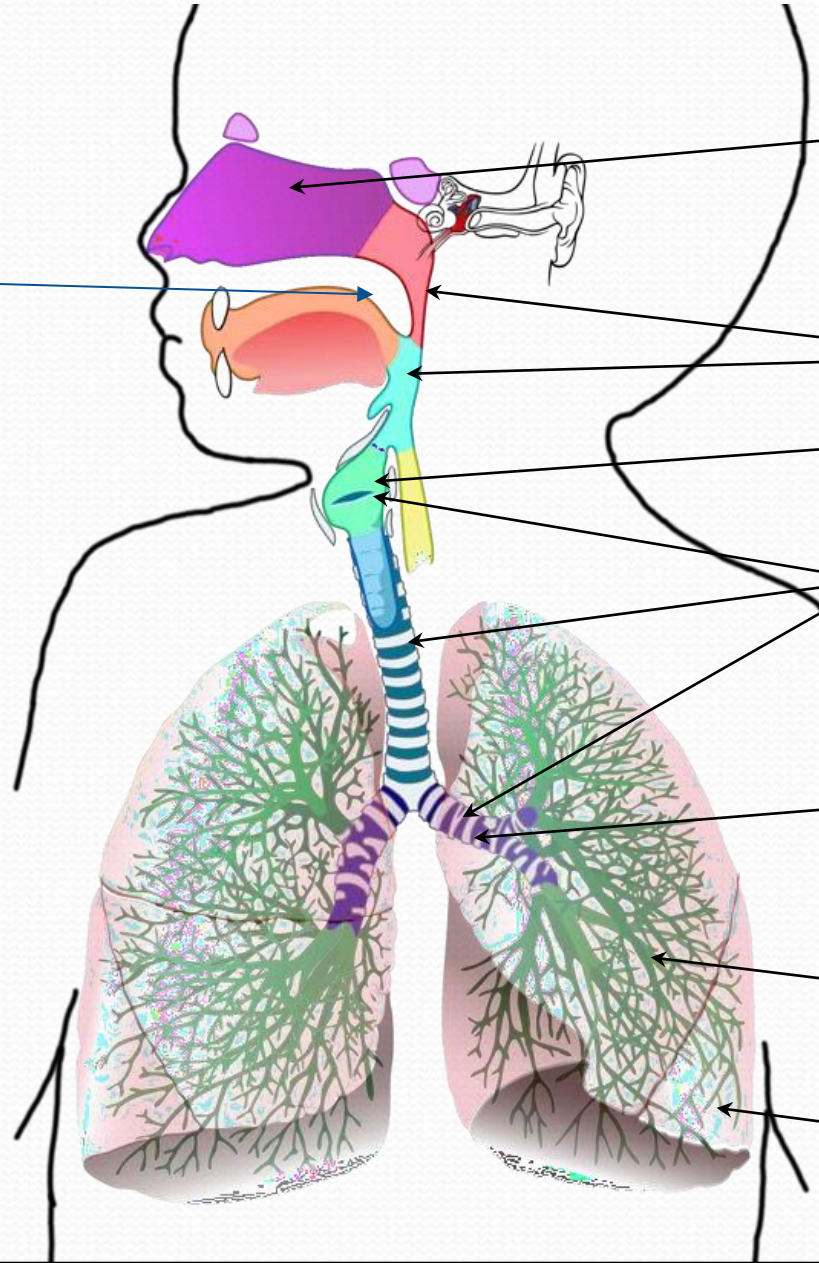
Respiratory System Infections

Anatomical Location of Viral Syndromes



EBV,CMV

Rhinitis
Common Cold

Rhinovirus, Coronavirus
Influenza

Pharyngitis
Sore Throat
Laryngitis

Adenovirus, Parainfluenza
Influenza

Laryngotracheobronchitis
Croup

Parainfluenza
Influenza

Bronchitis

Rhinovirus, Parainfluenza,
Adenovirus, Metapneumovirus
RSV, Coronavirus **Influenza**

Bronchiolitis

RSV (single serotype)
Metapneumovirus
Adenovirus **Influenza**

Pneumonia

All viruses **Influenza**

Influenza

- A common viral disease of the lower respiratory system caused by an **orthomyxovirus**
- 15-20% of world population
- 3-5 million sever cases
- 500000 death
- Influenza is pervasive worldwide and causes 3,000–50,000 deaths each year in the United States.
- Influenza infections are most typically characterized by **fever**, **chills**, and **body aches**. This is followed by symptoms similar to the common cold that may last a week or more

