# Viral Infections of Respiratory Tract

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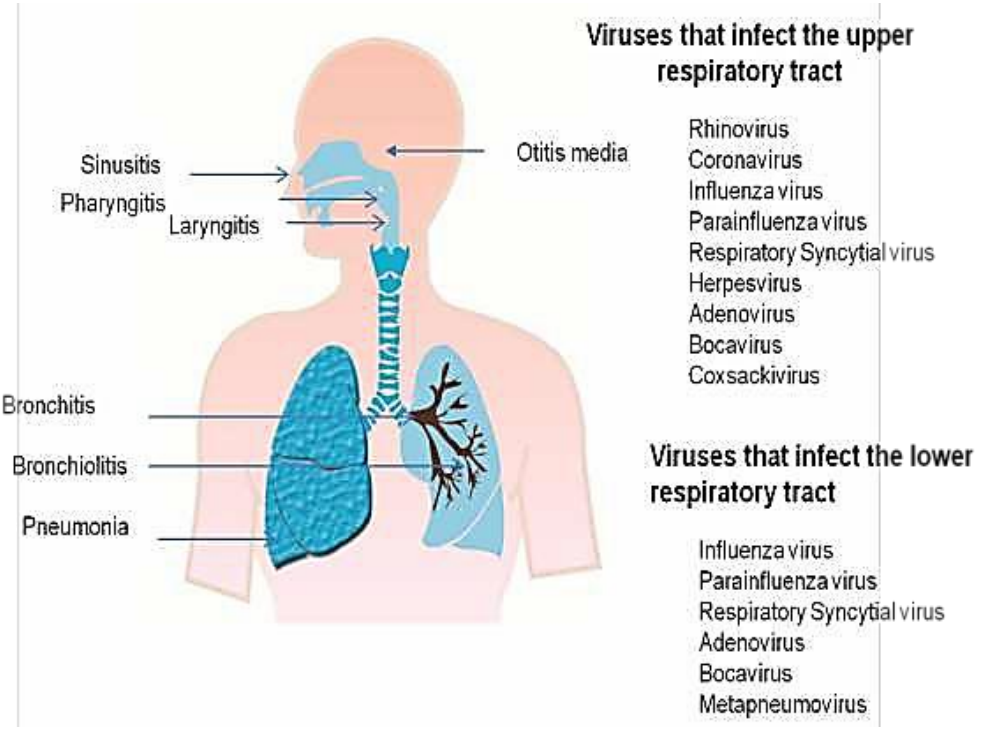
## Lecture Objectives-

- ✓ Enlist different respiratory tract infections.
- ✓ Identify the common etiological agents causing respiratory tract infections.
- ✓ Discuss the pathogenesis, signs and symptoms of the RT infections.
- ✓ Discuss the laboratory diagnosis of the infections .




## (Sore throat)

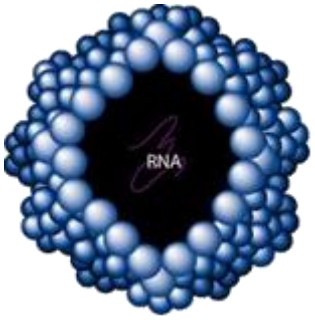
- White papules with red base on posterior palate and pharynx, fever **(Coxsackie A)**
- Inflamed tonsils/pharynx with severe fatigue, lymphadenopathy, fever, rash; heterophile(+); Downey type II cells **(Epstein-Barr virus)**

# (Common cold)

- **Viruses of Medical Importance**
  - Rhinoviruses (summer–fall)
  - Coronaviruses (winter–spring )
  - Adenovirus
  - Human metapneumovirus

### Rhinovirus

- Belongs to Picornaviridae family. Acid labile; grows at 33 C (91.4 F); over100 serotypesOver 100 serotypes
- Rhinoviruses have ss positive sense RNA as their genome.
- The virus particles are non- enveloped and are icosahedral in structure.




- Rhinovirus is transmitted through close contact, by means of virus contaminated respiratory secretions.
- Infection rates are highest among infants and children.

**Diagnosis:**

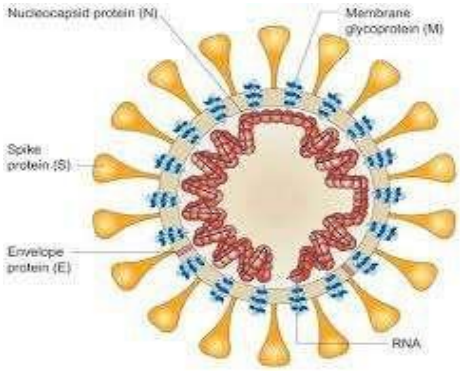
- Rhinitis, sneezing, coughing
- Common cold are generally mild and are self limiting with no systemic spread in healthy individuals.

