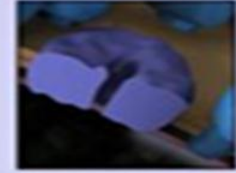


Hemagglutinin



Neuraminidase



M2 Ion Channel



RNP

# INFLUENZA VIRUS

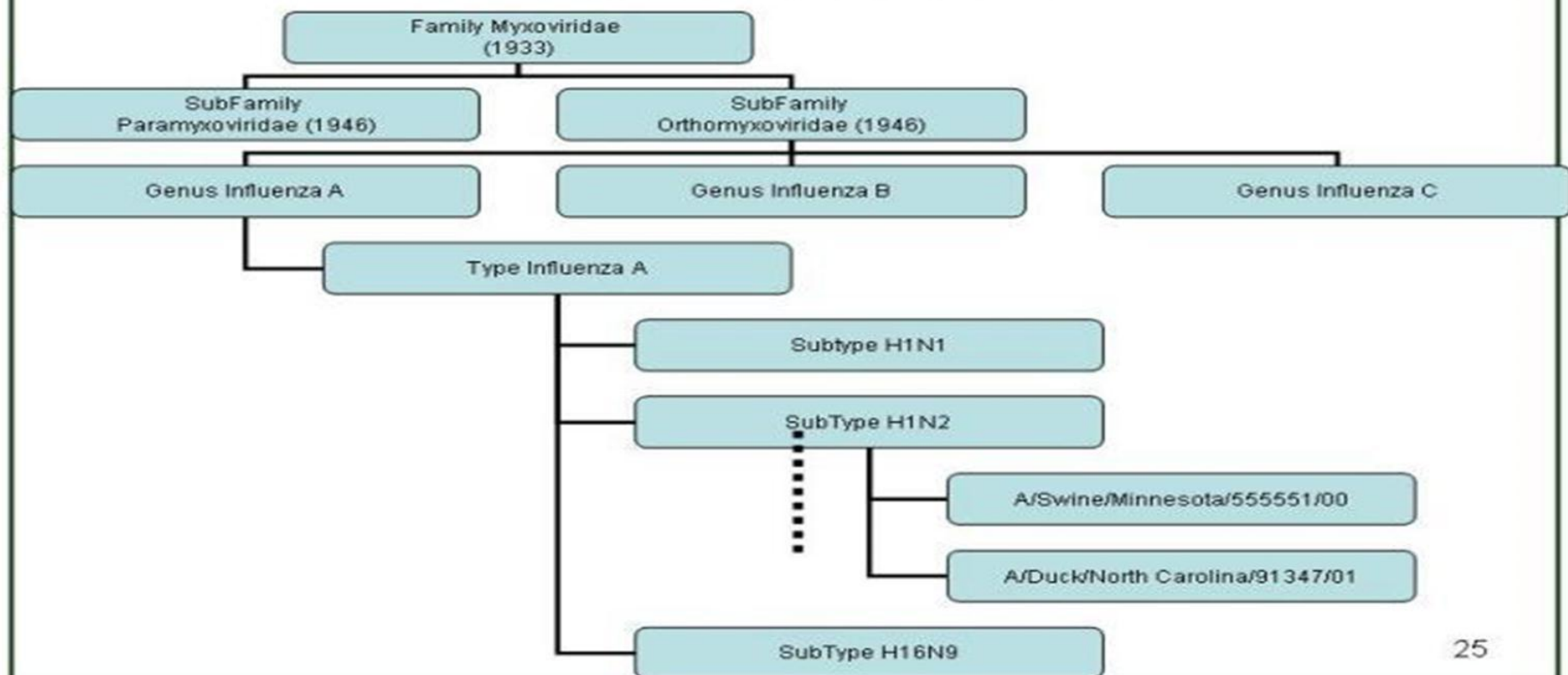
# Contents

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# Influenza (The flu)

- Influenza (the flu) is a contagious respiratory illness caused by influenza viruses. It can cause mild to severe illness, and at times can lead to death.
  
- In virus classification influenza viruses are RNA viruses/ Subfamily: Orthomyxoviridae.
  - Influenza virus A
  - Influenza virus B
  - Influenza virus C

# Classification



## Influenza A virus

- **Influenza A virus**; the most virulent human pathogens among the three influenza types.
- **Influenza A virus**; capable of infecting human as well as animals (ducks, chickens, pigs, whales, horses and seals). Wild aquatic birds are the natural hosts for a large variety of influenza A.
- **Influenza A virus** is the main cause of worldwide pandemics.
- **Influenza A viruses** subtypes e.g., (H1N1), (H5N1),....

## Influenza B virus

- **Influenza B virus;** it almost exclusively infects humans.
- **Influenza B virus;** less common than influenza A.
- **Influenza B viruses** are not divided into subtypes, but can be further broken down into different strains.
- **Influenza B virus;** mutates at a rate 2–3 times lower than type A. This reduced rate of antigenic change, combined with its limited host range ensures that pandemics of influenza B do not occur.

## Influenza C virus

- **Influenza C virus;** infects humans.
- **Influenza C virus;** less common than the other types and usually only causes mild disease in children.

# Virus Structure

- **The viral particles** of all influenza Viruses are similar in composition. These are made of a **viral envelope** containing two main types of **glycoproteins**, wrapped around a central core.
- **The central core** contains the viral **RNA genome** and other viral proteins that package and protect this RNA.



