Avian, Seasonal & Pandemic Influenza

Richard Kiang[1], Radina Soebiyanto[1,2]
[1]NASA/GSFC, Greenbelt, MD 20771
[2]USRA, Columbia, MD 21044

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Decision Support & Research Partners

- USDA Animal & Plant Health Inspection Service
- US Naval Medical Research Unit-2
- US DoD GEIS Central Hub
- US CDC Influenza Division
- US CDC Global Disease Detection Program
- Wetlands International Indonesia Programme
- Cobb Indonesia

Cobb*500*™

The worlds most efficient

The world's most efficient broiler has the lowest feed conversion, best growth rate and an ability to thrive on low density, less costly nutrition. These attributes combine to give the Cobb500™ the competitive advantage of the lowest cost per kilogram or pound of live-weight produced for the growing customer base worldwide.

The Cobb*500*™ has:

- Lowest cost of live weight produced
- Superior performance on lower cost feed rations
- Most feed efficient
- Excellent growth rate
- Best broiler uniformity for processing
- Competitive breeder

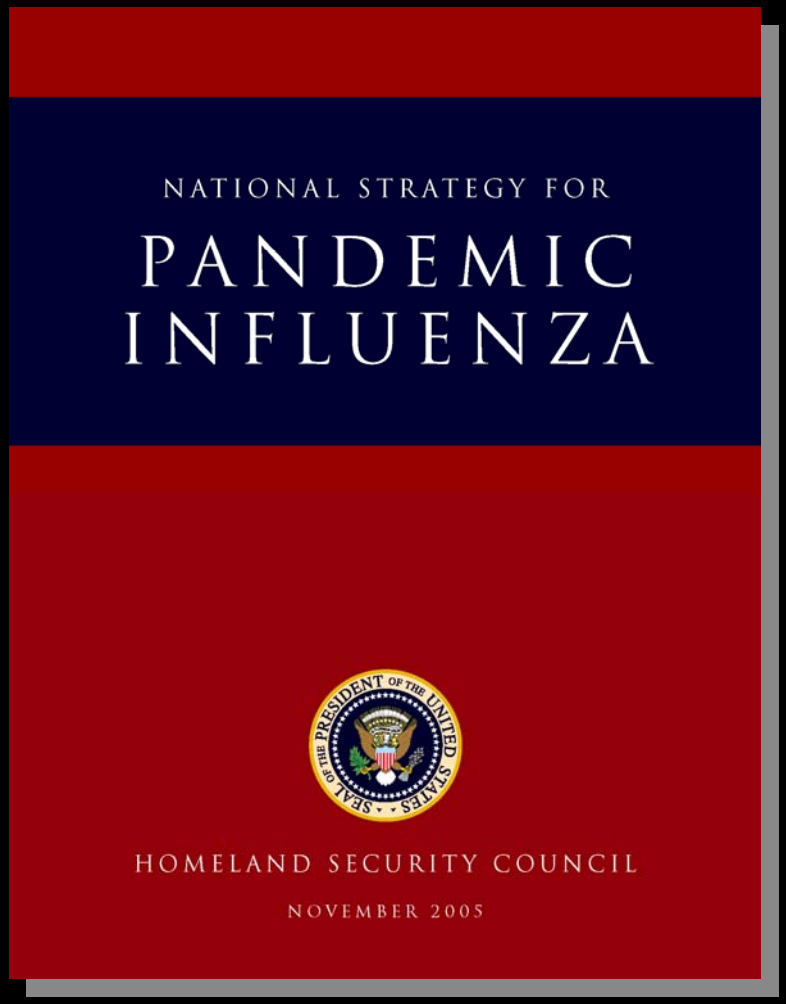
GOALS

- Reduce the economic loss of consumers and poultry industries
- Reduce human morbidity and mortality by limiting human infection
- Reduce the likelihood of forming pandemic strains due to co-infection in humans

OBJECTIVES

- Estimate the spatiotemporal risk for poultry outbreaks and for human infection
- Model on-farm and off-farm spread of H5N1 viruses
- Predict seasonal influenza transmission and provide pandemic early warning

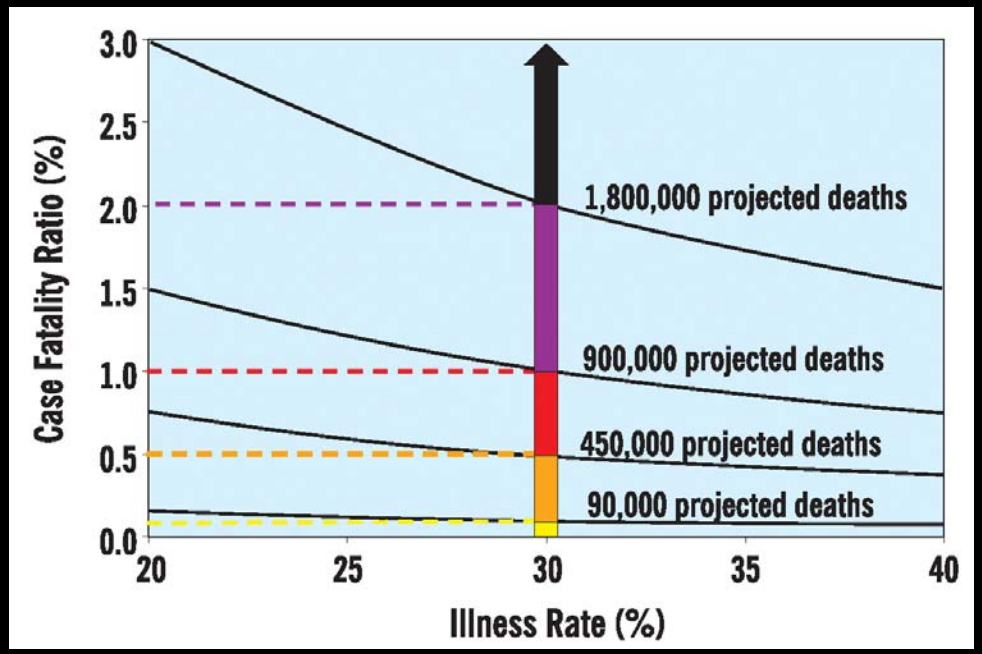
National Strategy for Pandemic Influenza

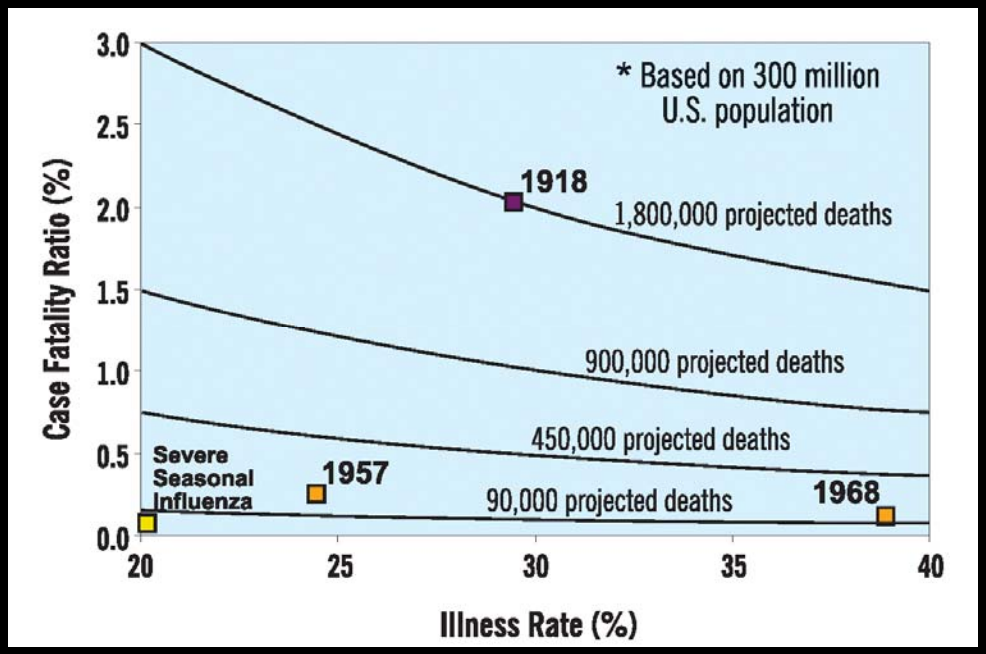


THREE PILLARS

- Preparedness & Communication
- Surveillance & Detection
- Response & Containment

Projected Deaths in US For Pandemics With Severity 1–5





Category	CFR
1	< 0.1 %
2	0.1 – 0.5 %
3	0.5 – 1.0 %
4	1.0 – 2.0 %
5	> 2.0 %

Pandemic	Deaths in US
1918 Spanish Flu	~ 500 K
1957 Asian Flu	70 K
1968 HK Flu	34 K

Source: USG Prepandemic Plannig Guidance

Project Capabilities That Can Be Used To Support End Users' Missions

	APHIS	Cobb Indo	NAMRU2	CDC
Spatiotemporal AI infection risks for poultry & humans	X	X	X	X
On- & Off-farm spread of HPAI viruses	X	X	X	X
Seasonal influenza & pandemic early warning			X	X

