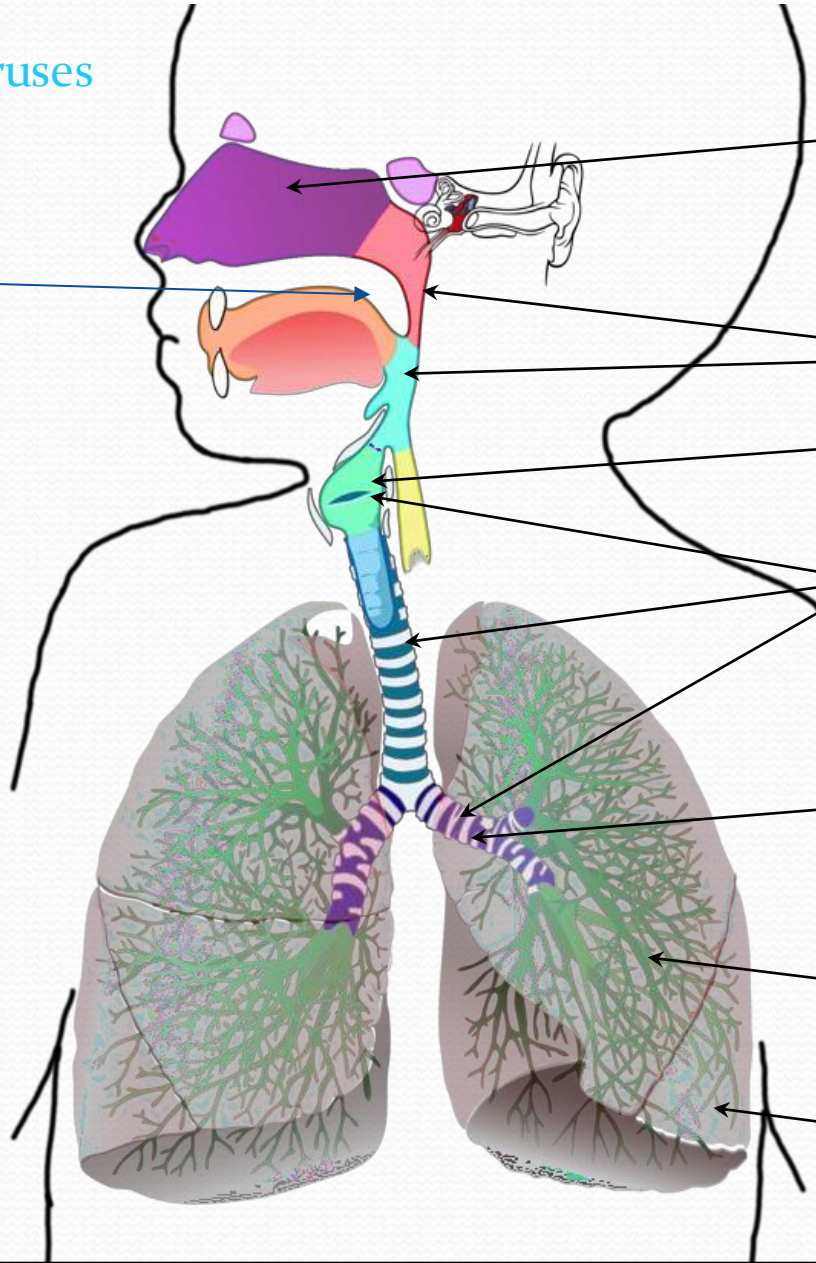
Respiratory System Infections

By Eman Alrousan , Hakam Ra’ed

Anatomical Location of Viral Syndromes

Green coloured viruses are DNA viruses.



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

Cough and sore throat

Myalgias, arthralgias and loose stool

- In general, influenza is self-limiting. However, serious cases can lead to pneumonia ,bronchitis, bronchiolitis 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

Important to know for exam purposes.