. **Prevention-**

- ✓ No vaccine available

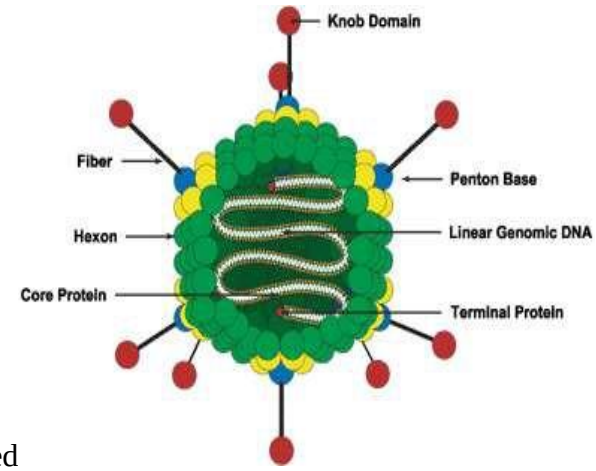
### Coronavirus

Second most common cause of the common cold. Belongs to the family coronaviridae.




- Enveloped, helical
- Positive-sense ssRNA
- Hemagglutinin molecules make up peplomers on virus surface, which
- give shape like sun with corona.

❖ **Adenovirus**




- dsDNA, nonenveloped
- Hexons, pentons, and fibers
- Over 50 serotypes

**Reservoir**: ubiquitous in humans and animals

**Transmission**: respiratory, fecal-oral, direct contact

**Pathogenesis**

- Penton fibers act as hemagglutinin
- Purified penton fibers are toxic to cells

**Diseases**

- Common cold

- Acute respiratory disease (ARD) and pneumonia: spring and winter peak incidence; children, young military recruits, college students serotypes 4 and 7; cough, conjunctivitis, fever, pharyngitis, hoarseness
- **Pharyngoconjunctivitis**: **swimming pool conjunctivitis**, pink eye; fever, sore throat, coryza, red eyes; nonpurulent
- Acute hemorrhagic cystitis: mostly boys age 5–15; dysuria, hematuria
- Gastroenteritis: daycare (not as common as rotavirus); serotypes 40 and 41

**Diagnosis**: serology; ELISA

**Prevention**: live, non attenuated vaccine

## Severe acute respiratory syndrome (SARS)

**Viruses of Medical Importance**

- SARS-CoV
- SARS-CoV-2
- Middle East respiratory syndrome CoV (MERS-CoV)

### SARS-CoV

**Reservoir**: birds and small mammals (civet cats)

**Transmission**: respiratory droplets; virus also found in urine, sweat, and feces; original case is thought to have jumped from animal to human

**Disease:** severe acute respiratory syndrome (SARS)

- Atypical pneumonia
- Clinical case definition includes fever of >38.0 C (100.4 F), flu-like illness, dry cough, dyspnea, and progressive hypoxia.
- Chest x-ray may show patchy distribution of focal interstitial infiltrates.

### SARS-CoV-2

- Which was first identified amid an outbreak of respiratory illness cases in Wuhan City, Hubei Province, China.

- Coronavirus disease 2019 (COVID-19) is defined as illness caused by a novel coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; formerly called 2019-nCoV),
- Like other RNA viruses, SARS-CoV-2, while adapting to their new human hosts, is prone to genetic evolution with the development of mutations over time, resulting in mutant variants that may have different characteristics than its ancestral strains.

**Transmission of SARS-CoV-2**

- The primary mode of transmission of SARS-CoV-2 is via exposure to respiratory droplets carrying the infectious virus from close contact or droplet transmission from presymptomatic, asymptomatic, or symptomatic individuals harboring the virus.
- Airborne transmission with aerosol-generating procedures has also been implicated in the spread of COVID-19.
- Fomite transmission from contamination of inanimate surfaces with SARS-CoV-2 has been well characterized based on many studies reporting the viability of SARS-CoV-2 on various porous and nonporous surfaces.

**Diagnostic Testing In COVID-19**

**Molecular Testing**

The standard diagnostic mode of testing is testing a nasopharyngeal swab for SARS-CoV-2 nucleic acid using RT-PCR assay. Other sites are oropharyngeal, anterior/mid-turbinate nasal swabs, nasopharyngeal aspirates, bronchoalveolar lavage (BAL) and saliva. The collection of BAL samples should only be performed in mechanically ventilated patients as lower respiratory tract samples seem to remain positive for a more extended period

**Serology Testing**

**Imaging Modalities**

Imaging studies may include chest x-ray, lung ultrasound, or chest computed tomography (CT).