Common Cold Vs Influenza

Sign/Symptom	Common Cold	Influenza
Fever	Low (37.2 °C [99 °F])	High (39 °C [102.2 °F])
Headache	Common	Common
Aches and pains	Mild	Severe
Fatigue	Slight	Severe
Nasal congestion	Common	Rare
Sneezing	Common	Rare

Myalgias, arthralgias and loose stool

- In general, influenza is self-limiting. However, serious cases can lead to pneumonia and other complications that can be fatal. Such cases are more common in the very young and the elderly
- The influenza virus is primarily transmitted by direct contact and inhalation of aerosols

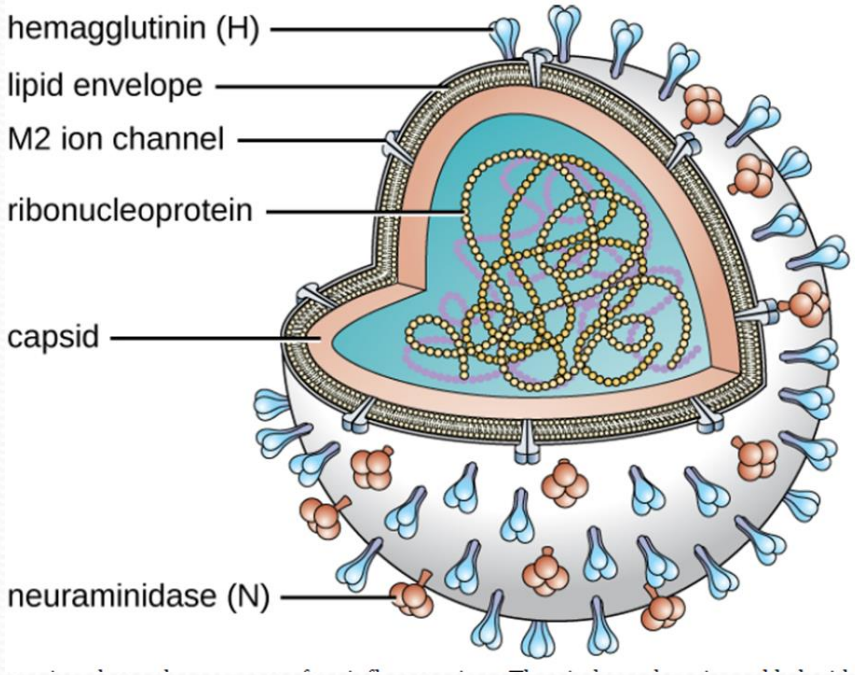
Reye syndrome

- A **complication of influenza** that occurs primarily in children and teenagers
- Swelling in the liver and brain, and may progress to neurological damage, coma, or death.
- Reye syndrome may follow other viral infections, like **chickenpox**, and has been associated with the use of **aspirin**.
- the CDC and other agencies recommend that aspirin and products containing aspirin never be used to treat viral illnesses in children younger than age 19 years.

- RS is primarily a children's disease, although it can occur at any age. It is often misdiagnosed. Symptoms may include:
  - Persistent or recurrent vomiting
  - Listlessness
  - Personality changes such as irritability or combativeness
  - Disorientation or confusion
  - Delirium
  - Convulsions
  - Loss of consciousness

Influenza virus

- The RNA genome
  - Seven or eight **segments**, each coated with ribonucleoprotein and encoding one or two specific viral proteins.
- The influenza virus is surrounded by a lipid membrane envelope, and **two of the main antigens** of the influenza virus are
  - The spike proteins hemagglutinin (H) and neuraminidase (N)
  - The hemagglutinin protein to bind to sialic acid receptors on host
  - Neuraminidase, which cleaves sialic-acid receptors to allow progeny viruses to make a clean exit



The influenza viruses

- There are three genetically related influenza viruses, called A, B, and C.

	Influenza A virus	Influenza B virus	Influenza C virus
Severity	Severe	Moderate	Mild
Animal reservoir	Yes	No	No
Genome segments	8	8	7
Population spread	Epidemic and pandemic	Epidemic	Sporadic
Antigenic variation	Shift/drift	Drift	Drift

- The most virulent group is the influenza A viruses, which cause seasonal pandemics of influenza each year.
- Influenza A virus can infect a variety of animals, including pigs, horses and even whales and dolphins.
- Influenza B virus is less virulent and is sometimes associated with epidemic outbreaks.
- Influenza C virus generally produces the mildest disease symptoms and is rarely connected with epidemics.
- Neither influenza B virus nor influenza C virus has significant animal reservoirs.

