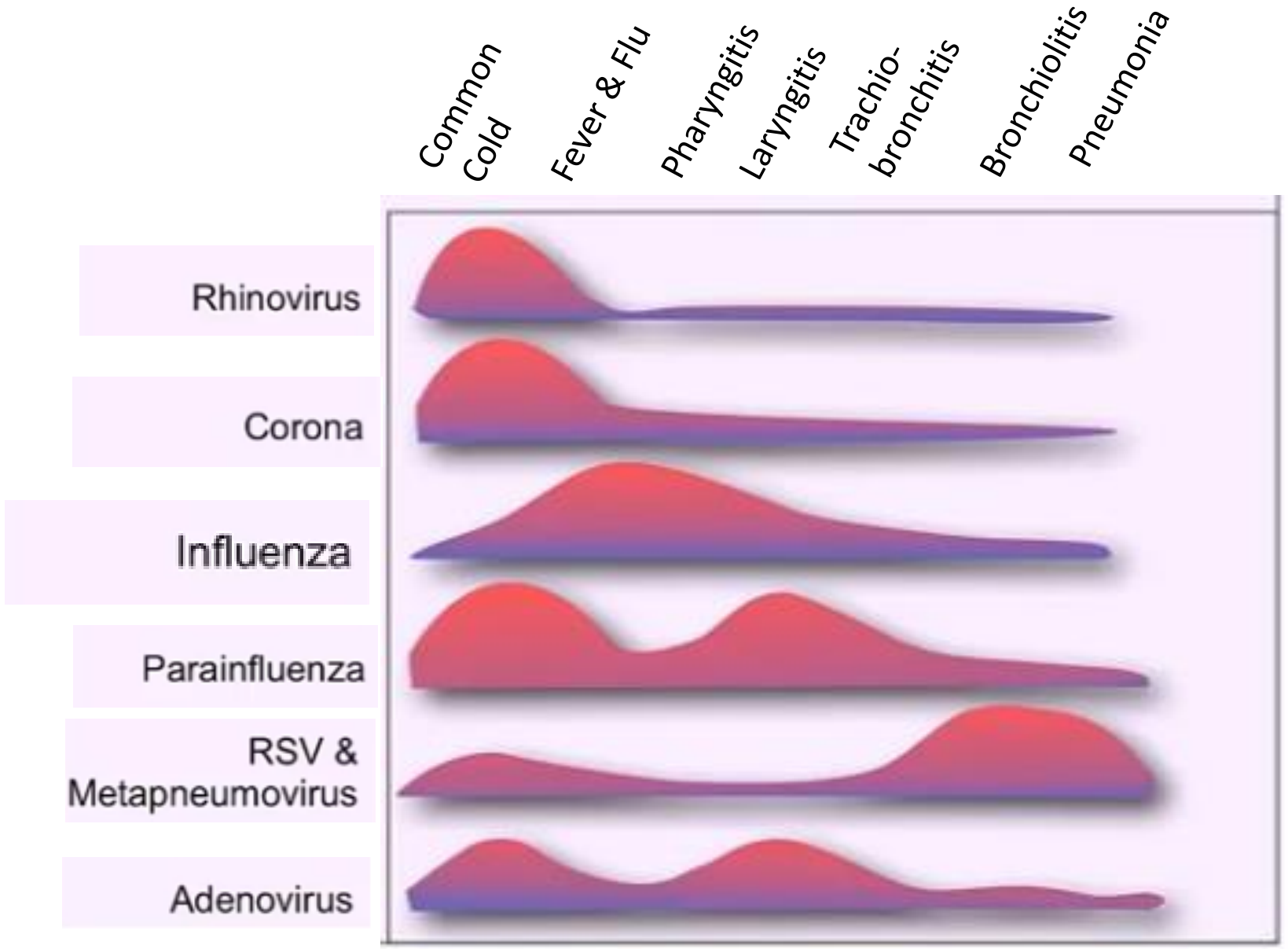


## Lower Tract

Trachea
Bronchi
Bronchioles
Lung

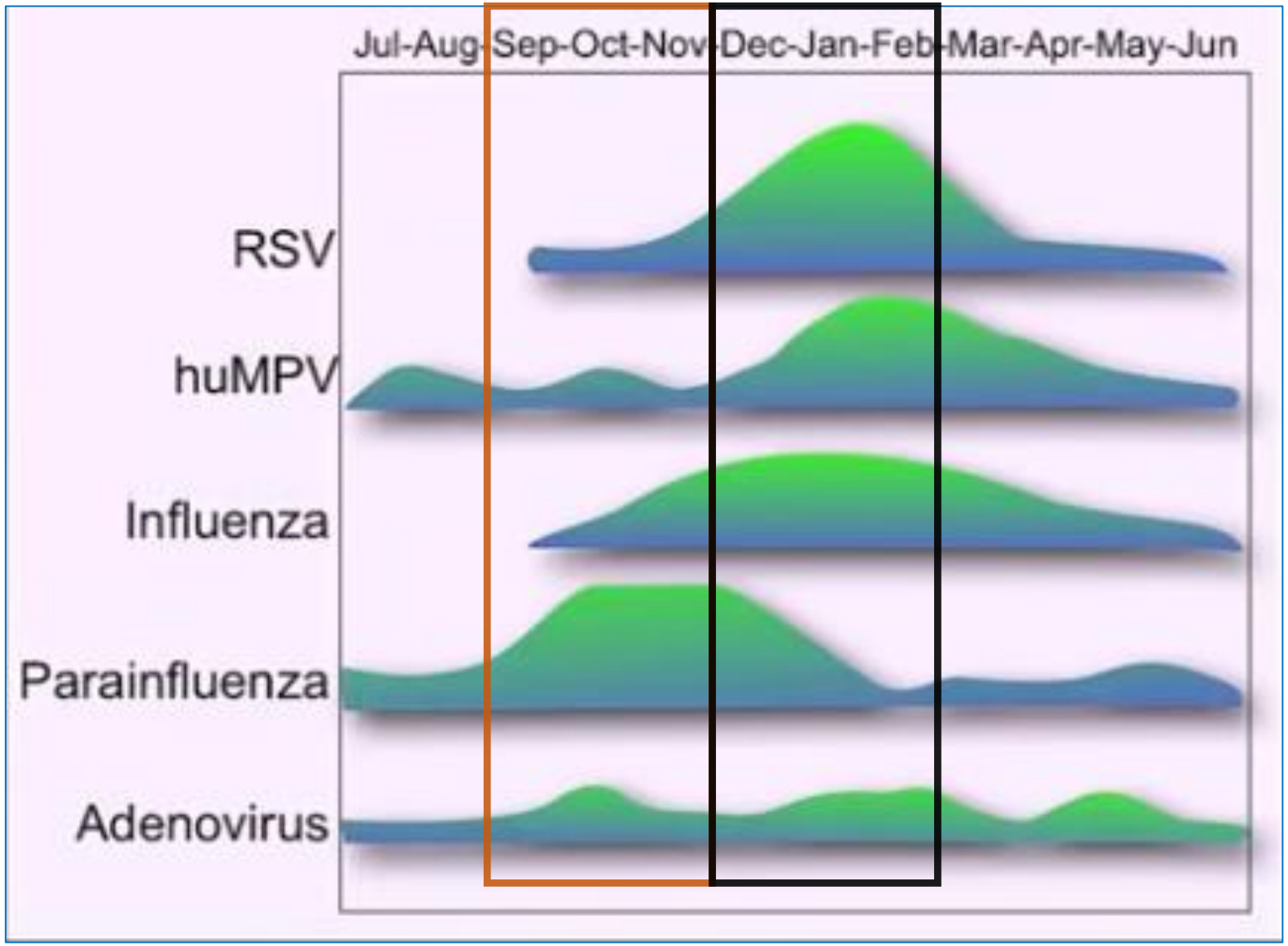
| | |
|---|---|
| Rhinitis<br>*Common Cold* | Rhinovirus, Coronavirus<br>**Influenza** |
| Pharyngitis<br>*Sore Throat* | Adenovirus, Parainfluenza<br>**Influenza** |
| Laryngitis | |
| Laryngotracheobronchitis<br>*Croup* | Parainfluenza<br>**Influenza** |
| Bronchitis | Parainfluenza,<br>Adenovirus, Metapneumovirus<br>RSV, Coronavirus **Influenza** |
| Bronchiolitis | RSV<br>Metapneumovirus<br>Adenovirus **Influenza** |
| Pneumonia | All viruses **Influenza** |

# Matrix of Respiratory Associated Viral Infections



# Seasonality of lower respiratory tract infections

Most of respiratory viruses are in winter due to mainly crowdedness



# *Streptococcus pneumonia*

45 years old man, smoker.

