



Critical Dialogues on Avian Influenza

Bringing Together the Public Health,
Animal Health, and Wildlife Management
Communities

Critical Dialogues on Avian Influenza:

- We will examine the interconnection and interdependency of factors and sectors involved in Avian Influenza:
 - Domestic animal health
 - Wildlife health
 - Human health
 - International commerce



Critical Dialogues on Avian Influenza:

- What is Avian Influenza?
- Why are we so concerned now?
- What is happening in Asia - Europe?
- What if it were to come to the US?
 - Animal health impact?
 - Human health impact?
 - Wildlife health impact?



Critical Dialogues on Avian Influenza:

- What is needed to prevent outbreaks of Avian Influenza?
 - In poultry?
 - In people?
 - In wildlife?
- How can we provide a coordinated national and global effort to deal with Avian Influenza?
- What is in the future regarding Avian Influenza?



Our goal:

- To highlight the multi-dimensional aspects of avian influenza
- Discuss the potential impact on human and animal health as well as in trade of poultry products
- Contrast the events in Asia with the potential of an epizootic or a pandemic of avian influenza in the US
- Emphasize the need to maintain a coordinated approach among the different sectors in dealing with all zoonotic diseases

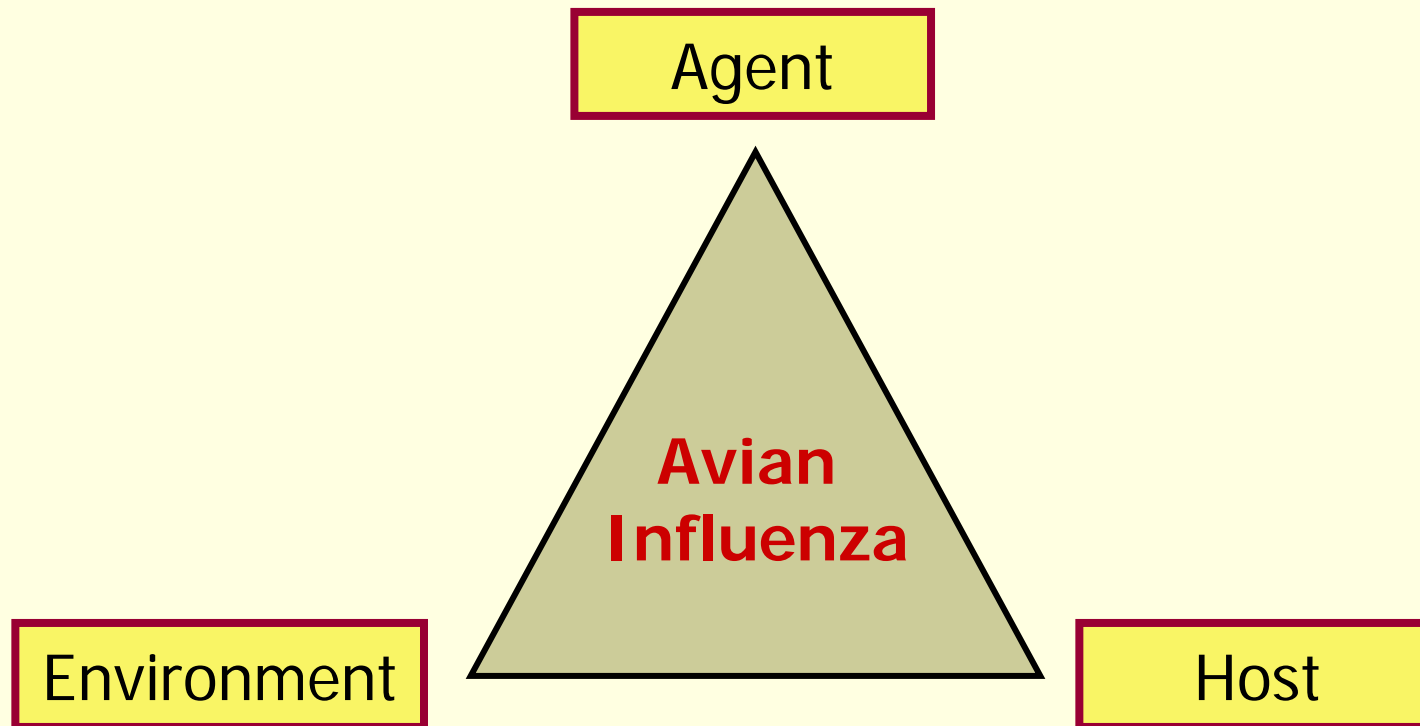




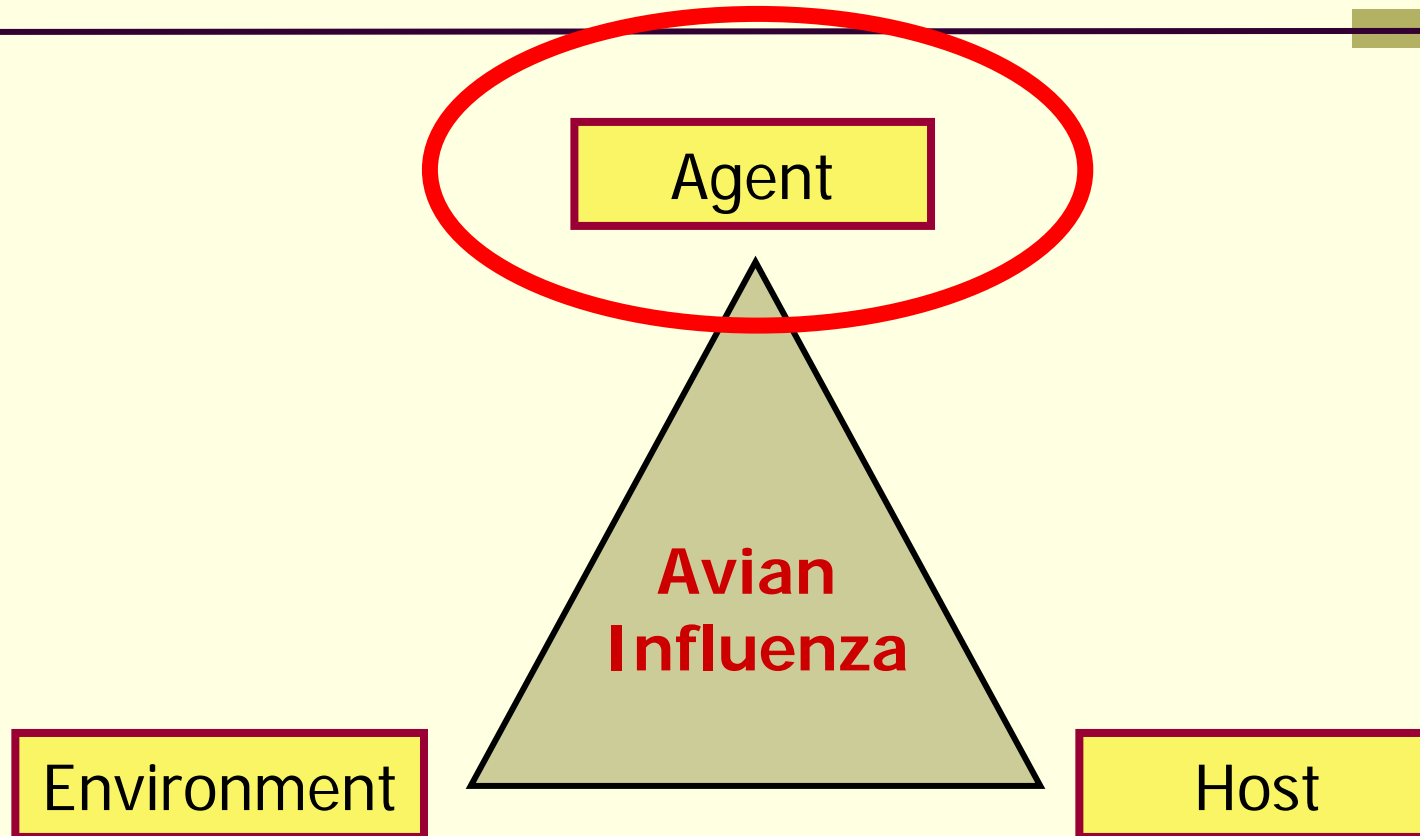
What is Avian Influenza?



Factors in the Cause of Avian Influenza



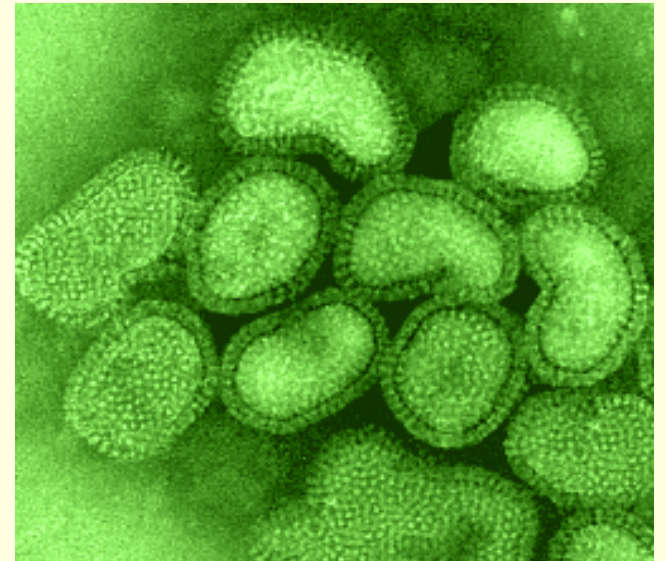
Factors in the Cause of Avian Influenza



Avian Influenza Virus

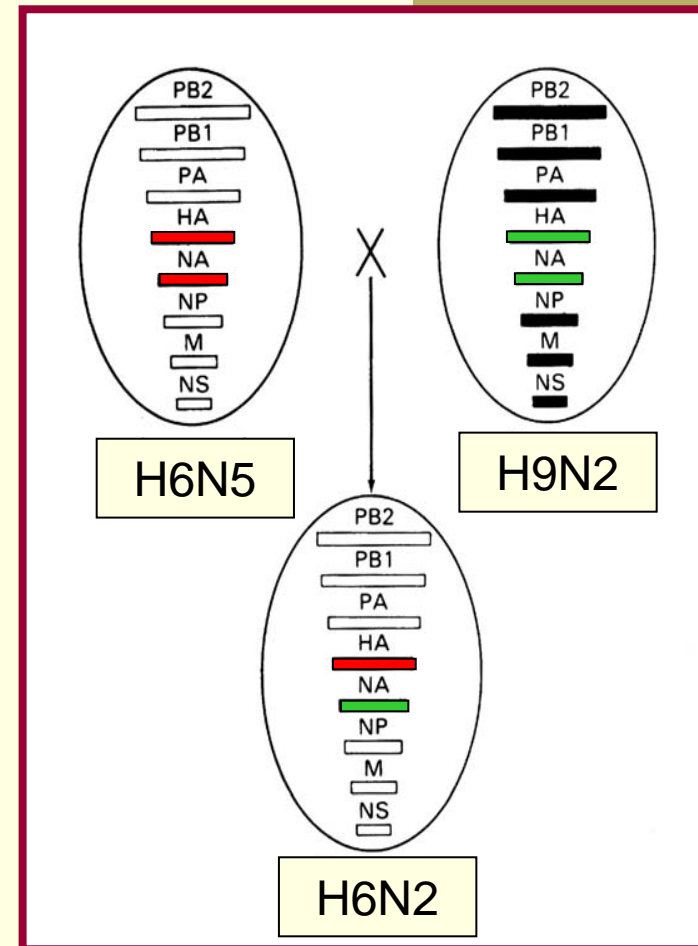
Type A - Orthomyxoviruses

- Two main surface proteins (antigens):
 - Hemagglutinin (H): 1 to 16
 - Neuraminidase (N): 1 to 9
- 144 possible H & N subtype combinations



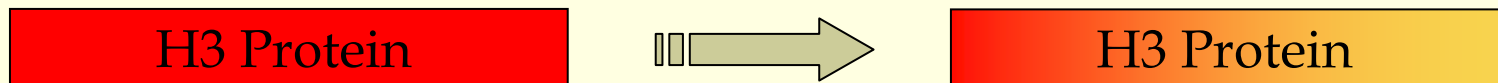
Antigenic Shift of Influenza Viruses

- Abrupt change in the H-N makeup of virus
- Occurs due to the reassortment of viral genes
- Occurs when a cell is infected with two virus subtypes



