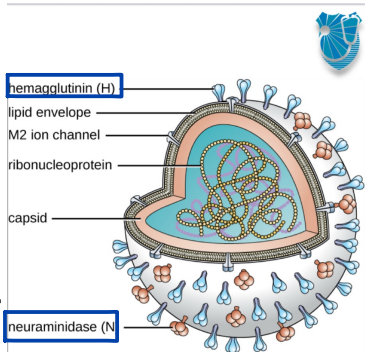
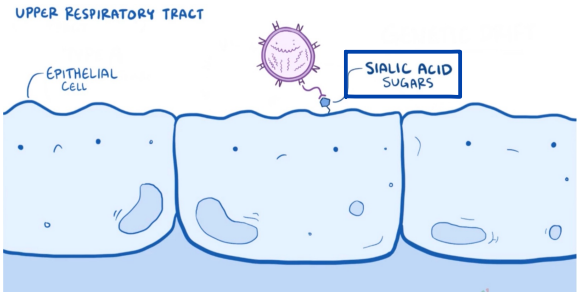
Microbiology Lecture 4

Done by : Mayas Abotarboush

1. Influenza Viruses (Orthomyxoviridae)

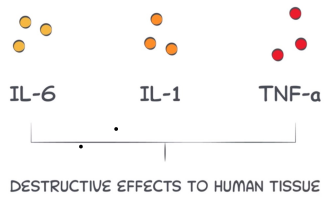


Structure: These are enveloped viruses with a segmented, negative-sense, single-stranded RNA genome (8 segments for types A and B). They feature two key surface glycoproteins: Hemagglutinin (HA) for attachment and Neuraminidase (NA) for viral release and spread.

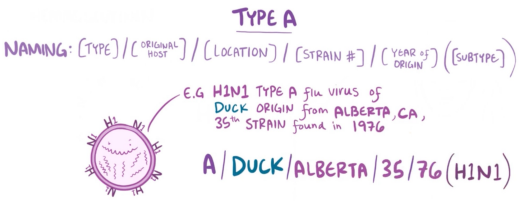


Pathogenesis: The primary targets are ciliated columnar epithelial cells in the upper and lower respiratory tracts. HA binds to sialic acid receptors, leading to viral replication that causes cell apoptosis, necrosis, and impaired mucociliary clearance

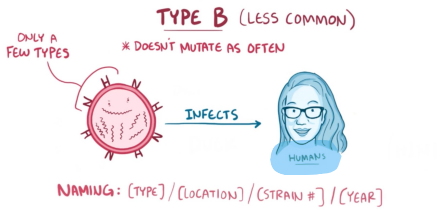
Immunopathogenesis: Detection by TLR3 and TLR7 triggers an antiviral state and systemic symptoms like fever and myalgia via cytokines (IFN, IL-1, IL-6, TNF-α). Severe cases may involve a cytokine storm, leading to pulmonary edema and ARDS.



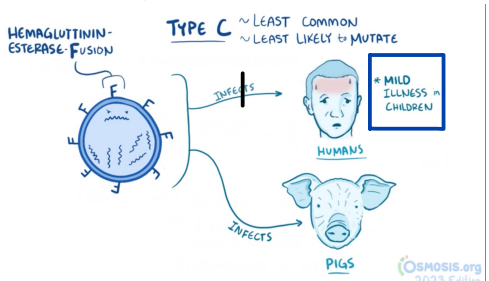
Types and Pandemics:



↳ Influenza A: Has animal reservoirs (birds, pigs); its segmented genome allows for antigenic shift (reassortment), causing pandemics.



↳ Influenza B: Primarily a human virus; undergoes antigenic drift only, causing seasonal epidemics.

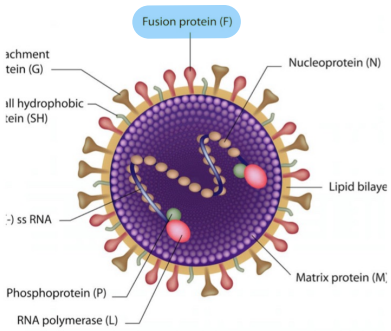


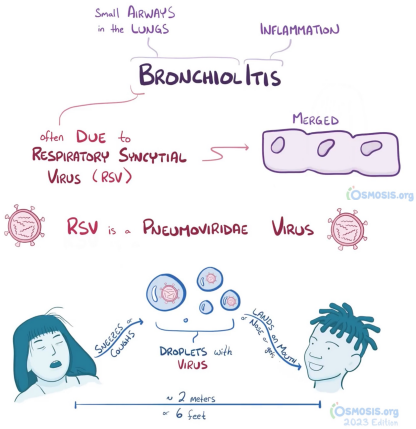
↳ Influenza C: Causes only mild upper respiratory infections (common cold) with weak immune activation