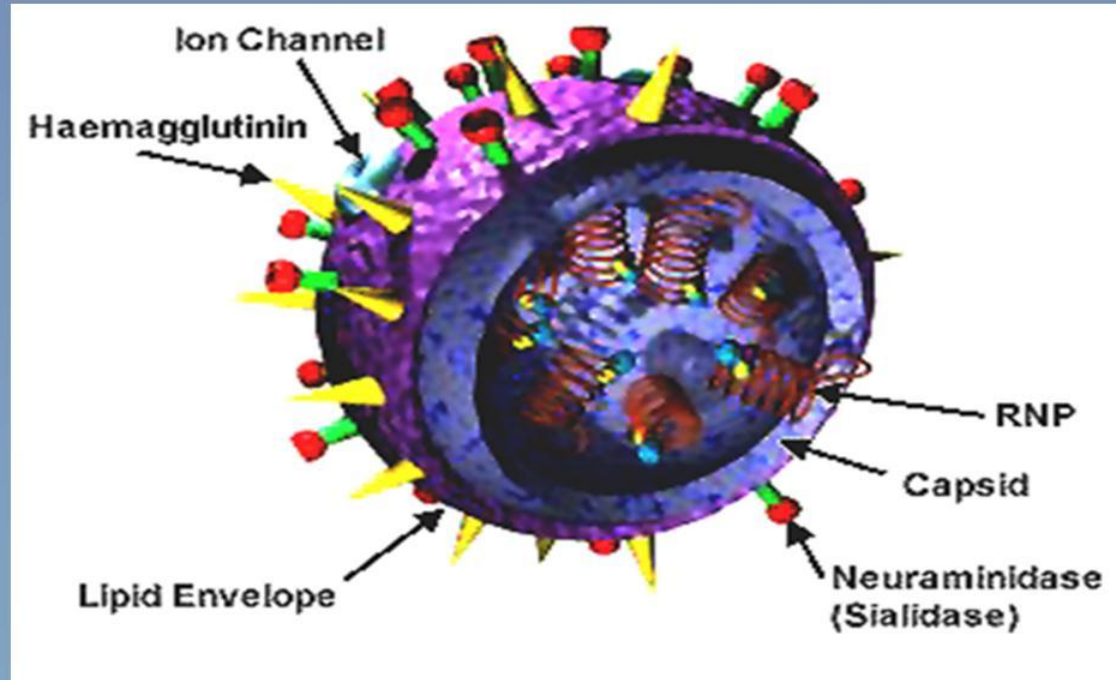
## Virus Structure

- Influenza viruses A, B and C are very similar in overall structure.
- The virus particle is 80–120 **nanometres** in diameter and usually roughly spherical, although filamentous forms can occur. These filamentous forms are more common in influenza C, which can form cordlike structures up to 500 **micrometres** long on the surfaces of infected cells.

# Virus Structure

- Enveloped virus/
- Helical nucleocapsid/
- Segmented, single stranded RNA of negative polarity/must be copied into positive-sense molecules in order to direct the production of proteins.

# Virus Structure



# The Influenza A Capsid

- The influenza A capsid contains the antigenic glycoproteins hemagglutinin (HA) and neuraminidase (NA); several hundred molecules of each protein are needed to form the capsid.

# The Influenza A Genome

- The influenza A genome encoding for 11 proteins: hemagglutinin (HA), neuraminidase (NA), nucleoprotein (NP), M1, M2, NS 1, NS2 (NEP/nuclear export protein), PA, PB1 (polymerase basic 1), PB1-F2 and PB2.

## Hemagglutinin and Neuraminidase

There are 16 H and 9 N subtypes known, but only H 1, 2 and 3, and N 1 and 2 are commonly found in humans.

**Hemagglutinin (HA)** is a lectin that mediates binding of the virus to target cells and entry of the viral genome into the target cell.

**Neuraminidase (NA)** is involved in the release of progeny virus from infected cells, by cleaving sugars that bind the mature viral particles.

These proteins are targets for **antiviral drugs**.