Antigenic Drift of Influenza Viruses

- Small changes in the surface proteins H or N
- Caused by errors in RNA polymerase replication
- Generates quasispecies (subtype families)
- New variants which encounter the least resistance become established



Drift over time could take months to years



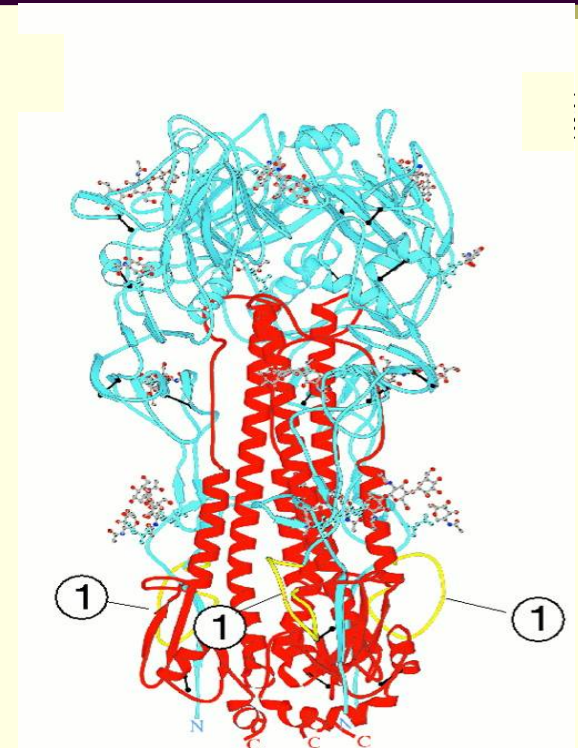
Two Types of Avian Influenza Virus

- Low Pathogenic Avian Influenza – LPAI
 - The great majority of AI viruses
 - Enteric infections only
 - Minor disease consequences
- Highly Pathogenic Avian Influenza – HPAI
 - Mostly H5 and H7 subtypes
 - Not all H5 or H7 are likely to be HPAI
 - Systemic infections
 - Major disease consequences



Change from a LPAI to a HPAI (H5 or H7 Subtypes)

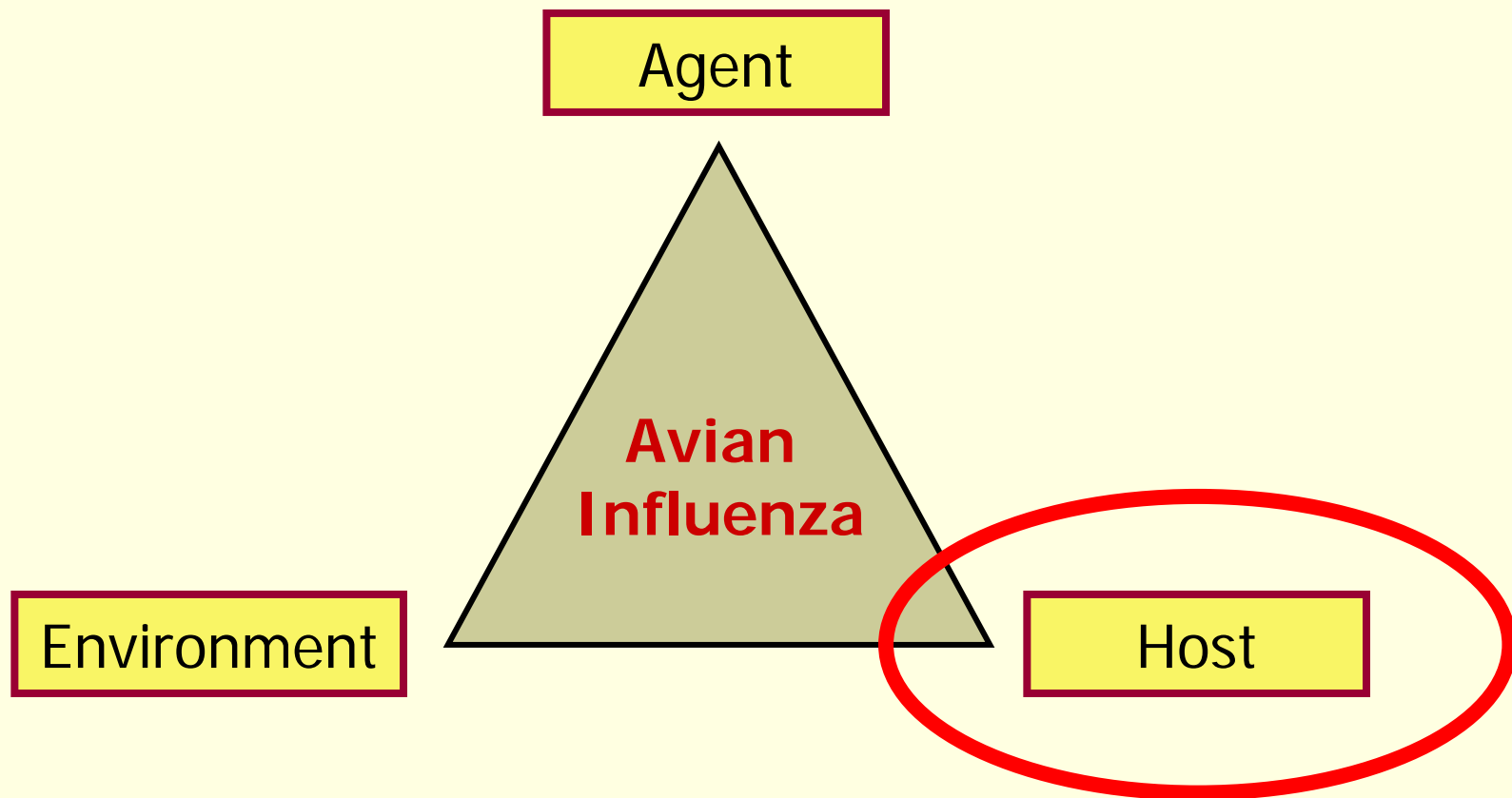
- Hemagglutinin of AI needs to be cleaved by an enteric protease for the virus to grow in intestinal cells (LPAI)
- If hemagglutinin cleavage site has multiple basic amino acids, then AI virus can grow in all tissues of the body (HPAI)
 - All tissues contain proteases












