



Lecture Ten

Viruses of Medical Importance

3- Influenza Viruses

By

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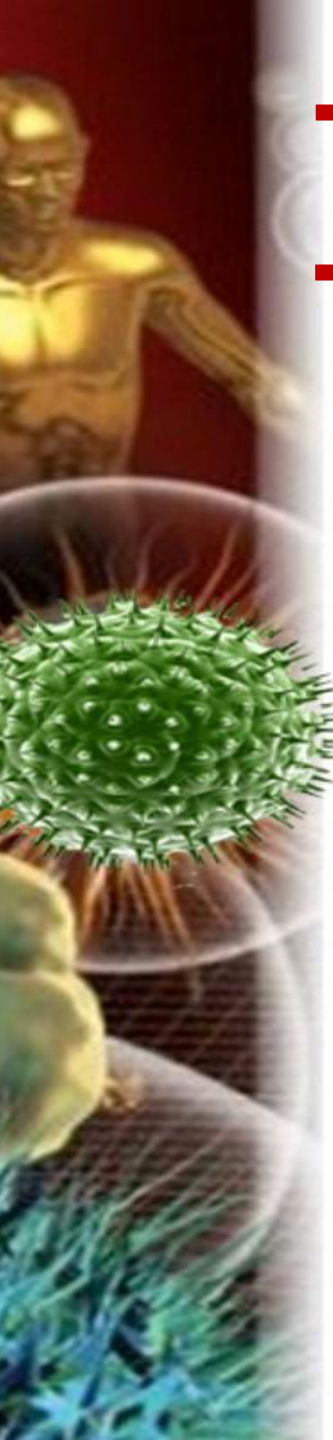
Botany and Microbiology Dept., KSU



Learning outcomes

By the end of this lecture students should

- **Know the history of Influenza virus.**
- **Have the knowledge HRSV epidemiology and modes of transmission.**
- **Recognize different symptoms associated with Influenza virus infection.**
- **Be aware of different ways for prevention and control measures.**



Virus Morphology and Characteristics

Virion: Pleo-morphic (mostly Spherical) – medium sized (80-120 nm in diameter).

Genome: RNA – single stranded – negative sense – Linear –segmented (7-8) – haploid – 13.5 kb long

Capsid: helical (NP)

Replication: Cytoplasm/nucleus

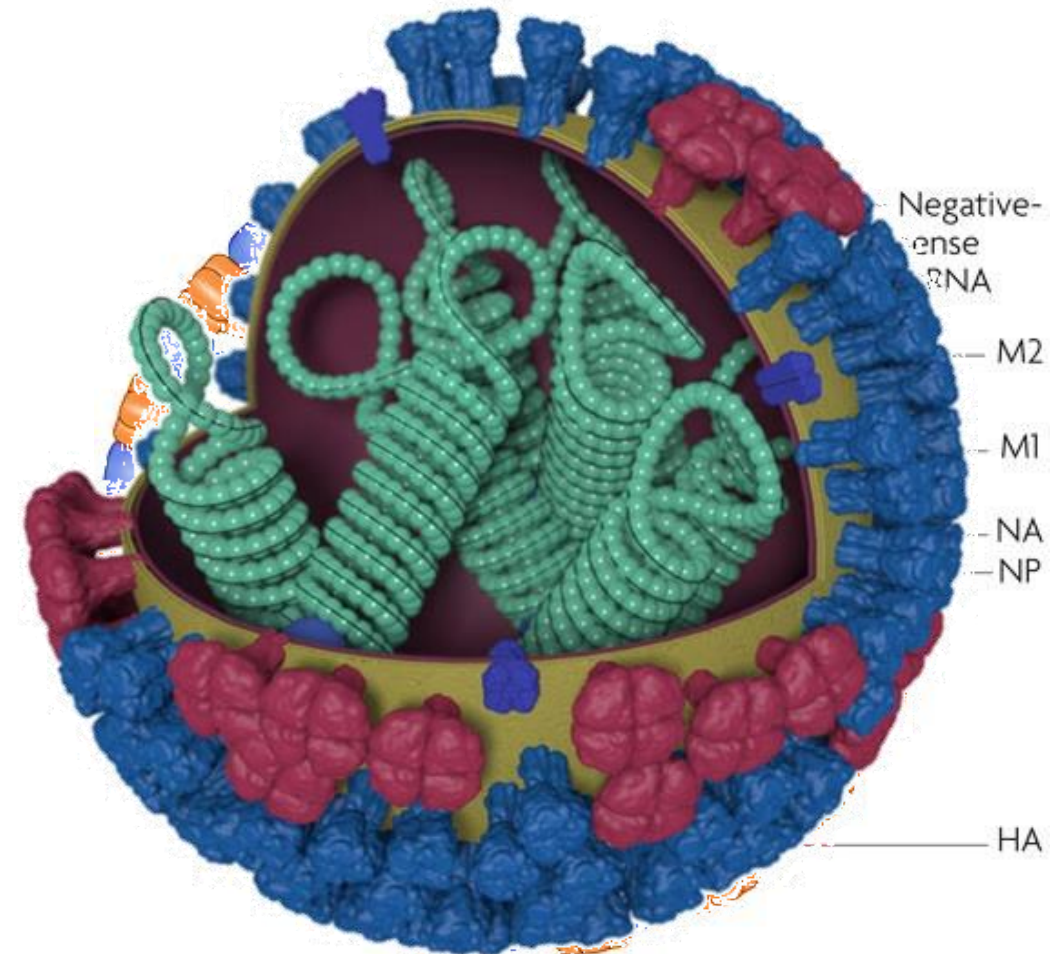
Envelope: Present

Peplomers: (Hemagglutinin HA,
Neuramindase NA)

Matrix proteins:

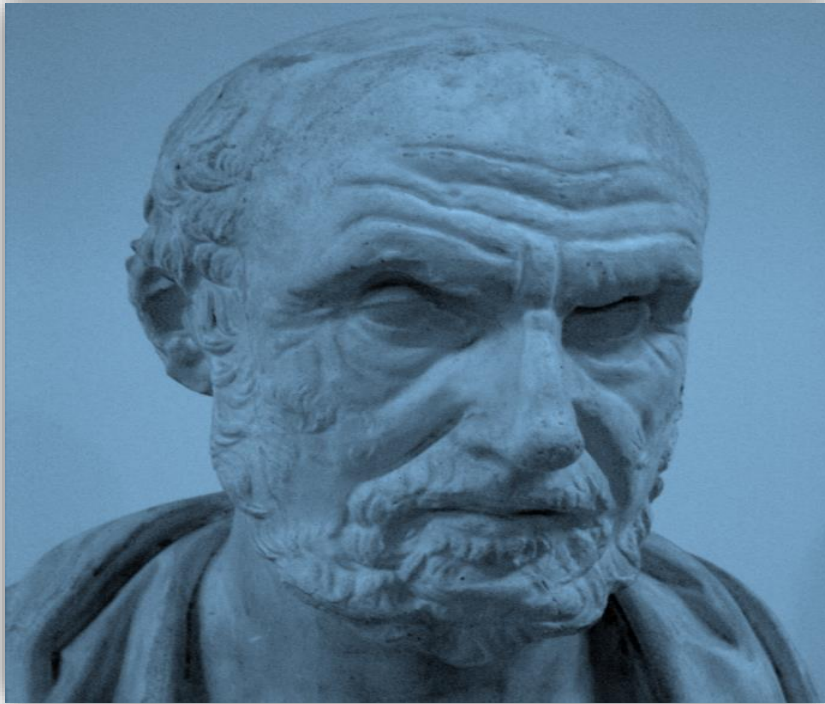
M1 (line the envelope)

M2 (ion-channel protein)



Influenza: History

❁ 412 BC: Hippocrates described the clinical manifestations of influenza.



Hippocrates

❁ 16th century onwards: More than 31 influenza pandemics were documented worldwide.



Influenza pandemics

Influenza: History

❖ **1918:** An influenza **H1N1 pandemic** killed 50 millions and results in the end of World War I



Spanish Flu

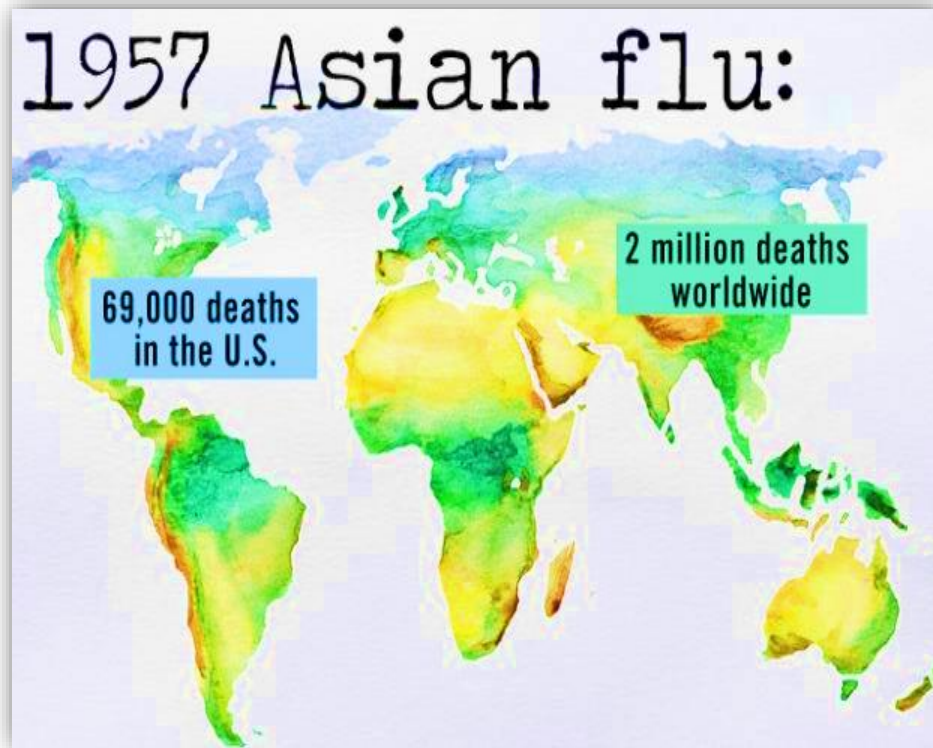
❖ **1933:** Influenza virus was isolated from ferrets – A milestone in development of Virology.



Smith and Andrews

Influenza: History

🦠 **1957:** A newly emerged influenza virus **H₂N₂** has swept the world and killed 2 millions.



Asian Flu

🦠 **1968:** An influenza pandemic caused by **H₃N₂** and killed 1 million



Hong Kong Flu

Influenza: History

🦠 **2003:** Appearance of new bird derived influenza strains in human (**H5N1 – H7N7 – H7N2 – H9N2**).



Avian Influenza

🦠 **2009:** A new variant of influenza virus **H1N1** (pdm09) was transmitted from pigs to humans in Mexico and affected 10 countries.

