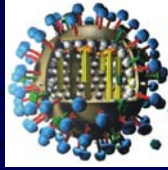


**WFS 101:
“Avian Influenza: Is it a threat?”**



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Lecture Structure

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

Topic Introduction

Fatal Contact: Bird Flu in America

9 May 2006, 8:00 p.m., EDT



<http://abc.go.com/movies/birdflu.html>

Influenza Viruses

Types:

A, B, C



- Humans can be infected by all types
- Birds can be infected by Type A only



➤ **Wild birds:** Reservoir of Type A

Subtypes:

Surface Glycoprotein: HA (16), NA (9)

H1, H2, H3

•**Hemagglutinin (HA):** Binds virus to cell

N1, N2, N3, N7
(H1N1, H1N2, H3N2)

•**Neuraminidase (NA):** Releases progeny virus particles → virulence

Strains:

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

(clades 1, 2, ...)

Classifications of Subtypes

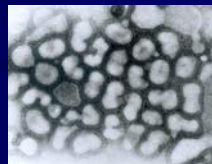
Classified based on the severity of illness

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
LP: Conjunctivitis, Upper respiratory symptoms
- 3) **Influenza A H9:**
 (H9N2) •9 Subtypes
 •LP
Only 3 human infections confirmed

HPAI H5N1: Fast mutating virus

- Epizootic (non-humans)
- Panzootic (multiple spp)


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



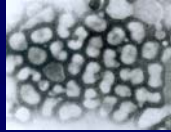
Clinical Effects of HPAI

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



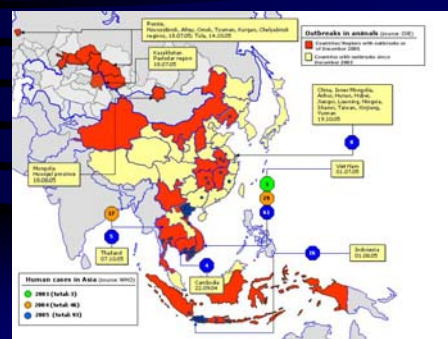
- Humans:**
- Alveolar Inflammation
 - > Hemorrhaging of epithelial cells
 - Obstruction of Airways
 - > Decreased Oxygen Diffusion
 - Renal failure, hepatic symptoms