Annual Review of
Biochemistry
Vol. 69: 531-569 (2000)



Factors in the Cause of Avian Influenza



Natural Reservoir of all Subtypes of Avian Influenza Viruses

Frequent	Common	Occasional	Rare or Unknown
<p>Waterfowl</p> 	<p>Gulls and terns</p> 	<p>Marine birds</p> 	<p>Cranes</p> 
<p>Shorebirds</p> 		<p>Upland gamebirds</p> 	<p>Songbirds</p> 
		<p>Ratites</p> 	<p>Raptors</p> 

Source: USGS Field Manual of Wildlife Diseases



Frequent Natural Reservoir of all Subtypes of Avian Influenza Viruses

Waterfowl



4 families with 48 genera and 161 species
(including Ducks, Geese, Swans and Screamers)

Shorebirds

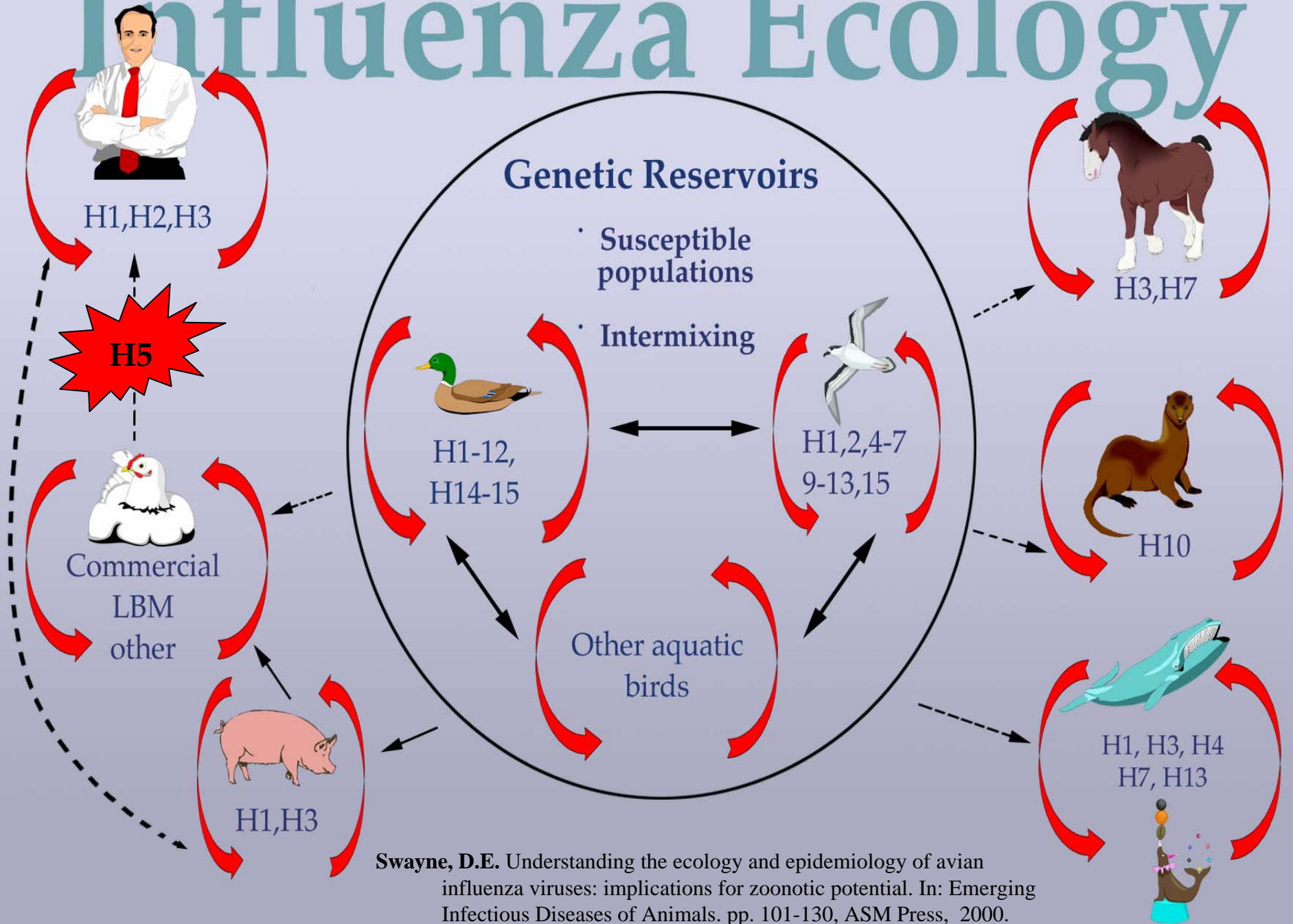


14 families with >60 genera and >200 species
(including killdeer, plovers and lapwings)

Mostly asymptomatic infections; virus excreted in feces



Influenza Ecology



Swayne, D.E. Understanding the ecology and epidemiology of avian influenza viruses: implications for zoonotic potential. In: Emerging Infectious Diseases of Animals. pp. 101-130, ASM Press, 2000.

Common Domestic Hosts for Avian Influenza

- Chickens



- Turkeys



Clinical Manifestations of Avian Influenza in Poultry

- Vary greatly depending on age, species, virus virulence, other infections, and production management
- Low Path:
 - Depression
 - Respiratory signs
 - Lower productivity
 - “Sleepy” chicks



From Dr. David Swayne



Highly Pathogenic Avian Influenza (Fowl Plague)

- Sudden onset high mortality
- Depression, +/- Nervous signs
- Face edema & hemorrhagic lesions



Previous Epizootics of HPAI in Domestic Poultry

- 1959-Scotland, H5N1
- 1961-S. Africa, H5N3
- 1963-England, H7N3
- 1966-Canada, H5N9
- 1975-Australia, H7N7
- 1979-England, H7N7
- 1983-84 - USA, H5N2
- 1983-Ireland, H5N8
- 1985-Australia, H7N7
- 1991-England, H5N1
- 1992-Australia, H7N3
- 1994-Australia, H7N3
- 1994-95-Mexico, H5N2
- 1995, 2001 & 2004 -Pakistan, H7N3
- 1997-Australia, H7N4
- 1997-Italy, H5N2
- 1996-2005 - Asia, H5N1
(Largest epizootic in 50 yrs)
- 1999-2000 - Italy, H7N1
- 2002 - Chile, H7N3
- 2003 - Netherlands, H7N7
- 2004 - USA, H5N2
- 2004 - Canada, H7N3
- 2004 - S. Africa, H5N2
- 2005 - N. Korea, H7N?