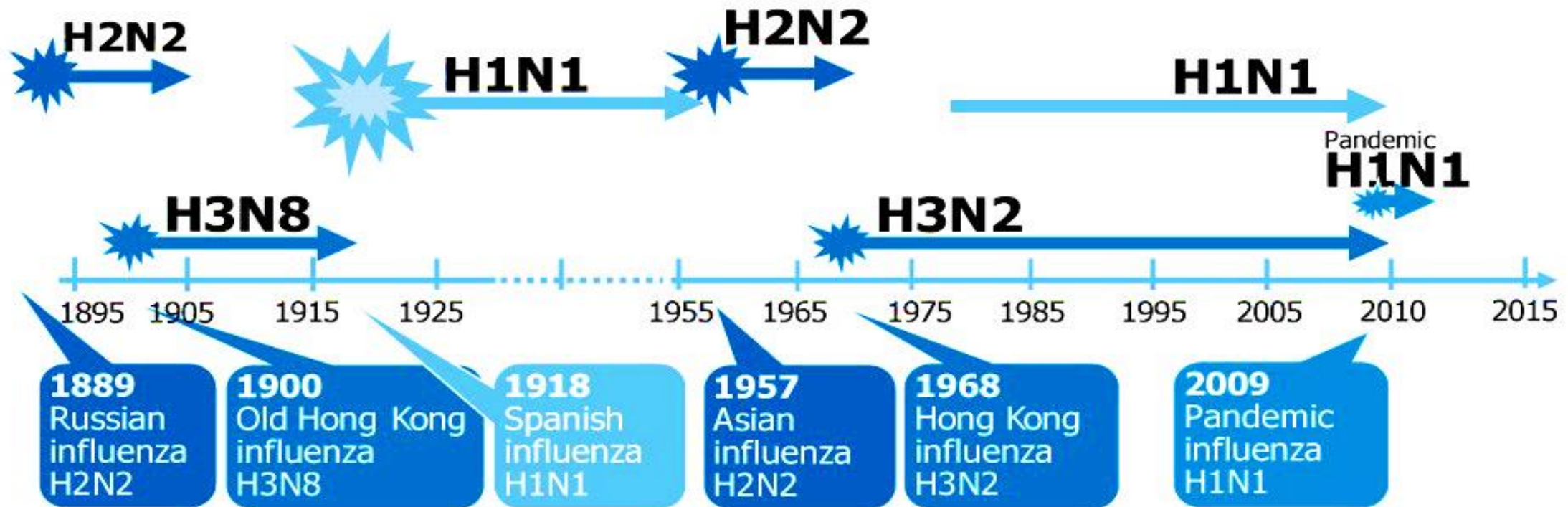


Swine Flu

Influenza: History

FIGURE

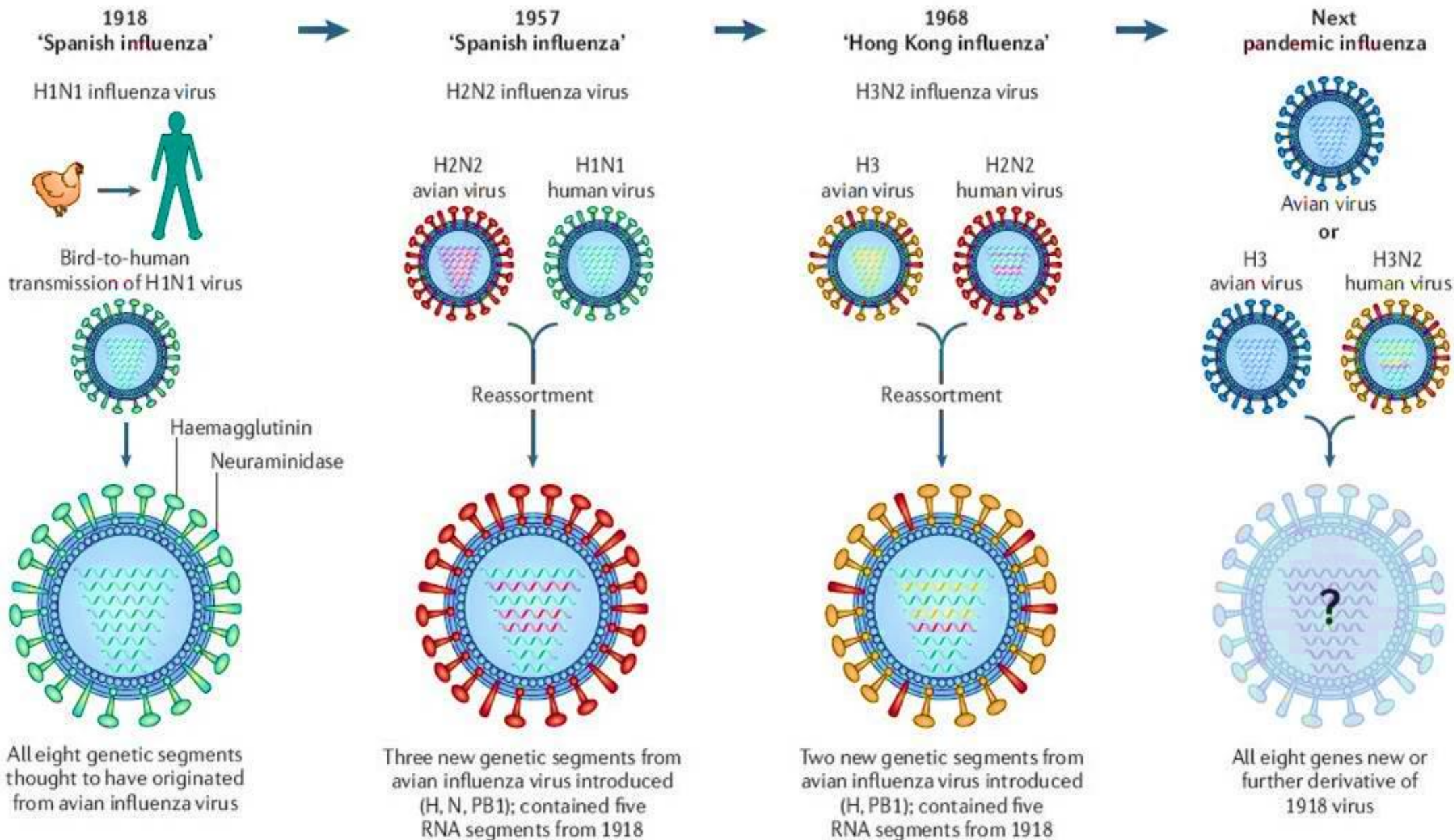
Recorded human pandemic influenzas since 1885 (early sub-types inferred)



Source: European Centre for Disease Prevention and Control (ECDC) 2009

Reproduced and adapted (2009) with permission of Dr Masato Tashiro, Director, Center for Influenza Virus Research, National Institute of Infectious Diseases (NIID), Japan.

Influenza: History



Taxonomy (ICTV, 2018)

Phylum: Negarnaviricota (2 subphyla)

Subphylum: Polyploviricotina (2 classes)

Class: Insthoviricetes (2 orders)

Order: Articulavirales (2 families)

Family: Orthomyxoviridae (7 genera)

Genus: Alphainfluenzavirus

Influenza A virus

18 HA
11 NA

Genus: Betainfluenzavirus

Influenza B virus

Two lineages:
Yam & Vic

Genus: Gamminfluenzavirus

Influenza C virus

Rare and less
significant

Taxonomy (ICTV, 2018)



Nomenclature

- 1- The antigenic type (e.g., A, B, C)
- 2- The host of origin (e.g., swine, equine, chicken, etc. For human-origin viruses, no host of origin designation is given.)
- 3- Geographical origin (e.g., Denver, Taiwan, etc.)
- 4- Strain number (e.g., 15, 7, etc.)
- 5- Year of isolation (e.g., 57, 2009, etc.)
- 6- For influenza A viruses, the hemagglutinin and neuraminidase antigen description in parentheses (e.g., (H1N1), (H5N1)).

