

Public Health Impact of Avian Influenza

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Outline

- **Background on influenza**
- **Impact of influenza**
- **Influenza A viruses**
- **Pandemics**
- **Avian influenza A viruses**
- **Human infections with avian influenza A viruses since 1997**
- **H5N1 Asia 2004**

Background: Human Influenza

Acute febrile respiratory illness

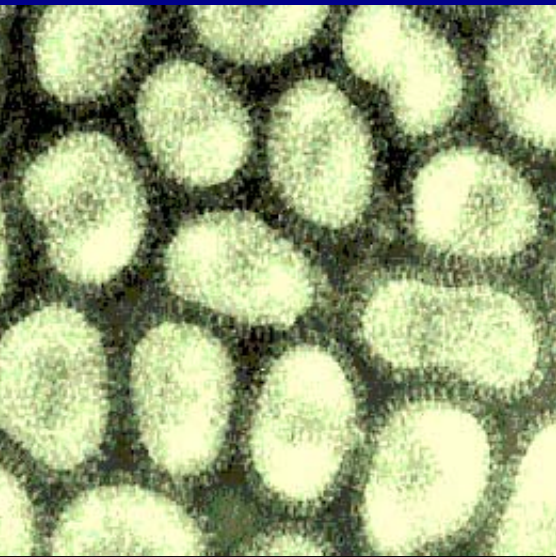
- Symptoms, signs may differ by age

Etiology: Infection with human influenza viruses (infect upper respiratory tract epithelial cells)

- 2 major surface glycoproteins
 - Hemagglutinin, Neuraminidase
- 8 gene segments code for 10 proteins

Types A and B viruses cause substantial illness and death among humans

Key Influenza Viral Features



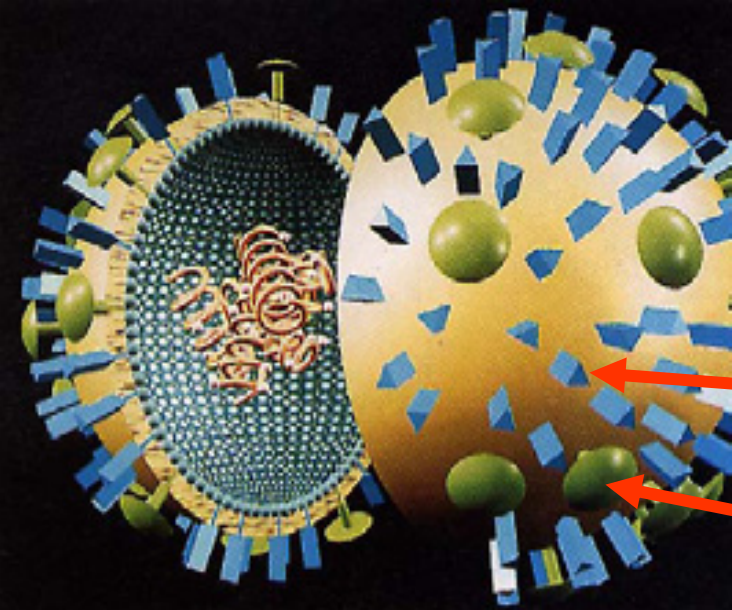
➤ Surface proteins (major antigens)

• Hemagglutinin (HA)

- Site of attachment to host cells
- Antibody to HA is protective

• Neuraminidase (NA)

- Helps to release virions from cells
- Antibody to NA can help modify disease severity



HA

NA

Impact of Influenza

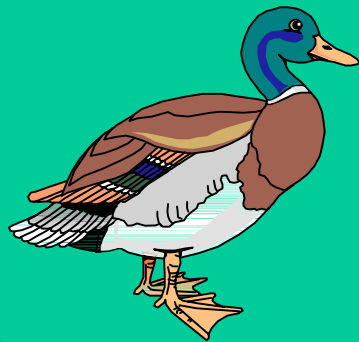
- **Seasonal epidemics in temperate regions**
 - U.S., Canada, Europe, Russia, China, Japan, Australia, Brazil, Argentina
- **Year-round activity in tropical climates**
 - Equatorial Africa, Southeast Asia
- **U.S. impact**
 - Average of >200,000 influenza-related hospitalizations/year
 - Average of >36,000 influenza-related deaths/year
- **3 global pandemics in the 20th century**

