Influenza A Viruses

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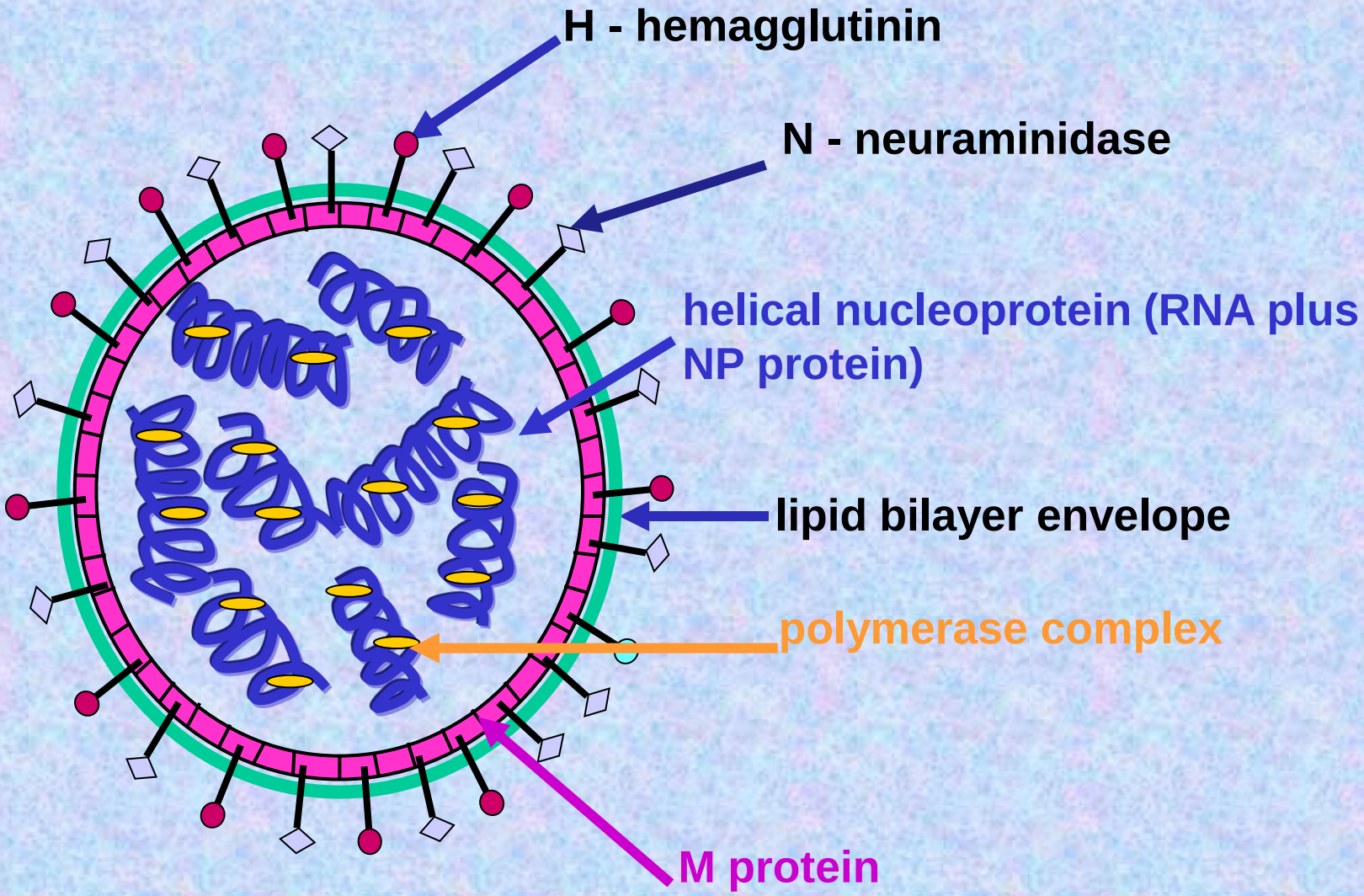
Types of influenza virus

- Three types of influenza virus: A, B and C
- Influenza A virus are associated with diseases in humans, poultry, pigs, horses and other mammals such as seals, dogs, cats and whales.
- Influenza B virus has been isolated from human beings only
- Influenza C virus can infect humans and, in some instances, swine and seals

Influenza virus

- The influenza A viruses are pleomorphic and can occur as spherical or filamentous forms.
- The genome of influenza viruses is segmented single-stranded RNA of negative polarity.
- There are eight RNA segments in influenza A and B viruses while influenza C virus has seven RNA segments.
- Type A viruses are further classified into subtypes based on their 18 haemagglutinin (H) and 11 neuraminidase (N) proteins.
- Except H17, H18 and N10, N11, all other haemagglutinins and neuraminidases in all probable combinations have been detected from birds.