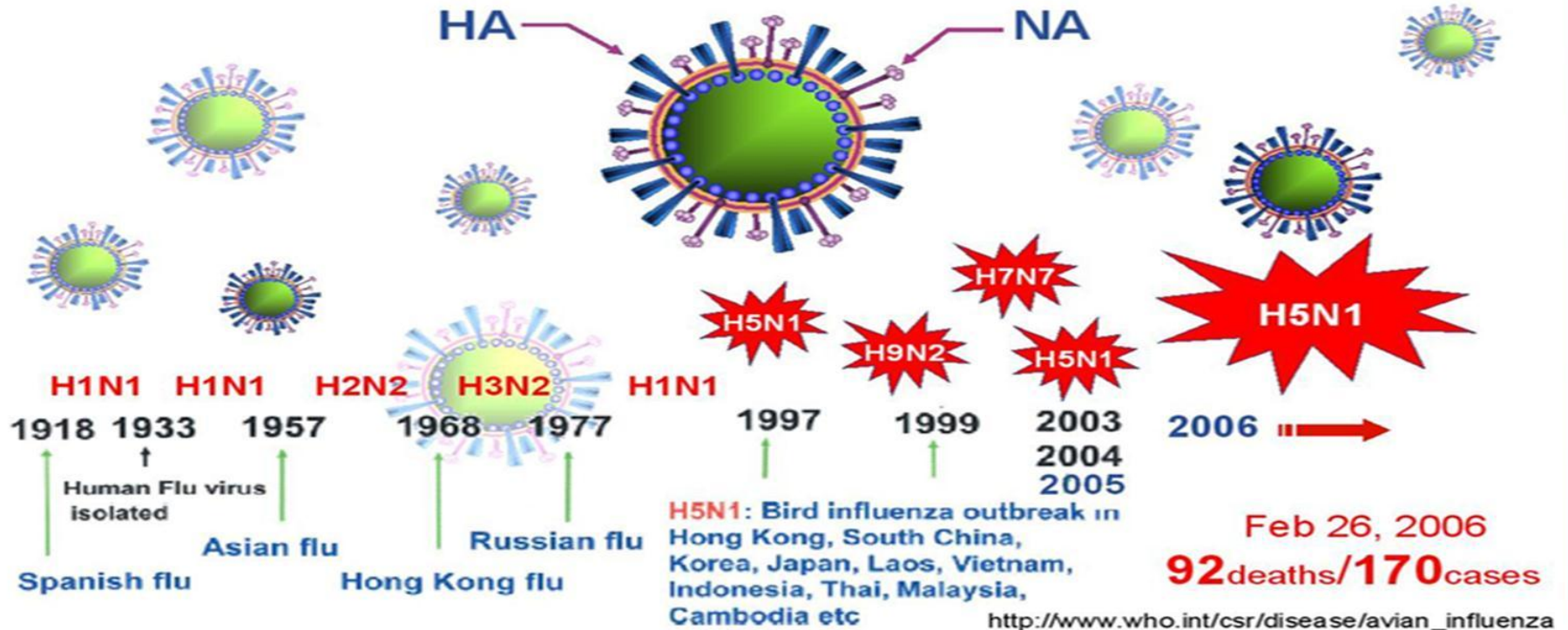
# The Influenza A Subtypes

- Type A subtypes of the **influenza** virus are classified by a naming system that includes:
  - The place the strain was first found
  - A lab identification number
  - The year of discovery
  - The type of HA and NA it possesses.

- H1N1, which caused **Spanish flu** in 1918, and the 2009 flu pandemic
- H2N2, which caused **Asian Flu** in 1957
- H3N2, which caused **Hong Kong Flu** in 1968
- H5N1, a current **pandemic** threat
- H7N7, which has unusual **zoonotic** potential
- H1N2, endemic in humans and pigs
- H9N2
- H7N2
- H7N3
- H10N7



# The Influenza A



## Different species harbor different strains of the flu virus:

- Human flu
- Bird flu
- Swine flu
- .....

# Influenza Virus Transmission

Three ways:

- Direct contact with infected individuals;
- Contact with contaminated objects (called fomites, such as toys, doorknobs); and
- Inhalation of virus-laden aerosols.

## **Infuenza Transmission Rates (CDC,2009)**

Body fluids and hand to hand contact 70%

Air borne 29%

Animal 1%

The following are proven to destroy Influenza Virus  
(CDC,2009)

Bleach

70% ethanol

Aldehydes

Oxidizing agents

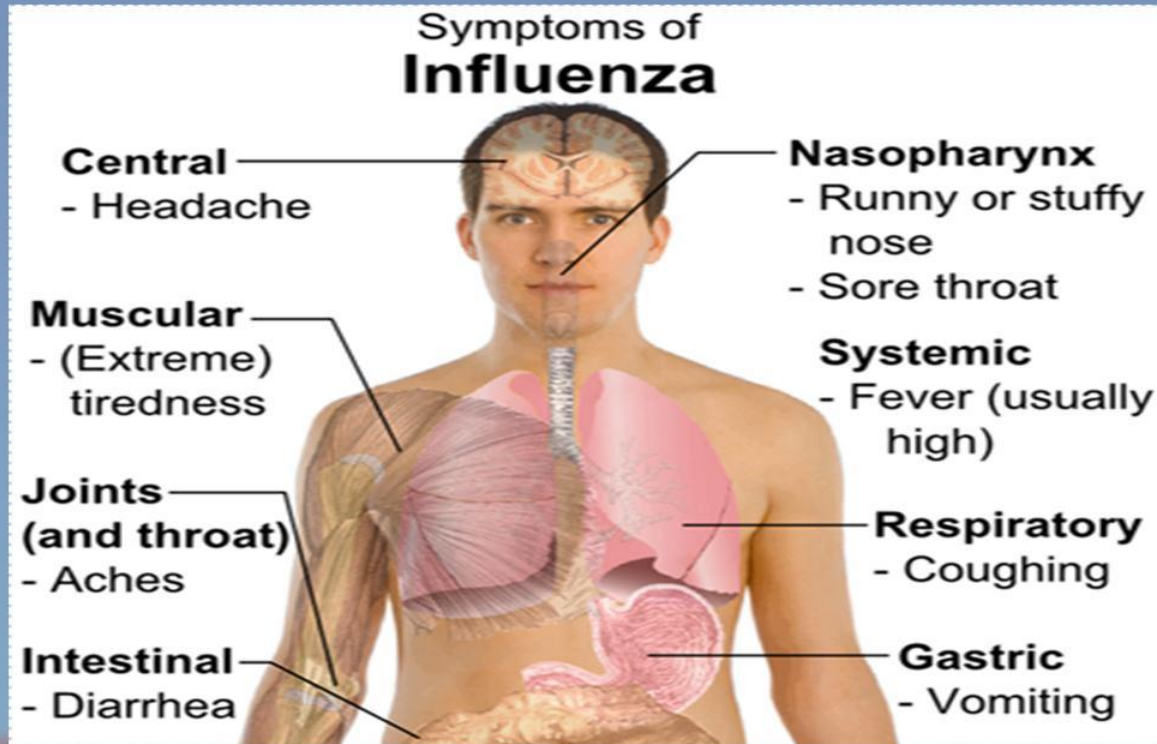
Quaternary amonium compounds

Inactivated by heat (133 F) for 60 minutes

PH less than 2 (very acidic)

# Human Influenza

- **Human influenza virus** subtypes that spread widely among humans.
- **Human flu-causing** viruses can belong to any of three major influenza-causing Orthomyxo viruses; **Influenza A; B; C virus**.
- Three known A subtypes of influenza viruses currently circulating among humans (**H1N1, H1N2, and H3N2**).



## Avian Influenza

- Avian influenza is an infectious disease of birds caused by type A strains of the influenza virus.
- These viruses occur naturally among wild aquatic birds worldwide and can infect domestic poultry and other bird and animal species. The disease, which was first identified in Italy more than 100 years ago.

## Avian Influenza

- **Fifteen subtypes** of influenza virus are known to infect birds, thus providing an extensive reservoir of influenza viruses potentially circulating in bird populations.
- **H5N1**; the strain of avian flu known as has been behind outbreaks of deadly avian flu.