Red represents shift from LPAI to HPAI



Newer Mammalian Hosts for Avian Influenza

■ Cats (& Civets ?)



■ Tigers & Leopards



Tigers and leopards (*Keawcharoen et al. 2004, Emerg Infect Dis*)

Domestic cats (*Kuiken et al. 2004 Science*)

Owsten banded palm civets (*ProMED, 2005*)



Humans: A New Host for Avian Influenza

- Hong Kong - 1997 (H5N1) – **First Case**
- The Netherlands - 2003 (H7N7)
- Canada - 2004 (H7N3)
- Asia (several countries) 2004- 2005 (H5N1)
- So far all cases are direct bird-to-human transmissions
- Current H5N1 has a high case fatality rate in sick patients (62 out of 121 died as of 24 Oct 2005)
 - How many are infected?
- H5N1 has caused a threat of a human influenza pandemic



New manifestations of Avian Influenza in Waterfowl



- Fatal infection in domestic ducks:
 - Mortality has been observed in natural and experimental infection
- Encephalitic fatal infection found in wild birds:
 - Bar-headed goose, great black-headed gull, brown-headed gull, ruddy shelduck, great cormorant

Sturm-Ramirez et al. 2002, J Virol.; Chen et al. 2005; Nature; Liu et al. 2005, Science



Drift of Asian H5N1 (1997-2005)

Duck Mortality in Experimental Infections

H5N1 Virus	Mortality (Dead/Inoculated)
<i>A/Whooper/Swan/Mongolia/244/05</i>	7/8
<i>A/Crow/Thailand/04</i>	8/8
<i>A/Egret/HK/757.2/02</i>	7/8
<i>A/Vietnam/1203/04</i>	7/8
<i>A/Prachinburi/6231/04</i>	3/8
<i>A/Ck/Korea/ES/03</i>	2/8
<i>A/Gs/Vietnam/113/01</i>	0/8
<i>A/Ck/HK/317.5/01</i>	0/8
<i>A/Dk/Anyang/ALV1/01</i>	0/8
<i>A/Env/HK/437-6/99</i>	0/8
<i>A/Ck/HK/220/97</i>	0/8

