WFS 101:  
“Avian Influenza: Is it a threat?”

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Lecture Structure
I. Influenza Viruses
II. Avian Influenza (HPAI H5N1)
III. Outbreaks
IV. Surveillance

Topic Introduction
Influenza Viruses

Types: A, B, C

Subtypes: H1, H2, H3

- Surface Glycoprotein: HA (16), NA (9)
  - Hemagglutinin (HA): Binds virus to cell
  - Nueraminidase (NA): Releases progeny virus particles

Wild birds: Reservoir of Type A

Strains: (clades 1, 2, …)

Slight differences in HA or NA genes such that antibodies do not recognize.

Classifications of Subtypes

Classified based on the severity of illness

1) Low Pathogenic (LP):
- Mild symptoms to influenza-like illness

2) Highly Pathogenic (HP):
- Severe illness and possibly death
Avian Influenza A Viruses

1) Influenza A H5: (H5N1)
   - 9 Subtypes
   - HP or LP
   - HP: Severe illness and death in humans

2) Influenza A H7: (H7N3, H7N7)
   - 9 Subtypes
   - HP or LP
   - HP: Conjunctivitis, Upper respiratory symptoms

3) Influenza A H9: (H9N2)
   - 9 Subtypes
   - LP
   - Only 3 human infections confirmed

HPAI H5N1: Fast mutating virus

Influenza Pandemics
(all of avian origin!)

1918: H1N1 “Spanish Flu”
   - 50-100 million
   - Worst pandemic in history
   - 2 days: healthy individuals

1957: H2N2 “Asian Flu”
   - 1-2 million

1968: H3N2 “Hong Kong Flu”
   - 1 million
   - Children and elderly

300K-500K die annually

Transmission of HPAI Viruses

Avifauna:
- Direct with saliva, nasal secretions, and feces
- Fecal-to-oral transmission
- Waterbirds: carry virus in feces and shed it
- Poultry: dirt, cages, water, feed

Humans:
- Cases are rare (329 to date)
- Contact with infected poultry or contaminated surface (closer 1 m); 2 from uncooked duck blood
- Unknown but likely inhale aerosolized virus particles (or ingest feces/uncooked animal parts)
- 9 cases of human-human transmission
Clinical Effects of HPAI

Avifauna:
- 90-100% Mortality in 48 hrs
- Petechial Hemorrhaging
  - Larynx, Trachea, Proventriculus
  - LPAI (reduction in weight or egg production, soft eggs)

Humans:
- Alveolar Inflammation
  - Hemorrhaging of epithelial cells
- Obstruction of Airways
  - Decreased Oxygen Diffusion
- Renal failure, hepatic symptoms

Current Knowledge or Issue

Epidemiology of HPAI H5N1

1997:
- First Human Case
  - Hong Kong: 6/18
2003:
- China: 2/3
  - Poultry Farms
  - 3 Flocks Korea
2004:
- Vietnam, Thailand
  - Two Weeks: 10 Countries (Asia)
- Waterfowl spreading
2005:
- Vietnam (33/64; 1 mil)
- Russia, Kazakhstan
2006:
- Europe, Africa
Mortality Rate of HPAI H5N1

2005 to 2007

61% Mortality Rate

HPAI H5N1 Effects on Poultry

<table>
<thead>
<tr>
<th>Infected Birds in 55 Countries</th>
<th>&gt;150 Million Poultry Euthanized</th>
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<tbody>
<tr>
<td>United States (16 Outbreaks: H5, H7 since 1997 but not H5N1)</td>
<td>• #1 Poultry Producer in World</td>
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<td>• $30 Billion Industry</td>
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<td>• 5 Billion lbs: Broiler Chickens</td>
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<td>• 90 Billion Eggs</td>
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Canada
23 Sept 07
H7N3
560 Infected
(49130 birds)

The Reservoir
Migratory Birds

Pacific Flyway is the Greatest Concern
Spill-over Reservoirs

**Pigs:**
- Carry H3N2 (dominant annual human flu)
- H5N1 isolated in 2004 (China)
- Antigenic shift: novel virus

**H5N1**

**Cats:**
- Can be infected with H5N1 (eating infected carcass)
- 140 tigers died in Thailand
- Excrete 1/1000 of the amount of virus compared to chickens

**Mice, Ferrets:**
- Have been infected with H5N1 in Lab

(Background involving antigenic shift)

Future Directions

Emergence of HPAI H5:N?

**Pandemic Predictions**
- ¼ - ½ infected (1.6-3.25 billion)
- 60% Mortality (1-2 billion)
- 1-5% Mortality (16-160 million)

**Prevention**
- Commercial vaccine: H5N1
- NA Plan for Avian & Pandemic Influenza
- Novel Strain Research
- 3 Months Develop, 1 Year

Bird Import Ban: H5N1 Infected Countries
Surveillance of HPAI
http://www.nwhc.usgs.gov/

Partnersed with USDA (APHIS) and State Agencies

75K-100K Samples in 2006: Waterfowl, Shorebirds, and Neotropical Migrants

Swabs: pharyngeal or fecal

1) Media kept frozen (-20C)
2) Refrigerate (<2 weeks)
3) Field: on ice
4) Insert into cloaca, circular swab
5) Ship immediately or store in -80C