Sudden onset fever and chills

Shortness of breath and pleuritic chest pain

Productive rusty colored sputum (blood stained)

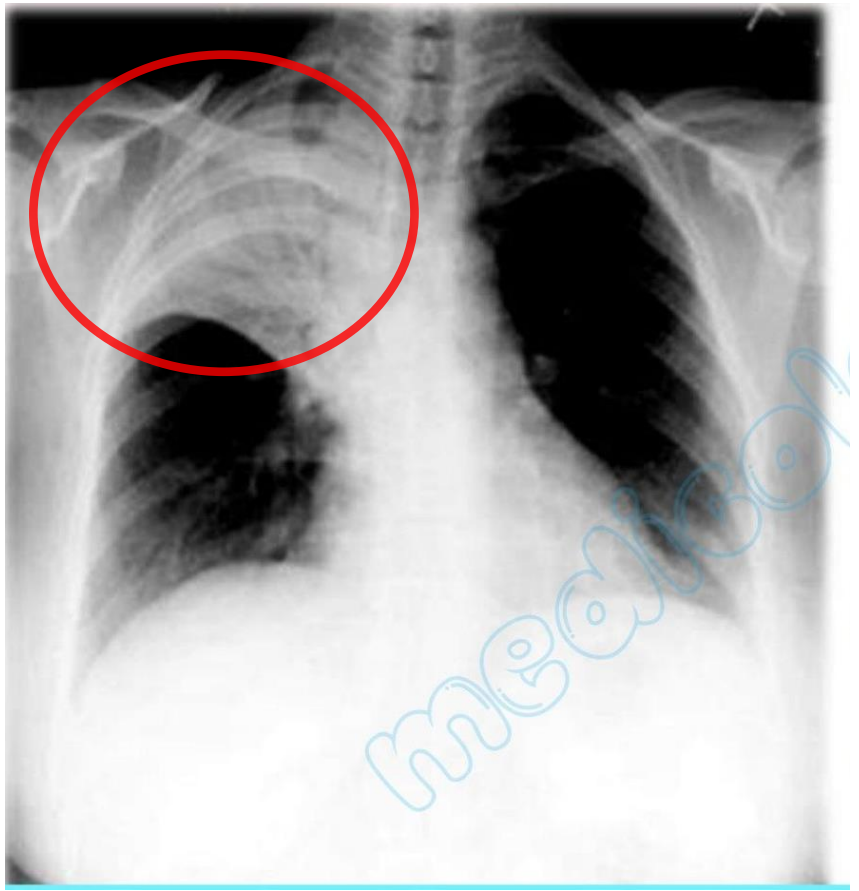
**Examination**:

Vitals: PR 110 (normal 60-100), T 39, B.P normal, O2 Saturation 90% (decreased)

Chest: decreased air entry, dull on percussion, decreased chest expansion.

CXR: Right upper lobe consolidation

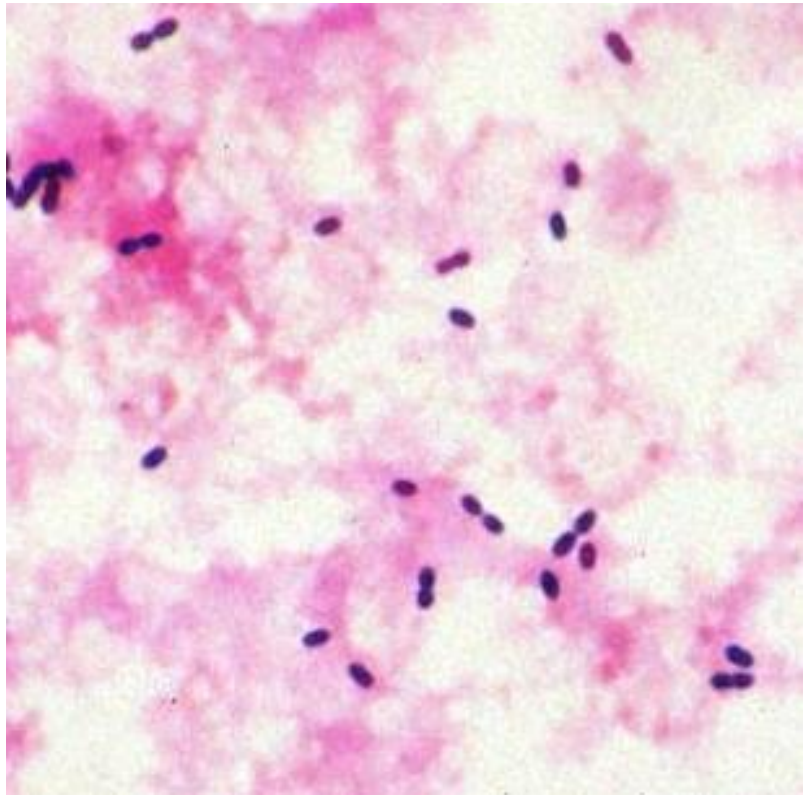
WBC 16000/mm3 (normal 4-11) mainly neutrophils



**Consolidation indicates filling of the alveoli and bronchioles in the lung with pus (pneumonia)**

# *Streptococcus pneumonia*

Member of the oropharyngeal flora of 5-70% of the population, with the highest isolation rate in children during the winter months.