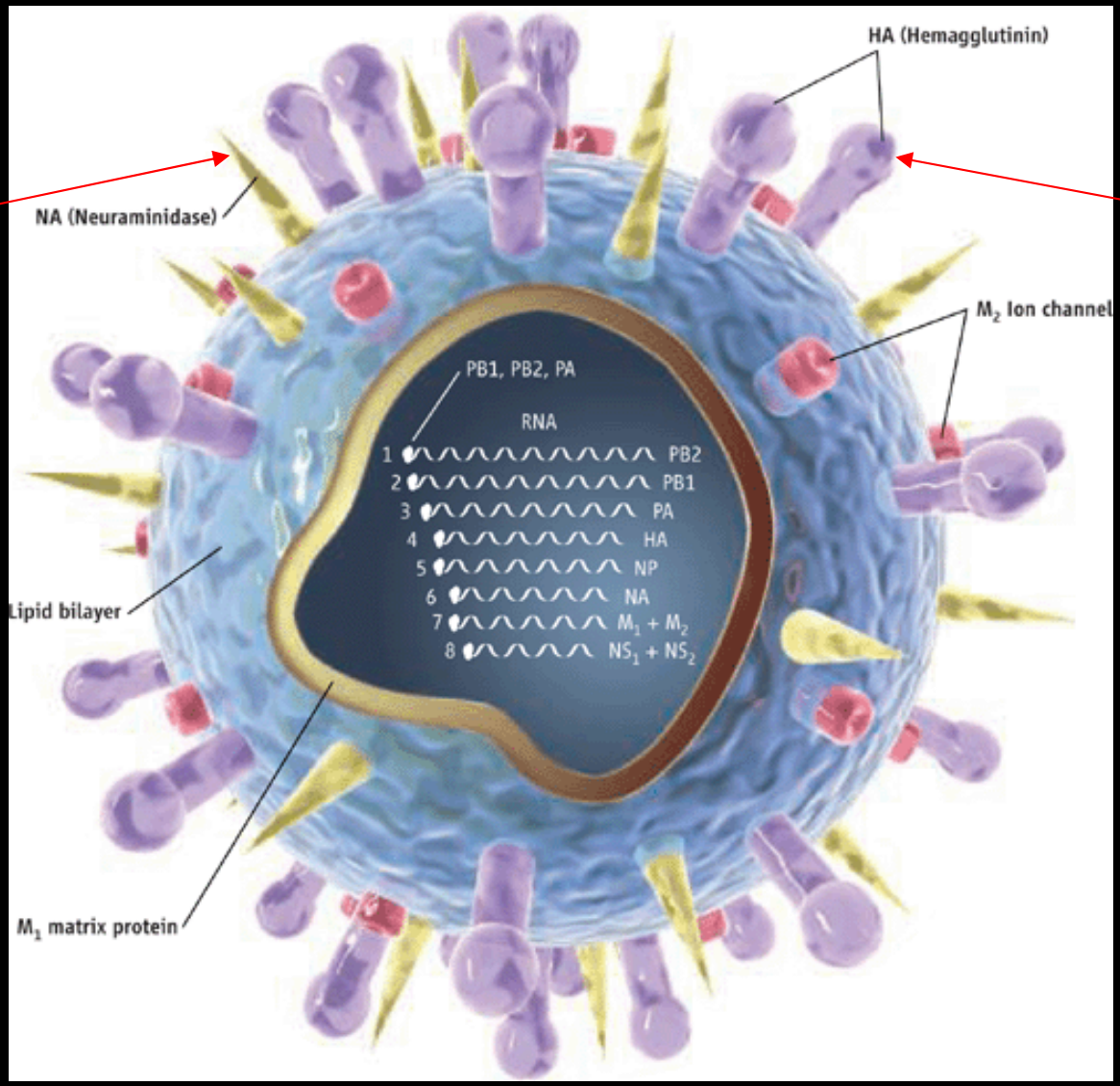
NA

HA

Neuraminidase

An enzyme for splitting mucoprotein in order to release progeny

9 types



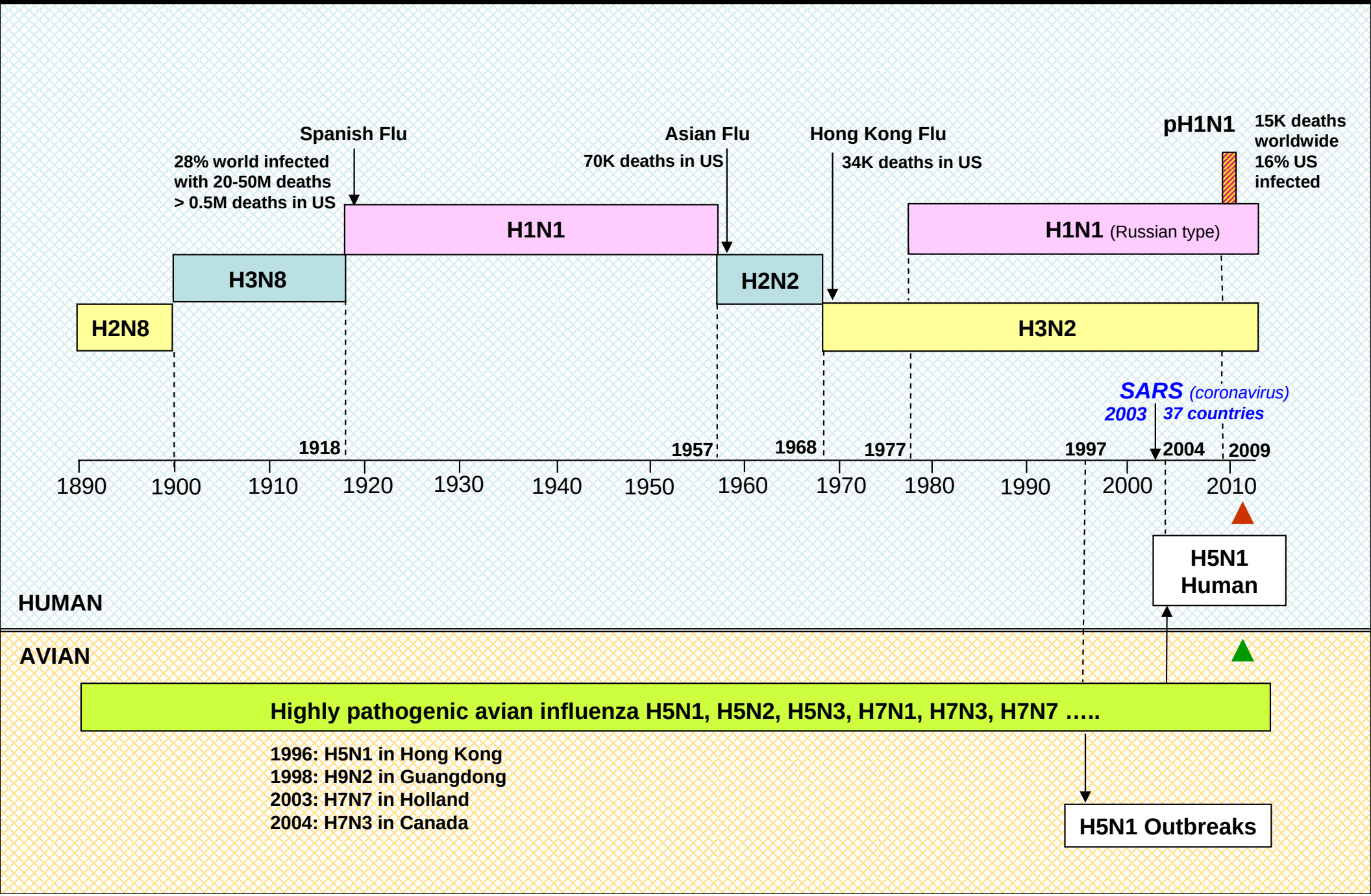
Hemaglutinin

A glycoprotein for binding to the host cell

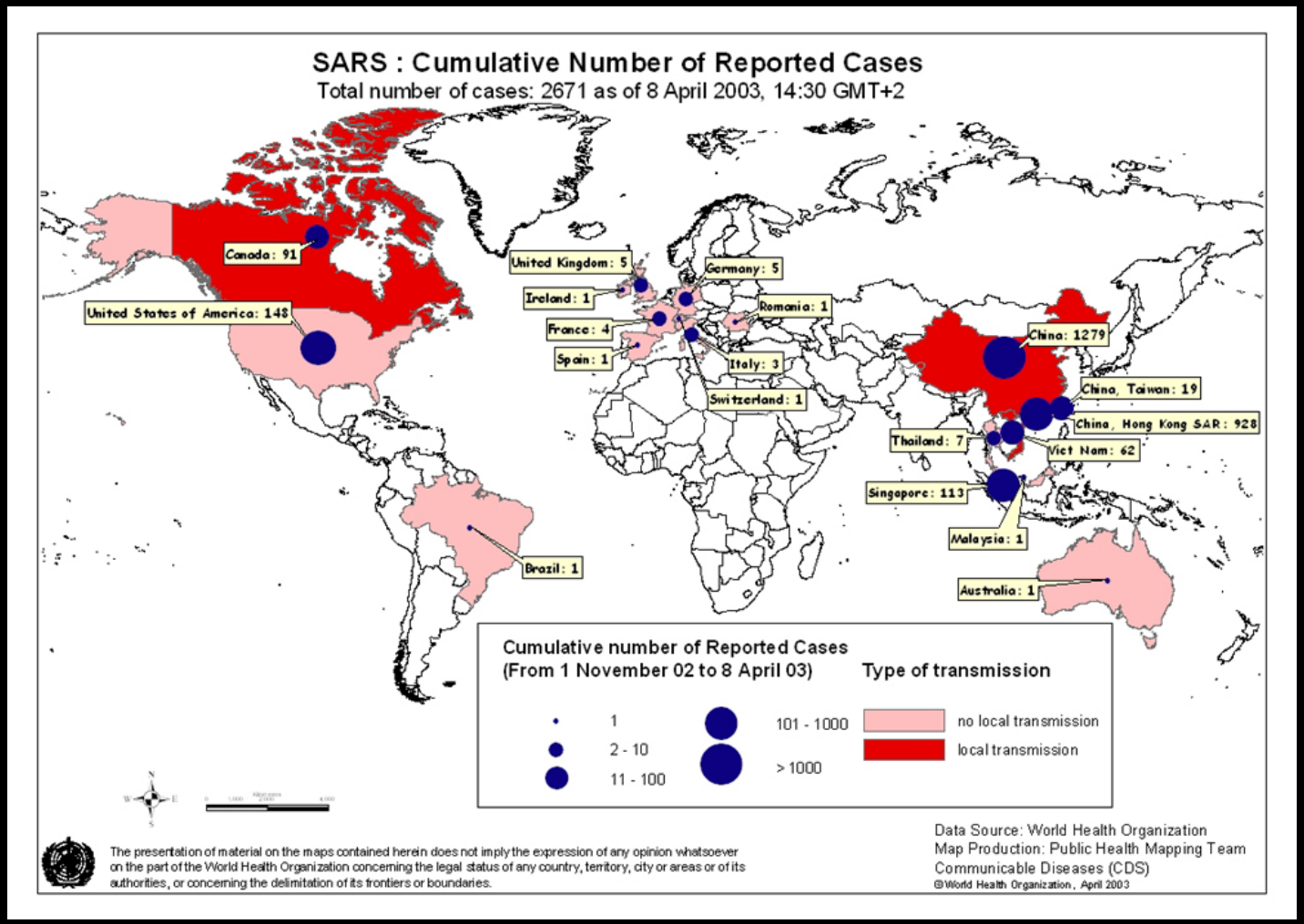
16 types

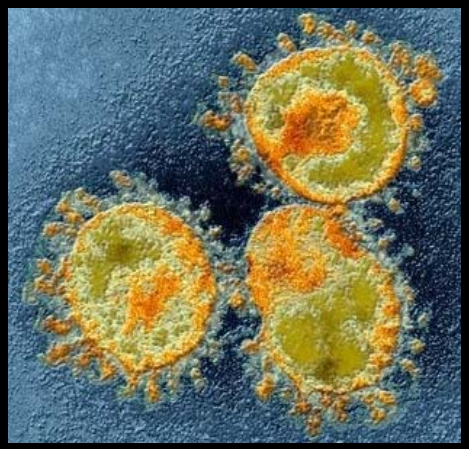
H1N1 + H2N2 → H1N1, H2N2, H1N2, H2N1

Human & Avian Influenza Epdemics & Pandemics



The 2003 SARS Outbreaks



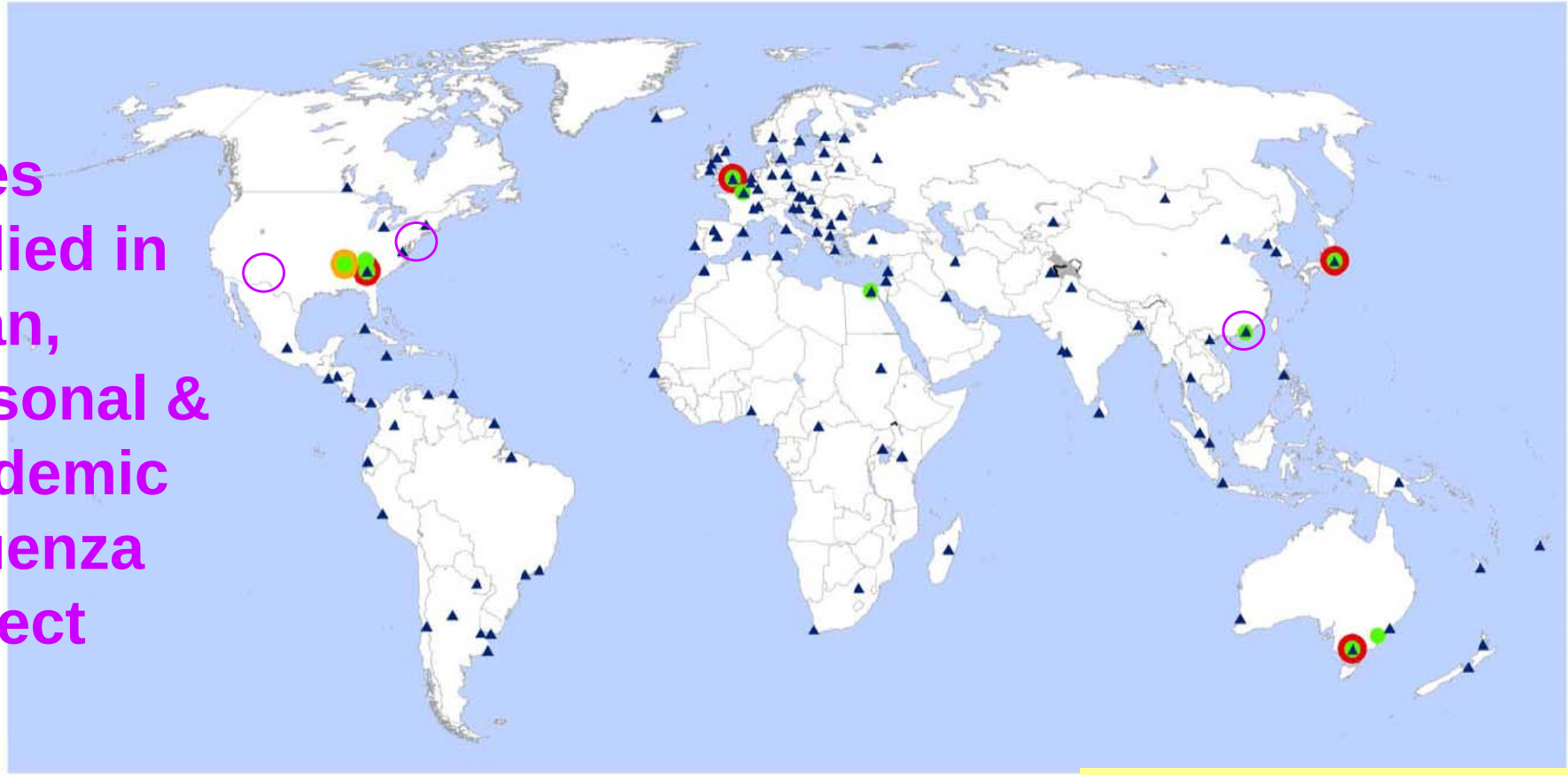


Human coronavirus

SARS increased public health as well as the general public's awareness of the seriousness of pandemic, and provided a real test ground for preventing and controlling respiratory disease.