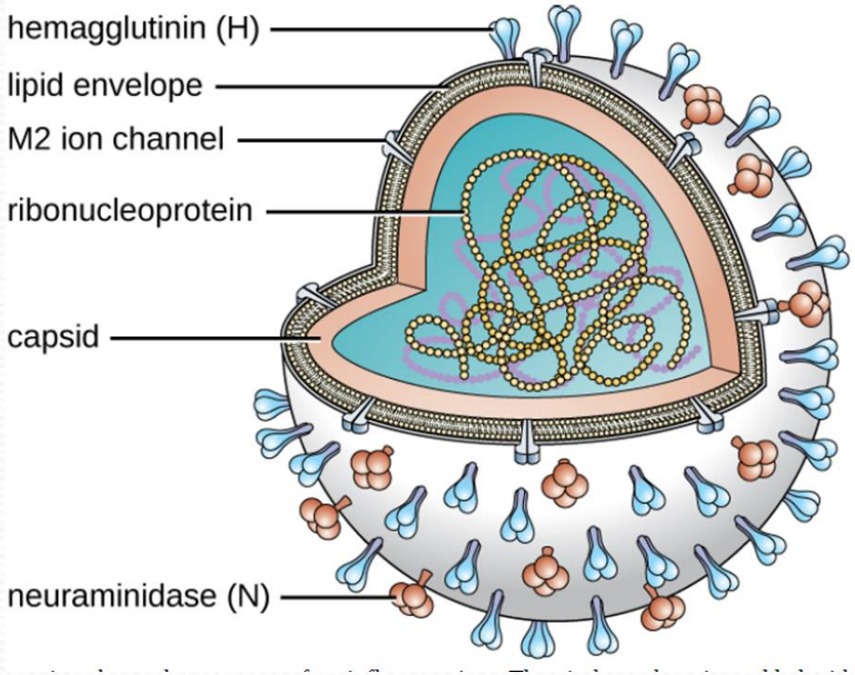
Reye syndrome

- A **complication of influenza** that occurs primarily in children and teenagers
- Swelling in the liver and brain, and may progress to neurological damage, coma, seizures, hallucinations 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
  - Liver abnormalities

Influenza virus

- The RNA genome(segmented)
  - 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 <u>bind</u> to sialic acid receptors on host,when reaching respiratory tract.
  - Neuraminidase, which cleaves sialic-acid receptors to allow progeny viruses to make a clean <u>exit</u>



The influenza viruses

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

Important

Most prevalent

	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, birds, 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 virus circulating this year won't be the same next year, which is why our immune system can't respond as effectively to the new strain(antigenic shift or drift).