*A gram positive* diplococci catalase negative.

It primarily causes disease of the upper and lower respiratory tract.

May spread to other sites, such as the joints, peritoneum, endocardium, biliary tract and, in particular, the meninges.

# *Streptococcus pneumonia*

## Virulence Factors

### Polysaccharide capsule

- The major virulence factor
- It prevents phagocytosis by host immune cells

### Pneumolysin

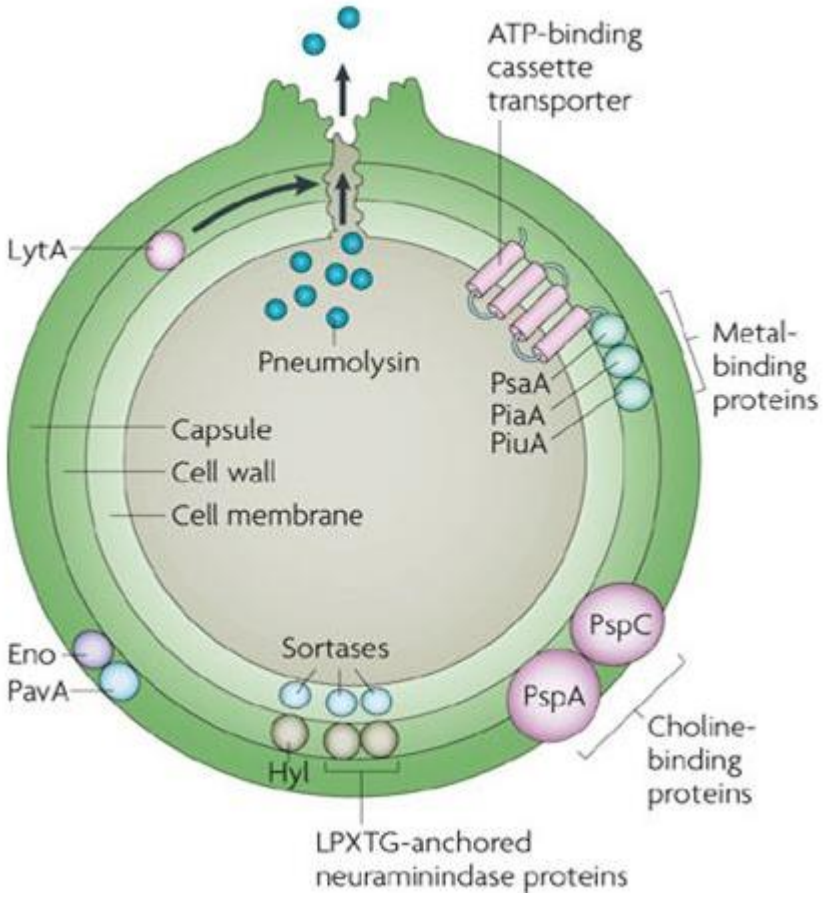
- Lyses host cells of immune system
- Facilitates colonization

### M-protein

- Antiphagocytic

### Lipoteichoic acid

- Activates complement
- IgA protease, helps in colonization



# *Streptococcus pneumonia*

## Epidemiology

**Source:**

Humans are the reservoir of pneumococci, which are commonly found in the upper respiratory tract of healthy persons throughout the world.

**Occurrence:**

- Pneumococcal infections are among the leading causes worldwide of illness and death for young children, persons who have underlying debilitating medical conditions and the elderly.
- The estimated global annual incidence is 1-3 per 1000 of the population, with a > 5% case fatality rate.

**Mode of Transmission:**

Pneumococci are transmitted from person-to-person by droplet spread, by direct oral contact and indirectly through articles freshly soiled with respiratory discharges.

# *Streptococcus pneumonia*

## Period of Communicability:

- Communicability associated with respiratory infection likely persists while pneumococci are present in respiratory secretions.
- Healthy persons is the major source of transmission
- Treatment with an antibiotic can terminate the communicability within 24 hours.