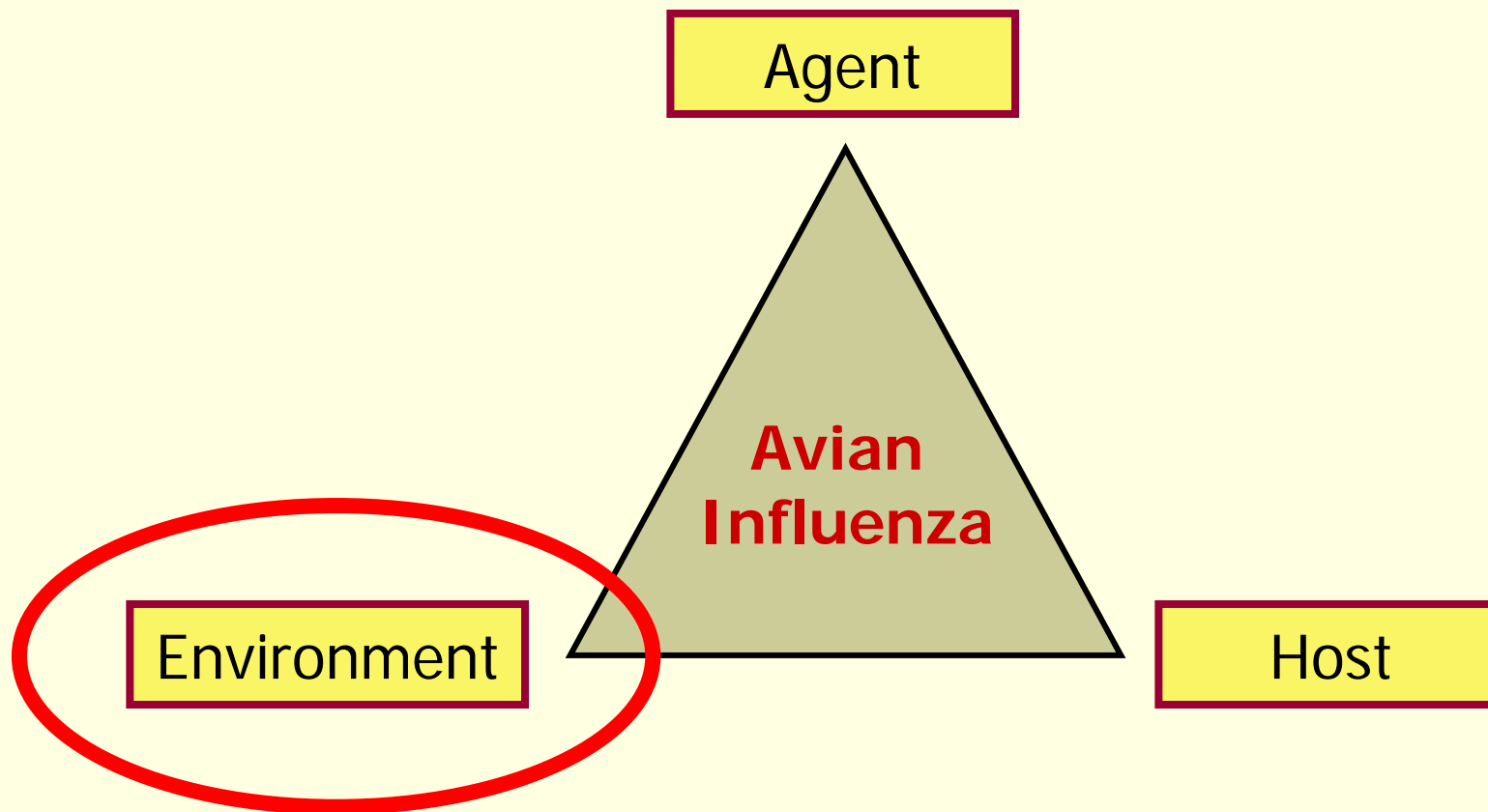


Avian Influenza: Immunity & Vaccination in Poultry

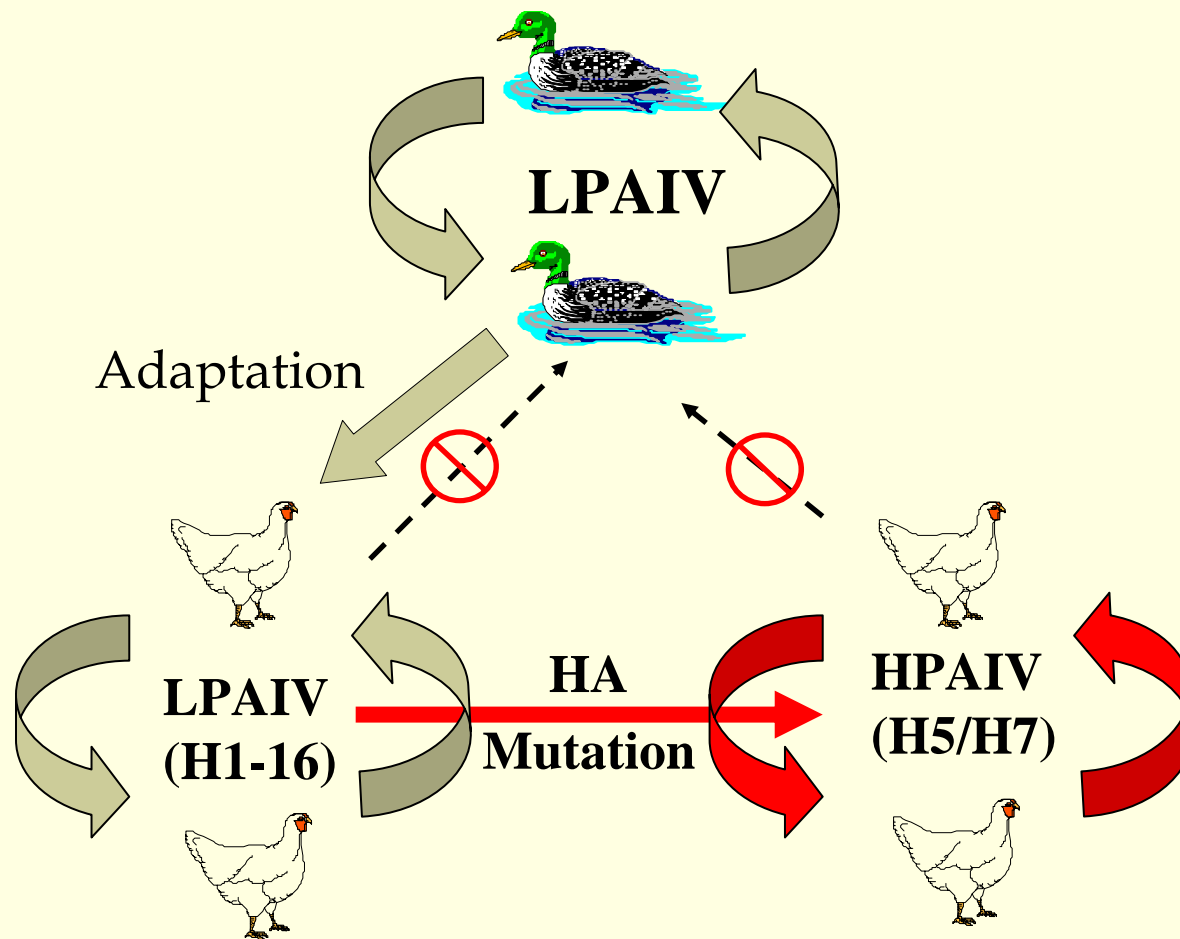
- Recovered infected birds develop immunity
- Vaccines need to be specific for each subtype
 - At least to the H-protein (H5, H7, etc)
- Types of vaccines:
 - Killed – whole virus
 - Live recombinant – containing only the H antigens
 - There is need of vaccines that allow differentiation between infected and vaccinated birds
- There is no current vaccination program in the US or in most of the world
 - The US has a short supply of emergency vaccine