WHO Global Influenza Surveillance Network

Cities studied in Avian, Seasonal & Pandemic Influenza Project



Legend

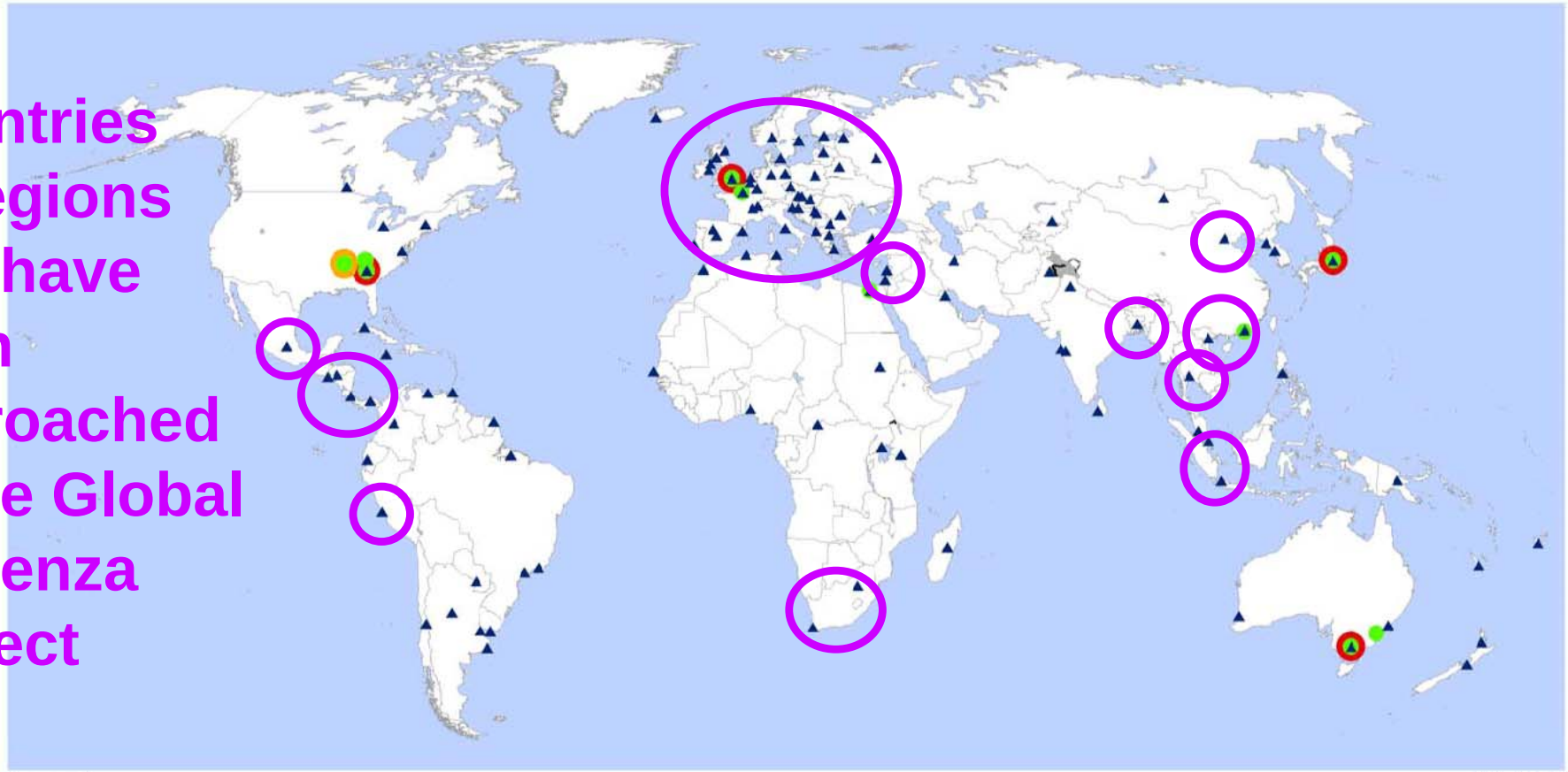
- National Influenza Centres
- WHO Collaborating Centres for Reference and Research on Influenza
- WHO Collaborating Centre for Studies on the Ecology of Influenza in Animals
- Reference laboratories

4 WHO Collaborating Centers

112 WHO National Influenza Centers in 83 countries

WHO Global Influenza Surveillance Network

Countries or regions that have been approached in the Global Influenza Project



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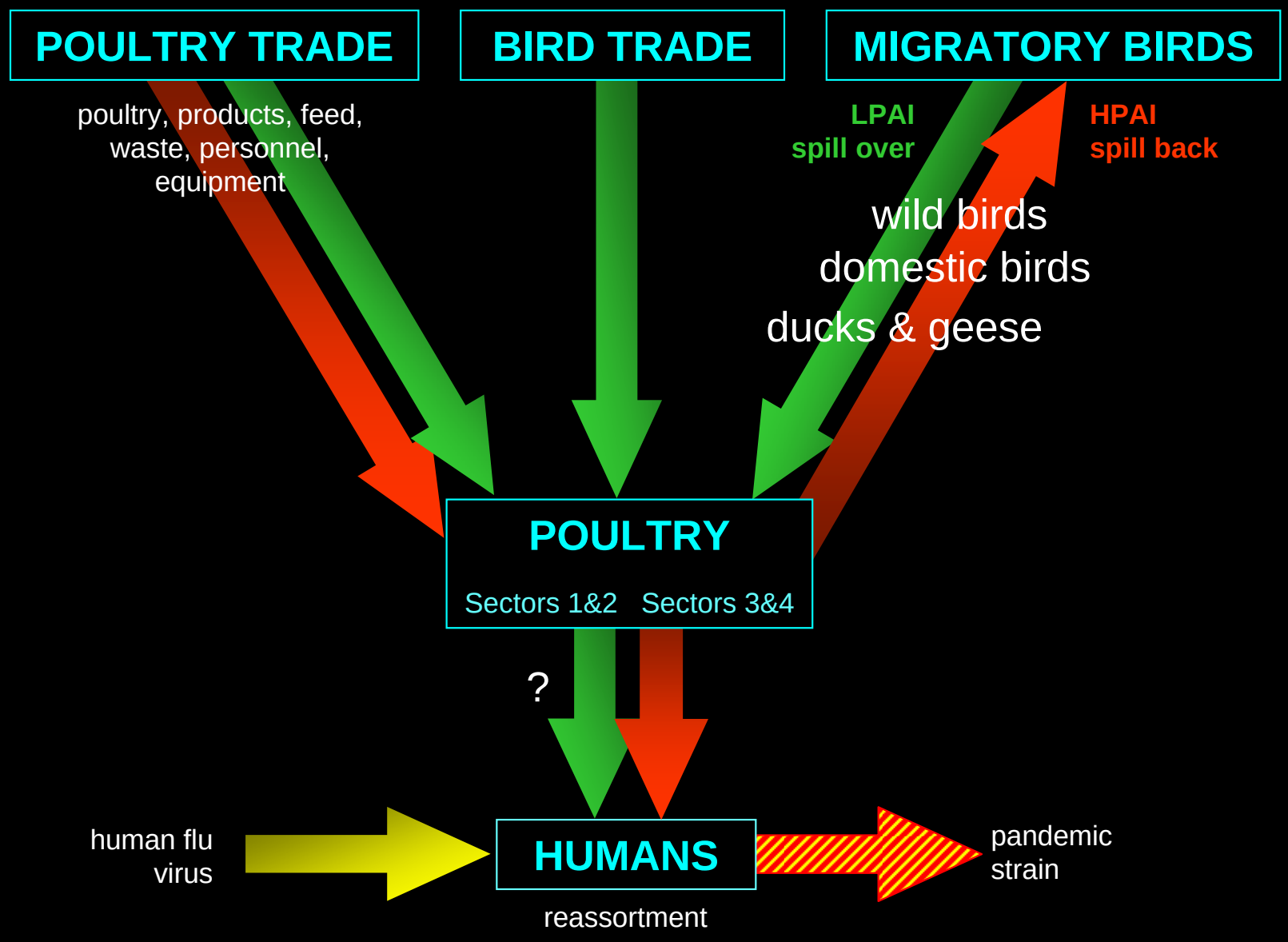
This project can contribute to GEO HE-09-02e and HE01 C1

H5N1 TRANSMISSION PATHWAYS



richard.kiang@nasa.gov

Asymptomatic Infection or Mild Illness?

- **Asymptomatic or mild H5N1 virus infection documented in Hong Kong, 1997**
  - **10% of Poultry Workers+ for H5N1 antibodies (N = 1525)** single serum specimen (avian-to-human transmission)
  - **3% of government poultry cullers+** for H5N1 antibodies, paired sera; **1 seroconverted** (N = 293)

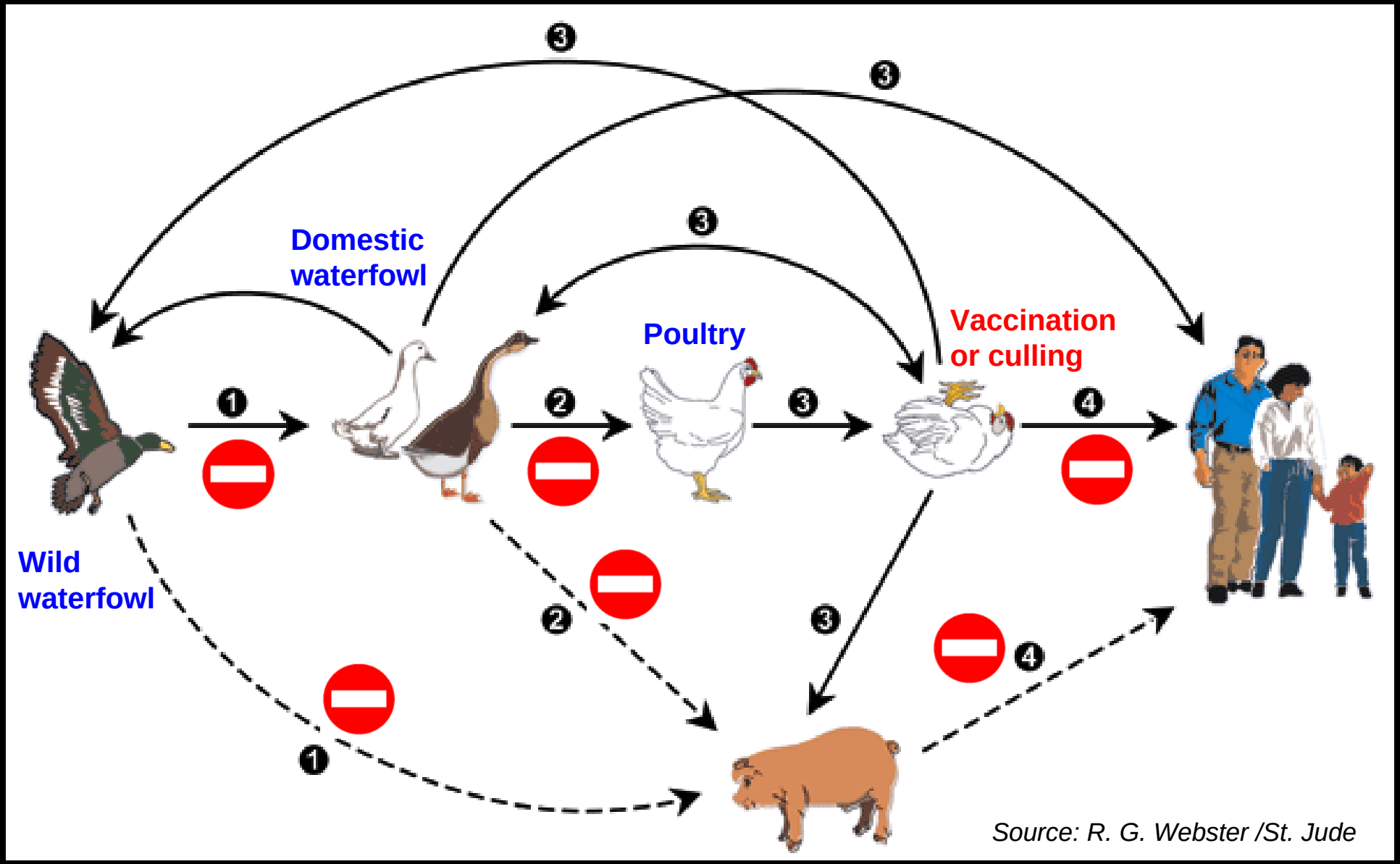
➢ **Frequency of asymptomatic or mild H5N1 virus infection since 1997 is unknown**

Source: T. Uyeki/CDC

Bridges et al., JID 2002;1005-1010; Chan PKS, CID 2002:34 (Suppl 2):S58-64.