Influenza virus



Evolution of Influenza Viruses

- Influenza viruses are dynamic and are continuously evolving by two different mechanisms

1. Antigenic drift
2. Antigenic shift

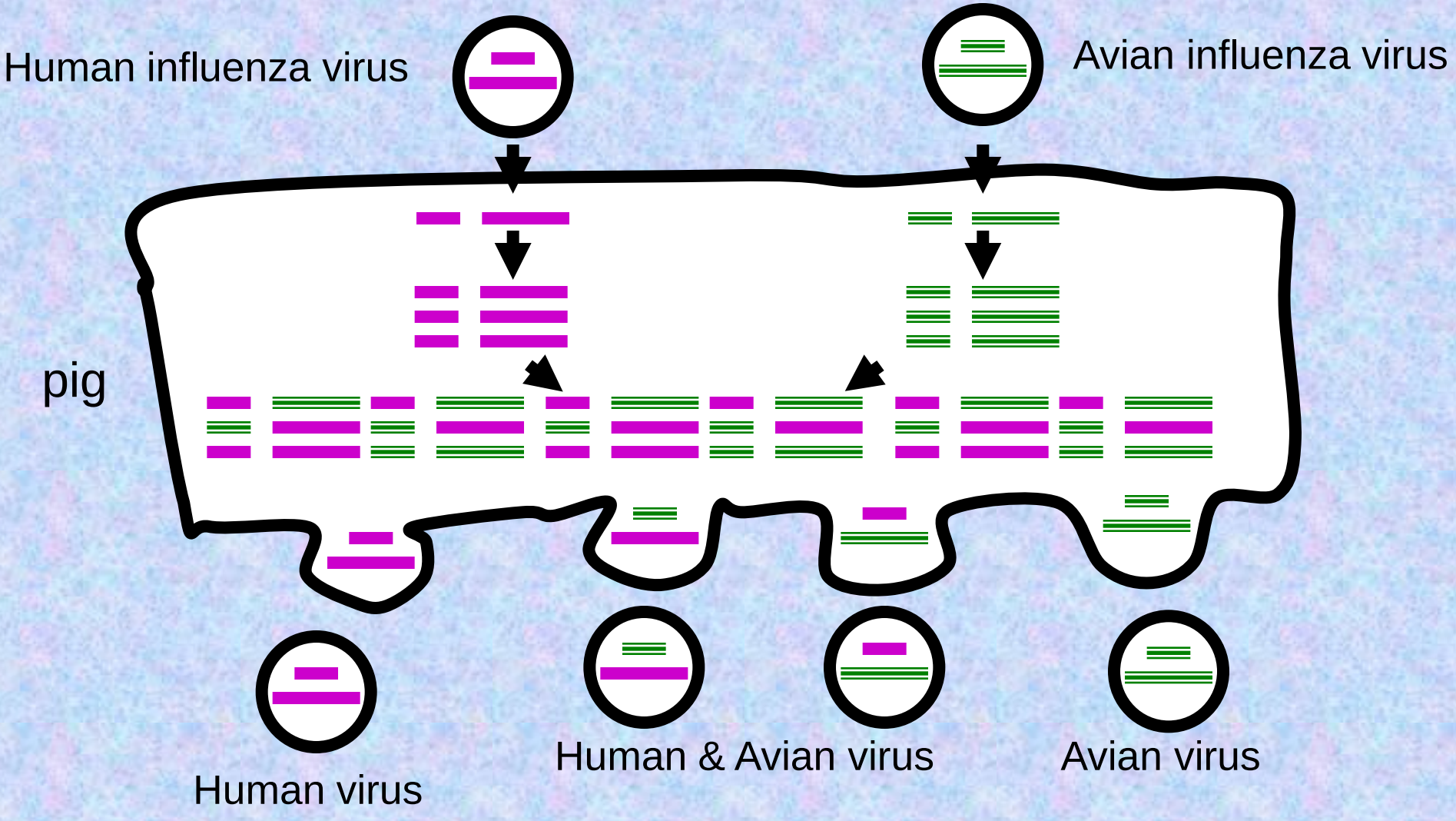
Antigenic drift

- Antigenic drift refers to small, gradual changes that occur through point mutations in the genes for surface proteins, haemmagglutinin and neuraminidase.
- Individual immune to the original strain is not immune to the drifted one.