The influenza A viruses

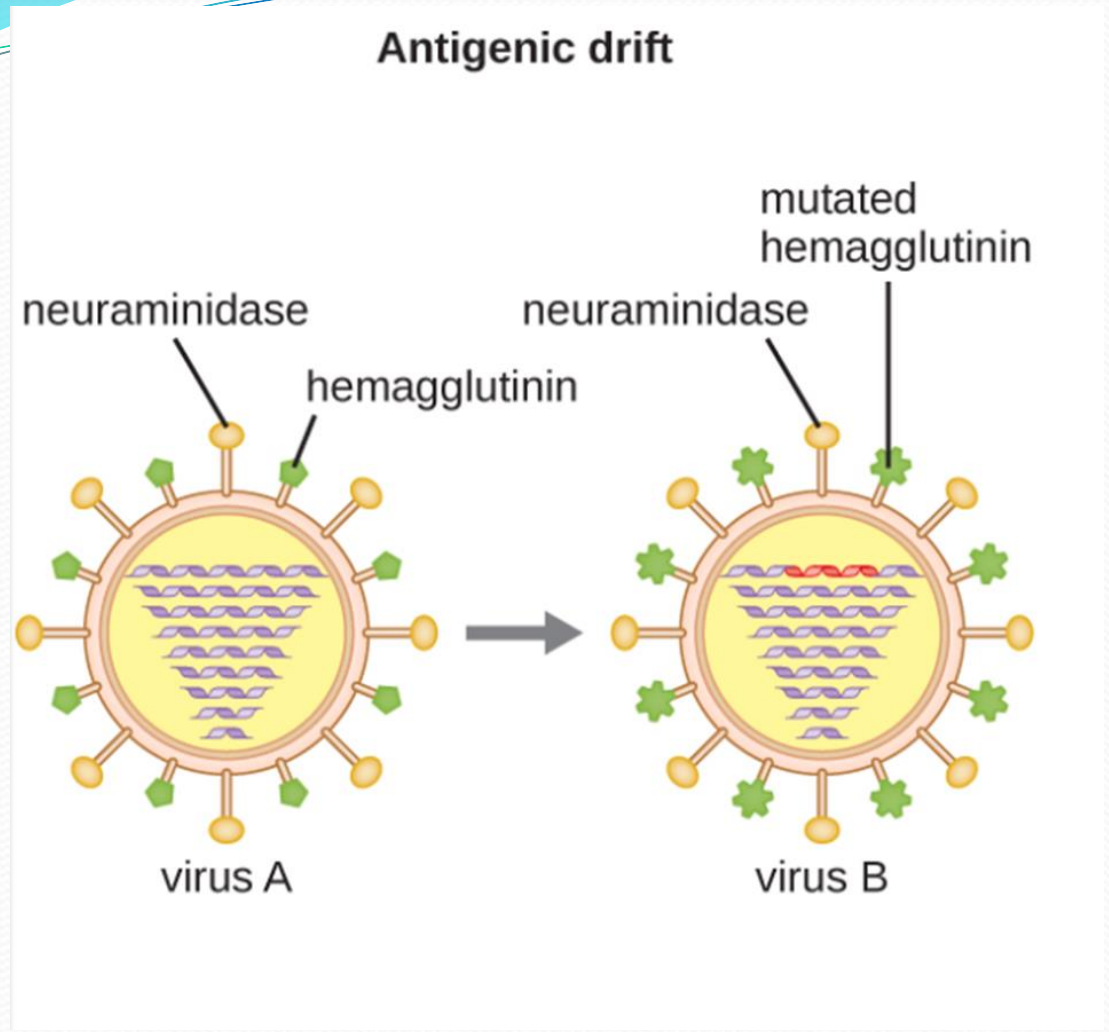
- The influenza A viruses
  - Have different subtypes
    - 18 known subtypes of hemagglutinin and 11 known subtypes of neuraminidase.
  - Influenza viruses are serologically characterized by the type of H and N proteins that they possess.
  - Of the nearly 200 different combinations of H and N, only a few, such as the H1N1 strain, are associated with human disease.