Influenza A Viruses

- **Subtypes based on surface glycoproteins**
 - Hemagglutinin (HA) and Neuraminidase (NA)
 - Current human influenza A virus subtypes:
 - H1 (H1N1, H1N2)
 - H3 (H3N2)
- **Cause epidemics and pandemics**
- **Infect multiple species**
 - Humans
 - Birds (wild birds, domestic poultry)
 - Other animals: pigs, horses, dogs, marine mammals (seals, whales)

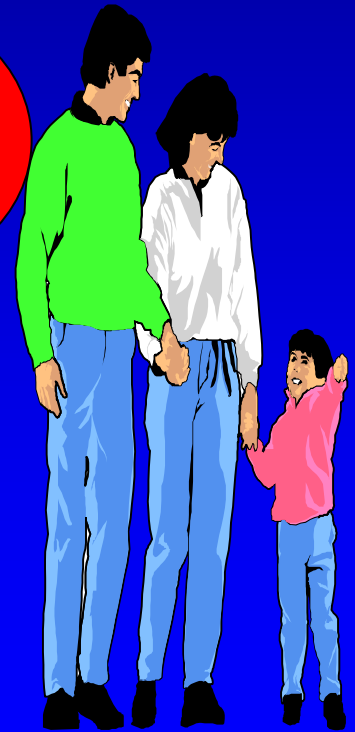
Natural Reservoir for New Human Influenza A Virus Subtypes: Waterfowl (Aquatic Ducks)

Avian Influenza
A Viruses
H1 - H15
N1 - N9



Human Influenza
A Viruses

H1 - H3



Influenza A viruses and Antigenic “drift”

Antigenic “drift”: Point mutations in the hemagglutinin gene cause minor antigenic changes to HA

- Continuous process
- Immunity against one strain may be limited
- Vaccine strains must be updated each year
 - 6-8 month process (85 million trivalent doses U.S.)
 - Targeted at high-risk (inactivated); healthy (LAIV)

➤ **Antigenic “drift” causes seasonal epidemics**

Influenza A viruses and Antigenic “shift”

Antigenic “shift”: Emergence of a new human influenza

A virus subtype (**new HA subtype ± NA**) through:

- Genetic reassortment (human and animal viruses)
- Direct animal (poultry) to human transmission