Examples

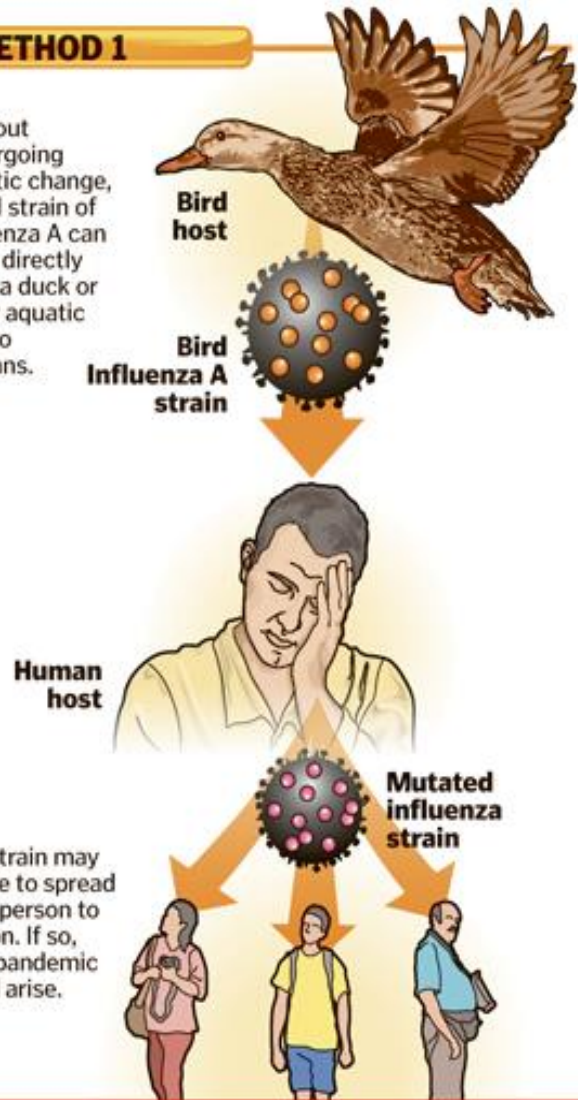
- **A/duck/Alberta/35/76 (H1N1) - duck origin**
- **A/Perth/16/2009 (H3N2) - human origin**

Killer flu MUTANT

Antigenic shift – the genetic change that enables a flu strain to “hop” from one animal species to another, including humans, is not new to science – it is exactly this that brought the 1957 Asian flu pandemic and the Hong Kong flu outbreak in 1968. Here is a look at the three ways whereby antigenic shift can produce new viral strains that our bodies have little or no defences against.

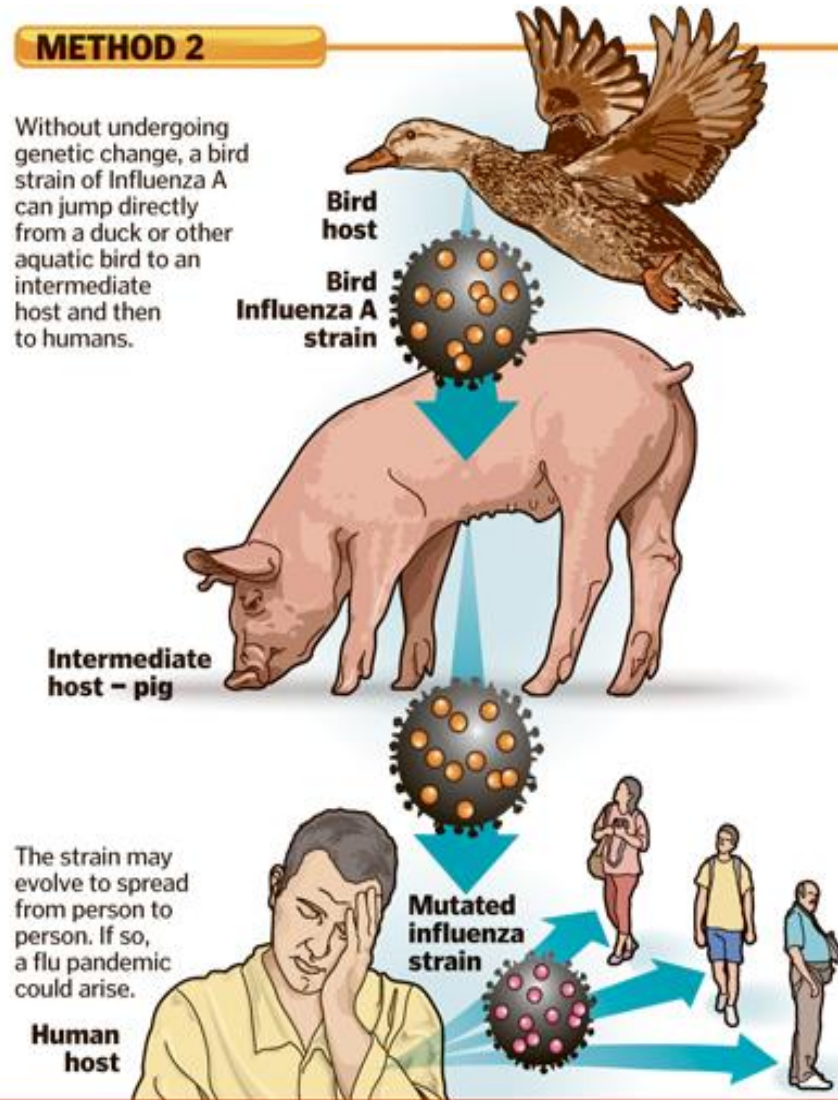
METHOD 1

Without undergoing genetic change, a bird strain of Influenza A can jump directly from a duck or other aquatic bird to humans.



METHOD 2

Without undergoing genetic change, a bird strain of Influenza A can jump directly from a duck or other aquatic bird to an intermediate host and then to humans.



METHOD 3

Bird host

A duck or other aquatic bird passes a bird strain of Influenza A to an immediate host such as chicken or pig.

Human host

A person passes a human strain of Influenza A to the same chicken or pig.