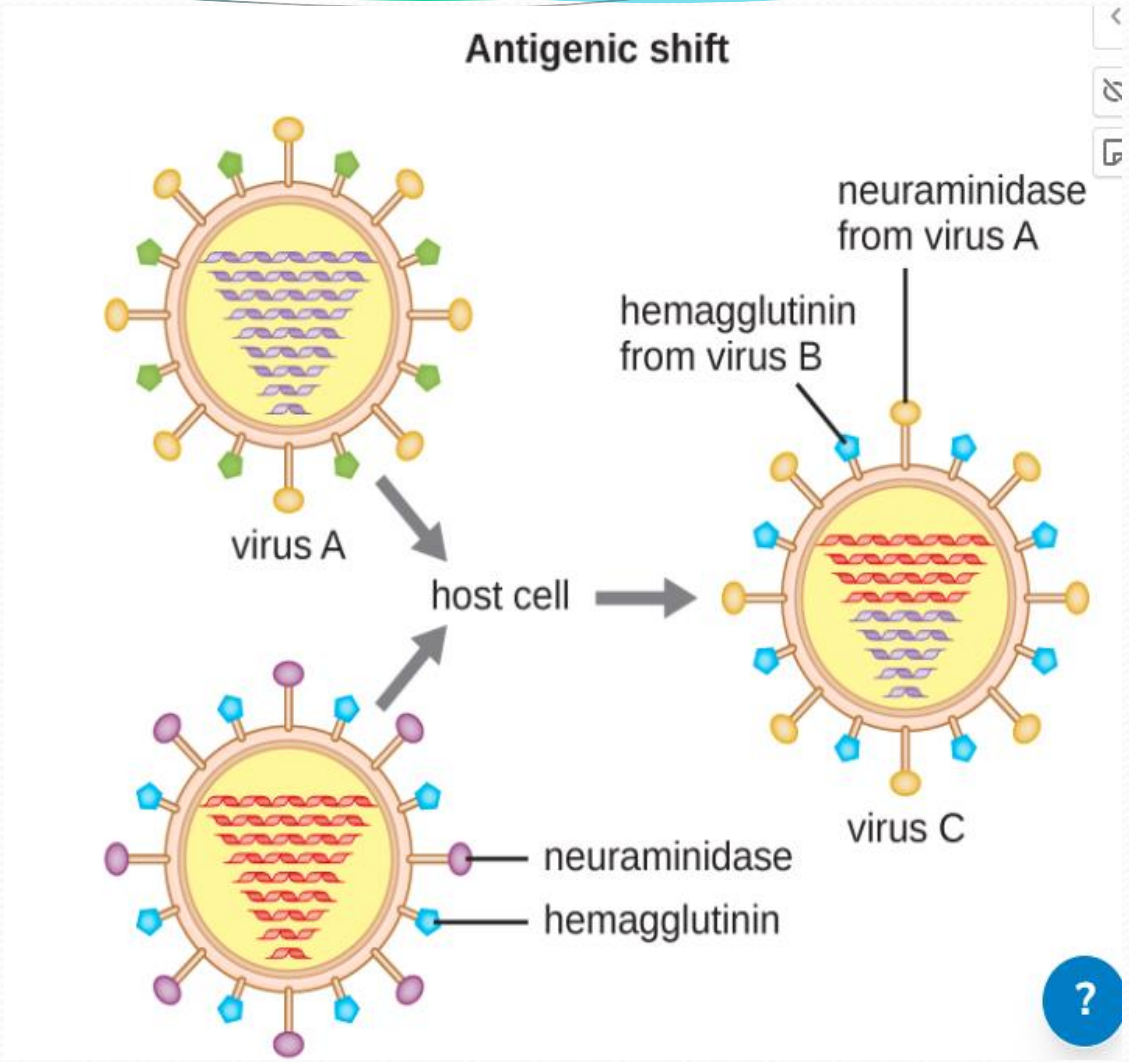
Influenza virus infections

- Elicit a **strong immune response**, particularly to the hemagglutinin protein
- Unfortunately, the antigenic properties of the virus change relatively rapidly, so new strains are evolving.
- When an influenza virus gains a new hemagglutinin or neuraminidase type, it is able to evade the host's immune response and be successfully transmitted, often leading to an epidemic.

Evolutionary changes

- Antigenic Variation in influenza viruses
  - Antigenic **drift** and Antigenic **shift**
- Antigenic drift is the result of point mutations causing slight changes in the spike proteins hemagglutinin (H) and neuraminidase (N).
- Antigenic shift is a major change in spike proteins due to gene reassortment.
  - Influenza viruses swap gene segments. This genetic exchange is possible due to the segmented nature of the viral genome
  - Occurs when two differing influenza viruses co-infect a cell.