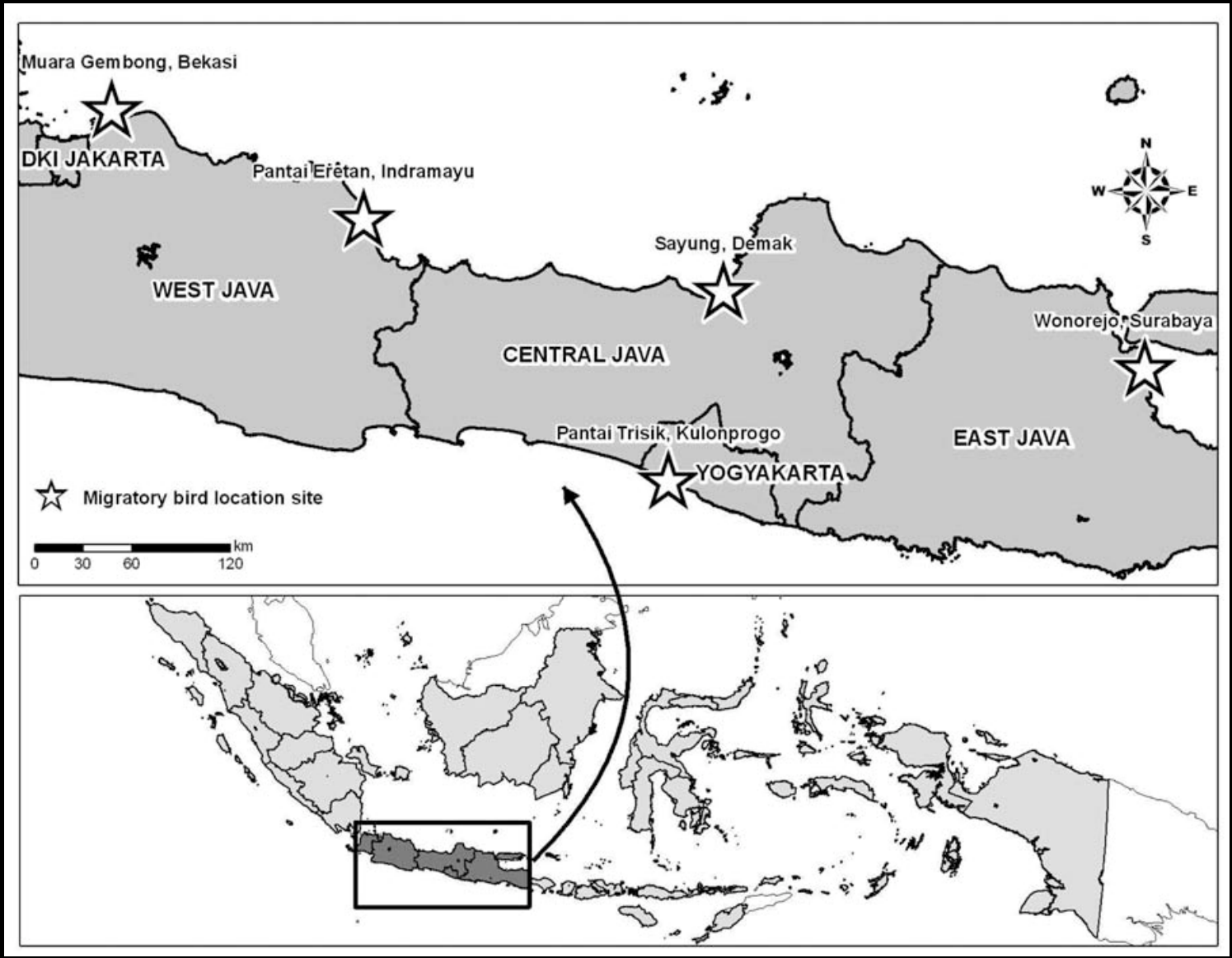
CDC
INFLUENZA DIVISION

Transmission through Waterfowl and Poultry And Control Options



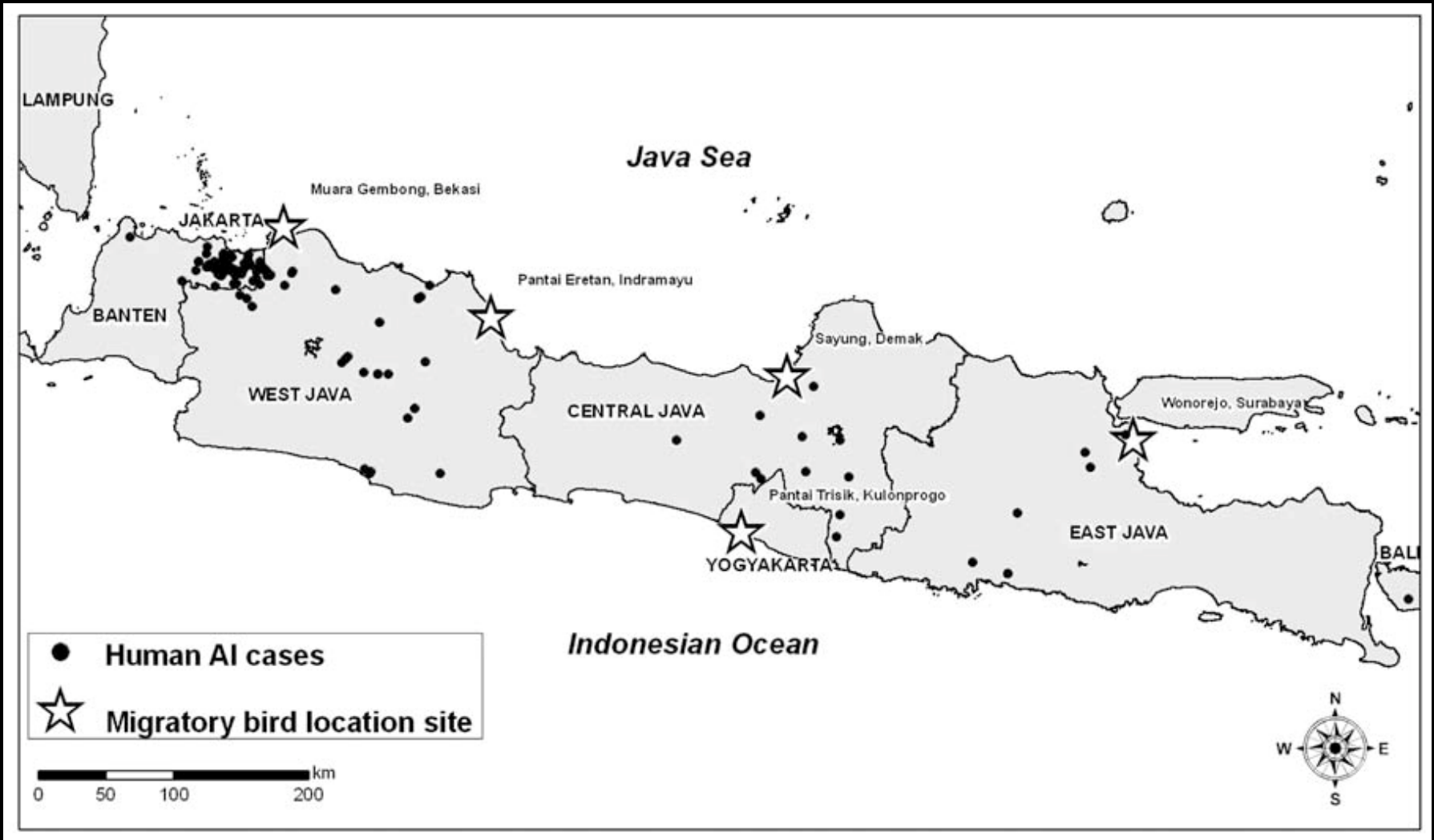
Prevent contact

NAMRU-2 Surveillance Sites For Migratory, Resident and Captive Birds



Source: A. C. Stoops/NAMRU-2

NAMRU-2 Surveillance Sites And Locations of Reported Human Cases



Source: A. C. Stoops/NAMRU-2

(continued)

- RNA was extracted from swabs; RT-PCR was conducted for H5N1 genes; antibodies was detected using hemagglutination inhibition and other tests.

- Species with the highest seropostive rates in each category are Muschovy duck (captive), striated heron (non-migratory) and Pacific golden plover (migratory).

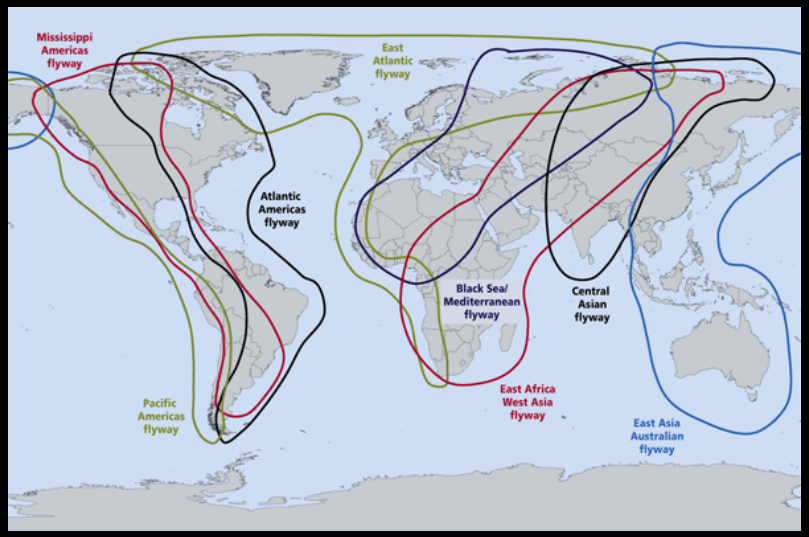
- 16% of the captive birds (duck, swan, pigeon, etc.) showed H5N1 antibody.

- Infected captive birds can be asymptomatic.

- In Indonesia, the role of migratory birds in H5N1 transmission is limited.

NAMRU-2 Bird Surveillance Study

- The role of migratory birds in the spread of H5N1 remains under considerable debates.
- In Indonesia, migratory pathways are only known for shorebirds (East Asian-Australasian flyway) and migratory ducks and geese (East Asian & Central Asian flyways).
- 4067 birds comprising of 98 species and 23 genera were collected in 2006-2007.
- Most common birds: striated heron, common sandpiper, and domestic chicken.