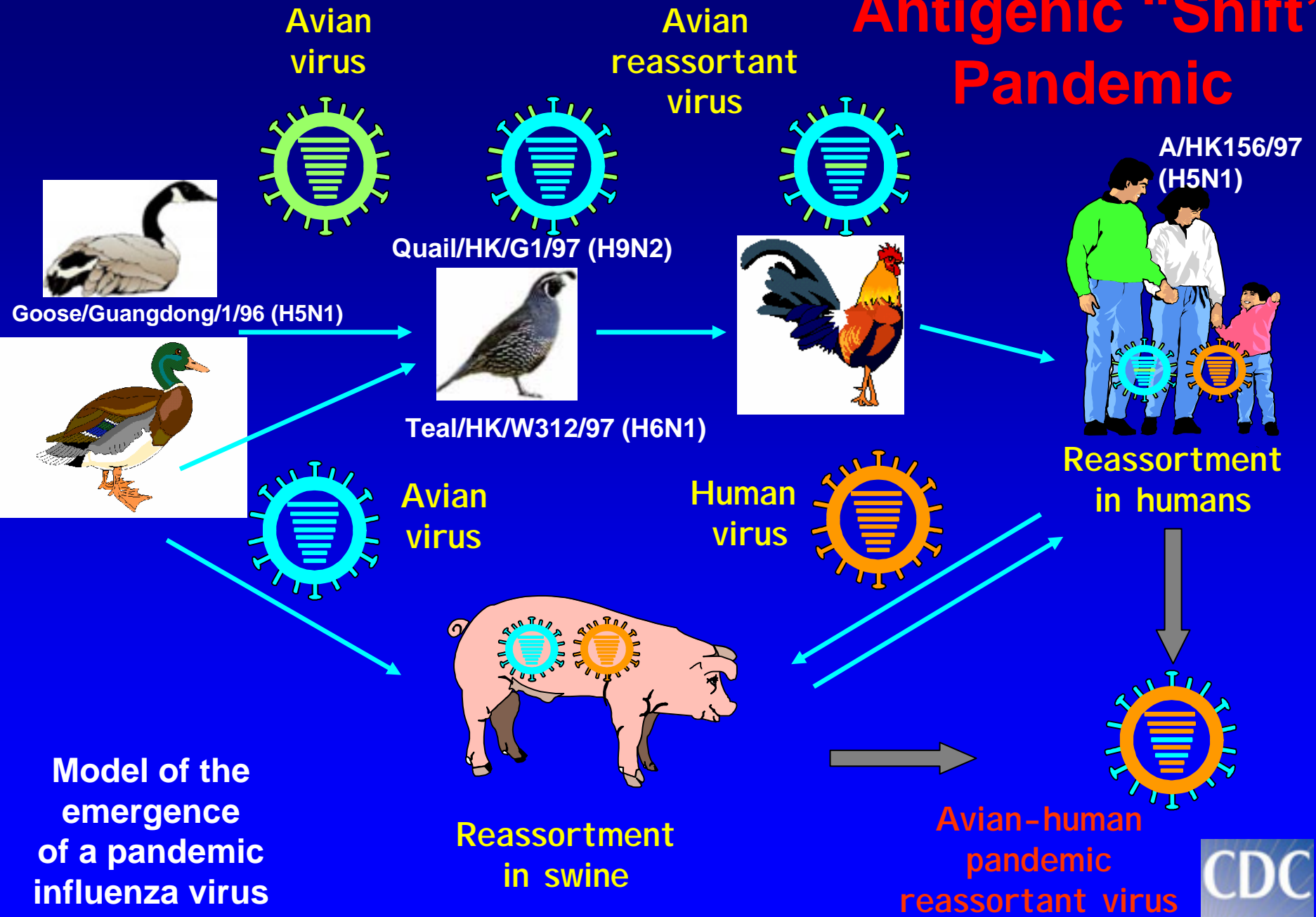
Because there is little or no immunity to a novel virus, a pandemic can occur if:

- Efficient and **sustained** virus transmission occurs among humans (sustained person-to-person spread)

A pandemic can result in:

- **Widespread morbidity and mortality worldwide**
- **High proportion of deaths among young adults**

Antigenic "Shift" Pandemic



Estimated Impact of Influenza Pandemics

1918-19 Spanish Flu (H1N1)

- 20-50 million deaths worldwide
- >500,000 U.S. deaths

1957-58 Asian Flu (H2N2)

- 70,000 U.S. deaths
 - *HA, NA, PB1 = Avian*

1968-69 Hong Kong Flu (H3N2)

- 34,000 U.S. deaths
 - *HA, PB1 = Avian*

Estimated Impact of a Future Influenza Pandemic in the U.S.

Deaths: 89,000 - 207,000

Hospitalizations: 314,000 - 734,000

Outpatient visits: 18 - 42 million

Additional illnesses: 20 - 47 million

Economic impact: \$71.3 - 166.5 billion

Population affected: 15-35%
(U.S. population: 290 million)



Avian Influenza A Viruses

- **Infect respiratory and gastrointestinal tracts of birds**
 - Usually do not cause disease in wild waterfowl
 - Genetic re-assortment occurs frequently
 - Can cause morbidity and mortality in domestic poultry
- **Avian influenza A viruses are shed in the respiratory tract and in feces**
 - Can survive at low temperatures and low humidity for days to weeks
 - Can survive in water
 - Can survive on surfaces
 - Disinfection of the environment is needed

Avian Influenza A Viruses

- **Low Pathogenic Avian Influenza viruses**
 - May not cause any illness in wild birds
 - Associated with mild illness in domestic poultry
 - Can evolve into highly pathogenic viruses
 - Associated with poultry outbreaks worldwide
- **Highly Pathogenic Avian Influenza viruses (HPAI)**
 - May not cause illness in wild birds
 - High mortality in domestic poultry
 - Subtypes: H5, H7
 - Molecular and pathogenicity criteria for determining HPAI

Avian Influenza A Viruses

Criteria for High Pathogenicity

Any one of the following:

- **Any avian influenza A virus that is lethal for four-week old chickens**
 - 6, 7 or 8 of 8 four-week-old chickens within 10 days following IV inoculation with 0.2ml of 1:10 dilution of infectious allantoic fluid.
- **Any H5 or H7 virus that has a multi-basic amino acid sequence at the hemagglutinin cleavage site compatible with HPAI.**
- Any non H5 or H7 that kills 1-5 of 8 inoculated chickens and grows in cell culture without trypsin

Fulfillment of one or more of criteria would categorize the virus as an HPAI virus.