Antigenic drift
neuraminidase
hemagglutinin
virus A
mutated
hemagglutinin
neuraminidase
virus B


Antigenic shift
virus A
host cell
neuraminidase
from virus A
hemagglutinin
from virus B
virus C
neuraminidase
hemagglutinin

Virus B

- The rate of antigenic variation in influenza viruses is very high, making it difficult for the immune system to recognize the many different strains of Influenza virus.
- Although the body may develop immunity to one strain through natural exposure or vaccination, antigenic variation results in the continual emergence of new strains that the immune system will not recognize.
  - This is the main reason that vaccines against Influenza virus must be given annually.
- Each year's influenza vaccine provides protection against the most prevalent strains for that year, but new or different strains may be more prevalent the following year.

Spanish flu

- The most lethal influenza pandemic in recorded history occurred from 1918 through 1919.
- An a**ntigenic shift** involving the recombination of avian and human viruses
  - A new H1N1 virus.
- Killed as many as 40 million to 50 million
- Originated in the United States.
- the conditions of World War I greatly contributed to the spread of this disease.
  - Crowding, poor sanitation, and rapid mobilization of large numbers of personnel and animals facilitated the dissemination of the new virus once it appeared.

Bird Flu (Avian Influenza)

- H5N1
- Cause severe respiratory symptoms.
- People who work with poultry, water fowl (like geese and ducks) and livestock are most at risk.
- Infected animal's body fluid
- It's extremely rare for it to spread from person to person

H1N1 swine flu

- H1N1 flu to be a pandemic in 2009
- That year the virus caused an estimated 284,400 deaths worldwide. In August 2010, WHO declared the pandemic over
- It's called swine flu because it's similar to a flu virus that affects pigs (swine).
- The virus leads to a lung (respiratory) disease in pigs.

Feature	Influenza (Seasonal Flu)	Bird Flu	Swine Flu
Host Species	Humans	Birds	Pigs and humans
Human Impact	Widespread, annual	Rare in humans	Widespread in pandemics
Mortality Rate	Relatively low	Very high	Similar to seasonal flu
Transmission	Person-to-person	Contact with birds	Person-to-person
Vaccination	Annual flu vaccine	Limited experimental vaccines	Covered in flu vaccines

Laboratory diagnosis

- Variety of Rapid influenza diagnostic tests (RIDTs).
  - These tests are inoculated by point-of-care personnel and give results within 15–20 minutes.
  - Unfortunately, these tests have variable sensitivity and commonly yield false negative results.
- Hemagglutination of erythrocytes (due to hemagglutinin action) or complement fixation.
- Patient serum antibodies

Treatment

- Three drugs that inhibit influenza neuraminidase activity are available: inhaled zanamivir, oral **oseltamivir (Tamiflu)**, and intravenous peramivir.
  - Can shorten the course of the disease.
  - Should start less than 48 hours from exposure or symptom for prophylaxis or treatment
  - Nursing home, young, old, pregnant, chronic lung, immunocompromised

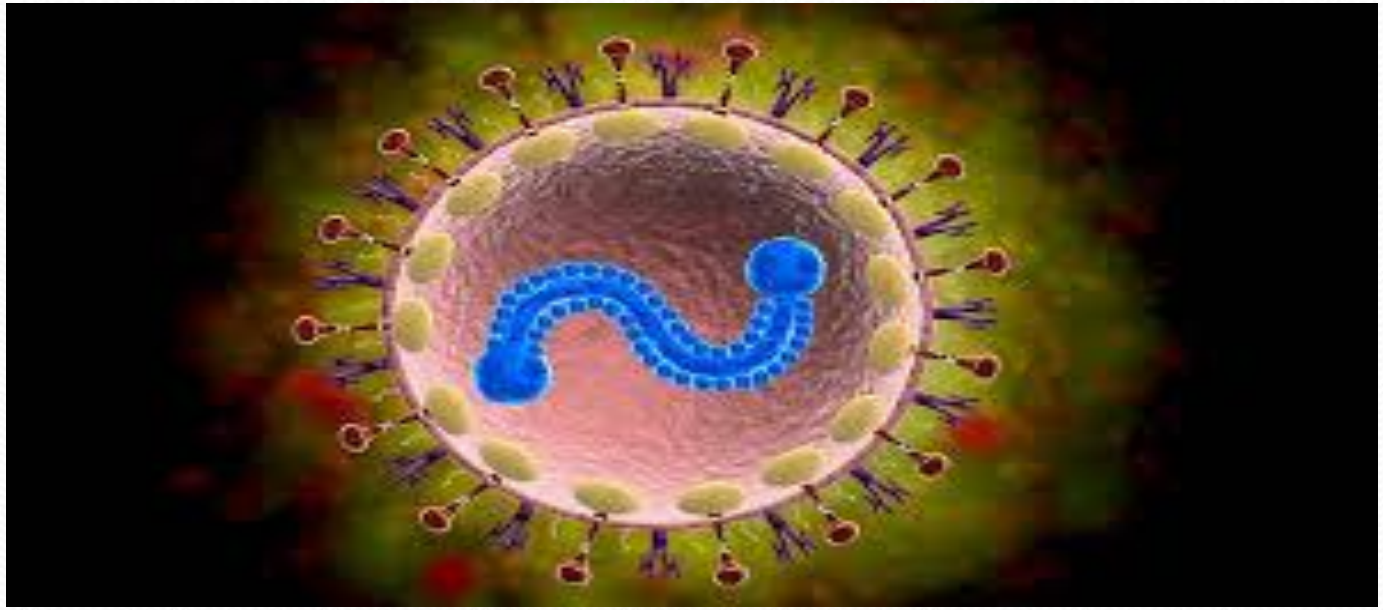
- A more effective means of controlling influenza outbreaks, though, is vaccination.
  - Every year against the strains expected to be predominant.
  - three or four viruses are selected—the two most prevalent influenza A strains and one or two influenza B strains.
  - Most of the influenza vaccines over the past decade have had an effectiveness of about 50%

