Orthomyxoviridae

Avian, Swine & Equine Influenza

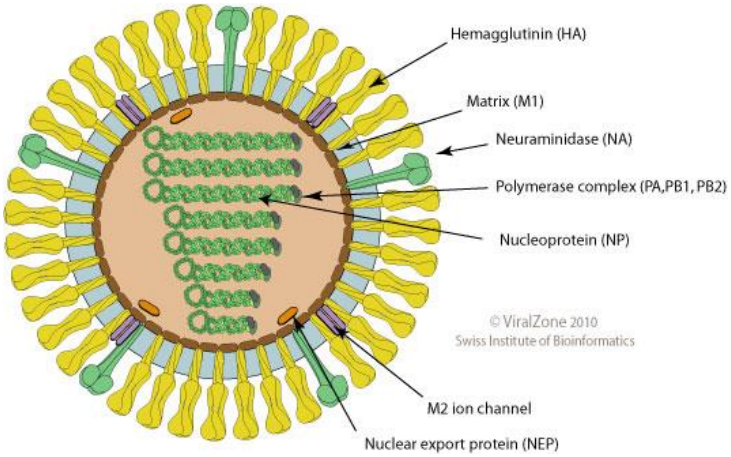
Greek 'myxa' = mucus and 'orthos' = correct or right.

Group V: Negative sense ssRNA viruses

Family: *Orthomyxoviridae*

Genus: ***Influenzavirus A***

Alphainfluenzavirus - A
Betainfluenzavirus- B
Gammainfluenzavirus- C
Deltainfluenzavirus
Isavirus
Quaranjavirus
Thogotovirus

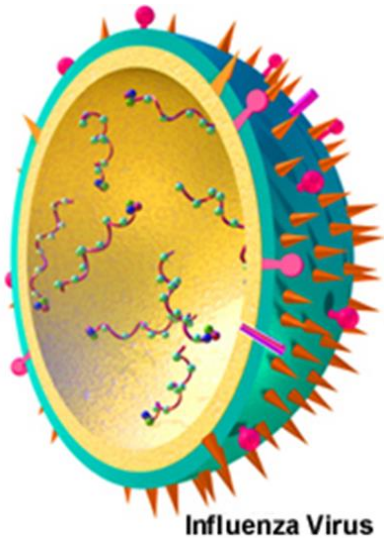


Subtype: H1N1

H5N1

Properties of OrthomyxoVirus

- Enveloped virus
- Virions are pleomorphic, spherical, or filamentous
- Size:80-120 nm in diameter
- Genome: linear negative-sense, single-stranded RNA, divided into eight or seven or six segments,
- Nucleocapsid: *helically , symmetrical*
- Consist of an envelope with large peplomers surrounding eight (genus *Influenzavirus A and Influenzavirus B), seven (genus Influenzavirus C), or six* (genus *Thogotovirus) segments*
- There are two kinds of peplomers H & N
- Transcription and RNA replication occur in the nucleus


Influenza Virus

Surface Antigens & Subtypes

18 HA and 11 NA types for influenza A

Hemagglutinin (HA)

Function: Sites for attachment to infect host cells

Neuraminidase (NA)

Function: Remove neuraminic acid from mucin & release from cell

Highly pathogenic AI (HPAI)

Any influenza virus lethal for 6,7 or 8 of eight , 4-8 weeks old susceptible chickens within 10 days following i/v inoculation with 0.2 ml of a 1/10 dilution of a bacteria free, infective allantoic fluid. Any virus with IVPI greater than 1.2

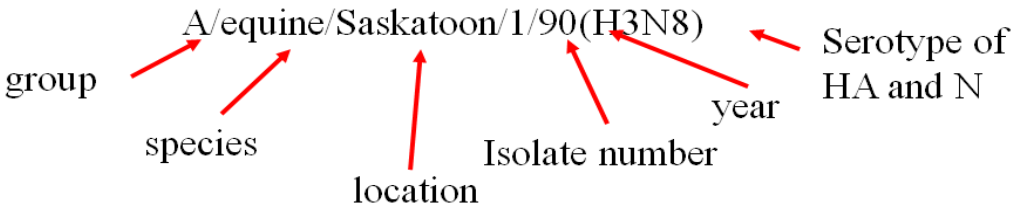
Low pathogenic AI (LPAI)

Low pathogenicity avian influenza (LPAI) viruses typically cause little or no clinical signs in infected poultry.