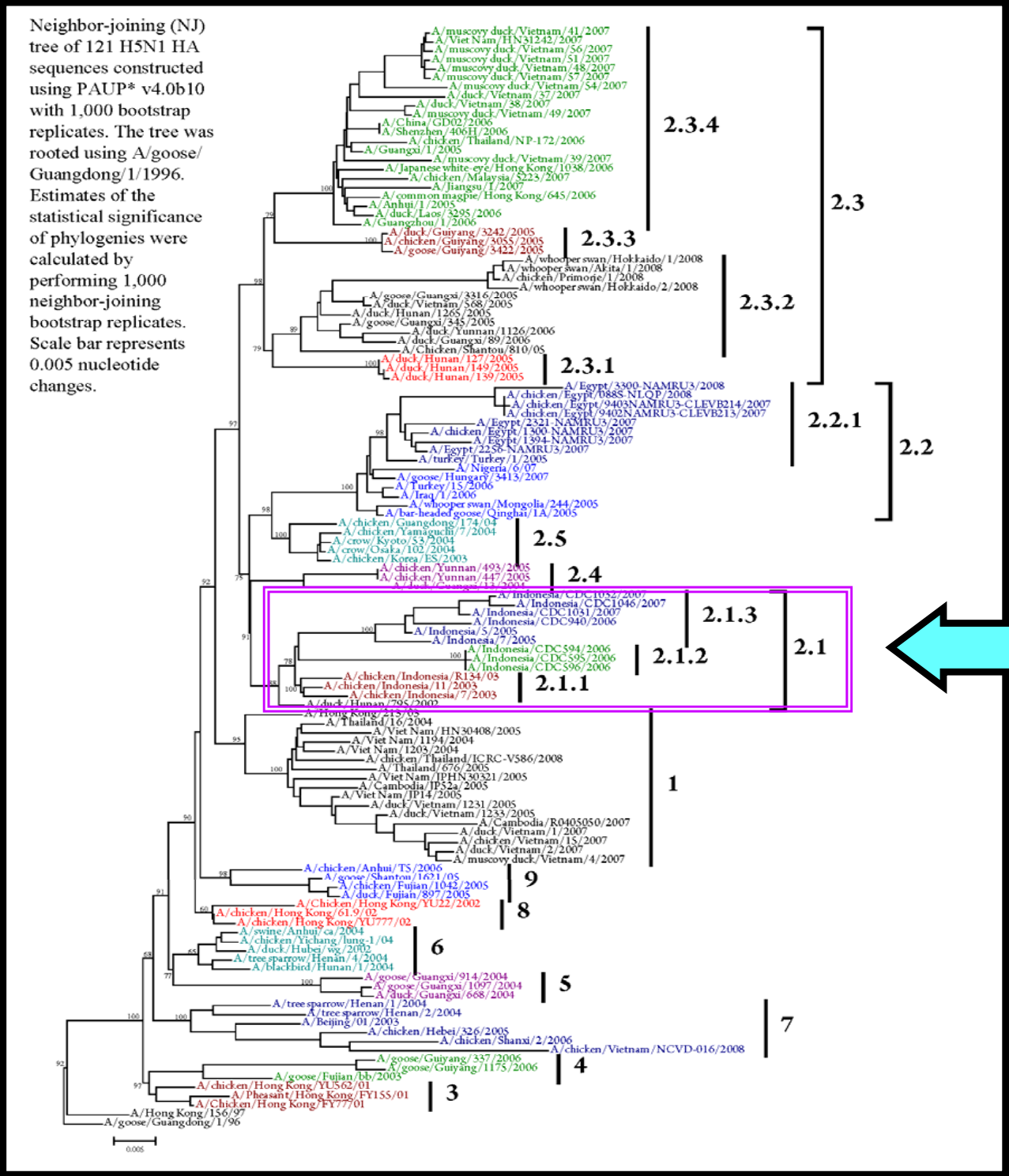


3%

6%

14%

Phylogenetic Tree of Hemaglutinin from H5N1 Viruses



Clade 2.1 is specific to Indonesia

Source: WHO, January 2009

Results of NAMRU-2 Bird Surveillance Study

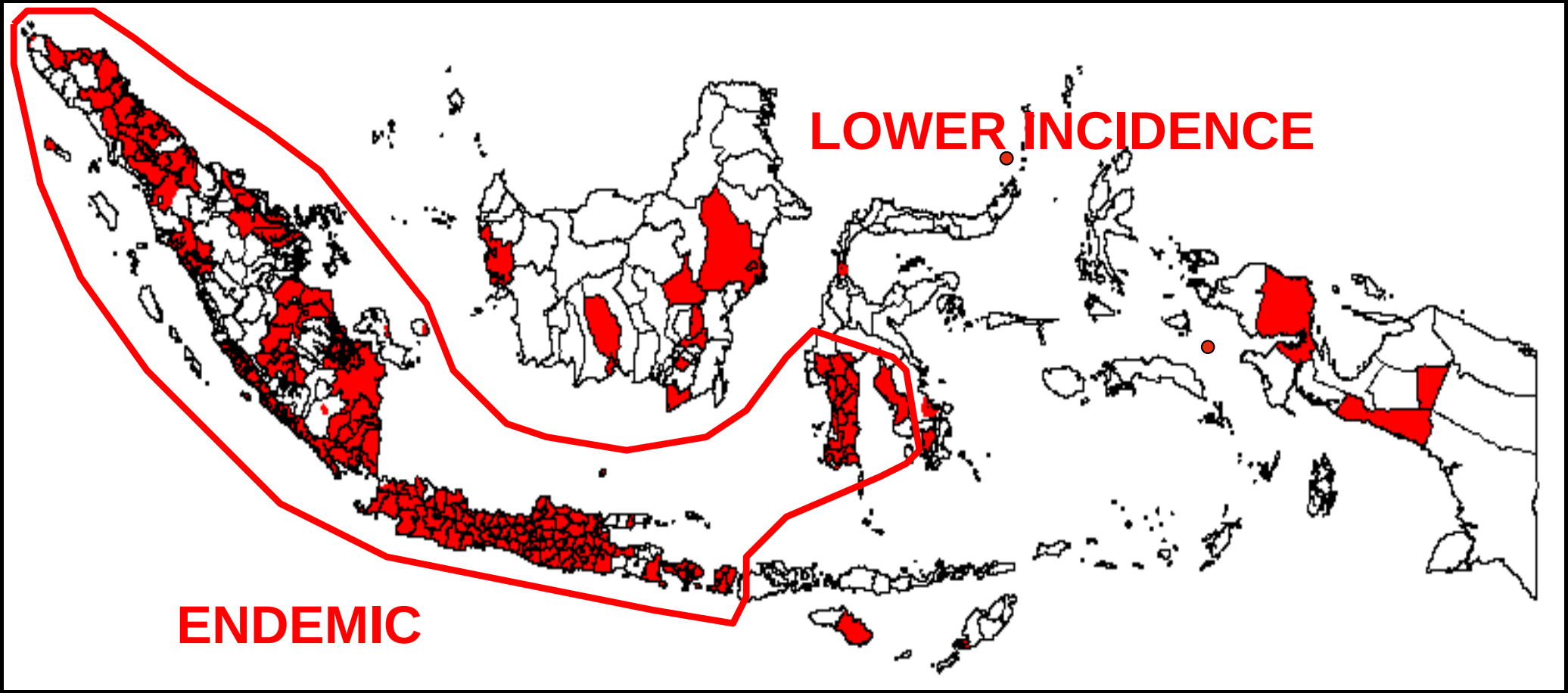
	ELISA H5 Positive			rRT-PCR H5 Positive		
	n	+	%	n	+	%
Captive birds	1110	179	16.1	412	7	1.6
Resident birds	1417	15	1.1	510	0	0
Migratory birds	1540	21	1.4	733	0	0