Bird influenza A strain

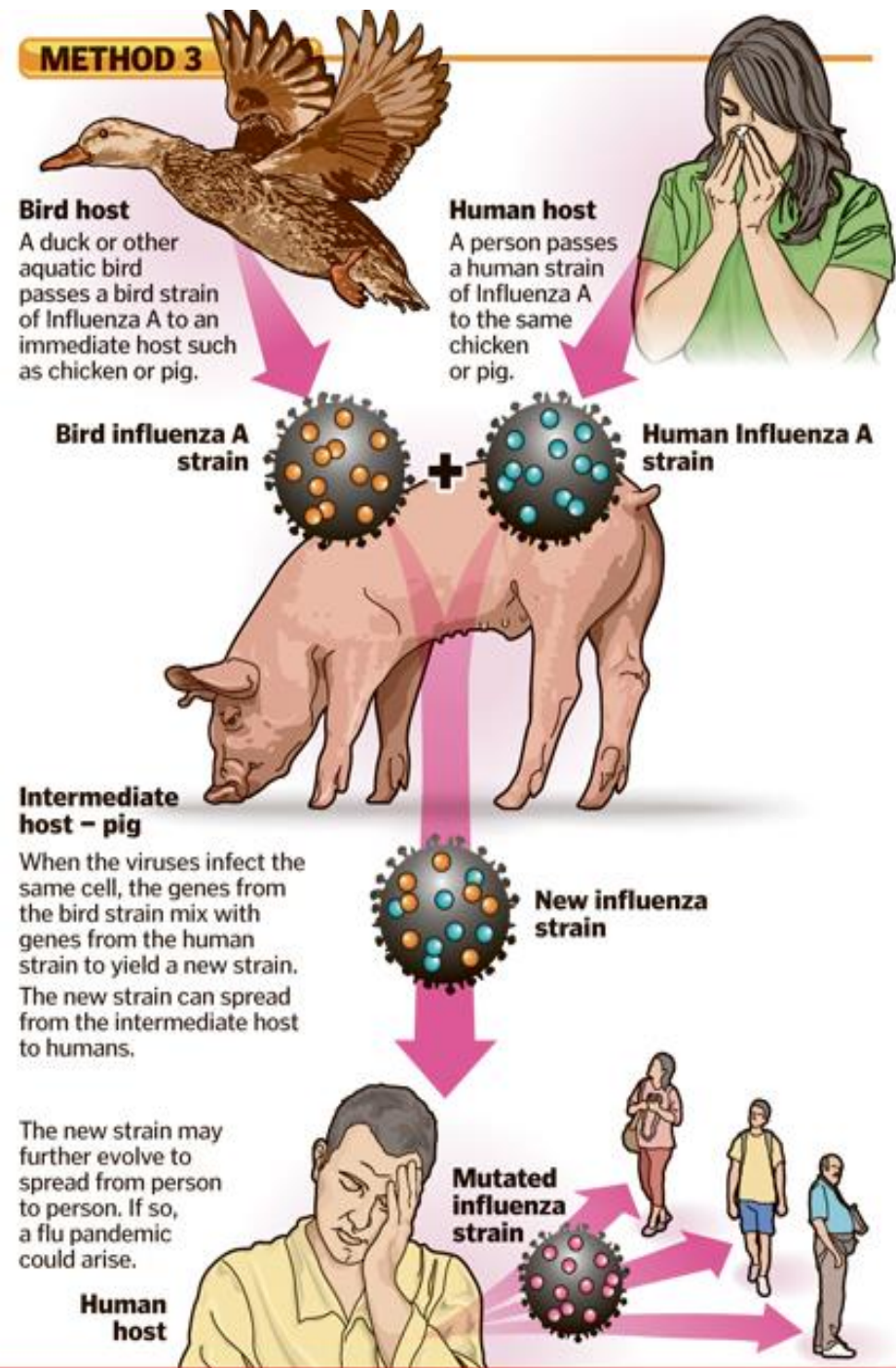
Human influenza A strain

Intermediate host – pig

When the viruses infect the same cell, the genes from the bird strain mix with genes from the human strain to yield a new strain. The new strain can spread from the intermediate host to humans.

The new strain may further evolve to spread from person to person. If so, a flu pandemic could arise.