H5 & H7 isolates that are not virulent for chickens and donot have an HAO cleavage site amino acid sequence similar to those that have been observed in HPAI virus.

Nomenclature of virus

A/equine/Prague/1/56(H7N7)
A/fowl/Hong Kong/1/98(H5N1)
A/swine/Lincoln/1/86(H1N1)

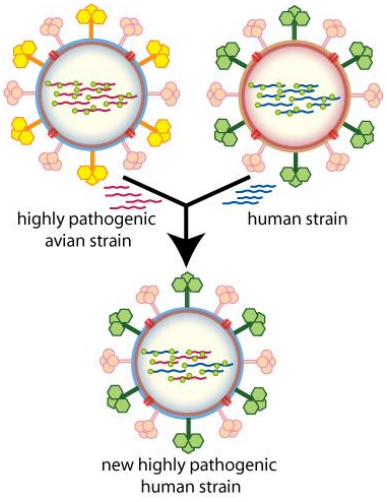


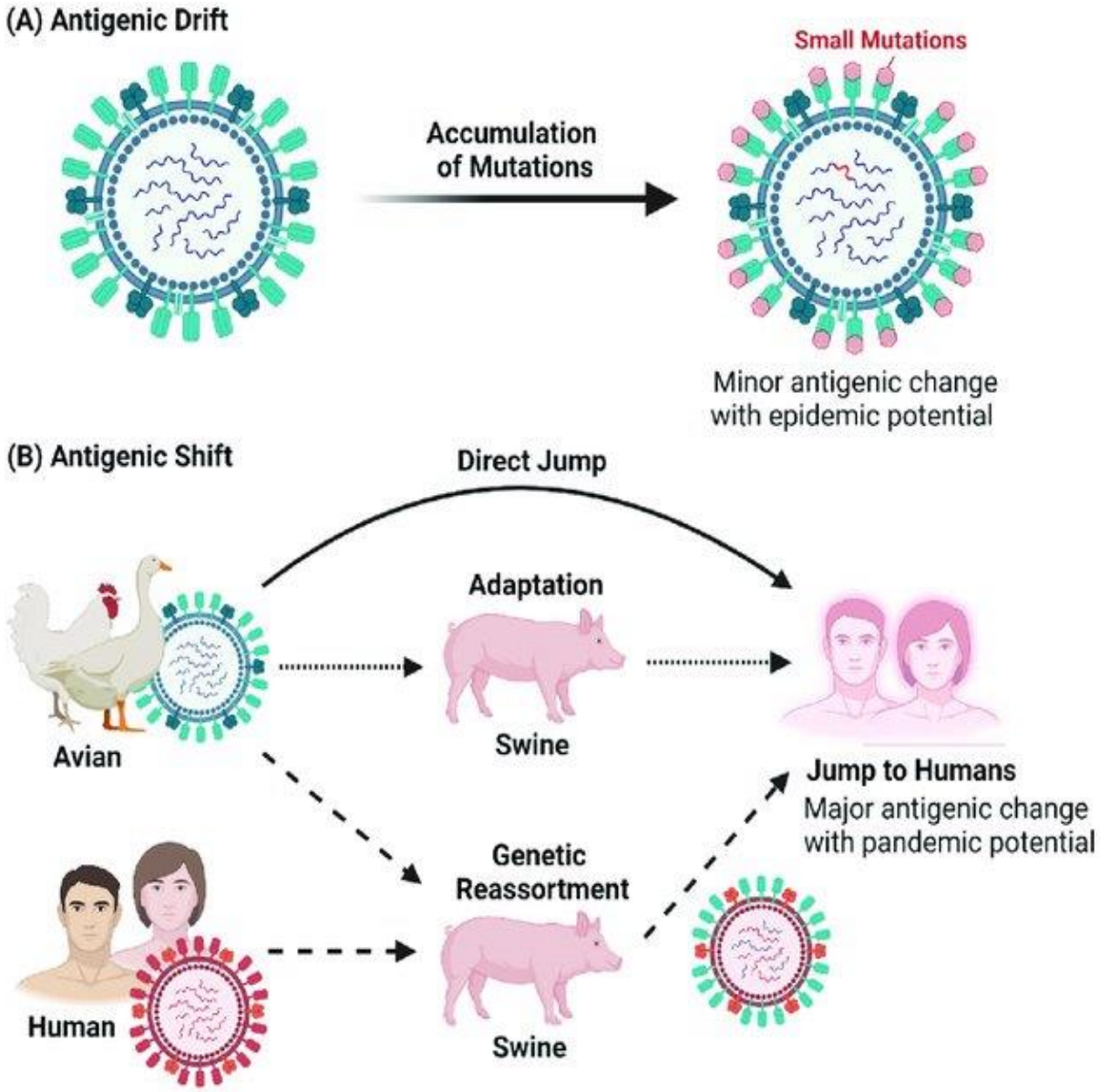
How antigenic shift, or reassortment, can result in novel and highly pathogenic strains of human influenza