Epidemiology: Transmission occurs via droplets, aerosols, and fomites, peaking in winter in temperate climates due to cold, dry air and indoor crowding

2. Respiratory Syncytial Virus (RSV) (Pneumoviridae)

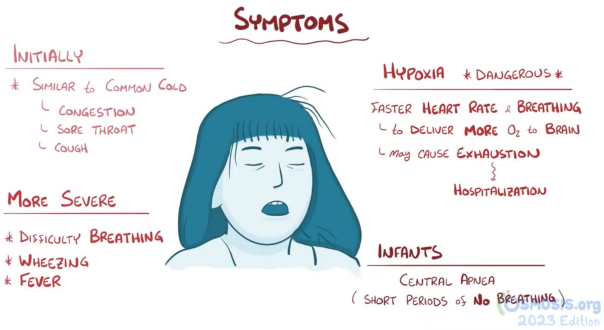
Characteristics: An enveloped, non-segmented, negative-sense ssRNA virus. It possesses a fusion (F) protein that causes characteristic cell fusion and syncytia formation.





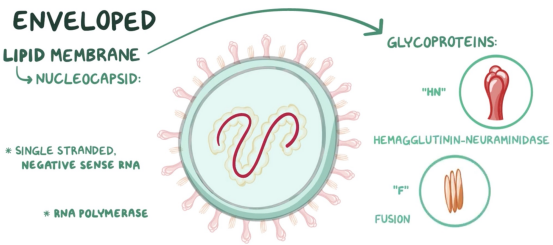
Pathogenesis: Infects bronchiolar epithelial cells, leading to inflammation, mucus production, and narrowed airways. This results in air trapping, atelectasis, and hypoxia, which is most severe in infants due to their small airway diameters.

Clinical Impact: RSV is the leading cause of bronchiolitis and pneumonia in infants. It causes approximately 100,000 deaths annually in children under five, mostly in low- and middle-income countries. Reinfection is common throughout life because immunity is short-lived



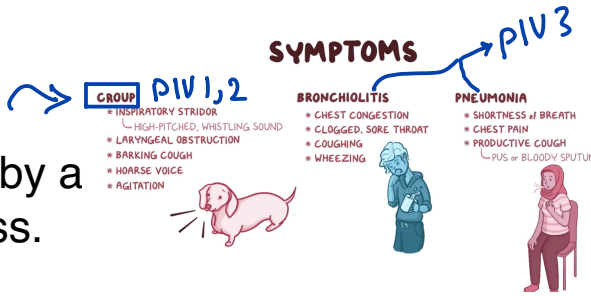
3. Parainfluenza Viruses (PIV) (Paramyxoviridae)

Characteristics: Enveloped, non-segmented, negative-sense ssRNA viruses. They feature an HN glycoprotein that combines hemagglutinin and neuraminidase functions.



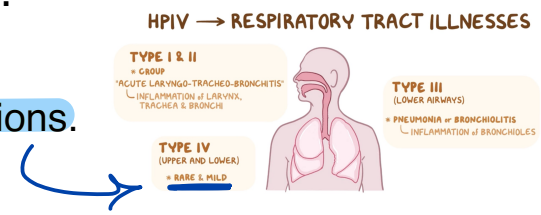
Clinical Syndromes:

PIV-1 and PIV-2: The most common causes of Croup (laryngotracheobronchitis), characterized by a barking cough, inspiratory stridor, and hoarseness.



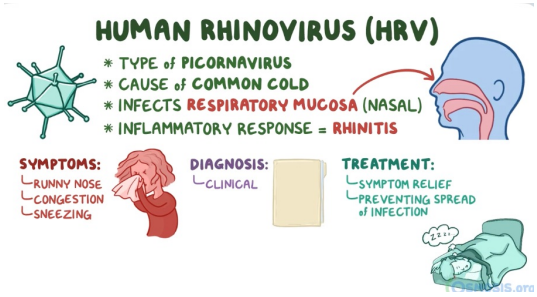
PIV-3: Associated with bronchiolitis and pneumonia.

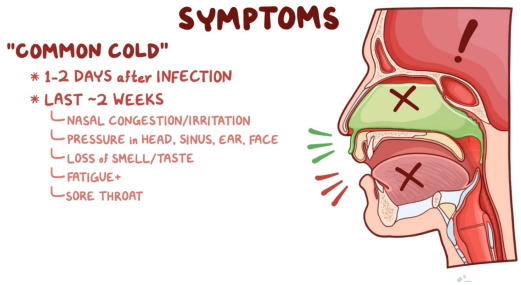
PIV-4: Generally causes mild upper respiratory tract infections.



