

Virology



Different types of flu viruses

- Flu viruses are divided into three main groups: Influenza **A**, **B** and **C**
- **A** viruses – source of ‘ordinary’ flu epidemics and all pandemics
- **A** viruses also infect birds and other animals such as pigs and horses
- **B** and **C** viruses infect humans only



Influenza Types	Hosts
Type A	Humans, birds, pigs and horses
Type B	Humans only
Type C	Humans only



How flu viruses change

“Some of the commonest infections have a particular ability to change, influenza viruses being the chameleons of the microbial world.”

Getting Ahead of the Curve – a strategy for combating infectious diseases
– A report by the Chief Medical Officer, January 2002



Classification of influenza viruses

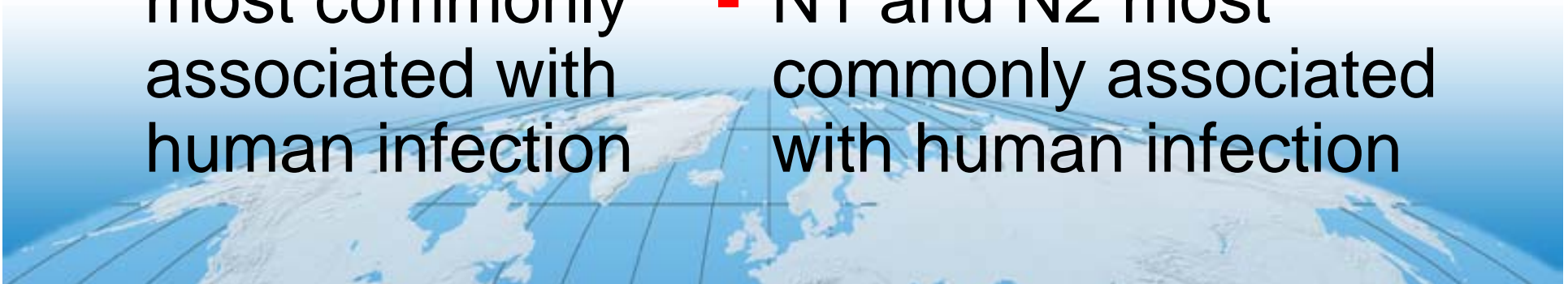
Two proteins on the surface of the virus:

Haemagglutinin (H)

- glycoprotein enables virus to attach to host cell
- 15 exist in nature
- H1, H2 and H3 most commonly associated with human infection

Neuraminidase (N)

- glycoprotein enzyme essential for virus replication
- enables new virion to be released from host cell
- N1 and N2 most commonly associated with human infection



Change

- Particular characteristic that enables influenza **A** viruses to cause annual epidemics, even pandemics
- Type **A** viruses undergo frequent changes in their surface antigens or proteins
- Minor changes - *antigenic drift*
- Major changes - *antigenic shift*



Antigenic drift

- Occurs among influenza **A** viruses resulting in emergence of new variants of prevailing strains every year
- New variants result in seasonal flu each winter
- Some years are worse than others – partly related to degree of ‘drift’



Antigenic shift

- Major changes occur in the surface antigens of influenza **A** viruses
- Occurs by mutation or by 'reassortment' between viruses
- Changes are more significant than those associated with antigenic drift
- Changes lead to emergence of potentially pandemic strains by creating a virus that is markedly different from recently circulating strains



Antigenic shift

Occurs in two ways:

- Sudden 'adaptive' change during replication of a normal virus **OR**
- From an exchange of genes between human strain of an influenza **A** virus and an animal strain



Antigenic shift

- Genetic exchange or 're-assortment' produces a new virus capable of causing a pandemic in humans
- Can occur when an animal becomes infected with human and animal flu virus at the same time
- Animal within which this genetic exchange takes place known as 'mixing vessel'



Antigenic shift

- Population will have little or no immunity to new virus:
 - all or most people will not previously have had infection due to it
 - will not have been vaccinated against it
- Lack of immunity allows virus to spread more rapidly and more widely than 'ordinary' flu viruses