Bronchiolitis/RSV

- Inflammation of bronchioles
- RSV is the most common cause of bronchiolitis and pneumonia in children younger than 1 year of age
- Pediatric less than 2 years (peak at 6 months)
- Runny nose , cough, **wheeze**, **cyanosis**, fever, fatigue and reduce activity
- Difficulty feeding due to **respiratory distress**.
- Wheezing and crackles on auscultation. Tachypnea (rapid breathing),Retractions (intercostal, subcostal),Nasal flaring and Cyanosis in severe cases.

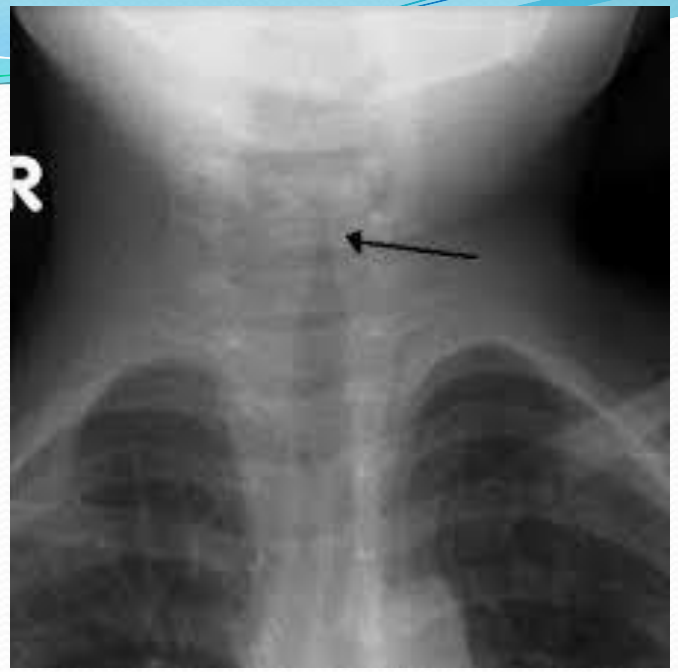
Treatment

- Assess severity
- Determine risks factors
- Supportive



Evade immune system and antibodies production: no natural immunity
Reinfection not sever

Croup



- Laryngiotrachibronchitis
- Viral (most common: parainfluenza virus).
- Cough (seal like, barking)
- More in fall
- **Inspiratory stridor** (An obstruction in the extrathoracic region), runny nose,fever, hoarseness
- Most common: **parpainflunza virus**, RSV
- Treatment:
  - Supportive
  - If sever: epinephrine, dexamethasone, O2
- D DX: Bacteria Tracheitis (S aureus)

Steeple sign

Feature	Croup
Etiology	Viral (most common: **parainfluenza virus**).
Age Group	Typically affects children **6 months to 3 years**.
Onset	Gradual, often preceded by **cold-like symptoms** (runny nose, fever, mild cough).
Key Symptoms	**- Barking**, "**seal-like" cough**. **- Inspiratory stridor. - Hoarseness**.
Severity	Usually **mild to moderate** (can be severe in rare cases).
Response to Treatment	Stridor improves with **humidified air, nebulized epinephrine, or corticosteroids**.
Voice Changes	Hoarseness common.
Fever	Low-grade fever.
Airway Management	Rarely requires intubation unless severe (e.g., impending respiratory failure).
Treatment	**- Mild cases**: Supportive care (humidified air, hydration). **- Moderate/severe cases**: Corticosteroids (e.g., dexamethasone), nebulized epinephrine.