4. Rhinoviruses (Picornaviridae)

Characteristics: Non-enveloped, positive-sense ssRNA viruses with over 150 serotypes, which explains why humans experience frequent reinfections. They replicate optimally at 33-35 °C, which limits their primary activity to the upper respiratory tract.



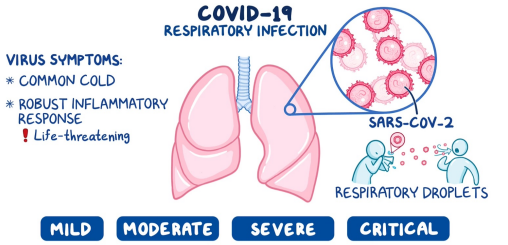


Clinical Impact: They are the most common cause of the common cold (coryza). Beyond the cold, they are major triggers for asthma exacerbations and can worsen COPD.

5. Human Coronaviruses (Coronaviridae)

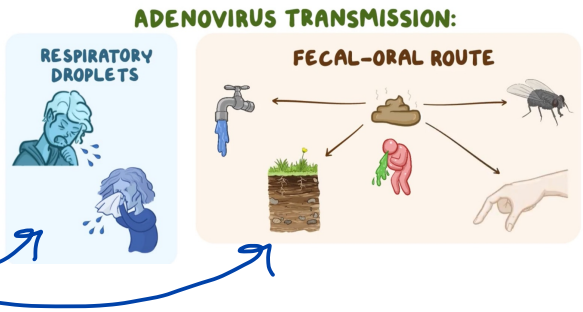
Characteristics: Enveloped, positive-sense ssRNA viruses.

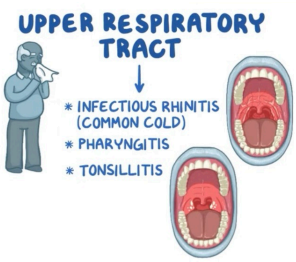
Clinical Impact: Common human strains (229E, NL63, OC43, and HKU1) are the second most common cause of the common cold. They show seasonal peaks in winter, and reinfection is frequent due to short-lived immunity.

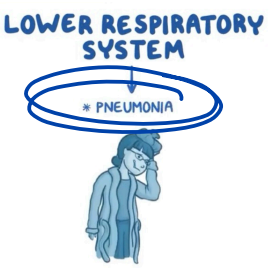


6. Adenoviruses (Adenoviridae)

Characteristics: Non-enveloped, dsDNA viruses that are exceptionally stable, surviving on environmental surfaces for long periods.

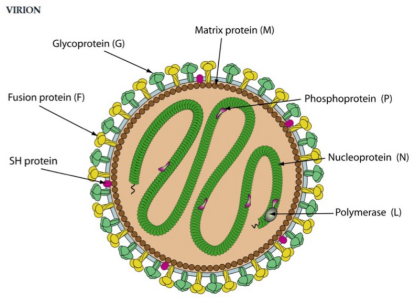






Clinical Impact: They cause a wide range of syndromes, including pharyngitis, pneumonia, and pharyngoconjunctival fever. Severe pneumonia outbreaks are classically associated with military recruits.

7. Human Metapneumovirus (hMPV) & Human Bocavirus (HBoV)



• hMPV (Pneumoviridae): An enveloped, negative-sense SsRNA virus that causes seasonal infections (late winter to spring). It is clinically indistinguishable from RSV, causing mild colds or severe bronchiolitis and pneumonia in high-risk groups.

• HBOV (Parvoviridae): A small, non-enveloped, SsDNA virus. It is often co-detected with other viruses like RSV or hMPV; because of prolonged viral shedding, its detection does not always prove it is the primary cause of the current illness.

Summary of Diagnosis, Management, and Prevention

• Diagnosis: Multiplex PCR (molecular testing) is the preferred method for definitive diagnosis in hospitals.
Antigen tests are faster but have variable sensitivity, though they are useful for RSV in children.

• Management: Supportive care is the priority (hydration, oxygen, antipyretics). Antivirals (Oseltamivir, Baloxavir) are reserved for severe or high-risk Influenza cases. Antibiotics are only used if a secondary bacterial infection (like S. aureus or S. pneumoniae) is suspected.

• Prevention:

↳ Influenza: Annual vaccines (IIV or nasal LAIV). (↑ inactivated influenza vac. / → attenuated)
↳ RSV: Maternal immunization, adult vaccines, and monoclonal antibodies (Nirsevimab, Palivizumab) for high-risk infants.
↳ Adenovirus: A live oral vaccine for types 4 and 7 is used exclusively for U.S. military personnel.

• General: Hand hygiene and environmental disinfection remain essential.