United States Animal Health Association, 1994.



Human infections with HPAI

Confirmed human infections with HPAI: associated with poultry outbreaks:

- **H5N1 (severe respiratory disease)**
 - 1997 Hong Kong (18 cases, 6 deaths)
 - Risk factor: visiting live poultry market
 - 2003 Hong Kong (2 cases, 1 death)
 - 2004 Vietnam, Thailand (44 cases, 32 deaths)
- **H7N7 (mild illness, conjunctivitis)**
 - 2003 Netherlands (89 cases, 1 death)
 - Most cases were poultry workers
- **H7N3 (mild illness, conjunctivitis)**
 - 2004 Canada (2 cases, 0 deaths)

Human infections with Low Pathogenic Avian Influenza A Viruses

Confirmed human infection with low pathogenic avian influenza A viruses:

- **H9N2** (uncomplicated influenza-like illness)
 - 1998 China (6 cases, no deaths)
 - 1999 Hong Kong (2 cases, no deaths)
 - 2003 Hong Kong (1 case, no death)
- **H7N2**
 - 2002, 2003 U.S. (2 cases, no deaths)

North America

Human Infections with HPAI

- **H7N3 (British Columbia, Canada, Feb. - April 2004)**
 - Highly pathogenic H7N3 detected in chicken farms
 - **2 persons involved in H7N3 poultry outbreak culling activities (mild illness and conjunctivitis; conjunctivitis and headache)**
 - **H7N3 isolated**
 - **One worker was not wearing eye protection**
 - **One worker was wearing glasses**
 - **Oseltamivir treatment given, full recovery**
 - Highly pathogenic H7N3 detected in chicken farms



North America: Human Infections with Low Pathogenic Avian Influenza Viruses

➤ H7N2 (Virginia, U.S., 2002)

- 1 person involved in culling activities (influenza-like illness) - not hospitalized, full recovery
- H7N2 infection detected by serology in acute and convalescent specimens
- Low pathogenic H7N2 in chicken and turkey farms

➤ H7N2 (New York, U.S., 2003)

- H7N2 confirmed in adult male with respiratory illness
- H7N2 isolated, serologically confirmed in 2004
- Fully recovered, source unknown
- Investigation on-going



H5N1 in Asia, 2003-04*

Unprecedented highly pathogenic avian influenza A (H5N1) outbreak among poultry

- Farms, backyard flocks affected
- Millions of chickens, ducks died; >100 million culled