Antigenic drift is **caused by point mutations and is defined as the minor gradual antigenic changes in the HA or NA protein**. Influenza A virus drift variants result from the positive selection of spontaneously arising mutants by neutralizing antibodies, that is, antibody escape mutants.

Antigenic Drift: Is the minor mutation of the surface glycoproteins, namely haemagglutinin (HA) & Neuraminidase (NA) of the influenza virus over a long period of time.

Antigenic Shift: Is a major change to the virus structure to create absolutely new subtype of virus by genetic reassortment . The antigenic shift **causes drastic changes in the genome of the IVs, and it is more prevalent in birds**. Since the genome of the IVs is segmented, when a host cell is infected with two different strains of the IVs, gene reassortment can occur.





(Source: Yeo, Joshua & Gan, Samuel Ken-En. (2021). Peering into Avian Influenza A(H5N8) for a Framework towards Pandemic Preparedness. Viruses. 13. 2276. 10.3390/v13112276)

Influenza Virus: Antigenic Shift and Antigenic Drift

Avian Influenza (Fowl Plague)

Avian Influenza is an infectious viral disease of birds caused by type 'A' strains of the influenza virus. The flu virus appears naturally among birds. Wild migratory birds such as ducks, geese, gulls and shorebirds are natural carriers of the virus, but are resistant to severe infection from the virus.

Physical Properties of Avian Influenza virus

Temperature : **Inactivated by 56°C/3 hours**; 60°C/30 min. **pH** : Inactivated by acid pH
Chemicals : Inactivated by oxidising agents, sodium dodecyl sulphate, lipid solvents, B-propiolactone
Disinfectants : Inactivated by **formalin** and iodine compounds
Survival : Remains viable for long periods in tissues, feces and also in water

HOST : Aquatic birds, Poultry birds, Human, Pig, Horse, Seals.
TROPISM : Epithelial respiratory cells.

History Avian Influenza

First noticed in Italy in the year 1878 killing a large number of birds
The causative agent as a virus was established in the year 1901
Relationship between human influenza A virus established in 1955
February 2006 – H5N1 Avian Influenza outbreak in the Nandurbar district of Maharashtra.

Transmission Avian Influenza

Aerosol, Contaminated water & food, Inanimate Objects, Workers, Migratory Birds

Clinical Signs Avian Influenza

Clinical signs are dependent on the virulence of the infecting virus and the species infected .
In outbreaks of Highly Pathogenic Avian Influenza (HPAI) mortality can be up to 100%.
Low Pathogenic Avian Influenza (LPAI) in chickens may even go unnoticed.

Symptoms of HPAI in chickens

Sudden Death, Depression
If survives for 48 hours: Decreased Appetite, Cessation / drop in Egg Production
Swollen Blue Combs and Wattles
Coughing, Sneezing , respiratory distress, Lacrymation, edema of head, face and neck
Cyanosis of unfeathered skin - Comb, Diarrhea

Symptoms of LPAI in chickens

Mild respiratory disease, Sinusitis, Depression, Decreased egg production.


Cyanosis of comb


Swollen wattle


Edema of head, face

Material Collection Avian Influenza
Throat swab or cloacal swab, Serum.