Antigenic drift and shift

Drift - 2003

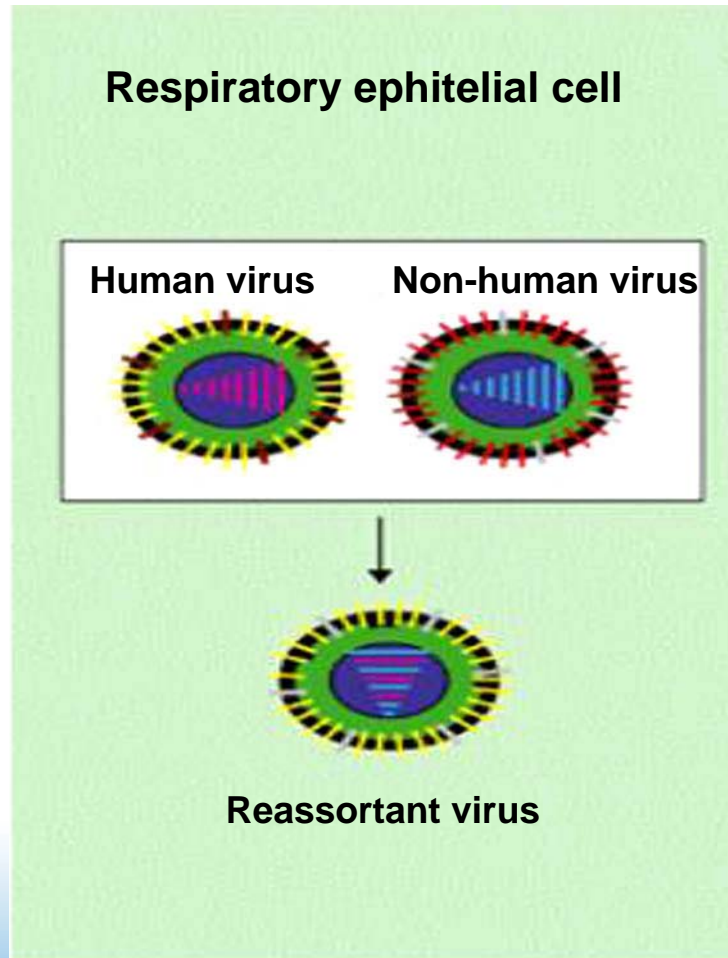
- From Influenza A (H3N2), Panama strain
- To Influenza A (H3N2), Fujian strain

Shift - 1957

- From Influenza A (H1N1) variants
- To Influenza A (H2N2) 'Asian' flu

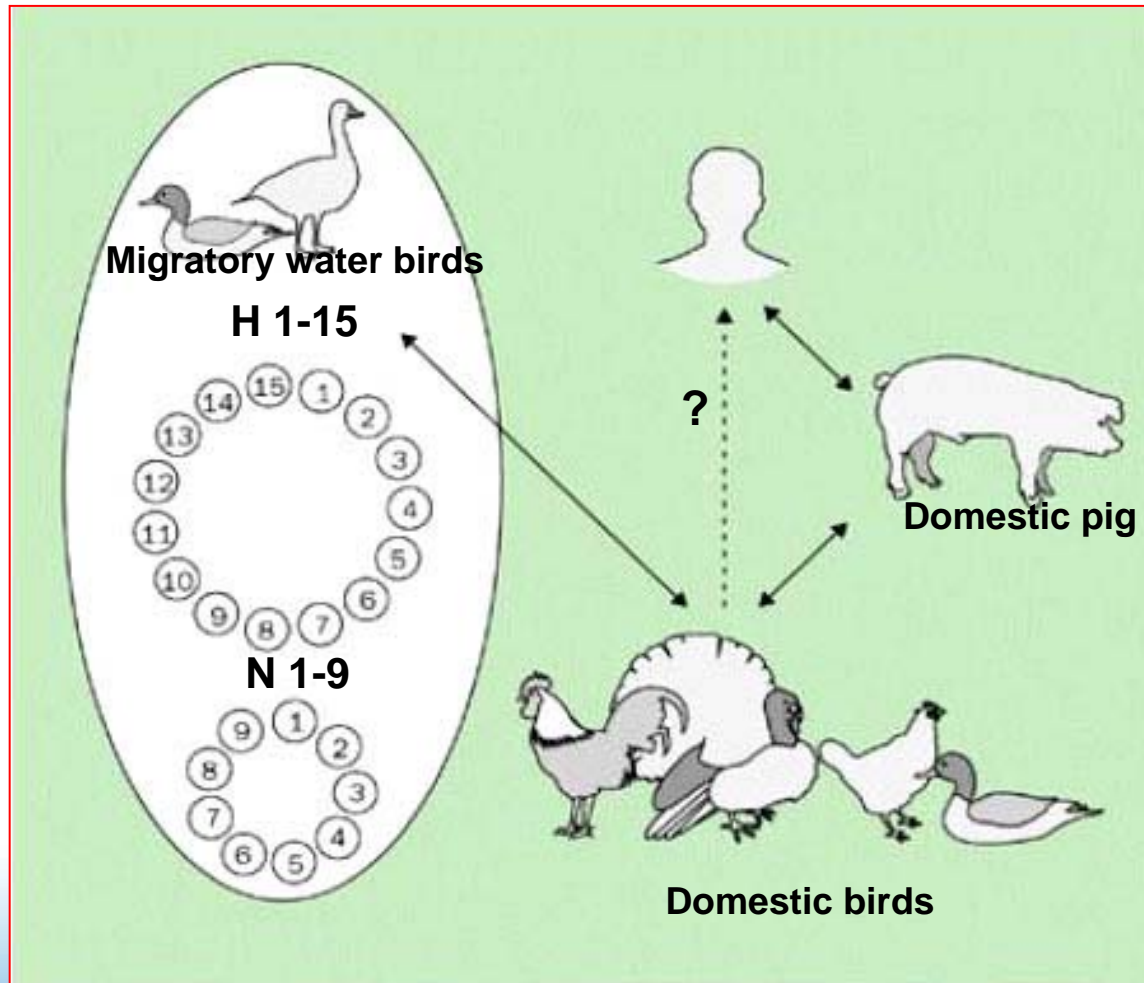


How antigenic shift can occur



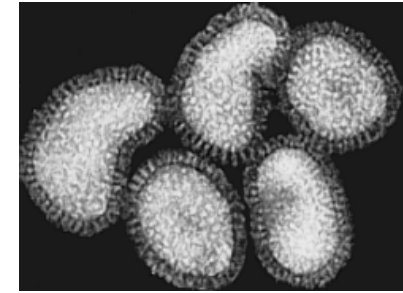
Karl G Nicholson, John M
Wood, Maria Zambon
Lancet 2003; 362: 1733-45