Human host



Genetic Variability

1- Antigenic Drift

UCG-ACA-UUU-GCG

↓ Mutation

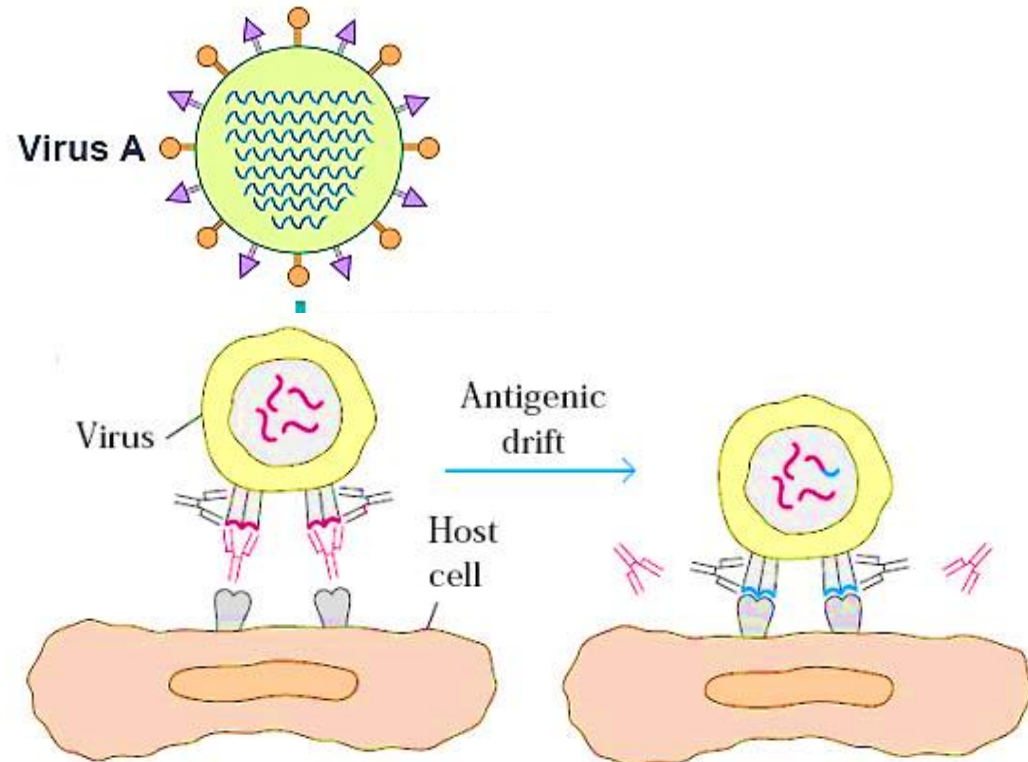
UCG-ACA-CUU-GCG

↓ Transcription

AGC-UGU-GAA-CGC

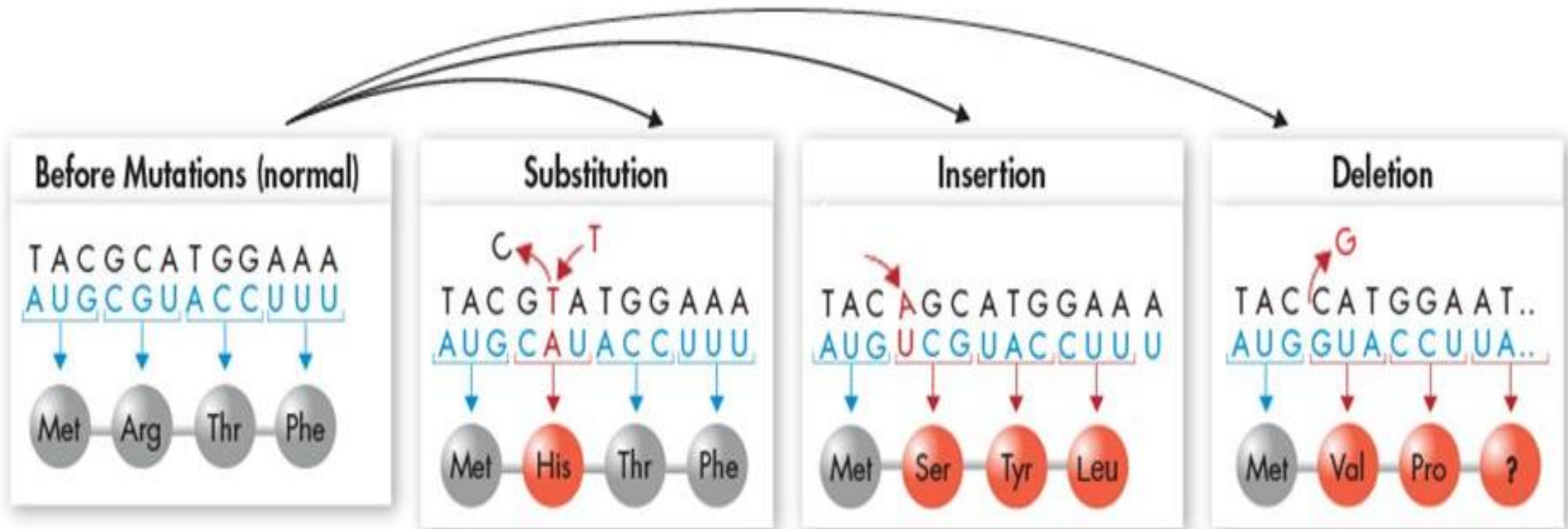
↓ Translation

Ser-Cys-Glu-Arg



Genetic Variability

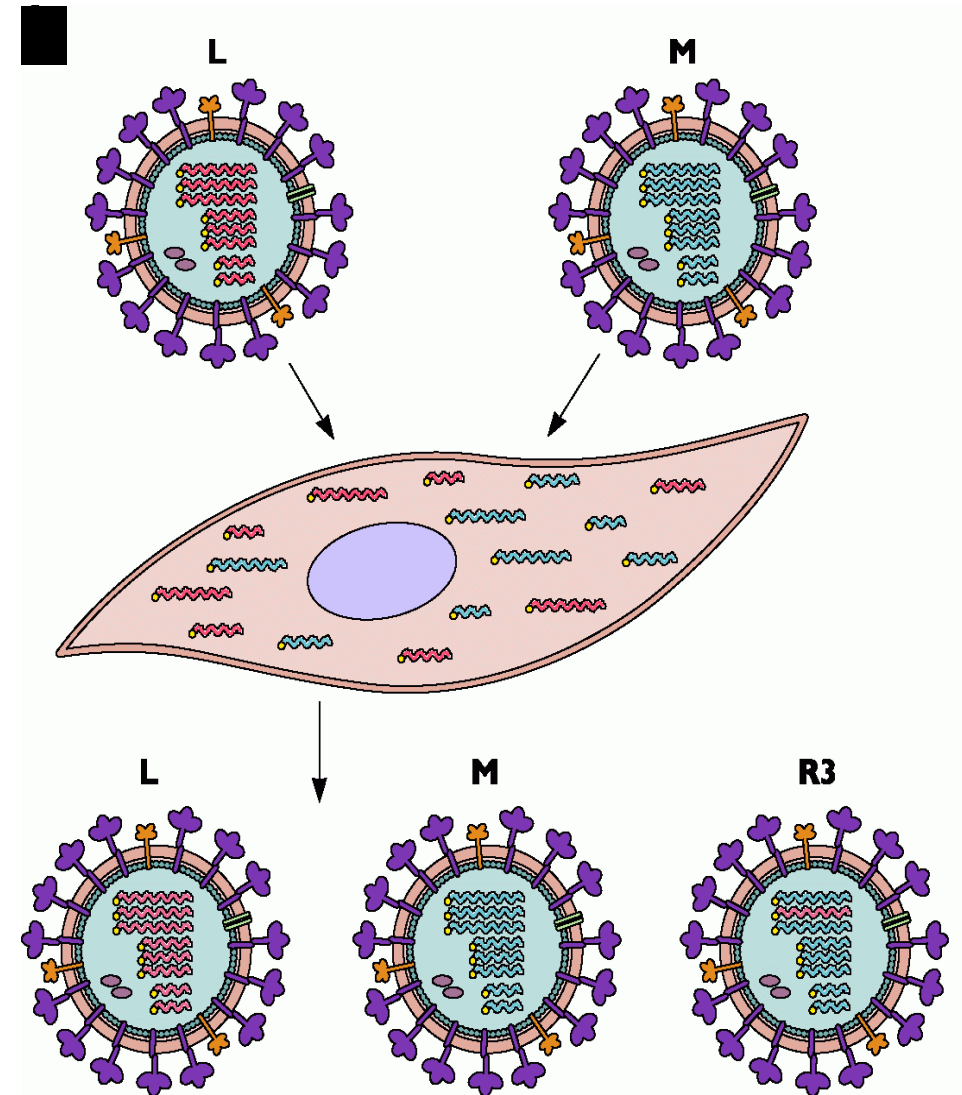
1- Antigenic Drift



Genetic Variability

2- Genetic Shift – Reassortment

- New Strains
- New Subtypes
- Potential Epidemics and Pandemics



Epidemiology and Transmission



Mode of transmission

- Inhalation of respiratory droplets (require close contact between persons because droplets do not remain suspended more than 1 meter in the air).
- Airborne transmission (aerosols) is possible but rarely.
- Contact with infected fomites (surfaces, tools, cloths, ...)

Seasonal: Common in winter months (December – March)

Risk factors: **Very young** (<1 year of age) and **elderly** (>65 years of age), **Pregnancy**, Immunocompromised patients, Individual with chronic pulmonary diseases, Comorbidities, Obesity.

Incidence: 1 billion infections of which 3-5 millions of severe illness, 300,000 – 500,000 deaths.