Feature	Bacterial Tracheitis
Etiology	Bacterial (most common: **Staphylococcus aureus**; others include Streptococcus, Moraxella).
Age Group	Slightly older children (**5–8 years**), but can occur in younger children.
Onset	Rapid progression following a viral illness or can appear suddenly.
Key Symptoms	- High fever. - **Severe stridor (inspiratory and expiratory)**. - Toxic appearance (lethargy, cyanosis, severe distress).
Severity	Severe and **life-threatening** due to airway obstruction from thick purulent secretions.
Response to Treatment	Minimal or no response to treatments for croup (e.g., epinephrine).
Voice Changes	Hoarseness is less common but may occur.
Fever	High fever.
Toxic Appearance	Frequently present: patient appears **toxic and ill**.
Airway Management	High risk of airway obstruction; **intubation is often required** to manage secretions.
Treatment	- Requires **broad-spectrum IV antibiotics** (e.g., ceftriaxone + vancomycin). - Airway clearance under controlled conditions (e.g., bronchoscopy or suctioning).

Viral bronchitis/chest cold

- **Viral bronchitis** refers to inflammation of the bronchi (large airways) caused by a viral infection. It is one of the most common causes of **acute bronchitis** and is usually self-limited, resolving within a few weeks.
- **Common Viruses**:
  - Influenza virus, Parainfluenza virus, Respiratory Syncytial Virus (RSV), Adenovirus and Coronavirus
- **Cough** (hallmark symptom):
  - Begins as dry and unproductive.
  - Progresses to a productive cough with mucus (clear, yellow, or green sputum).
  - For 10-20 days

- Other Symptoms:
  - Low-grade fever, Fatigue, **Wheezing** or mild dyspnea, Sore throat (often a prodromal symptom), Chest discomfort or tightness (due to coughing).
- Signs:
  - **Rhonchi or wheezing** on auscultation (which may improve after coughing).
- Most cases resolve within 2–3 weeks.
- Supportive Care:
  - Hydration: To thin mucus and maintain airway clearance.
  - Rest: Allow recovery.
  - Analgesics/Antipyretics: Acetaminophen or ibuprofen for fever and discomfort.
  - Cough Suppressants (e.g., dextromethorphan)
- Bronchodilators:
  - Short-acting beta-agonists (e.g., albuterol) may be used if wheezing or bronchospasm is present

Viral Pneumonia

- Viruses cause fewer cases of pneumonia than bacteria;
- Several viruses can lead to pneumonia in children and the elderly.
  - adenoviruses, Coronaviruses, influenza viruses, parainfluenza viruses, and respiratory syncytial viruses.
- The signs and symptoms produced by these viruses can range from mild cold-like symptoms to severe cases of pneumonia,
  - the virulence of the virus strain and the strength of the host defenses

Coronaviruses.

- Large family of viruses that usually cause mild to moderate upper-respiratory tract illnesses
  - Severe acute respiratory syndrome (SARS)
  - Middle East respiratory syndrome (MERS)
  - SARS-CoV-2
- zoonotic infections
- Bats and civet cats are thought to have been the reservoirs for SARS;
- Camels seem to be the reservoir for MERS.