## Incubation Period:

The incubation period varies by type of infection and can be as short as 1-3 days.

## Predisposing factors:

- Pneumonia results from aspiration of pneumococci contained in upper airway secretions into the lower respiratory tract; for example:
    - Loss of consciousness: general anesthesia, convulsions, alcoholism, epilepsy or head trauma
- Respiratory viral infections, such as influenza, chronic bronchitis
- Young and elderly people.
- Immune suppressed people (e.g Chronic diseases, drugs, asplenia)
- Structural respiratory abnormalities.

# *Streptococcus pneumonia* / Respiratory Presentation

## 1- Pneumonia (chest infection):

- Pneumonia is defined as an acute respiratory illness associated with recently developed radiological pulmonary shadowing which may be segmental, lobar or multilobar.
- *Str. pneumoniae* is a frequent cause of pneumonia where vaccination is not available.
- Contiguous spread commonly results in complications such as:
- Inflammatory involvement of the pleura, Empyema and Pericarditis.
- Bacteraemia may complicate pneumococcal pneumonia in up to 15% of patients. This can result in metastatic involvement of the meninges, joints and, rarely, the endocardium.

# *Streptococcus pneumonia* / Respiratory Presentation

## 1- Pneumonia (chest infection):

**Signs and symptoms:**

The patient rapidly becomes more ill with a high temperature (up to 39.5°C), pleuritic pain and a dry cough.

A day or two later, rusty-coloured sputum is produced

The patient breathes rapidly and shallowly, the affected side of the chest moves less, and signs of consolidation may be present.

The mortality rate from pneumococcal pneumonia in those admitted to hospital is approximately 15-25%.

# *Streptococcus pneumonia* / Respiratory Presentation

## 1- Pneumonia (chest infection):

- Chest X-ray confirms the area of consolidation (lobar), but radiological changes lag behind the clinical course;

- So that X-ray changes may be minimal at the start of the illness. Conversely, consolidation may remain on the chest X-ray for several weeks after the patient is clinically cured.

- The chest X-ray usually returns to normal by 6 weeks

# *Streptococcus pneumonia* / Respiratory Presentation

## 2- Otitis media and sinusitis

- Middle ear infections (otitis media) affect approximately half of all children between the ages of 6 months and 3 years.

- Approximately one-third of cases are caused by *Str. pneumoniae*. Disease occurs after acquisition of a new strain to which there is no pre-existing immunity.

- The prevalence is highest among children attending primary school, where there is a constant exchange of pneumococcal strains.

- Pain, fever, ear discharge…

# *Streptococcus pneumonia*

## Treatment

Follow the antibiotic guidelines

## Vaccines:

Protein Conjugated vaccine (PCV): protection for 7-13 y
3 doses for those < 2 years age

Non-conjugated polysaccharides : 23 polyvalent vaccine > 2 years who are at risk

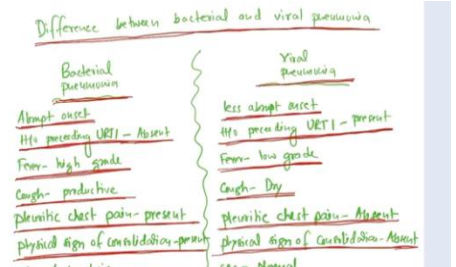
# Difference between bacterial and viral pneumonia

## Bacterial pneumonia

- Abrupt onset
- not preceding URTI
- fever: high grade
- Cough: productive
- Pleuritic chest pain: present
- Physical sign of consolidation: yes
- CBC: neutrophil predominate
- CXR: lobar and segmental opacity
- Blood culture: positive in 10% of cases

## Viral pneumonia

- Less abrupt onset
- preceding URTI
- fever: low grade
- Cough: dry
- Pleuritic chest pain: absent
- Physical sign of consolidation: No
- CBC: lymphocytes predominate
- CXR: interstitial infiltrate. No consolidation
- Blood culture: negative