ELISA: enzyme-linked immunosorbent assay

RT-PCR: reverse-transcriptase polymerase chain reaction

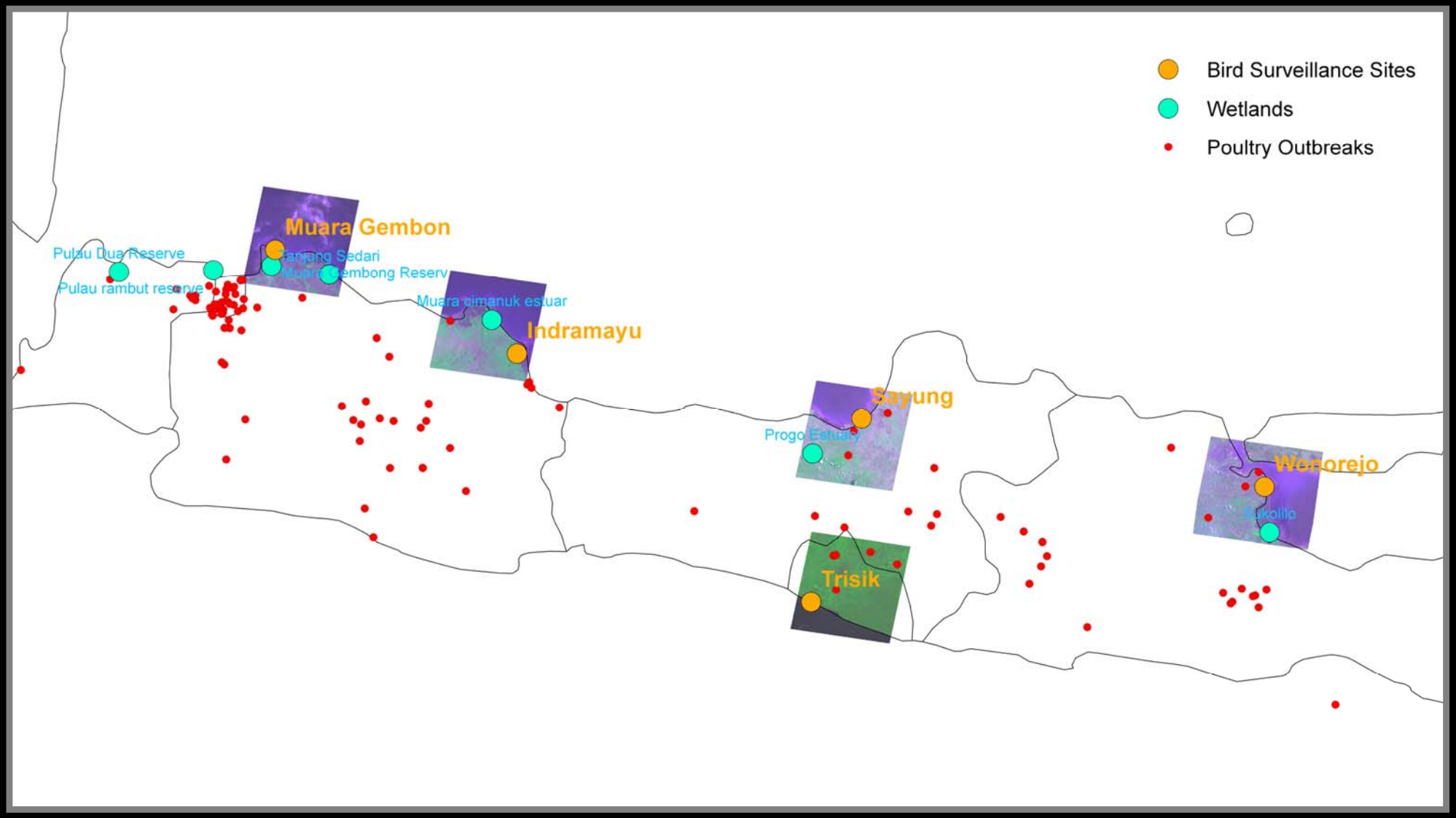
Source: A. C. Stoops/NAMRU-2

HPAI Endemic Regions in Indonesia

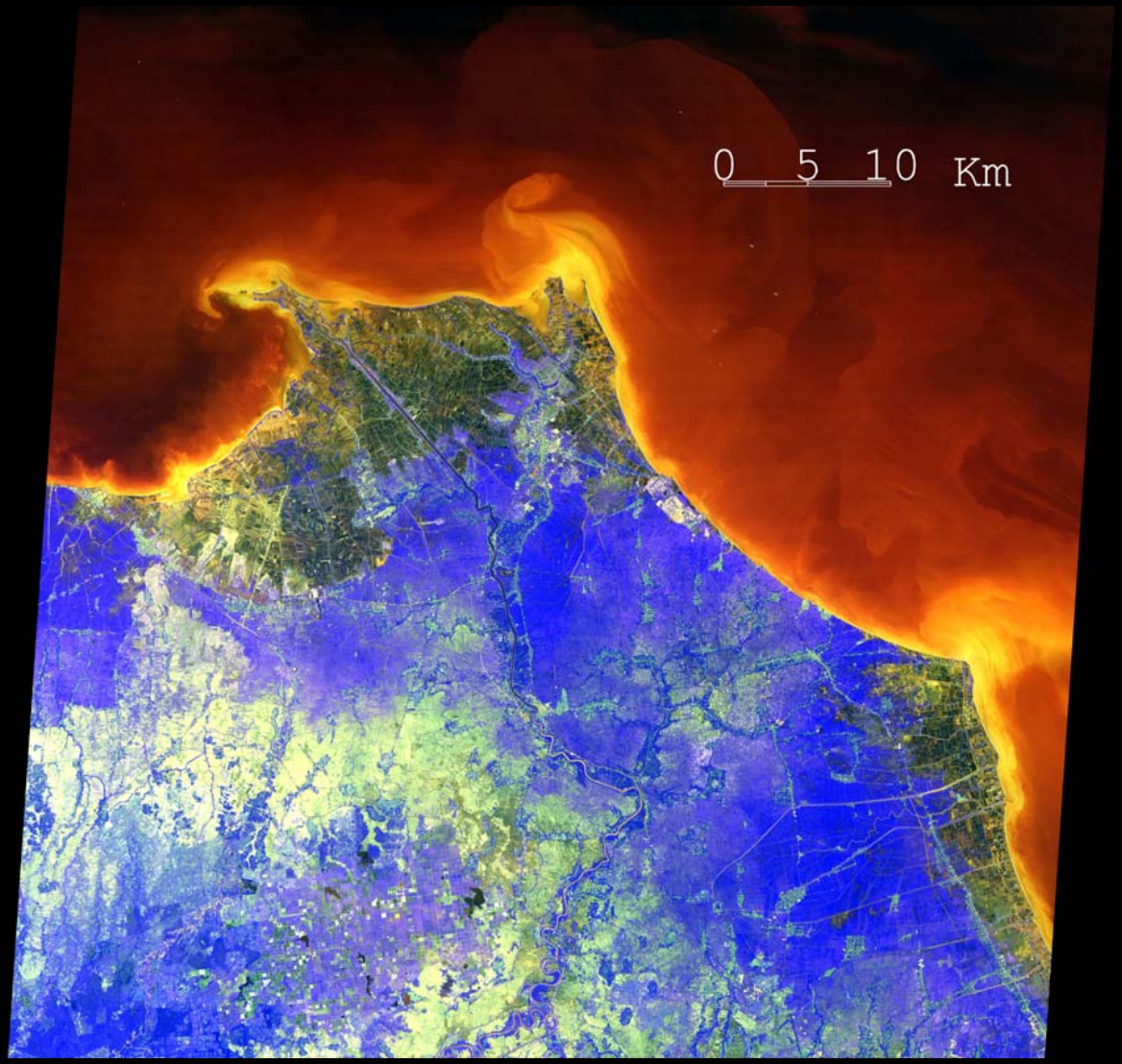


Source: E. Sawitri/Indonesian MoA

NAMRU-2 Bird Surveillance Sites on Java



Buffer zones can be established to limit the spread of H5N1 around wetlands and the nearby farmlands



EU's & UK's Practice:

3 km protection zone

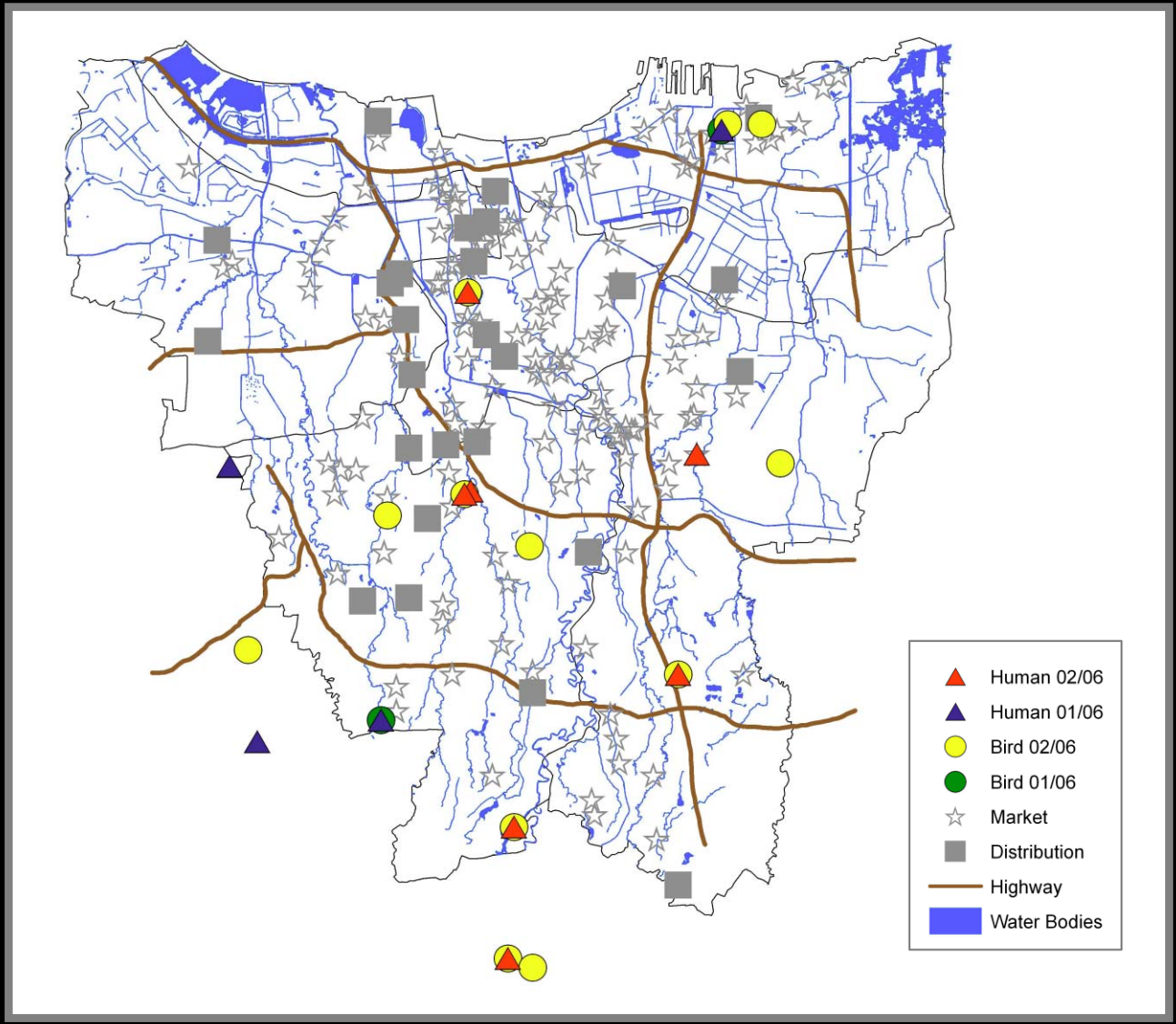
10 km surveillance zone

larger restricted zone

ASTER image showing NAMRU-2 bird surveillance site around Muara cimanuk estuar

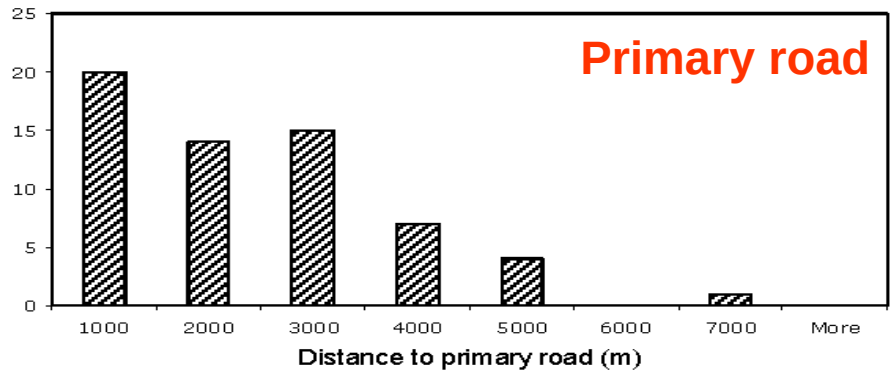
Poultry Outbreaks, Human Cases, Wet Markets, And Distribution Centers in Greater Jakarta