The influenza A viruses

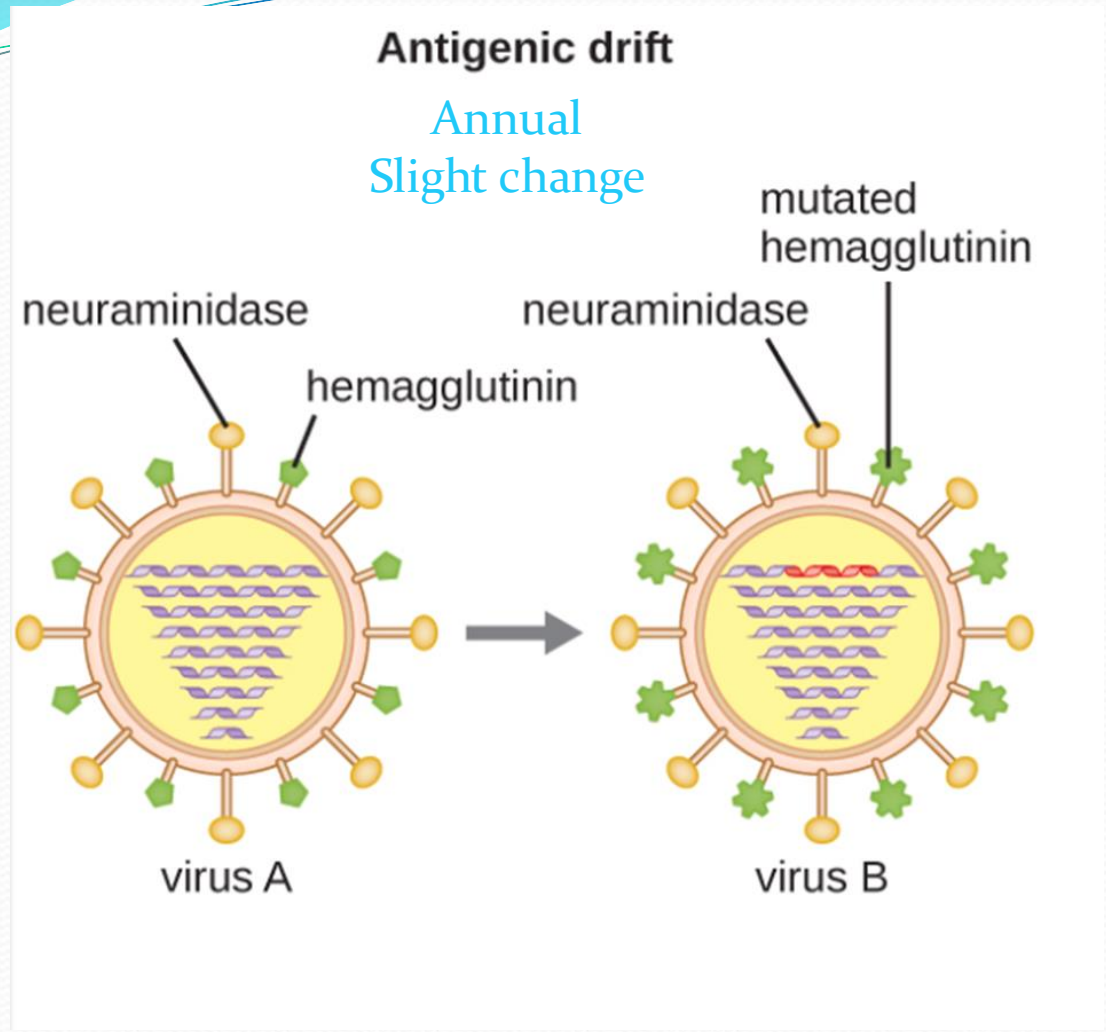
- The influenza A viruses
  - Have different subtypes
    - 18 known subtypes of hemagglutinin(H) and 11 known subtypes of neuraminidase(N). That's why H1N1 differs from H2N2 (different antigen).
  - Influenza viruses are serologically characterized by the type of H and N proteins that they possess.
  - Of the nearly 200 different combinations of H and N, only a few, such as the H1N1 strain, are associated with human disease.