# *Streptococcus pneumonia*

## Case 1

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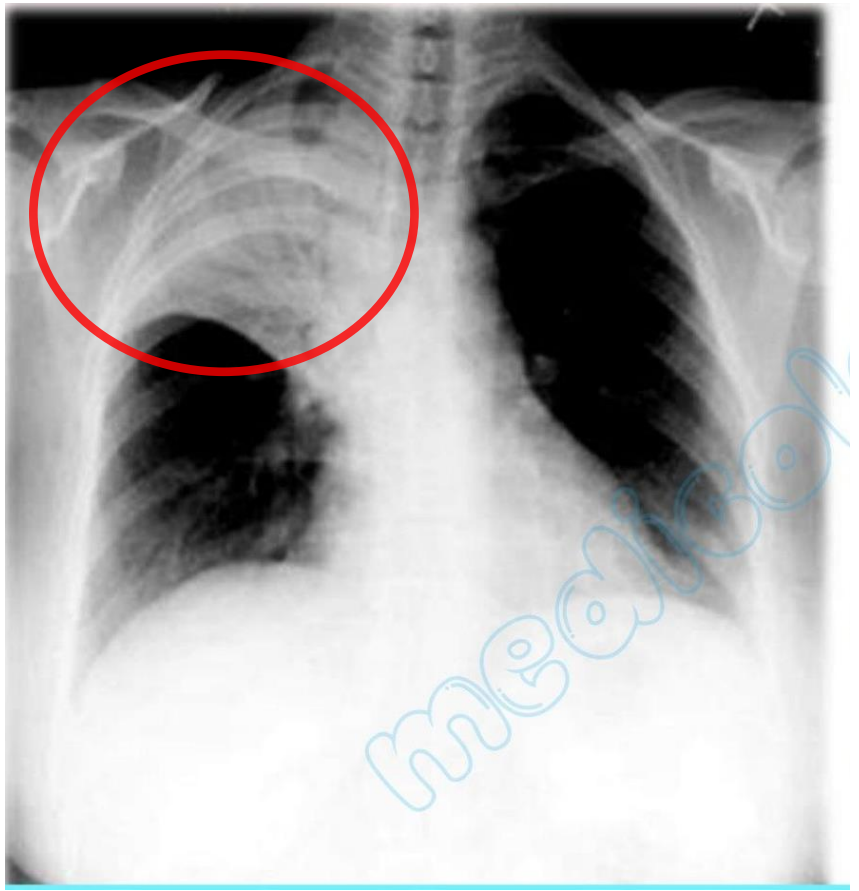


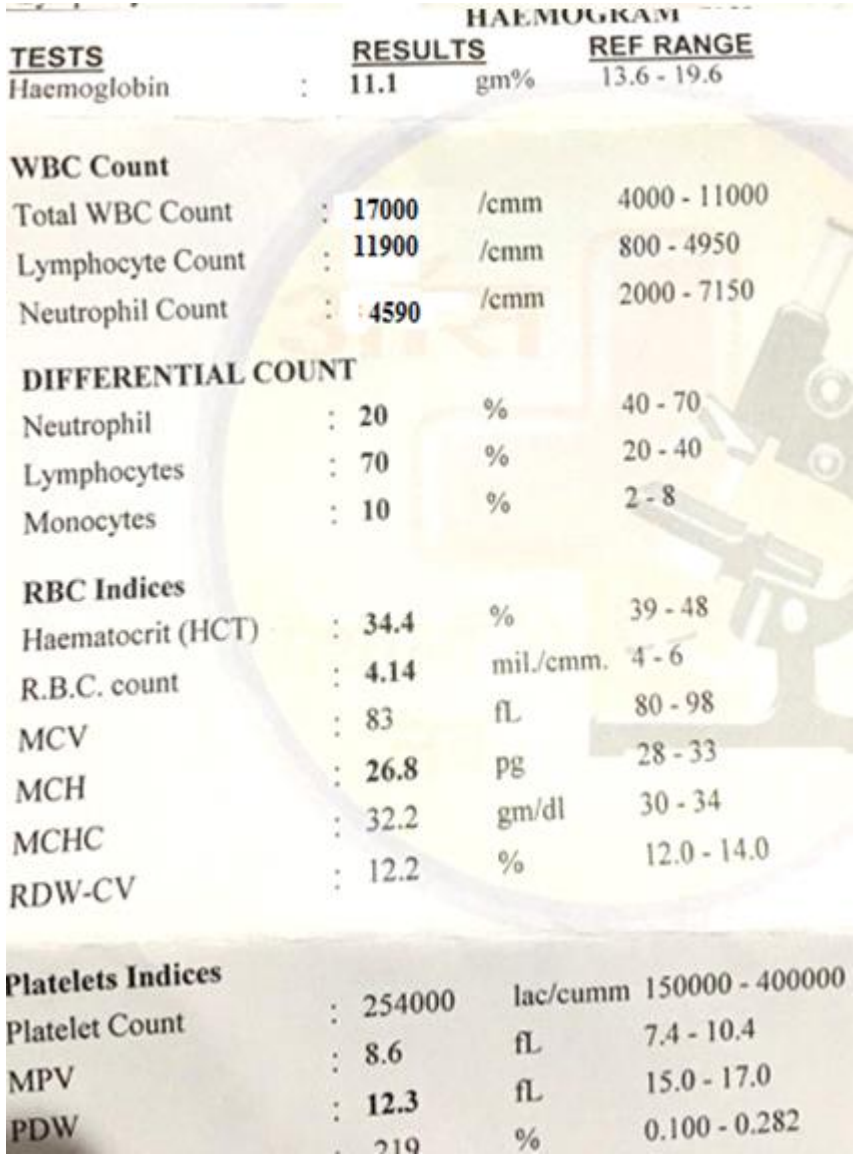
**Consolidation indicates filling of the alveoli and bronchioles in the lung with pus (pneumonia)**