# Avian Influenza

- Avian influenza transmitted by birds usually through feces or saliva.
- Avian influenza is not usually passed on to humans, although it has been contracted by people who have handled infected birds or touched surfaces contaminated by the birds.

# Avian Influenza

- Migratory water birds, especially wild ducks. They may do not show clinical disease. The virus colonizes the intestinal tract and is spread in the feces . They act as a reservoir for the infection of other species .

# Avian Influenza

- Low pathogenicity (LPAI) - usually only causing mild respiratory disease in domestic poultry .
- High pathogenicity (HPAI) - the more virulent type formerly known as fowl plague which often results in up to a 100% flock mortality.

## Bird flu and danger to humans

Bird flu, or avian flu, has a high mortality rate in humans, but as of yet, can ~~not~~ be transmitted from person to person. ...

**WHO, February 20th, 2006:**  
**"Human infections remain a rare event."**

### Infection with type A virus H5N1

**1** Most virulent bird flu virus; mutates rapidly, altering its genetic material

**2** Humans infected by close contact with live infected poultry

**3** Birds carry virus and excrete it in feces, which dries, becomes pulverized and then can be inhaled or taken in by touch

**4** Humans have no immunity against this virus

### Reason for concern

Humans infected with bird flu could serve as a host for a new genetic subtype that can be transmitted from person to person

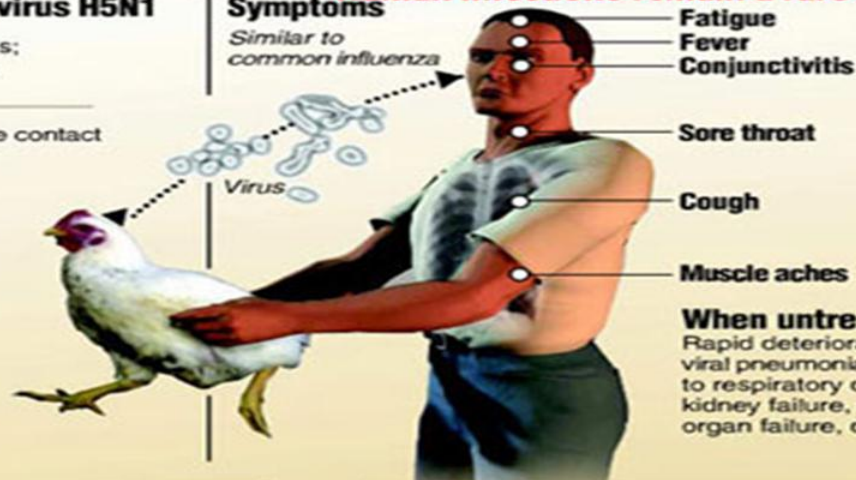


Might start influenza pandemic



### Symptoms

Similar to common influenza



Fatigue  
Fever  
Conjunctivitis

Sore throat

Cough

Muscle aches

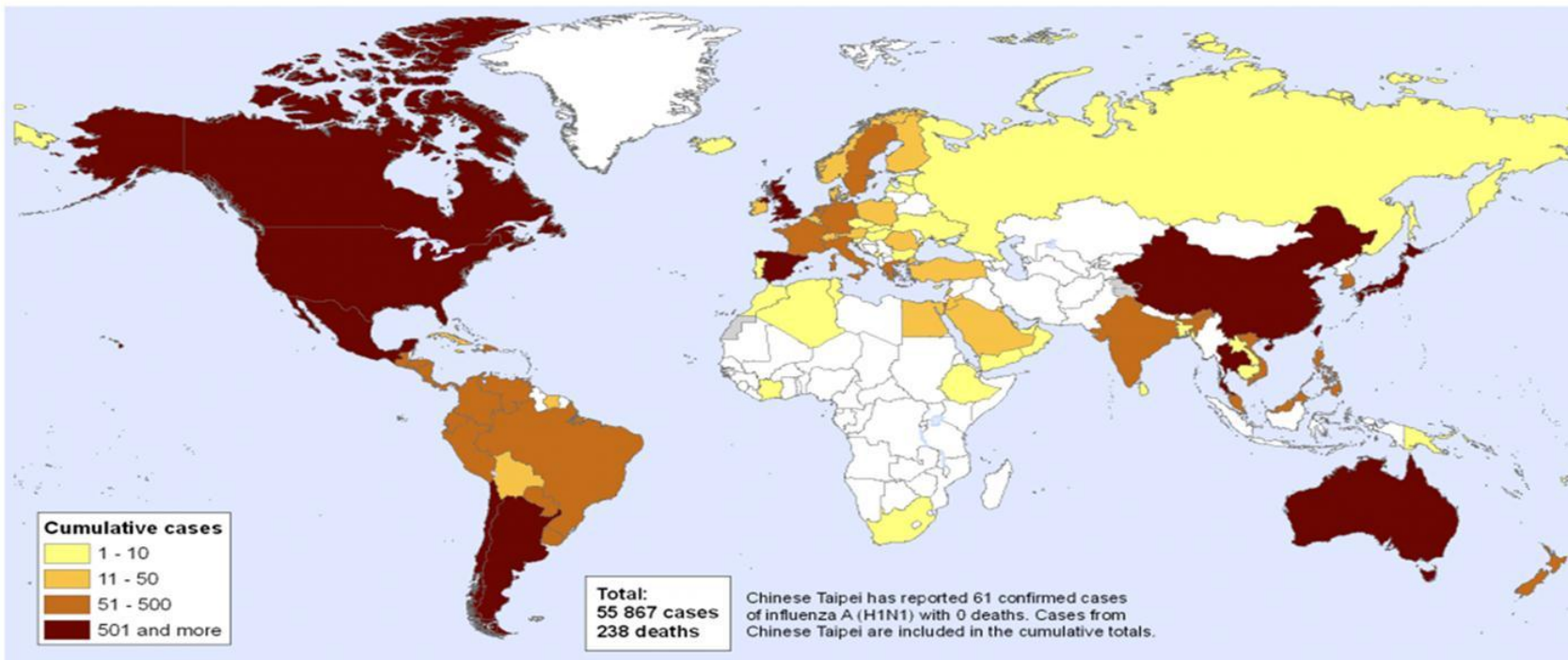
### When untreated

Rapid deterioration; viral pneumonia leading to respiratory distress, kidney failure, multi-organ failure, death