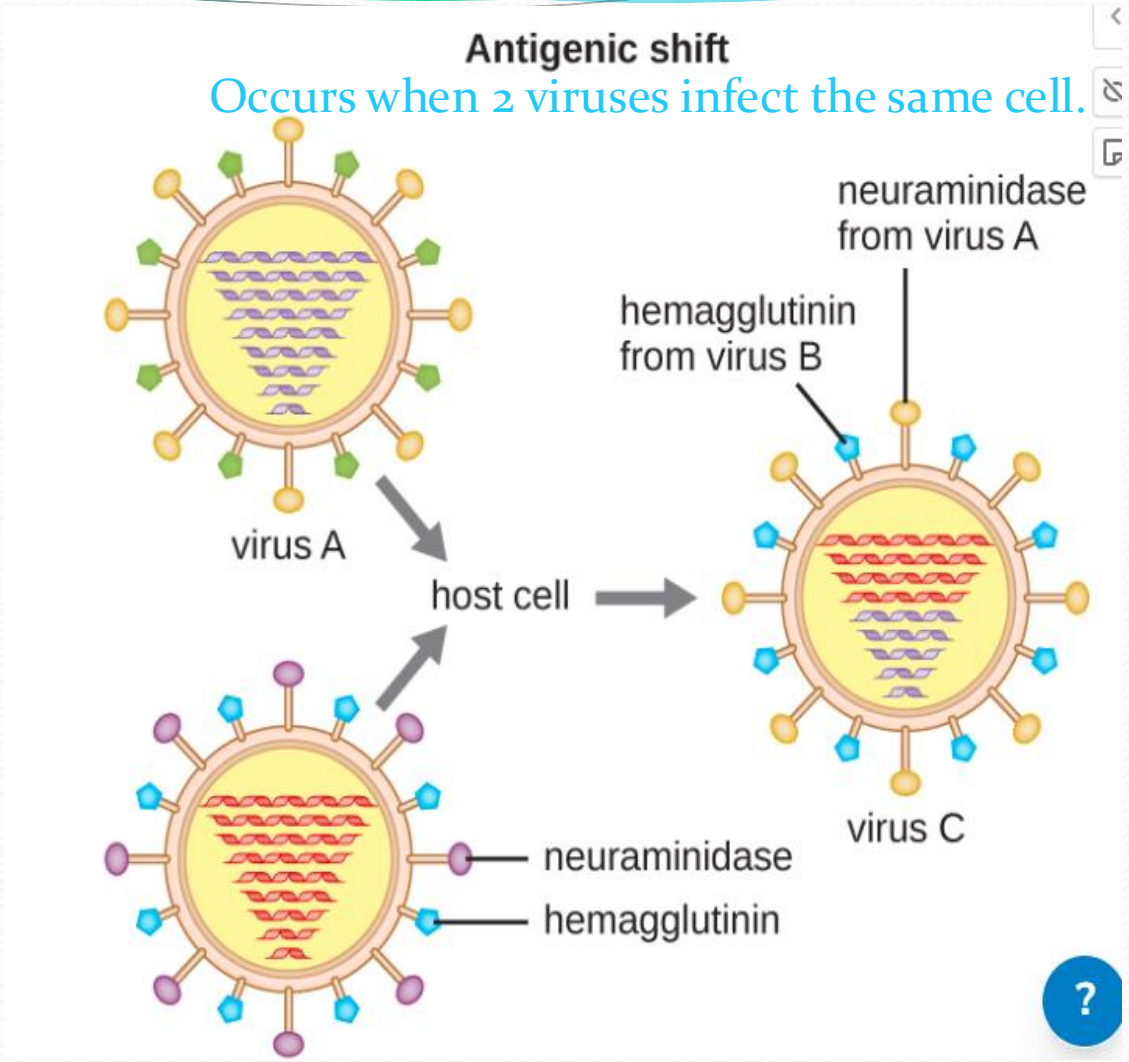
Influenza virus infections

- Elicit a **strong immune response**(unlike rhinovirus), 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(whole segment is changed).
  - 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.
  - Any change (shift or drift), requires new antibody development.





Virus B

Like changes from H1N1 into H5N5 for example .

- 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.

Scientists monitor influenza strains globally until February each year to identify the most likely strain to spread in the upcoming season. The final predicted strain is used to create the flu vaccine, which is then distributed to provide protection against the expected virus.

It was a typical influenza outbreak until it infected birds, triggering an antigenic shift.

Spanish flu

- The most lethal influenza pandemic in recorded history occurred from 1918 through 1919.
- An a**ntigenic <u>shift</u>** involving the recombination of avian(birds)and human viruses
  - A new H1N1 virus.(first appearance)
- 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.

Caused by antigenic shift

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.
- Mainly spread from Infected animal's body fluid
- It's extremely rare for it to spread from person to person

By an Antigenic shift occurred in pig's respiratory tract

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.