**Viral
Pneumonia**

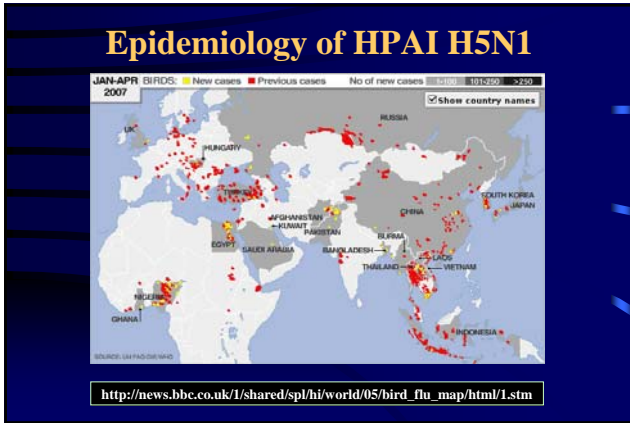


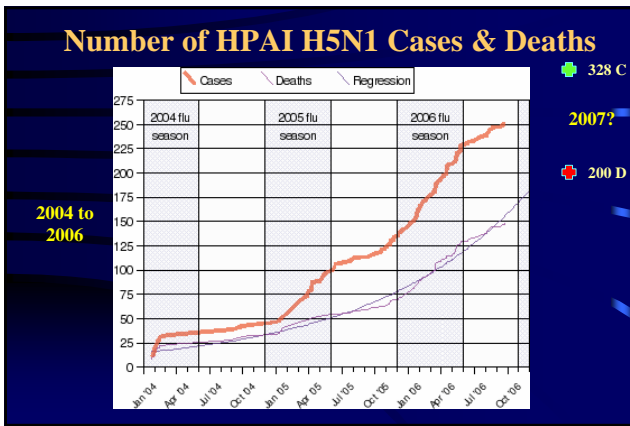
Current Knowledge or Issue

Epidemiology of HPAI H5N1



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





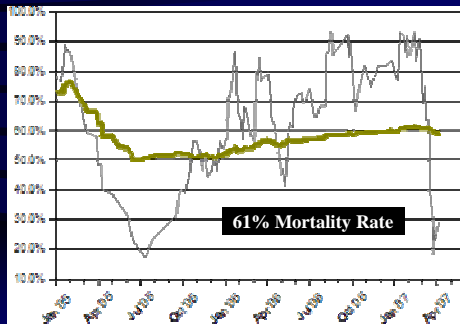
Confirmed Cases & Deaths by Country

01 October 2007

Country	2003		2004		2005		2006		2007		2003-07	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Azerbaijan	0	0	0	0	0	0	8	5	0	0	8	5
Cambodia	0	0	0	0	4	4	2	2	1	1	7	7
China	1	1	0	0	8	5	13	8	3	2	25	16
Djibouti	0	0	0	0	0	0	1	0	0	0	1	0
Egypt	0	0	0	0	0	0	18	10	20	5	38	15
Indonesia	0	0	0	0	20	13	55	45	31	27	106	85
Iraq	0	0	0	0	0	0	3	2	0	0	3	2
Lao People's Democratic Republic	0	0	0	0	0	0	0	0	2	2	2	2
Nigeria	0	0	0	0	0	0	0	0	1	1	1	1
Thailand	0	0	17	12	5	2	3	3	0	0	25	17
Turkey	0	0	0	0	0	0	12	4	0	0	12	4
Viet Nam	3	3	29	20	61	19	0	0	7	4	100	46
Total	4	4	46	32	96	43	115	79	65	42	328	200

Mortality Rate of HPAI H5N1

2005 to 2007



HPAI H5N1 Effects on Poultry

Devastating Effects on Poultry Industry

Infected Birds in 55 Countries >150 Million Poultry Euthanized
 •1.6 million birds in Thailand

Canada

23 Sept 07
 H7N3
 560 Infected
 (49100 birds)

United States (16 Outbreaks: H5, H7 since 1997 but not H5N1)



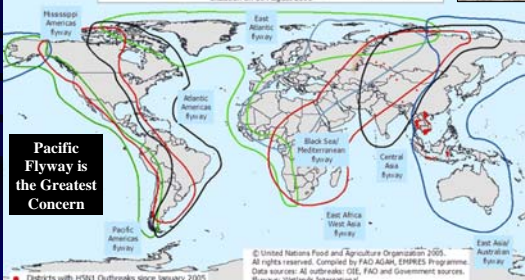
•#1 Poultry Producer in World
 •\$30 Billion Industry
 •5 Billion lbs: Broiler Chickens
 •90 Billion Eggs



The Reservoir Migratory Birds



HSN1 outbreaks in 2005 and major flyways of migratory birds
 Situation on 30 August 2005



Spill-over Reservoirs

Pigs, Cats, and Others

Pigs:

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

H3N2 ↔ H5N1




Cats:

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

Mice, Ferrets:

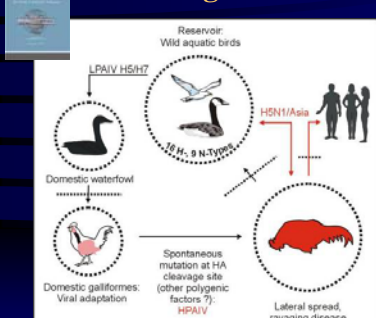
- Have been infected with H5N1 in Lab

(documented causing systemic infections)

Future Directions

Emergence of HPAI H5:N?



Reservoir: Wild aquatic birds

LPAIV H5N7

Domestic waterfowl

Domestic galliforms: Viral adaptation

Spontaneous mutation at HA cleavage site (other polygenic factors ?): HPAIV

Lateral spread, ravaging disease

H5N1/Asia

Bird Import Ban: H5N1 Infected Countries

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



Surveillance of HPAI

National Wildlife
Health Center
Madison, WI

<http://www.nwhc.usgs.gov/>

Partnered 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