**New Influenza A (H1N1),  
Number of laboratory confirmed cases as reported to WHO**

**Status as of 24 June 2009  
06:00 GMT**



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Map produced: 24 June 2009 10:00 GMT

Data Source: World Health Organization  
Map Production: Public Health Information  
and Geographic Information Systems (GIS)  
World Health Organization



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# The A/H1N1 virus

An unusual cocktail  
of avian, swine and human viruses



**Bird flu**

**Human flu**



**Swine flu**

Pigs may harbour several flu viruses simultaneously. The pathogens may mix to create a new viral strain



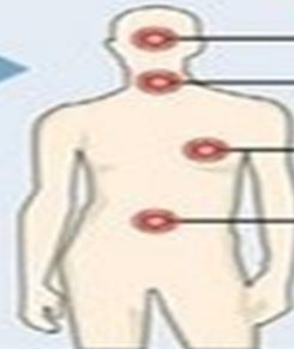
## Transmission

**Pig to human**

By inhaling viral particles  
(there is no risk from eating cooked pork)



**Human to human**  
By inhaling viral particles



## Symptoms

- High fever
- Coughing, sneezing
- Breathing difficulties
- Loss of appetite

# The Influenza A

- Influenza A viruses are constantly changing, and they might changed over time to infect and spread among humans.
- All type A influenza viruses, including those that regularly cause seasonal epidemics of influenza in humans, are genetically labile and well modified to elude host defenses.

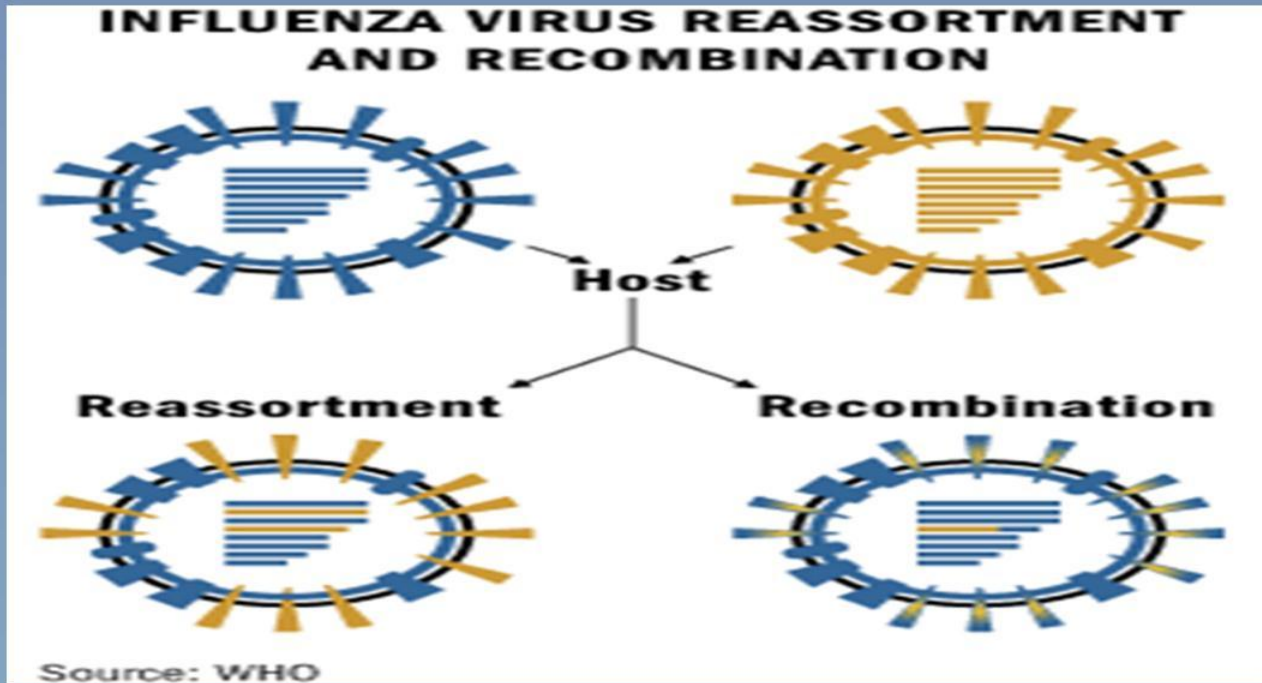


# The Influenza A

- Influenza viruses lack mechanisms for the “proofreading” and repair of errors that occur during replication. As a result of these uncorrected errors, the genetic composition of the viruses changes as they replicate in humans and animals, and the existing strain is replaced with a new antigenic variant.