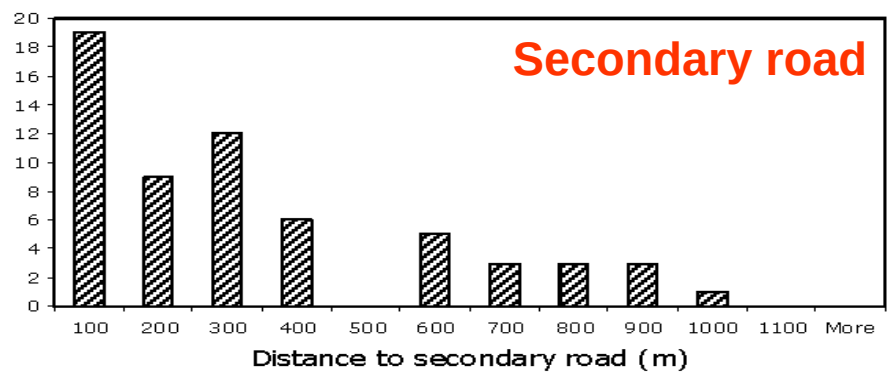
January – February 2006

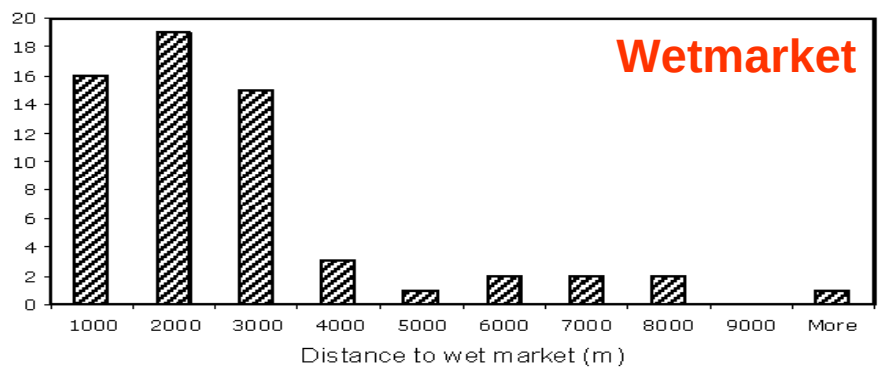


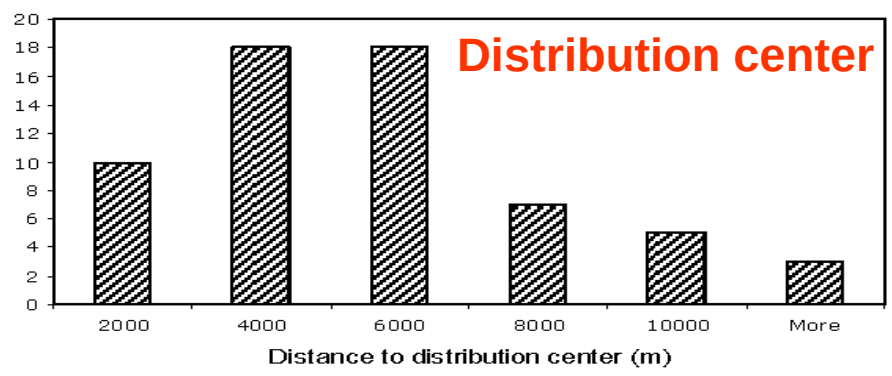
richard.kiang@nasa.gov

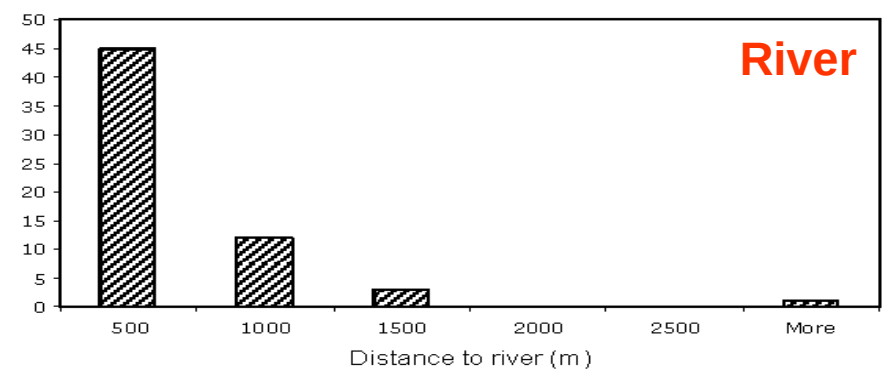
Distance From Where Outbreaks Occurred

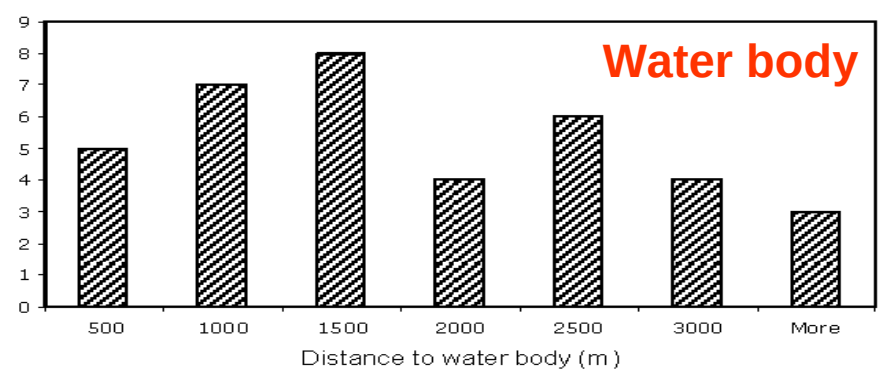










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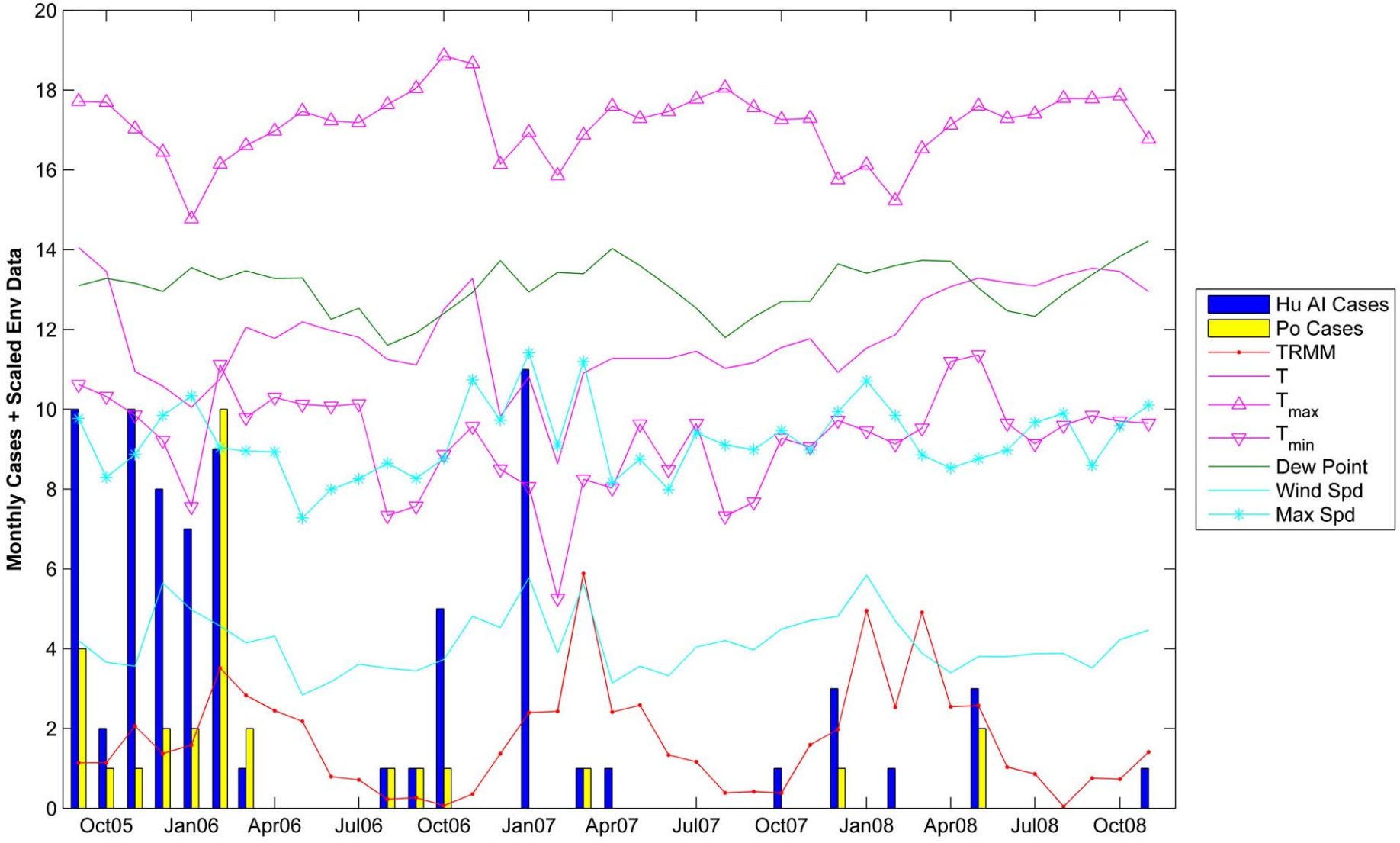
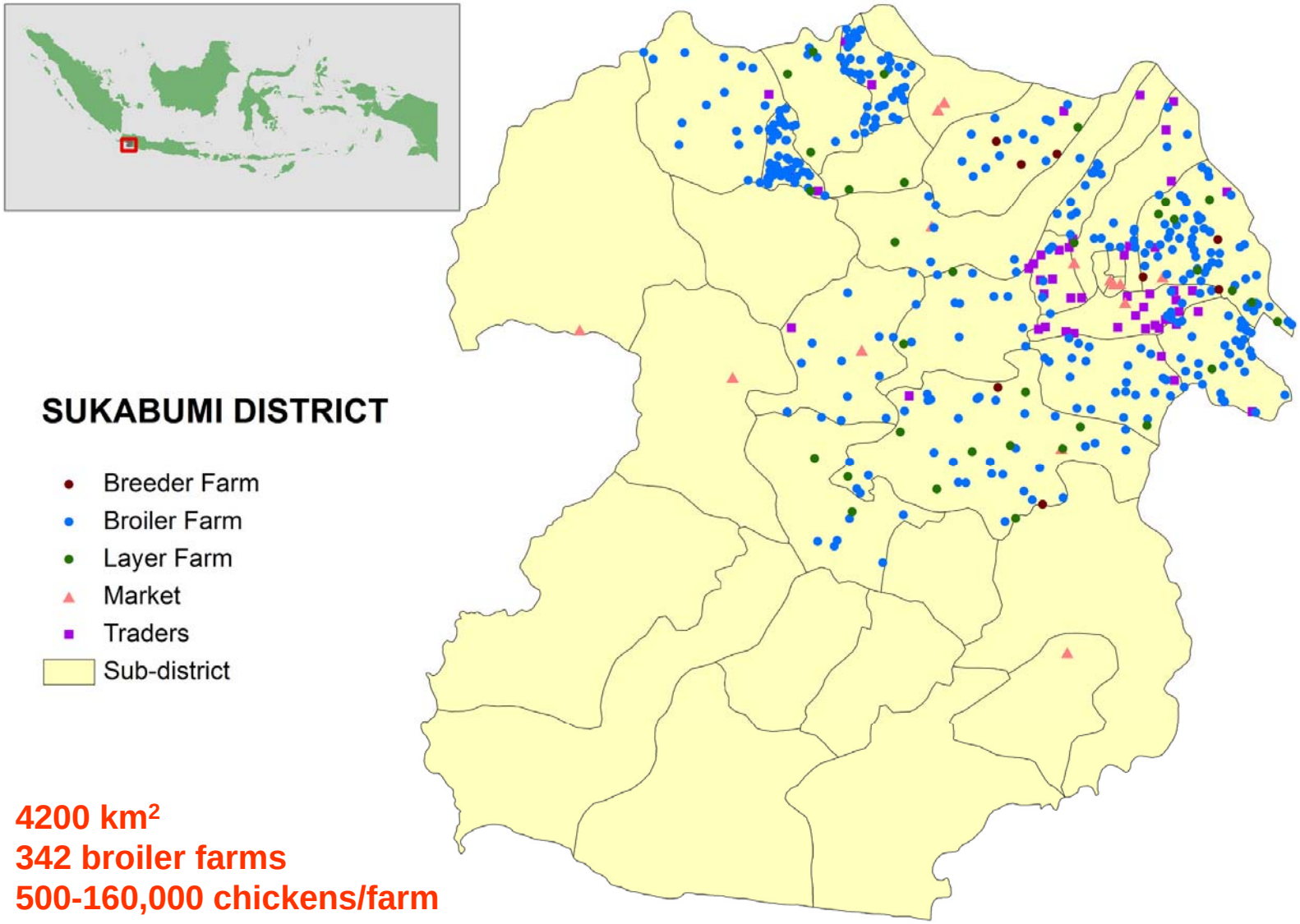
TARUMAN

Human & Poultry Cases vs. Meteorological Parameters in Greater Jakarta



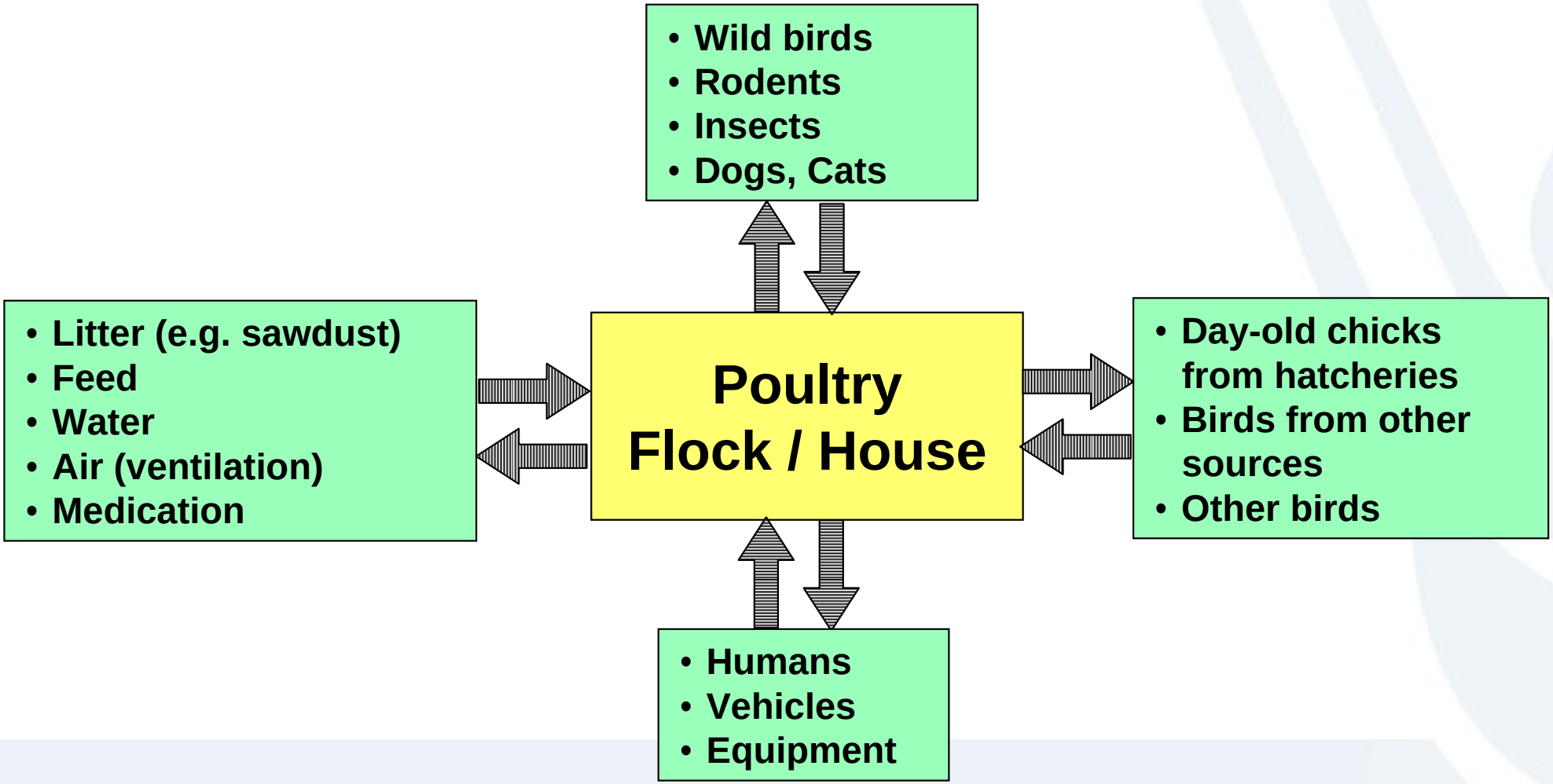
Densely Populated Sector I Poultry Production Area Near Jakarta