# Case 2

A 59-year-old man with emphysema secondary to a 50-pack-year smoking history presents with a fever, chills, chest pain, and cough. He had a “cold” with mild cough and congestion for approximately 3 days but then had the abrupt onset of more severe symptoms. His temperature has been as high as 39.4°C (103°F), and he’s had shaking chills. His cough is productive of sputum that looks like “rust.” When he coughs or takes a deep breath, he gets a sharp, stabbing pain in his left lower chest. He has been taking numerous over the counter cold medications without relief and has had to use his inhaler more often than usual. On examination, he is quite ill appearing. His temperature is 38.8°C (101.9°F), pulse is 110 beats per minute, blood pressure 110/60 mm Hg, and respiratory rate is 28 breaths per minute. His pulmonary examination is significant for dull on percussion in the left lower fields and expiratory wheezing heard in all other fields. His heart is tachycardic but otherwise normal on auscultation. The remainder of his examination is normal. His white blood cell count is markedly elevated. An electrocardiogram is normal. A chest x-ray shows a dense infiltration of the left lower lobe along with a pleural effusion on the left side.

- **What would you expect to see on Gram stain of a sputum sample?**

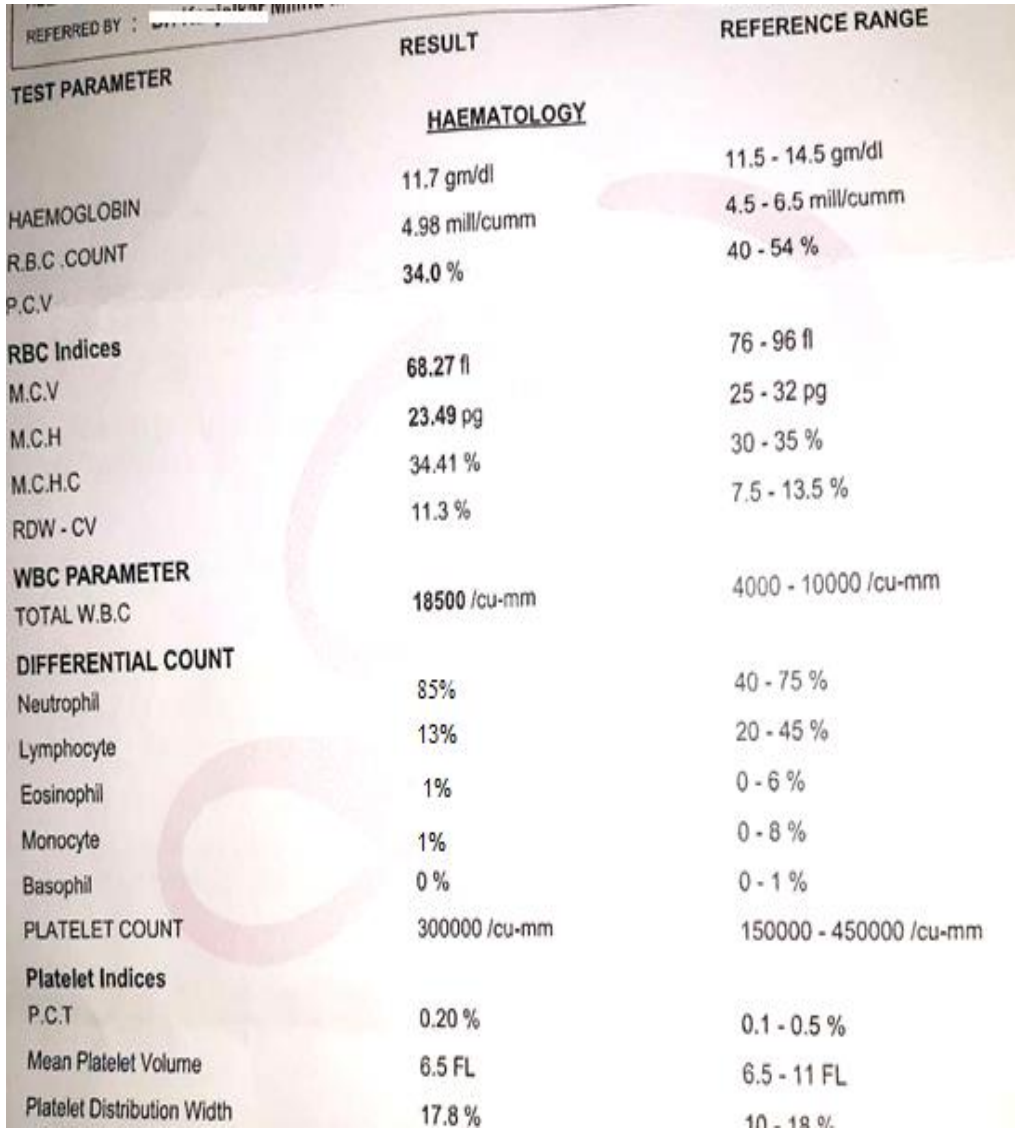
# Complete blood count bacterial and viral *pneumonia*