## Viruses undergo genetic change by several mechanisms

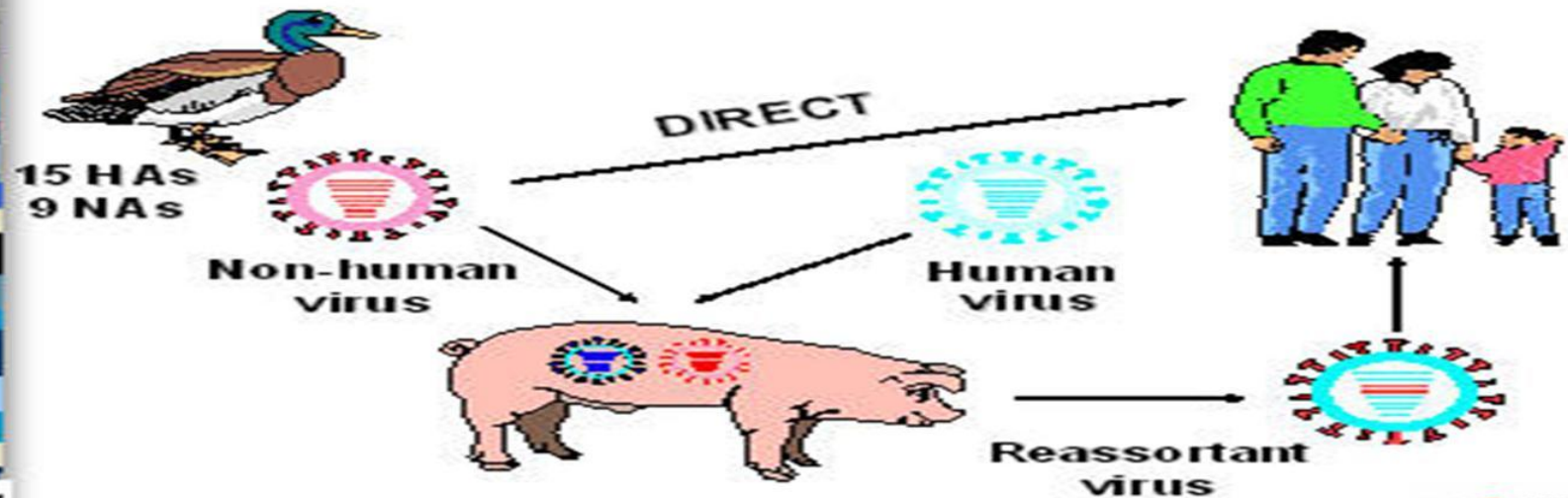
- Genetic drift where individual bases in the DNA or RNA mutate to other bases.
- Antigenic shift is where there is a major change in the genome of the virus. This occurs as a result of recombination.

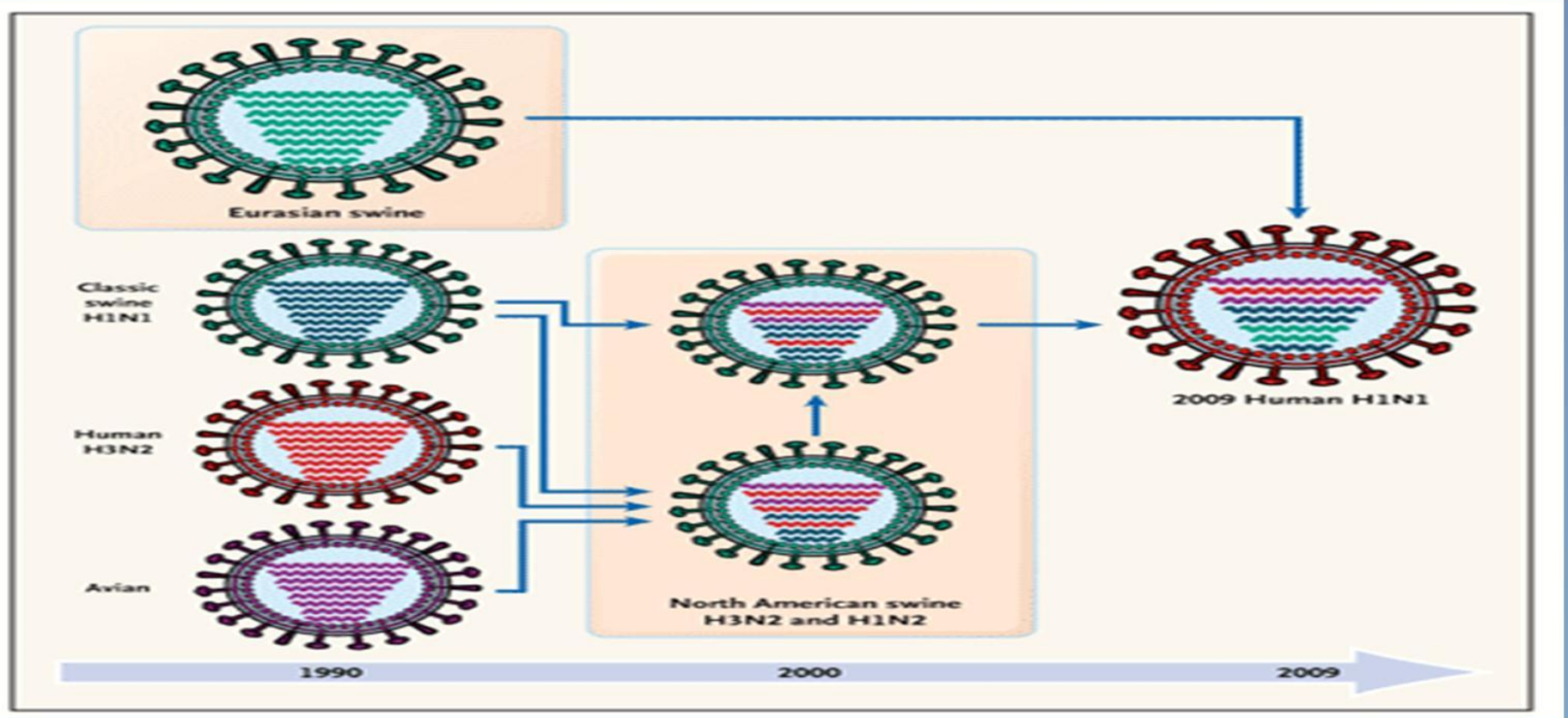


## Genesis of Human Influenza Viruses

When a virus such as H5N1 comes along, it may merge with a flu that a human body already has and develop (or mutate) into a whole other subtype for which our body has not built immunity. This, then, is what has prompted the concerns of the public health community.