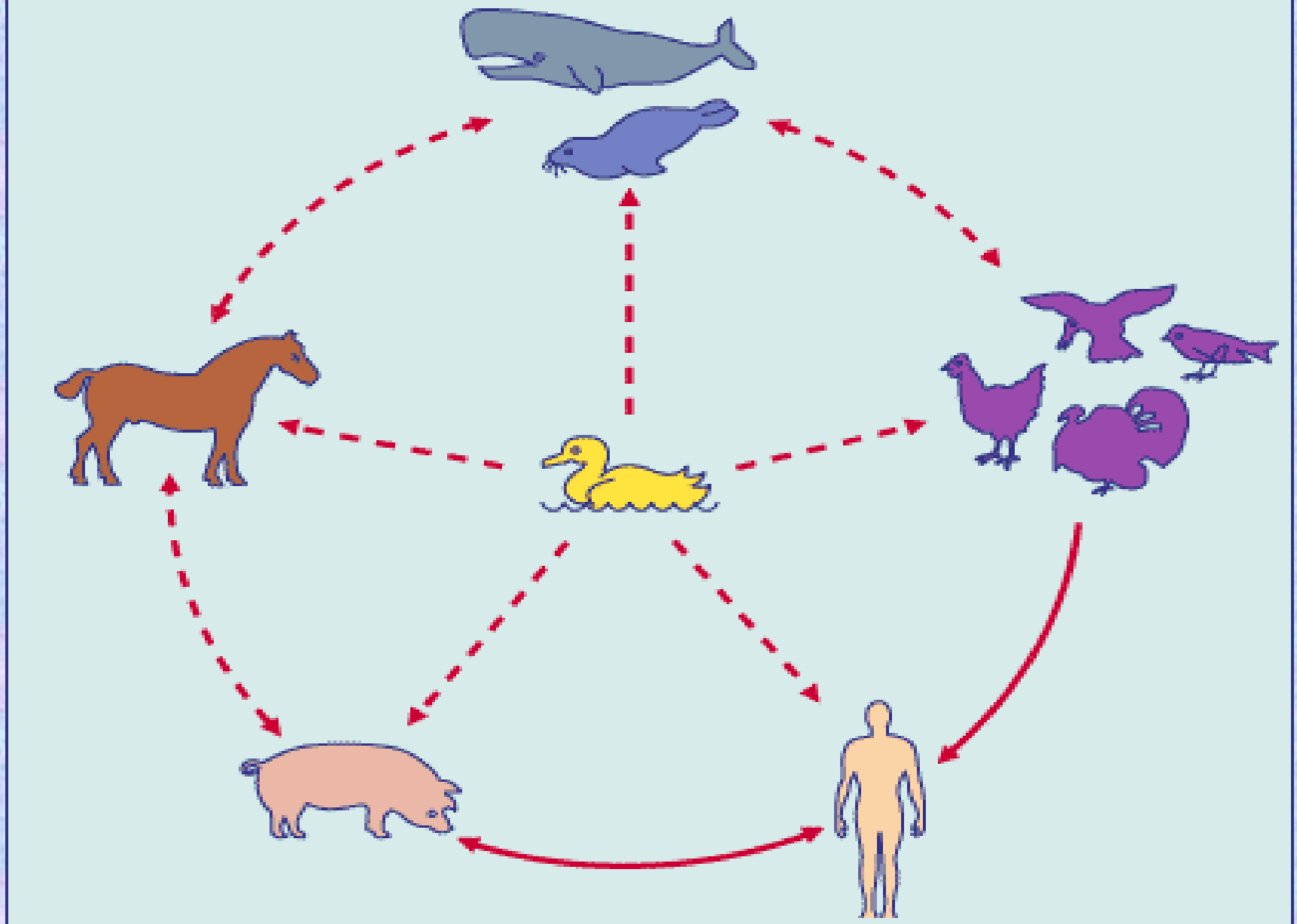
Antigenic shift (genetic reassortment)

- Antigenic shift happens only occasionally in viruses with segmented genomes.
- The latter term denotes the exchange of one or more genome segments between two related viruses which infect a host cell at the same time. Thus, the virus gains a new antigenic pattern/specificity
- Although avian influenza A subtypes usually cannot infect humans and poultry is usually not susceptible to human virus subtypes
- pigs play an important role in the formation of new influenza viruses. They serve as a kind of ‘melting pot’ as they are susceptible to double infections with avian as well as human influenza viruses.

Reassortment



The reservoir of influenza A viruses



Influenza virus A in Poultry

- Cause respiratory disease, besides respiratory disease some of these viruses can cause generalized disease in fowl in which, diarrhoea, paralysis and decreased egg production are also observed.