HAEMOGRAM

| TESTS | | RESULTS | | REF RANGE |
|---|---|---|---|---|
| Haemoglobin | : | 11.1 | gm% | 13.6 - 19.6 |
| **WBC Count** | | | | |
| Total WBC Count | : | 17000 | /cmm | 4000 - 11000 |
| Lymphocyte Count | : | 11900 | /cmm | 800 - 4950 |
| Neutrophil Count | : | 4590 | /cmm | 2000 - 7150 |
| **DIFFERENTIAL COUNT** | | | | |
| Neutrophil | : | 20 | % | 40 - 70 |
| Lymphocytes | : | 70 | % | 20 - 40 |
| Monocytes | : | 10 | % | 2 - 8 |
| **RBC Indices** | | | | |
| Haematocrit (HCT) | : | 34.4 | % | 39 - 48 |
| R.B.C. count | : | 4.14 | mil./cmm. | 4 - 6 |
| MCV | : | 83 | fL | 80 - 98 |
| MCH | : | 26.8 | pg | 28 - 33 |
| MCHC | : | 32.2 | gm/dl | 30 - 34 |
| RDW-CV | : | 12.2 | % | 12.0 - 14.0 |
| **Platelets Indices** | | | | |
| Platelet Count | : | 254000 | lac/cumm | 150000 - 400000 |
| MPV | : | 8.6 | fL | 7.4 - 10.4 |
| PDW | : | 12.3 | fL | 15.0 - 17.0 |
| | : | 219 | % | 0.100 - 0.282 |

Viral pneumonia



| REFERRED BY : | RESULT | REFERENCE RANGE |
|---|---|---|
| TEST PARAMETER | | |
| | HAEMATOLOGY | |
| HAEMOGLOBIN | 11.7 gm/dl | 11.5 - 14.5 gm/dl |
| R.B.C .COUNT | 4.98 mill/cumm | 4.5 - 6.5 mill/cumm |
| P.C.V | 34.0 % | 40 - 54 % |
| **RBC Indices** | | |
| M.C.V | 68.27 fl | 76 - 96 fl |
| M.C.H | 23.49 pg | 25 - 32 pg |
| M.C.H.C | 34.41 % | 30 - 35 % |
| RDW - CV | 11.3 % | 7.5 - 13.5 % |
| **WBC PARAMETER** | | |
| TOTAL W.B.C | 18500 /cu-mm | 4000 - 10000 /cu-mm |
| **DIFFERENTIAL COUNT** | | |
| Neutrophil | 85% | 40 - 75 % |
| Lymphocyte | 13% | 20 - 45 % |
| Eosinophil | 1% | 0 - 6 % |
| Monocyte | 1% | 0 - 8 % |
| Basophil | 0 % | 0 - 1 % |
| PLATELET COUNT | 300000 /cu-mm | 150000 - 450000 /cu-mm |
| **Platelet Indices** | | |
| P.C.T | 0.20 % | 0.1 - 0.5 % |
| Mean Platelet Volume | 6.5 FL | 6.5 - 11 FL |
| Platelet Distribution Width | 17.8 % | 10 - 18 % |

Bacterial pneumonia