## Genesis of New Human Influenza Viruses





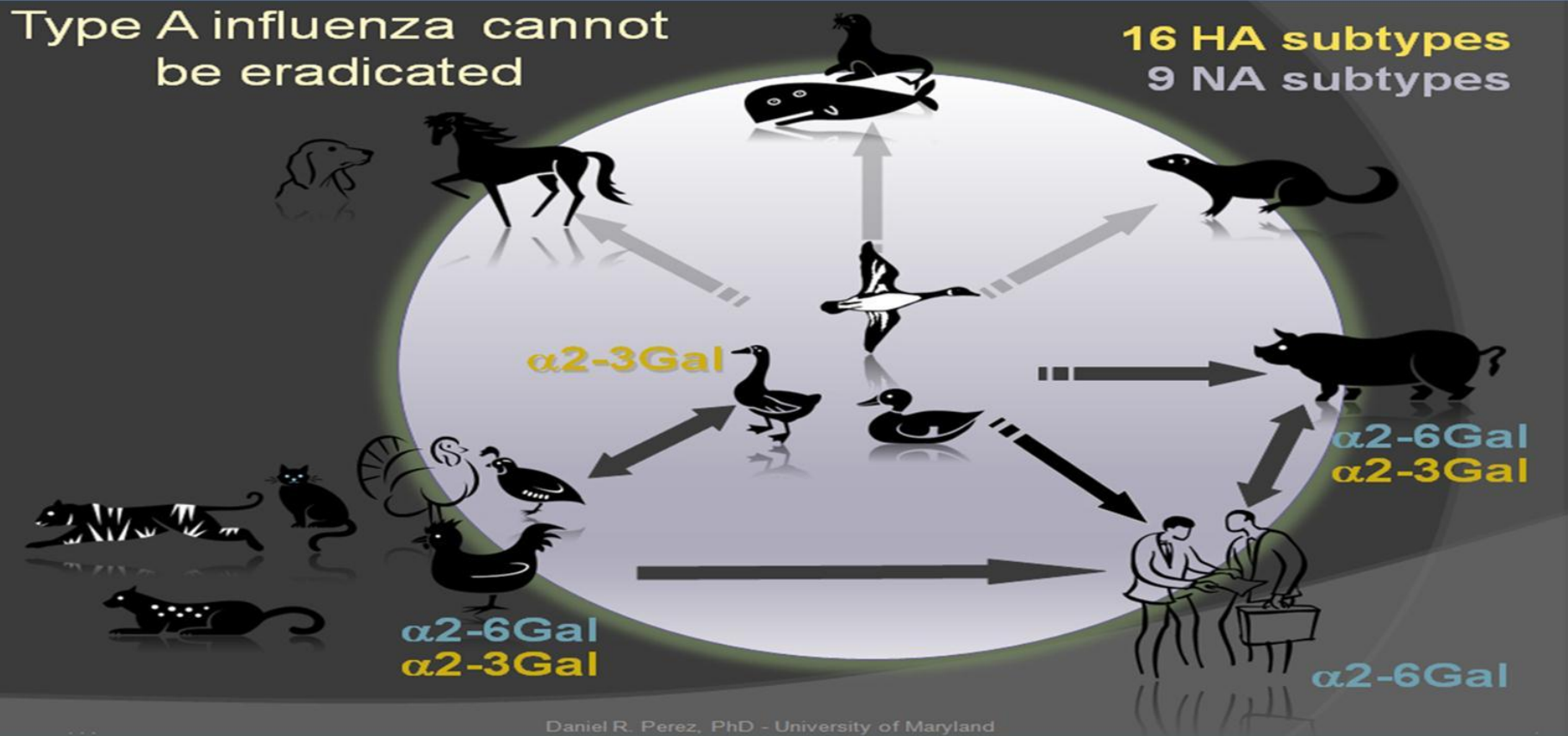
## Seasonal flu/ Pandemic flu

- **Epidemic (seasonal) influenza** which occurs annually and is attributable to minor changes in genes that encode proteins on the surface of circulating influenza viruses. These are known as interpandemic epidemics.
- **Pandemic influenza** which occurs when more significant changes in the influenza A virus arises when human virus strains acquire genes from influenza viruses of other animal species. When this happens, everyone in the world is susceptible to the new virus, and a worldwide epidemic or pandemic can result.

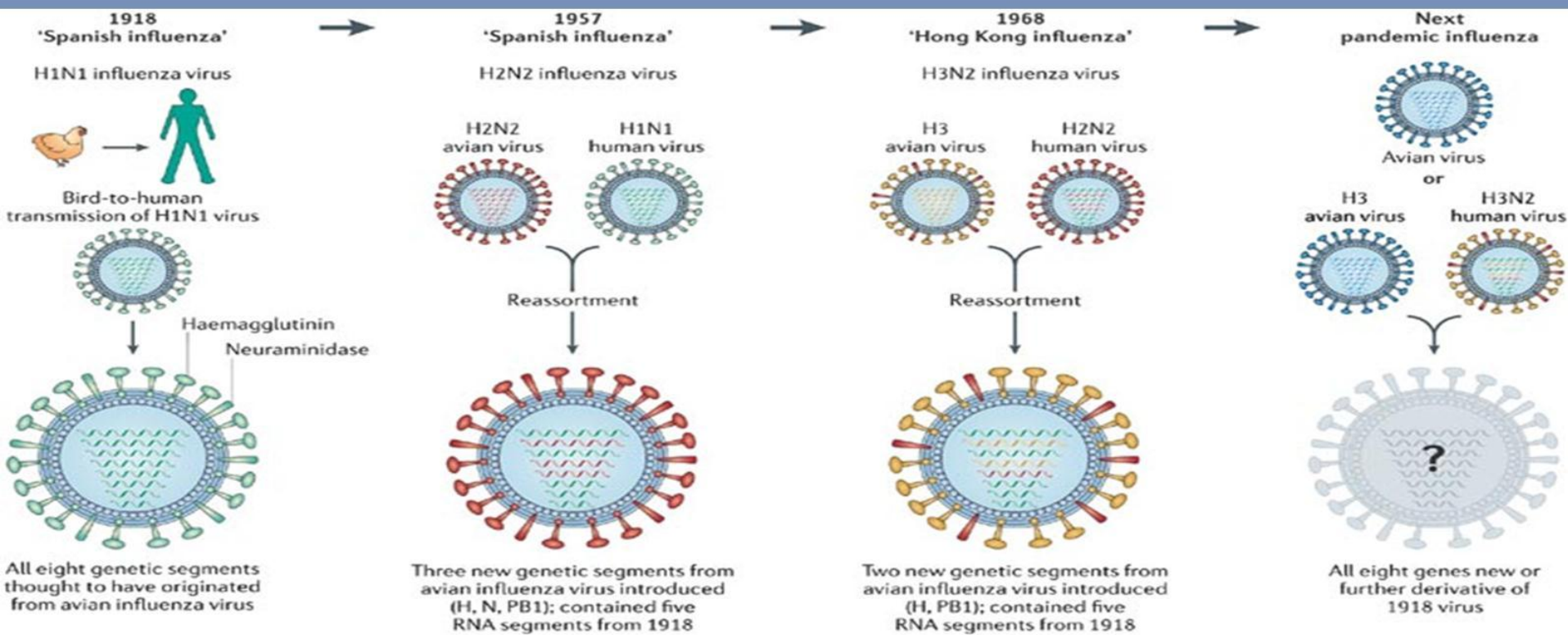
# Type A Influenza Can not be Eradicated