**Other Laboratory Assessment**

Complete blood count (CBC), Additional tests such as testing for inflammatory markers such as ESR, C-reactive protein (CRP), ferritin.

**Prevention of COVID-19**

**A) Active Immunization (Vaccination)**

- RNA Vaccines (Moderna, Pfizer)
- Viral Vector vaccines (Oxford/AstraZeneca, Gamalaya-Sputnik)

- Inactivated Virus (SinoVac, SinoPharm)

**B) Passive Immunization (Antibody Administration)**

- Monoclonal Antibodies
- Polyclonal Antibodies
- Convalescent Plasma : When someone recovers from COVID-19, they can choose to donate blood plasma This plasma can then be given intravenously to someone who's severely ill with COVID-19.

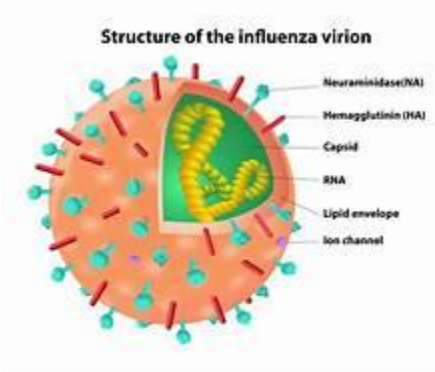
**Middle East respiratory syndrome CoV (MERS-CoV)**

- Was first identified in Saudi Arabia in 2012.
  - Reservoir: bats and camels
  - Disease and transmission: similar to SARS

## (Influenza)

- Viruses of Medical Importance:
  - Influenza A
  - Influenza B

***Overview of Influenza virus***




**Family Characteristics(ORTHOMYXOVIRIDAE)**

- Negative-sense ssRNA
- Enveloped
- Segmented (8 segments)
- Helical

**Distinguishing Features**

- Envelope contains two glycoproteins, H and N
- Used to serotype virus.

**Reservoir**

- Influenza A (birds, pigs, humans)
- Influenza B (humans only)

**Transmission**

- Direct contact

- Respiratory
- 1997 H5N1 strain jumped directly from birds to humans
- 2009 H1N1 strain—quadruple reassortment virus (North American swine, avian, human; Asian and European swine)

**Pathogenesis**

**Antigenic drift**

- Influenza A and B
- Slight changes in antigenicity due to mutations in H and/or N
- Causes epidemics

**Antigenic shift**

- Influenza A only
- Rare genetic reassortment
- Coinfection of cells with two different strains of influenza A (H5N1 and H3N2); reassortment of segments of genome
- Production of a new agent to which population has no immunity
- Responsible for pandemics

**Clinical picture**

- Headache and malaise
- Fever, chills, myalgias, anorexia
- Bronchiolitis, croup, otitis media, vomiting (younger children)
- Pneumonia/secondary bacterial infections
- Can lead to Reye syndrome or Guillain-Barré syndrome

**Diagnosis**

- Rapid tests (serology) e.g. ELISA, HAI
- Clinical symptoms plus season.
- RT-PCR

**Prevention**

- The vaccine is normally trivalent, consisting of one A H3N2 strain, one A H1N1 strain, and one B strain..
- Vaccine-induced immunity is decreased by antigenic drift and is absent if there is antigenic shift.

There are 2 types of vaccine:

-**(killed vaccine)** trivalent inactivated influenza vaccine (TIV)

Two strains of influenza A (H3N2, H1N1, for example) and one strain of influenza B are incorporated into the vaccine.

-**(Live-attenuated influenza vaccine)** (LAIV)

Intranasal administration

## ( Bronchitis & Bronchiolitis )

- Respiratory syncytial virus (RSV)
  - Negative-sense ss enveloped RNA (Paramyxovirus)

**Disease**

- Adults: colds
- Infants/ child < 5 years: bronchiolitis and necrosis of bronchioles, atypical pneumonia (low fever, tachypnea, tachycardia, expiratory wheeze).

**Diagnosis**

- Indirect fluorescent antibody
- ELISA
- Syncytia (multinucleate giant cells) in tissue culture media
- RT-PCR

**Reference**

KAPLAN Medical, USMLE Step 1 Lecture Notes 2021, Immunology and Microbiology;Pages:308,309,321,324,325,334,337,340,341,380,383.

**Recall Question**

**Which one of the following structural features is specifically seen in *Adenovirus*?**

a. Enveloped, ss linear DNA

b. Enveloped, ds circular DNA

c. Non-enveloped, ds linear DNA

d. Non-enveloped, ss circular DNA