SARS-CoV

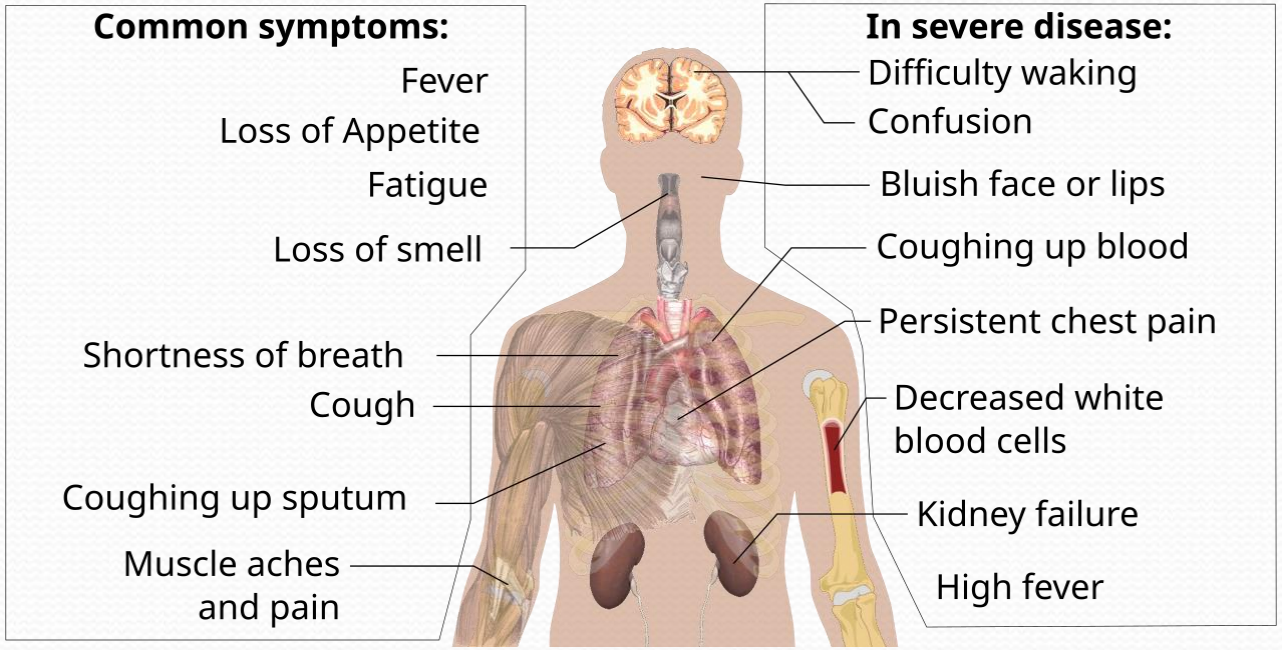
- SARS (2002, china)
  - Fever, chills, and body aches which usually progressed to pneumonia.
  - Within about 1 year, more than 8,000 people experienced influenza-like symptoms and nearly 800 people died.
  - 10% fatality rate
  - No human cases of SARS have been reported anywhere in the world since 2004.

MERS-CoV

- MERS (2012) :
  - Emerged in 2012
  - Fever, cough, and shortness of breath which often progress to pneumonia or kidney failure; GI symptoms
  - 35% people with MERS have died.
  - Sporadic MERS cases continue to occur, primarily in the Arabian Peninsula.
  - As of 2015, over 1,300 people in 27 countries have been infected.
    - 500 people have died.
- There are no specific treatments for either MERS or SARS.

COVID-19

- SARS-CoV-2, which emerged in 2019 and causes coronavirus disease 2019 (COVID-19)
- Fever, cough, loss of smell and taste, fatigue myalgia, diarrhea and GI symptoms



Feature	SARS	MERS	COVID-19
Causative Virus	SARS-CoV	MERS-CoV	SARS-CoV-2
Year Identified	2002	2012	2019
Primary Region of Outbreak	China, spread to other countries	Middle East (Saudi Arabia, UAE)	Worldwide
Reservoir Host	Bats	Bats	Bats
Intermediate Host	Civet cats	Camels	(uncertain)
Primary Mode	Respiratory droplets	Close contact with camels	Respiratory droplets, aerosols
Human-to-Human Transmission	Yes, but less efficient	Limited	Highly efficient
Community Spread	Moderate	Rare	Widespread
Incubation Period	2–10 days	2–14 days	2–14 days
Common Symptoms	Fever, cough, shortness of breath	Fever, cough, shortness of breath	Fever, cough, fatigue, shortness of breath, **loss of smell/taste**
Severe Symptoms	Pneumonia, acute respiratory distress	Pneumonia, kidney failure, ARDS	Pneumonia, ARDS, multi-organ failure
Case Fatality Rate (CFR)	~10%	~34%	~1–2% globally (varies by region/age)
Total Cases	~8,000	~2,600 (as of 2023)	>770 million (as of 2023)
Global Spread	Epidemic	Limited outbreaks	Pandemic
Vaccines	None	None	Multiple vaccines developed
Antiviral Treatments	Supportive care	Supportive care	Antiviral drugs (e.g., remdesivir)
Control Measures	Isolation, quarantine, masks	Isolation, contact with camels avoided	Masks, vaccines, social distancing

Family	Examples
Orthomyxoviridae	Influenza A, B, C, D
Coronaviridae	SARS-CoV, MERS-CoV, SARS-CoV-2
Paramyxoviridae	RSV, Parainfluenza, Metapneumovirus
Picornaviridae	Rhinovirus,
Adenoviridae	Adenoviruses
Reoviridae	Reoviruses
Herpesviridae	Cytomegalovirus (CMV)
Togaviridae	Rubella virus
Paramyxoviridae	Measles virus
Bunyaviridae	Hantaviruses