Emerging Respiratory Diseases
- Avian influenza
- SARS

Avian influenza
- Influenza type A
- Segmented genomes (8 segments)
- Hemagglutinin and neuraminidase spikes on surface of virus
- Enveloped with helical capsid

Influenza
- Hemagglutinin (HA): Site for attachment of virus to host cell. Antibody against HA prevents initiation of infection. Attaches to sialic acid containing glycoproteins in membrane.
- Neuraminidase (NA): Cleaves the terminal sialic acid residue from host cell receptor and allows release of progeny virus

Avian influenza
- Type A influenza can infect several animal species: birds, pigs, horses, seals, whales.
- Birds are the natural hosts for influenza A viruses as all known subtypes of influenza A circulate among wild bird populations.
- Influenza A viruses can be divided into subtypes on the basis of their surface proteins: Hemagglutinin (HA) and neuraminidase (NA)
- HA: 15 known types (only H1, H2, H3 circulate widely in humans)
- NA: 9 (only N1 and N2 circulate widely in humans)

Avian influenza in birds
- Wild birds: usually asymptomatic.
- Domesticated birds: often fatal.
- Humans: rare cause of disease.
- Birds secrete virus from:
  - Intestines (fecal – oral transmission most common)
  - saliva
  - nasal secretions
- The virus can survive in manure for three months at cool temperatures.
Avian influenza in domestic birds

- 1997: 1.5 million birds, Hong Kong’s entire poultry population culled.
- 1999: Hong Kong: 1.24 million birds culled.
- 1999: Italy - 13 million birds culled.
- 2000: US Pennsylvania outbreak – A (H5N2) – 17 million birds culled
- 2002: Virginia, A (H7) outbreak. 4 million turkeys and chickens culled.
- Feb 2004: 12,000 chickens in Delaware destroyed due to H7 outbreak. Other flocks within 2 mile radius will be tested. S. Korea immediately halted imports of US poultry.

Avian influenza in Humans

- 1997: Hong Kong. A (H5N1) First time an avian influenza virus had ever been transmitted directly to humans. 18 hospitalized, 6 deaths. Rare human to human transmission noted. To control outbreak – 1.5 million chickens killed.
- 1999: Hong Kong. A (H9N2) confirmed in two children and their parents. Additional cases mainland China.

Confirmed Cases of Avian influenza A (H5N1) – 1/30/04

<table>
<thead>
<tr>
<th>Country</th>
<th>Total Cases</th>
<th>Deaths</th>
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</thead>
<tbody>
<tr>
<td>Thailand</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Vietnam</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>8</td>
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</tbody>
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Lab confirmed cases.
Avian influenza in humans

- Symptoms in humans:
  - typical influenza
  - eye infections
  - Pneumonia – ARDS
- Transmission to humans:
  - Poor sanitation in poultry markets
  - Chicken stalls and markets in close proximity to living and playing areas
  - Practice of slaughtering chickens at the retail outlets

Concern over potential for Pandemic influenza

- Pandemics:
  - 1918-1919 “Spanish flu” A (H1N1): 500,000 deaths in US. (50% young healthy adults)
  - 1957-1958 “Asian flu” A (H2N2): 70,000 deaths US.
  - 1968-69: “Hong Kong flu” A (H3N2): 34,000 deaths US.

Influenza

“I shall only observe, that they gave way to a new epidemic which proceeded from the manifest qualities of the air in November. For at the beginning of this month a cough arose, which was more epidemic than any I had hitherto observed; for it seized nearly whole families at once. ... it was attended with a fever and its usual concomitants. Though coughs are common at the beginning of winter, yet everybody wondered to find them so frequent this year;”

Thomas Sydenham 1679
Continued human exposure to influenza viruses circulating in wild and domestic avian species = Pandemic threat.

Whats the concern about H5N1?

- Mutates rapidly
- Potentially very contagious
- Documented propensity to acquire genes from viruses infecting other species.
- Can cause severe disease in humans
- Vaccine development difficult:
  - Traditional vaccines are made by the chick-embryo method. This is slow and limited by the supply of fertile eggs.
  - Current H5, H7 viruses rapidly lethal to chick embryos and traditional methods may not work.
Avian influenza

- Vaccine development requires engineering a suitable vaccine strain so that it does not cause disease and then growing it in large quantities in hen’s eggs.
  - HA and NA proteins from novel avian or human virus with remaining 6 proteins derived from a human influenza virus that is non-pathogenic. If no suitable non-pathogenic virus – then HA will be modified to remove determinants of high pathogenicity.
- Plasmid reverse genetic technology – not yet studied in clinical trials.
- Simply finding enough eggs is a problem – as most are already set aside for making normal flu shots.