Diagnosis of Avian Influenza
1. Isolation of Virus
9-11 day-old embryonated chicken eggs (SPF)
Cell cultures (Chicken embryo fibroblast)
Demonstration of hemagglutination property and confirmation by HI Test.
Strain virulence evaluation: intravenous pathogenicity index (IVPI) in 4-8 week-old chickens

2. Serological tests
Hemagglutination inhibition tests (subtype specific serum)
Agar gel immunodiffusion
ELISA (Influenza A nucleoprotein)
Immunofluorescence technique
Single Radial Hemolysis

3. Molecular Techniques
Subtype specific Polymerase Chain Reaction
Multiplex PCR
Real time PCR
RT-PCR

Differential diagnosis Avian Influenza
- Acute fowl cholera
- Velogenic Newcastle disease
- Infectious laryngotracheitis
- Infectious Bronchitis

Principle of Vaccination - Avian Influenza
Effective HPAI Vaccine- Not only Protect against disease but also prevent shedding of virus.
Vaccine with closer antigenic Match.
Only in High Risk Areas/Endemic. No licence for use in India.

Avian Influenza Vaccines Available Abroad
Inactivated Adjuvanted Whole Virus Vaccine, Homologus (INTERVET),
Heterologus
DIVA Based Vaccines
Recombinant Vaccines
Recombinant fowl pox-vectored vaccine that co-expresses the HA and NA of the A/goose/Guangdong/1/96 virus Merial
A recombinant LaSota strain of Newcastle disease virus (NDV) expressing an H5 HA insert

In India- Vaccination not permitted / Not recommended

- Expensive
- No cross protection between 16 H subtypes
- Possible creation of reassortant virus-Update the vaccine annually.
- Two doses of 10ug.
- BSL3 Containment facilities for production of vaccine.
- Whole vaccine virus s/b preferred.
- Vaccine induced antigenic drift.
- Efficacy of vaccine in ducks.

Inactivated H5 and recombinant vaccine licensed in the U.S. for emergency in HPAI outbreaks

Human Influenza Chemotherapy (Birdflu)

Prevent membrane fusion

Amantidine (Symmetrel)
Remantidine (Flumadine)

Neuraminidase inhibitors

Zanamivir (Relenza)
Oseltamivir (Tamiflu)

Control Strategy

1) Biosecurity and quarantine
2) Rapid Diagnostics and surveillance
   High level of true surveillance to detect the emergence of antigenic variants. (1st Week)
3) Elimination of infected poultry or controlled marketing of convalescent poultry. Culling of infected poultry reduces the viral load-& likelihood of transmission to human
4) Decreasing host susceptibility to the pathogen by vaccination- Vaccination to reduce the re-invasion of the virus in endemic areas.
5) Combined Antiviral therapy.
6) Education of personnel, owners, and villagers on disease transmission, prevention and control.
7) Political commitment & determined implementation.
8) Planning, communications, and preparation.

What is Bird flu?

Bird flu, or avian flu, is an infectious type of influenza that spreads among birds. In rare cases, it can affect humans.

Avian influenza, also known as bird flu, is *a highly contagious viral disease* that affects domestic and wild birds, have potential to infect humans.

Avian Influenza in general is termed as 'Bird flu'.

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Swine Influenza

Porcine Influenza

History : First report was observed in USA in 1918; Subtype- H1N1, Pigs as major reservoir
Host Swine Influenza : Pigs of all age, Turkeys, Human
Transmission Swine Influenza
Aerosol and direct contact with infected animals. Recovered animals sheds virus for long time.

Pathogenesis Swine Influenza
Incubation period: 1-3 daysAfter entry virus multiplies in the mucosa of respiratory tract.
Develops rhinitis - May progress to Bronchopneumonia
Clinical signs Swine Influenza
Severe **paroxysms of coughing, dyspnoea, anorexia**, **oculo-nasal discharge, rise of temperature**. Recovery after 5-7 days
Secondary bacterial infection-Haemophilus suis
Lesions include-Emphysema, hyperplasia of bronchial epithelial cells.

Laboratory diagnosis Swine Influenza
Material collection: pharyngeal or nasal swab (50% GPB)
Isolation of virus-ECE-Allantoic cavity route-Confirm by HI test
Neuraminidase inhibition test.