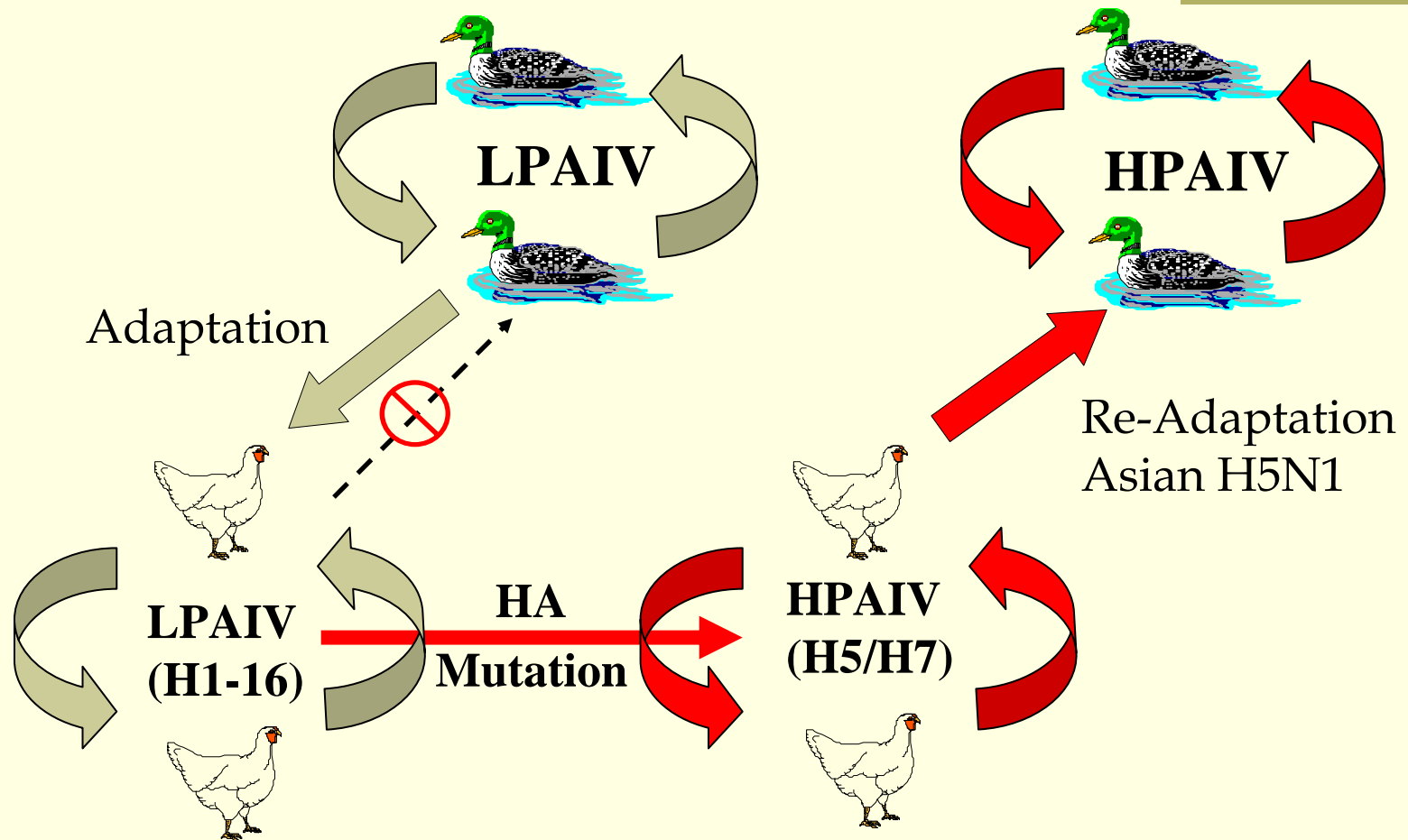
Factors in the Cause of Avian Influenza



Previously Known Ecology and Epidemiology



Latest Ecology and Epidemiology



Poultry Production Practices and Risk of Avian Influenza

LOW



Bio-barrier

HIGH



Other Current Avian Influenza Issues

- Mixing of species
 - Backyard production
 - Exotic animal parks
 - Live bird markets
- Changes in husbandry practices
 - Low technology poultry operations
 - Poor on-farm biosecurity practices
 - Back to nature farming



Other Current Avian Influenza Issues

- We are in the middle of the “Livestock Revolution”, a global trend of increased animal protein production and consumption
- Rapid rise in production and consumption of poultry products by 40% expected by 2020
 - Beef 24%, and Pork 31%
- Developing countries, using low technology production and marketing, will be generating 60% of meat and 52% of milk by 2020

Livestock to 2020: The Next Food Revolution, a joint IFPRI, FAO, ILRI study.



Other Current Avian Influenza Issues

- Weaknesses in animal and human health infrastructure:
 - Limited diagnostic capacity
 - Inadequate monitoring and surveillance
 - Insufficient research infrastructure and funding
- Lack of effective communication and cooperation between animal and public health sectors, and agricultural and wildlife sectors



Other Current Avian Influenza Issues

- Increased international travel (human & animal) and international trade
- Lack of appropriate laws and law enforcement
- Economic crises, political upheavals, wars and civil unrest which will exacerbate the impact of animal disease outbreaks



Other Current Avian Influenza Issues

- Societal knowledge and perceptions
 - Fears about infectious diseases
 - Lack of knowledge about food sources
 - Lack of knowledge and appreciation for the role of agriculture in the national economy
- Cultural traditions
 - i.e. Chinese “Year of the Rooster”



US Animal Health Actions

- Enhanced monitoring and surveillance of:
 - Commercial poultry
 - Live bird markets
 - Backyard operations
 - Wild birds