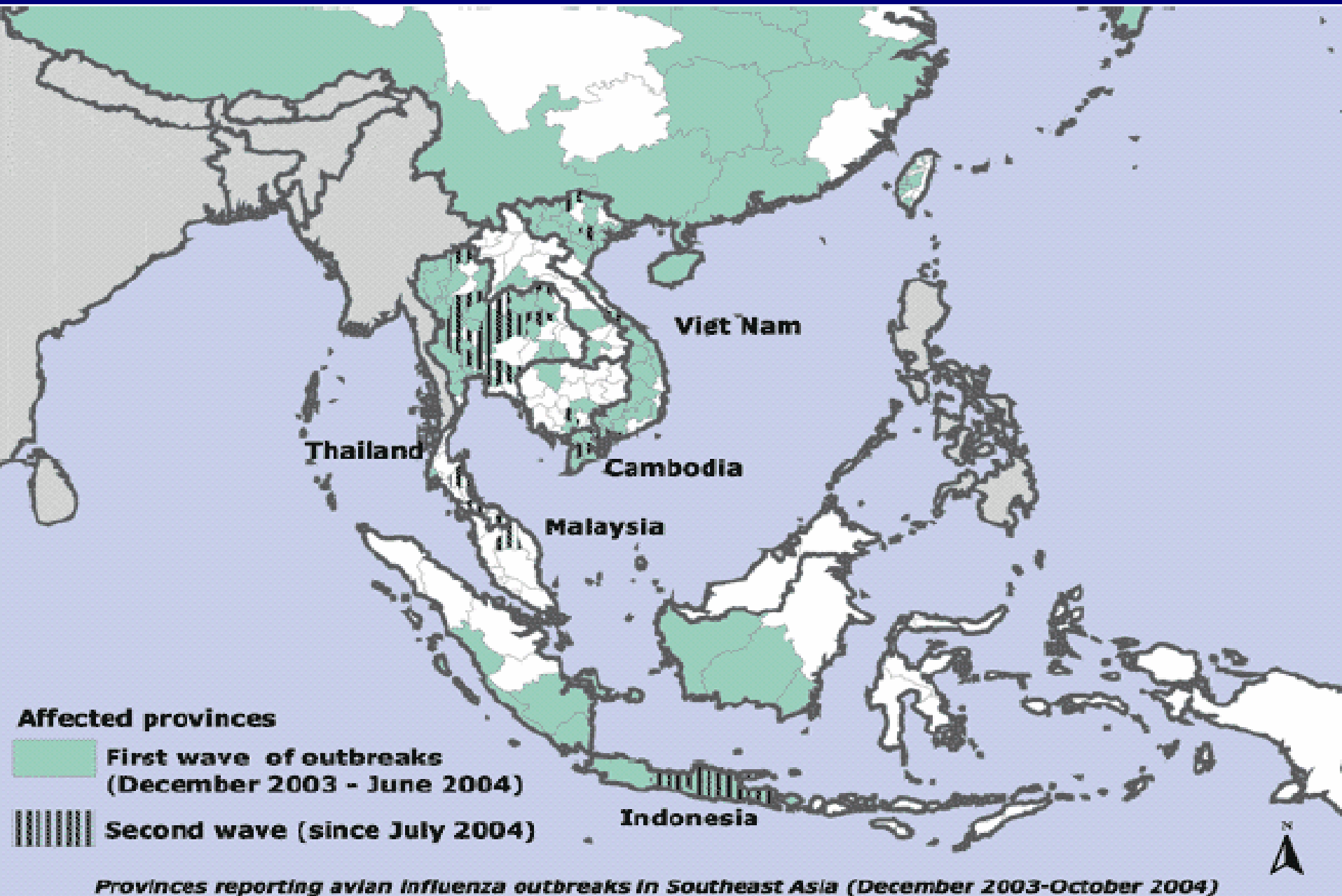
9 countries reported H5N1 poultry outbreaks

➤ 7 countries: control is unclear

- Vietnam, Thailand, Laos, Cambodia, Indonesia, Malaysia, China
- Widespread outbreaks



H5N1 Poultry Outbreaks, Asia 2003-04



Source: U.N. Food and Agricultural Organization

Human H5N1 cases 2004*

- **44 confirmed human H5N1 cases, 32 deaths**
 - Thailand: 17 confirmed cases, 12 deaths
 - Vietnam: 27 confirmed cases, 20 deaths
 - Overall case fatality: 73%
 - Most cases had contact with sick or dead poultry
 - Majority of cases: children, young adults
 - Viruses resistant to antiviral drugs amantadine, rimantadine (susceptible to oseltamivir)
 - No evidence of genetic reassortment
 - No evidence of sustained human-to-human transmission
 - No currently available human H5N1 vaccine



*As of November 2, 2004. Most recent case reported Oct. 25th

H5N1 Issues

- **Viruses circulating widely among poultry in several Asian countries**
 - **Cannot be eradicated anytime soon**
 - **Activity may increase during cooler months**
 - **Viruses continue to evolve**
- **Can infect cats**
- **Has infected tigers, leopards (Thailand)**
- **Has infected pigs (China)**
- **Ducks may be infected without illness**

Public Health Issues for Poultry Workers: U.S.

- Both HPAI and low pathogenic avian influenza A viruses can spread from poultry to humans
- Infection is uncommon, but preventive measures are critical
 - Personal protective equipment
 - Decontamination
 - Antiviral medications
- **Major concern: Co-infection with HPAI virus and human influenza A virus, leading to genetic reassortment and a virus more easily transmitted among people**

Thank you for your attention

➤ **Questions?**