Prevention and control Swine Influenza
Quarantine
Symptomatic treatment
Inactivated vaccine available-No satisfactory protection

Human
Symptoms fever, cough, sore throat, chills, weakness, body aches.
Children, pregnant women and elderly are at risk.
People may experience:
Pain areas: in the muscles
Cough: can be dry
Gastrointestinal: diarrhoea, nausea, or vomiting
Whole body: chills, fatigue, or fever
Also common: headache, shortness of breath, or sore throat

Transmission Swine Influenza
The main route of swine flu virus spread between humans is exposure to the virus when someone infected sneezes or coughs, and the virus enters
one of the potential mucous surfaces, or when a person touched something infected with the virus and subsequently touch their nose.

Equine Influenza

History

First report was observed in Sovinova, Czechoslovakia in 1956

Subtype- H7N7, H3N3 –Florida, USA (1963), World wide in distribution.

Host Equine Influenza

All breeds and all ages of Horses, donkeys, mules are susceptible.

Transmission Equine Influenza

Aerosol and direct contact with infected animals.

International spread- Transport of horses for racing and breeding purpose.

Pathogenesis Equine Influenza

Incubation period: 1-3 days After entry virus multiplies in the mucosa of respiratory tract.

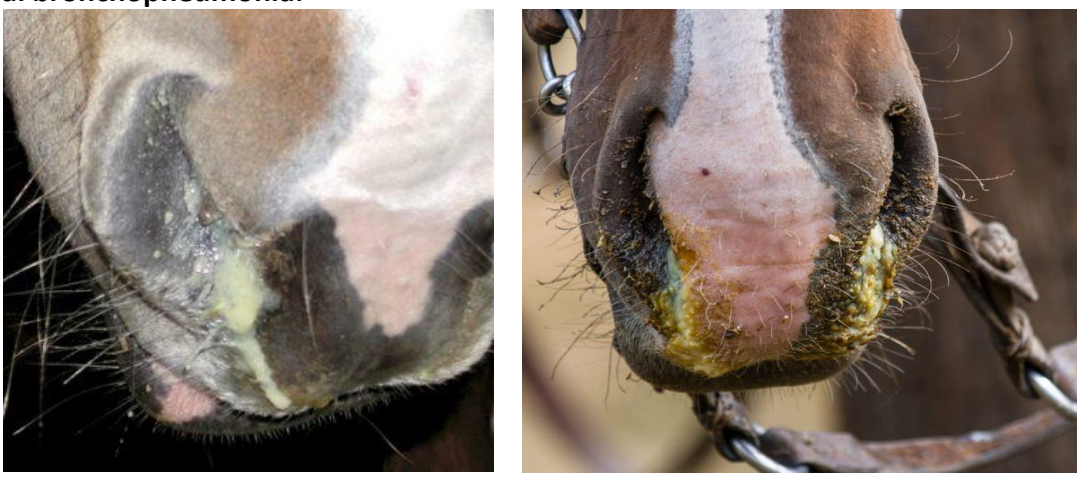
Develops rhinitis - May progress to Bronchopneumonia.

Clinical signs Equine Influenza

Coughing, dyspnoea, reddening of nasal mucosa, anorexia, **oculo-nasal discharge, sudden rise of temperature**. Swelling of pharyngeal lymph node, Recovery after 5-7 days.

Secondary bacterial infection-Mucopurulent nasal exudate.

Catarrhal bronchopneumonia.



Equine Influenza - Mucopurulent nasal exudate

Laboratory diagnosis Equine Influenza

Material collection: pharyngeal or nasal swab (50% GPB).

Isolation of virus-ECE-Allantoic cavity route-Confirm by HI test.

Neuraminidase inhibition test.

Prevention and control Equine Influenza

Quarantine and Biosecurity at stud farms.

Equine influenza Bivalent inactivated vaccines available.

Two doses at a interval of 3-4 weeks.

Reference

Yeo, Joshua & Gan, Samuel Ken-En. (2021). Peering into Avian Influenza A(H5N8) for a Framework towards Pandemic Preparedness. Viruses. 13. 2276. 10.3390/v13112276.

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