Types of Influenza in Poultry

Depending on the pathogenicity there are two types:

1. **High Pathogenic Avian Influenza (HPAI)**
2. **Low Pathogenic Avian Influenza (LPAI)**

HPAI

- HPAI are causing fowl plague, a systemic infection have mortality and morbidity reaching up to 100%

There are two forms of HPAI

1- Peracute form of HPAI

- Characterised by death without showing any signs

2- Acute form of HPAI

- Characterised by severe respiratory sounds, depression, coughing and sneezing
- Watery eyes with excessive eye discharges
- Cyanosis of head, combs, wattles and shanks
- Swelling of head, face and sinuses and ruffled feathers
- Diarrhoea (initially bright green, later white)
- Nervous signs such as convulsion, blindness or paralysis.

HPAI

- All types of domestic as well as captive birds are found to be affected by HPAI
- The presence of HPAI infection will result in trade embargoes on the export of poultry and poultry products from a region/country in which HPAI has been detected.

LPAI

- The majority of the avian influenza viruses cause local infection in the respiratory tract or in the gut, which frequently remains asymptomatic
- Some of the clinical indications are minor respiratory distress, depression and lower egg production.
- The mortality rates may be as low as 0 %

HPAI and LPAI

- Only **H5** and **H7** subtypes are recognized to cause HPAI
- Low pathogenic **H5** and **H7** avian influenza viruses can mutate into the highly pathogenic form of the virus
- The presence of **H5** or **H7** infection with heavy mortality (≥ 75%) that mean HPAI

Role of Migratory Birds in Spreading Influenza Viruses

- Wild waterfowl are the primordial reservoir of all influenza viruses.
- The virus is usually introduced in a country through the wild waterfowl.
- Faecal material of wild waterfowl is rich source of the virus and all subtypes of influenza A viruses can be isolated from such clinical materials as these birds have probably carried the influenza viruses for centuries.

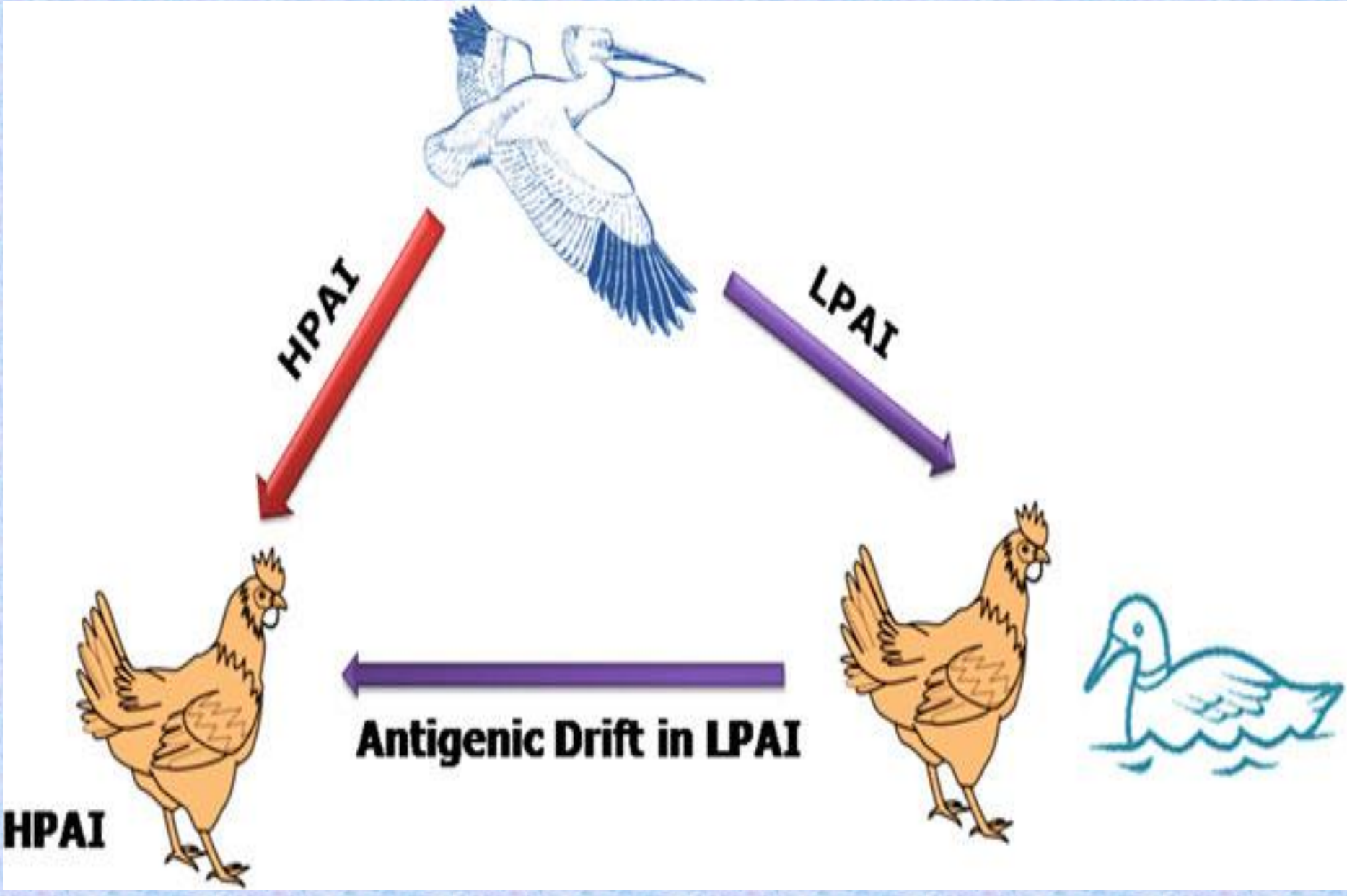
Role of Migratory Birds in Spreading Influenza Viruses