Epidemiology and Transmission- Animal reservoir



Ducks



Geese



Waders



Swans



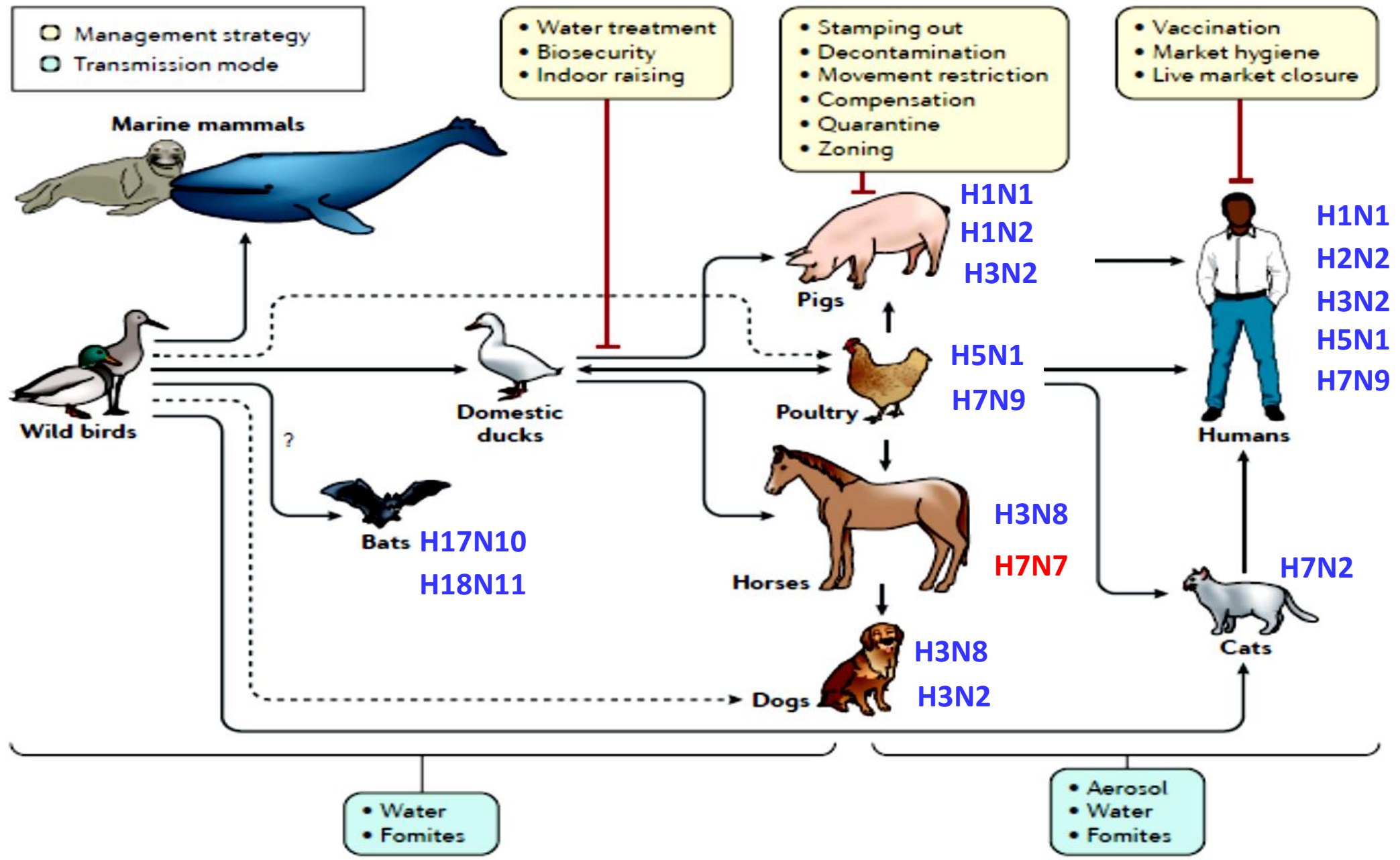
Pigs



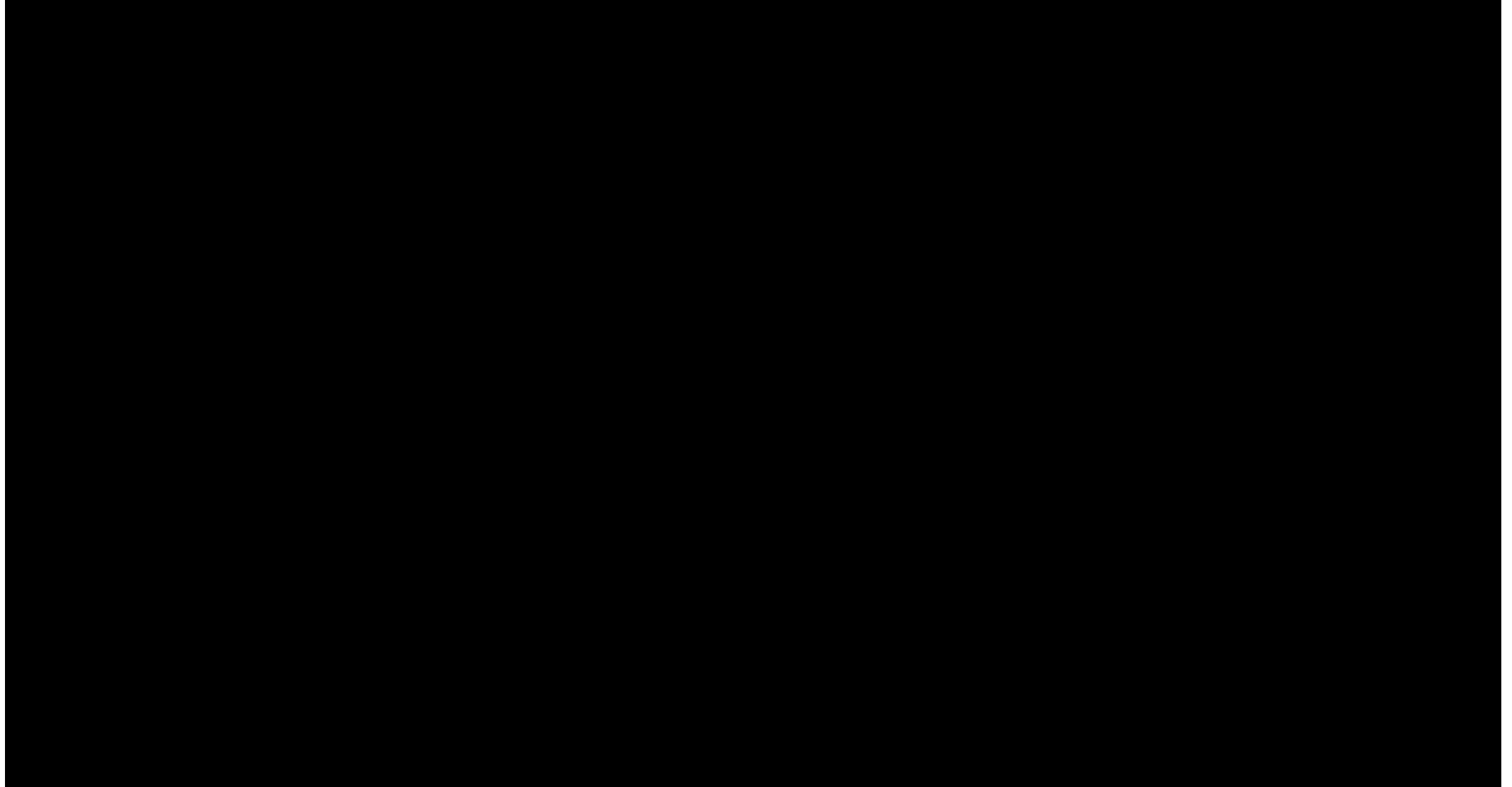
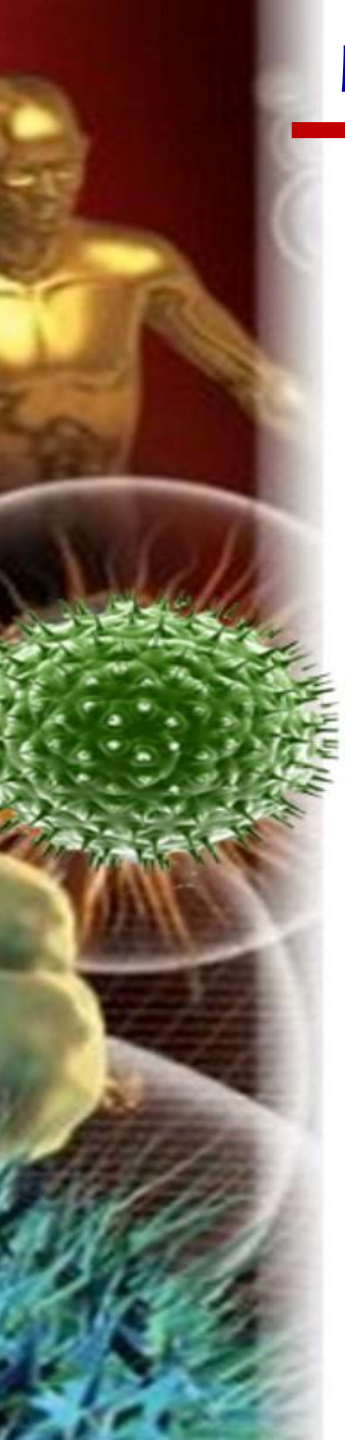
Horses