Origin of Pandemic Influenza

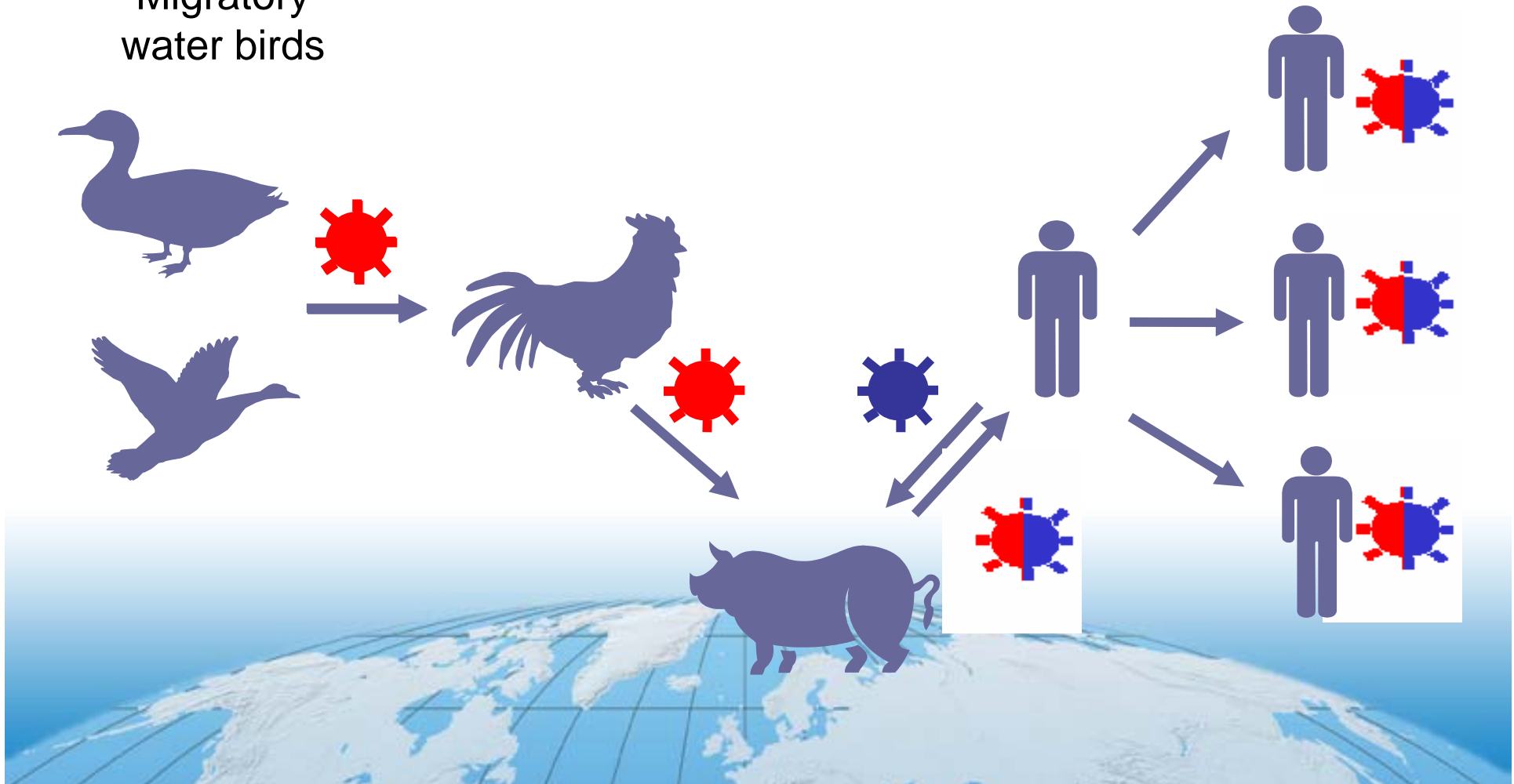


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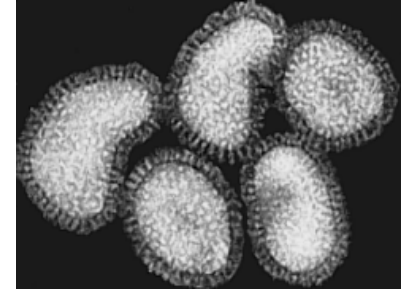
Pandemic strain reassortment in pig



Migratory
water birds



Pandemic strain Reassortment in humans



Migratory
water birds