- There is increased chance of contact infection to domestic birds in a particular geographical location due to congregations of migratory waterfowl.
- Healthy domestic ducks and geese can transmit the viral agent to chickens and having more important roles in the perseverance of the virus and its broadcasting between domestic chickens and farms.
- Most avian influenza virus infections have not produced recognizable disease in wild birds. All these birds are the asymptomatic reservoirs of avian influenza viruses.

Role of Migratory Birds in Spreading Influenza Viruses

- Migratory birds were thought to transmit only LPAI to domestic birds.
- These LPAI in the domestic birds underwent mutations and finally the accumulated mutations may sometimes result in the generation of HPAI.
- There is speculated that the migratory birds may directly transmit HPAI to the domestic birds
- Natural infections of wild birds with HPAI viruses are rare.
- Few countries like Hong Kong and China have also reported outbreaks of HPAI in domestic waterfowl, and migratory waterfowl, killing thousands of birds.
- Viral isolation from dead migratory birds revealed their potential role in spreading of HPAI.

Role of Migratory Birds in Spreading Influenza Viruses



Control of HPAI

- The control programs for H5 and H7 LPAI because of concern of mutation to HPAI
- Controlling the infection in poultry is important to prevent human infections.
- Influenza virus infection first occurs in domestic waterfowl in which most of these infections remain asymptomatic therefore, the separation of chickens from these poultry birds is very important

Methods of Control

1. Stamping out policy
2. Protection zone
3. Vaccination

1- Stamping out policy

- This method are used for foreign animal diseases
- Requires both good veterinary infrastructure and a diagnostic network
- Can be the most cost effective if outbreaks identified early
- Approach not practical when a disease is widespread in the country

2-Protection Zone

1. A 3 km radius area surrounding the infected farm is declared as ‘protection zone’ for a period of no less than 21 days from the date of identification of the influenza virus.
2. Controlled entry and exit into the protection zone will be put in place strictly.
3. The vehicles and other materials that leave the premises have to be cleaned and disinfected before their exit.

2- Protection Zone

5. The litter or manure is not transported out of the protection zone.
6. Prevent wild birds from coming in contact directly or indirectly with the domestic poultry within the zone by construction of temporary enclosures on the premises.
7. Public awareness about the disease has to be increased.
8. Live poultry shows, displays or markets are discouraged.
9. A complete ban has to be imposed on bird hunting within the zone.

3- Vaccination

The following vaccine types are currently available

1- Inactivated vaccines:

- Monovalent including either H5 or H7strains
- Bivalent including H5 and H7 strains

Both monovalent and bivalent vaccines can contain homologous or heterologous neuraminidase subtype

2- Live recombinant vaccines (fowlpox H5): these are efficacious only in chicken.

3- Vaccination

Various vaccination strategies can be applied:

1. Mass vaccination: vaccination is applied to all susceptible birds.
2. Targeted vaccination: vaccination is applied to defined categories of birds.
3. Ring vaccination: vaccination is applied in a defined area around an outbreak.

3- Vaccination

- Vaccines will prevent clinical disease, but not infection
- Good vaccines, properly administered, can reduce virus shedding from infected birds and reduce chance of virus spread
- Proper vaccination programs must also include good surveillance, education, quarantines and animal movement controls
- Vaccination can be used to reduce the susceptible population, and when used with stamping out may be an effective tool
- Vaccination without the proper controls may reduce disease, but will not eliminate it