Mode of transmission



Pathology and Clinical Picture – Video



Pathology and Clinical Picture



Symptoms

Incubation Period: 1-4 days; average 2 days (Short)

- Influenza viruses cause clinical symptoms ranging from mild to severe and eventually lead to Death.
 - It starts suddenly with one or more of these signs: fever – headache – nasal congestion – dry cough – sore throat – fatigue – pain in muscles and joints – chills and sweat).
 - In children, vomiting and otitis media may happen.
 - The disease is resolved 3-7 days after appearance of clinical signs.
- * Influenza is more severe in people with underlying cardiac and pulmonary diseases, weakened immune system and in the elderly.

Complicated Influenza: Bronchitis and pneumonia, Asthma, Sinusitis, Otitis media

Prevention and Control



1- Treatment

- In most cases, patients need only rest and fluid uptake.
- Symptomatic treatment is always used to contain the influenza symptoms (e.g. antipyretics, anticough, ... etc).
- Antibiotics may be used to avoid secondary bacterial infections.
- Anti-influenza drugs:
 - 1- **Neuraminidase inhibitors:** Zanamivir (Relenza), Oseltamivir (Tamiflu) and Peramivir (Rapivab)
 - 2- **M2 inhibitors:** Amantadine and Rimantadine

Prevention and Control

1- Treatment



NDC 0115-1911-01

Rimantadine Hydrochloride Tablets

100 mg

Rx only
100 Tablets



USUAL DOSAGE: See accompanying outsert for complete prescribing information.
Each tablet contains 100 mg rimantadine HCl. This is a bulk package. Dispense in a tightly-closed, light-resistant container as defined in the USP with a child-resistant closure, as required.
Store at 20°C to 25°C (68°F to 77°F) [see USP Controlled Room Temperature].
Do not use if printed safety seal under cap is broken or missing.
Keep this and all medication out of reach of children.

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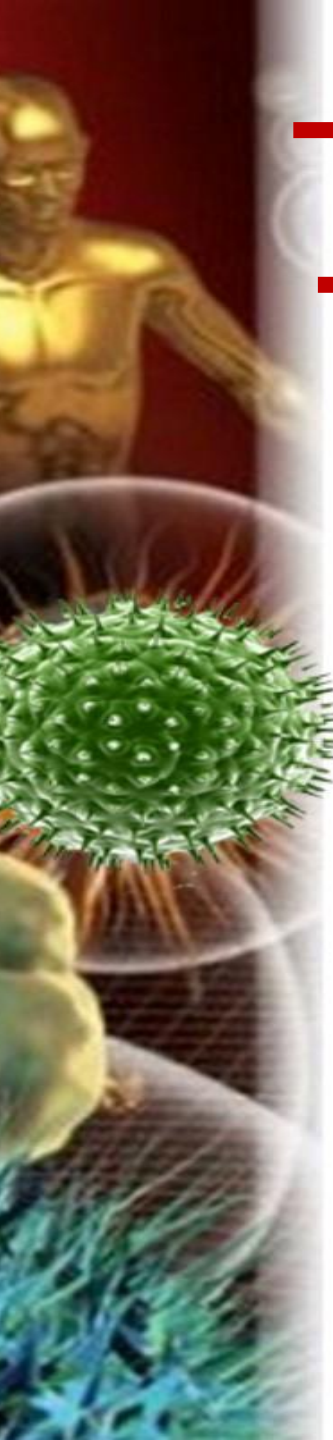
LOT & EXP AREA UNVARNISHED



Prevention and Control

2- Vaccines

- Annual vaccination of all people above **6 months of age** is strongly recommended.
- Each year, influenza vaccine provides protection against 3-4 influenza viruses that are expected to cause influenza epidemic in this year.
- The available vaccines usually contain two influenza A subtypes (**H1N1 and H3N2**) and one or two lineages of influenza B viruses.
- Vaccines are available as an injection or a nasal spray.





Thank
You