- Continuous emergence of new virus variant

Type A influenza cannot be eradicated



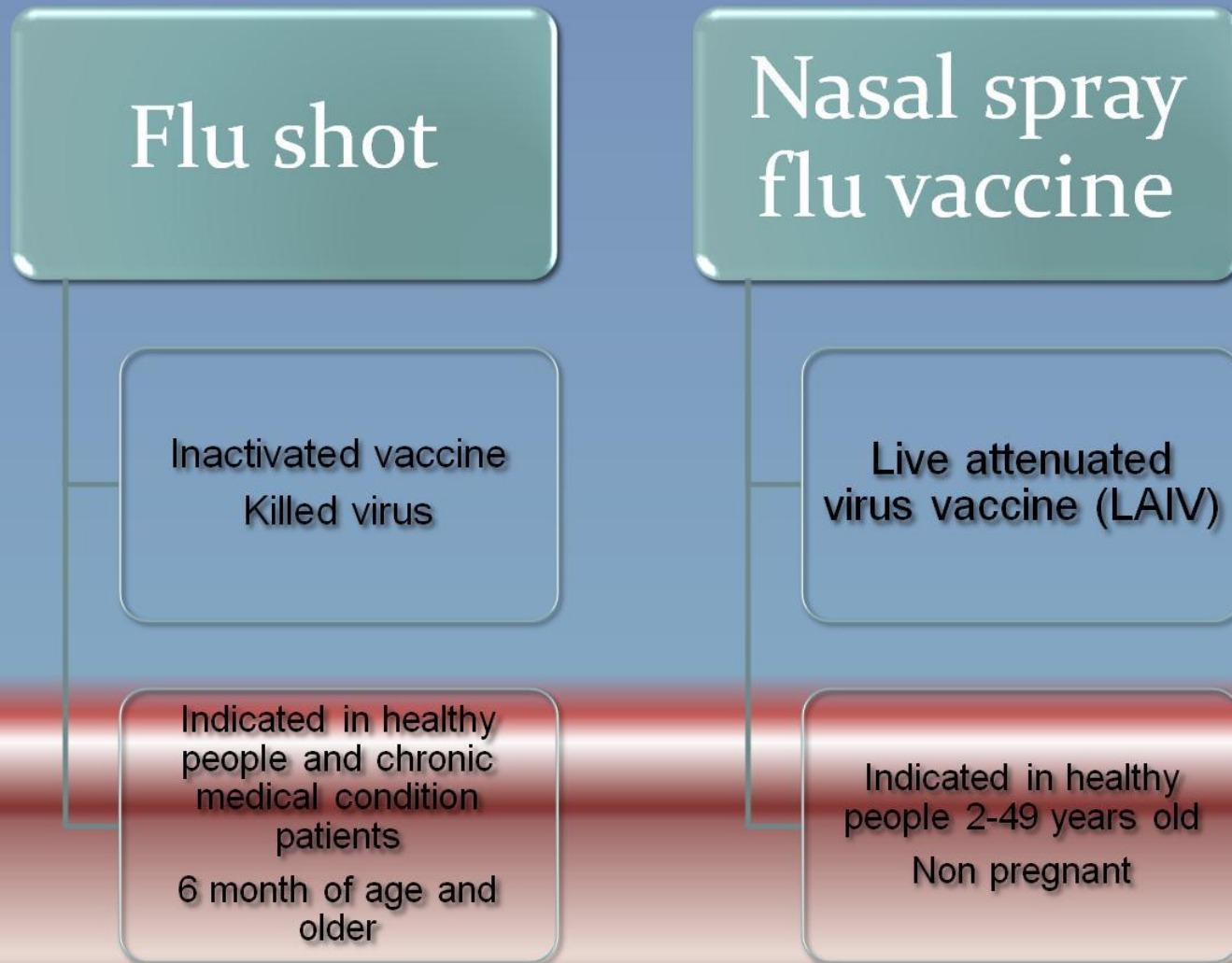




# **Infection Control**

# **Vaccination**

# Vaccination



## **Vaccination/ Common side effects include:**

- Local reactions at the injection site (soreness, swelling, redness).
- Possibly some systemic reactions (fever, headache, muscle or joint aches).
- These symptoms are mild, self-limited and last 1-2 days.

## Treatment

- Treatment with oseltamivir (trade name Tamiflu®) or zanamivir (trade name Relenza®) is recommended for all people with suspected or confirmed influenza who require hospitalization.



THANK YOU