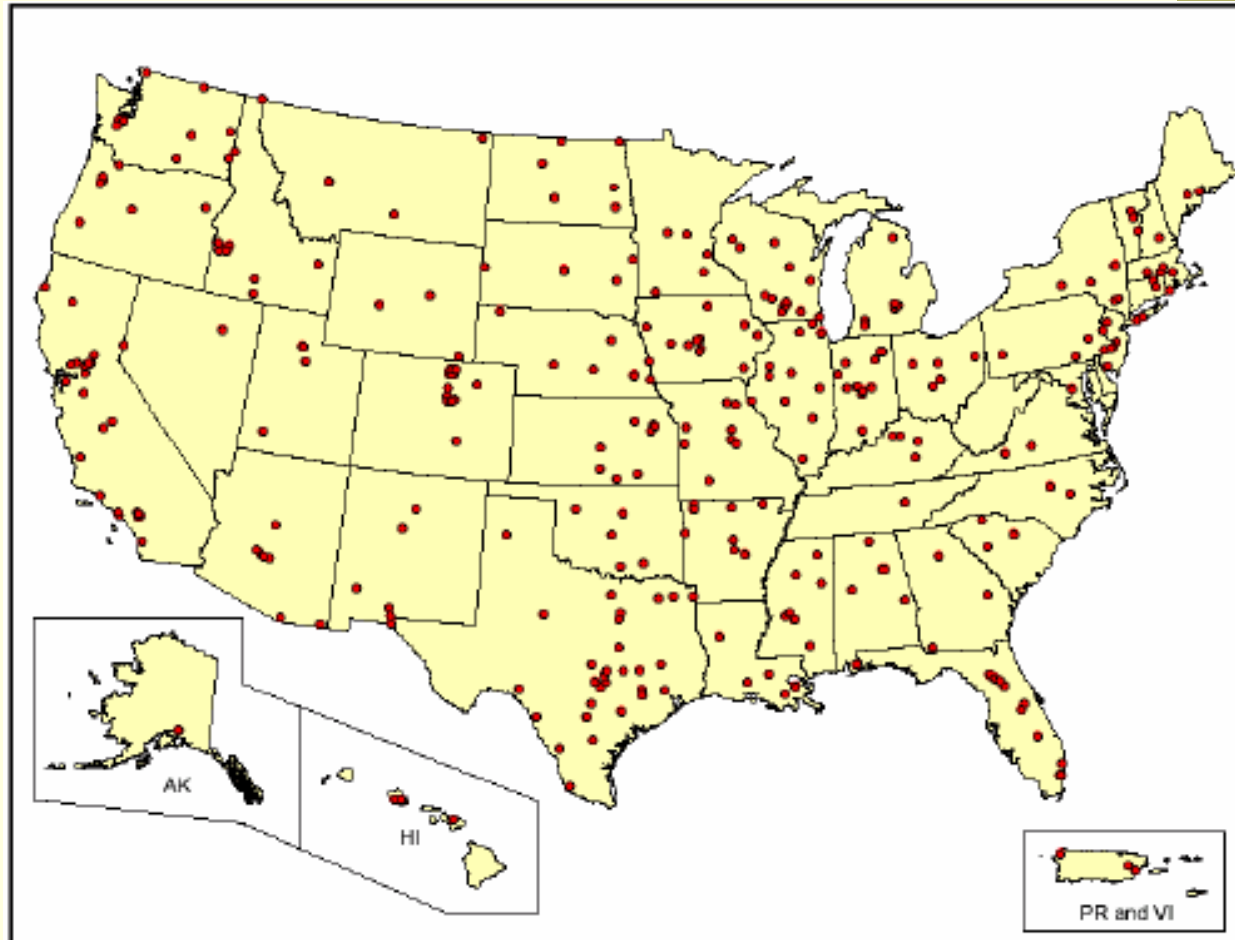


US Animal Health Actions

- Early detection and diagnosis of animal health events
 - Live bird market testing
 - In New York City: federal & state program with testing at Cornell University
 - Foreign Animal Disease Diagnosticians
 - National Animal Health Laboratory Network

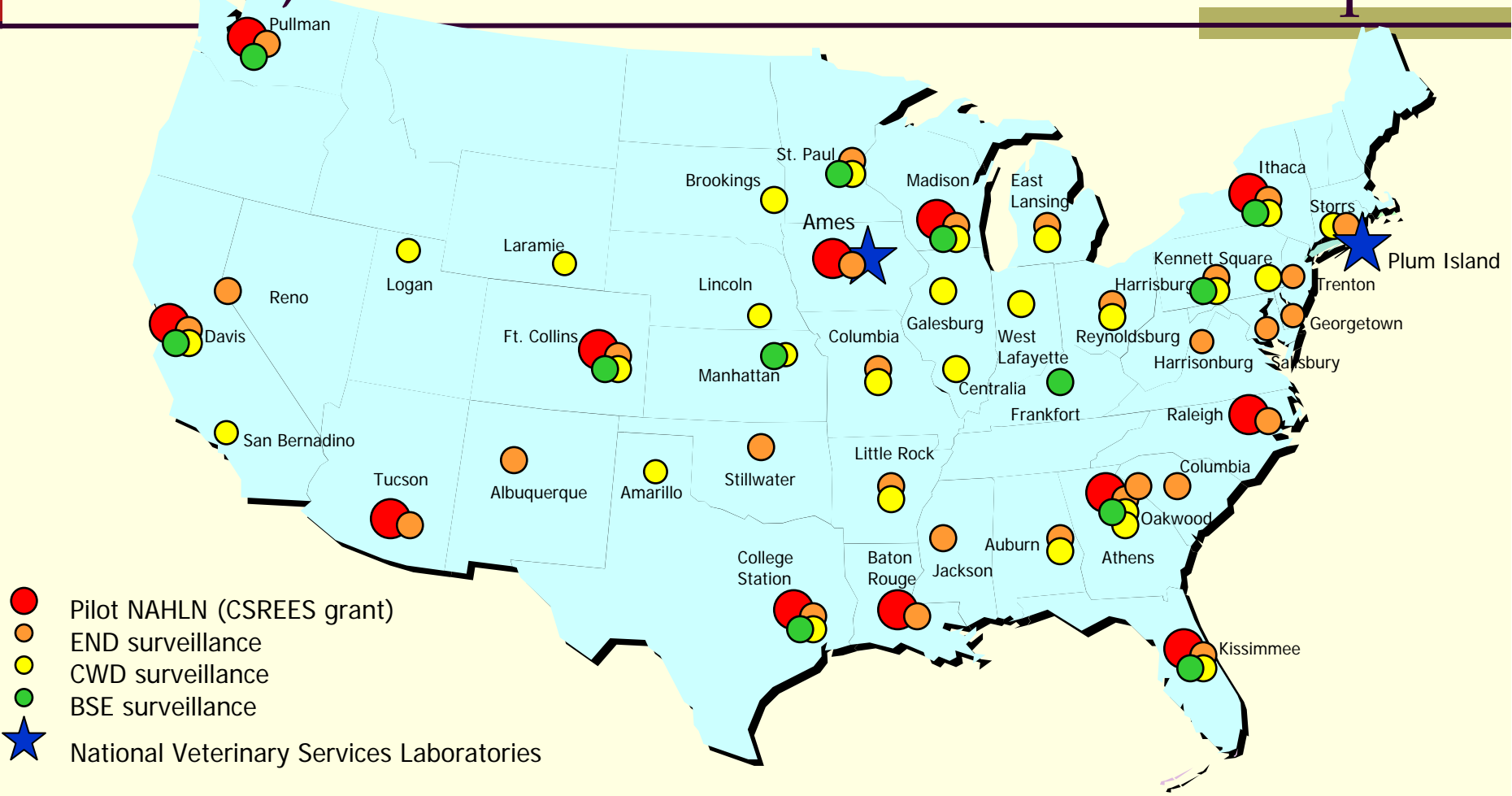


Foreign Animal Disease Diagnosticians State, Federal & Academic Partnership



National Animal Health Laboratory Network

State, Federal & Academic Partnership



Acknowledgements

Selected slides provided by

- Robert Heckert
- Joe Giambrone
- Fred Hoerr
- David Swayne



Questions