Poultry Farms, Markets & Traders In Sukabumi District



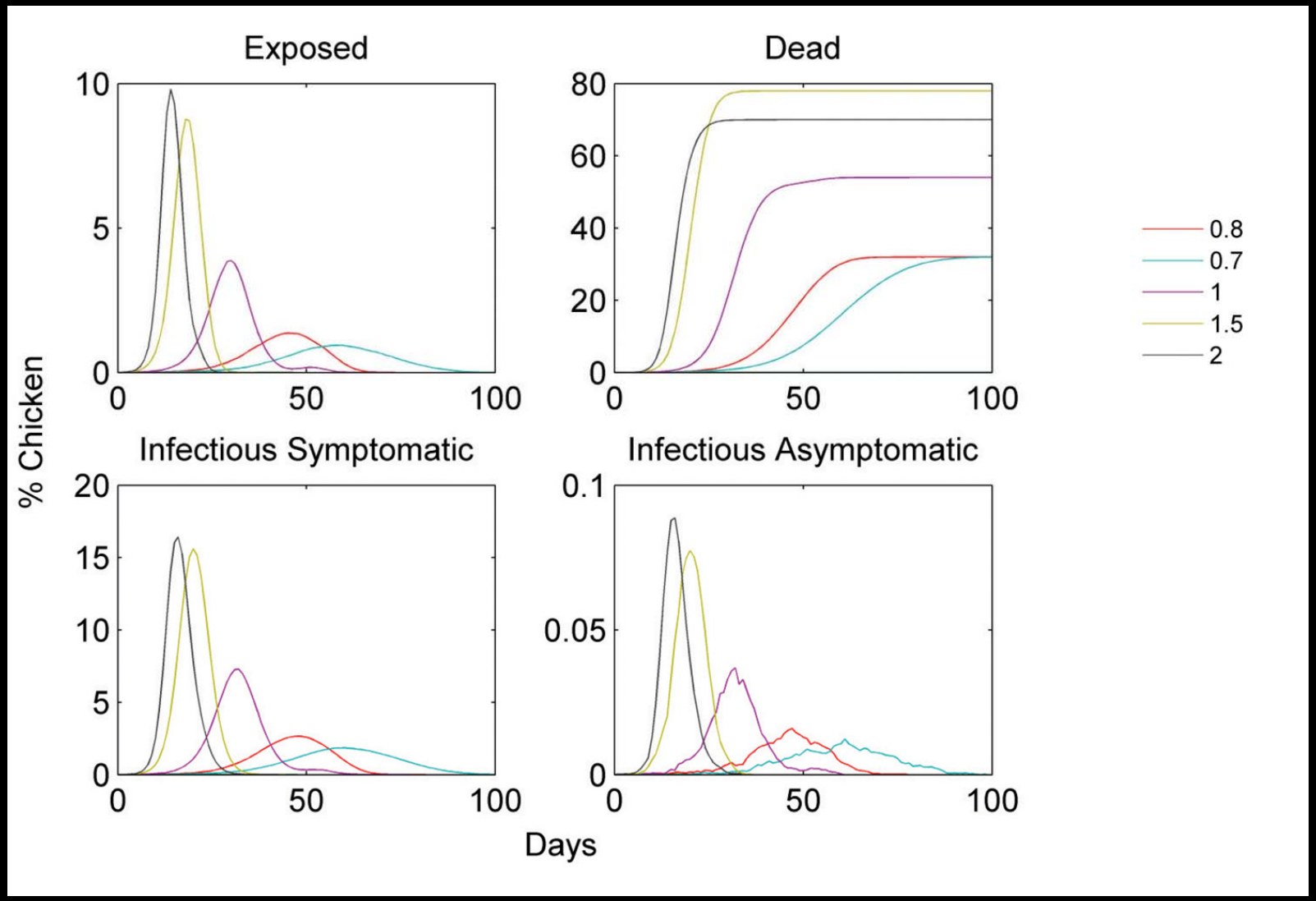
4200 km²
342 broiler farms
500-160,000 chickens/farm
14 wetmarkets

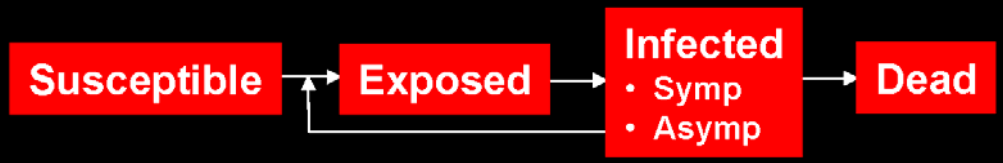
Factors influencing Biosecurity



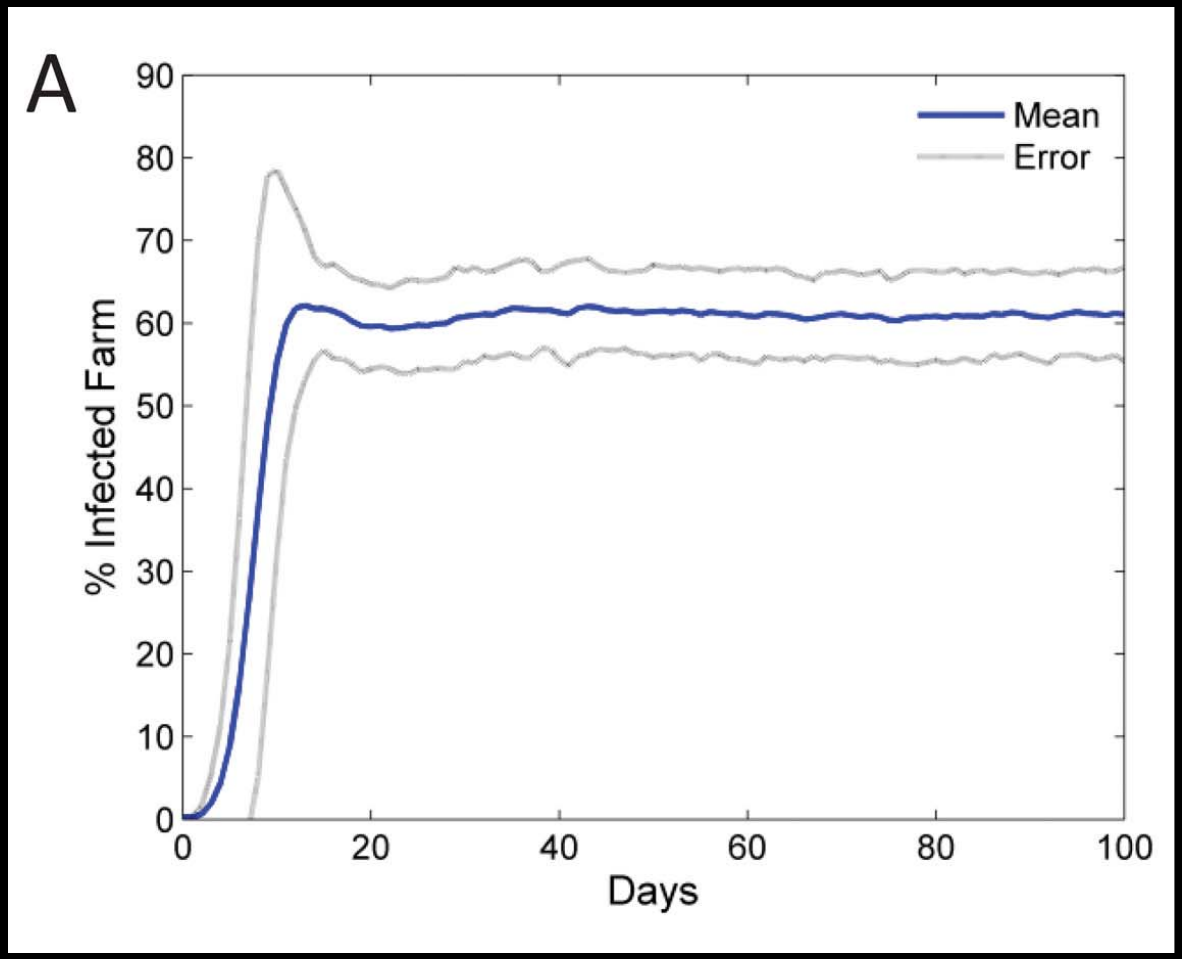
Source: O. Thieme/FAO

SEIR Compartmental Model for Simulating H5N1 Transmission in Each Poultry Farm

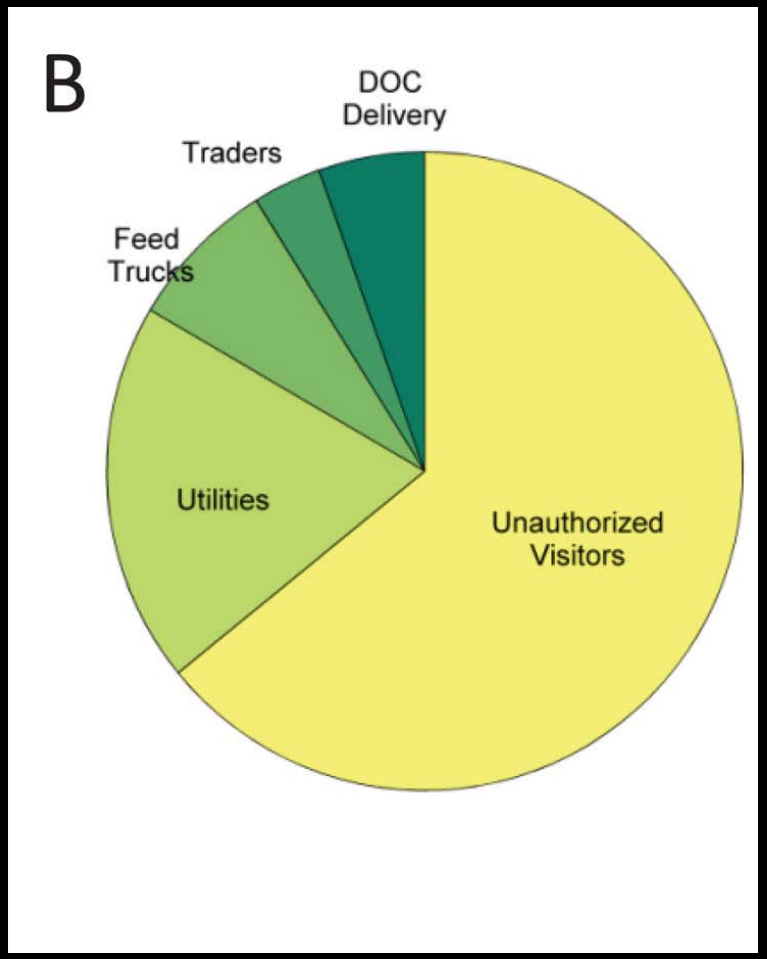




Markov Chain Monte Carlo Method For Simulating Between-Farm Transmission

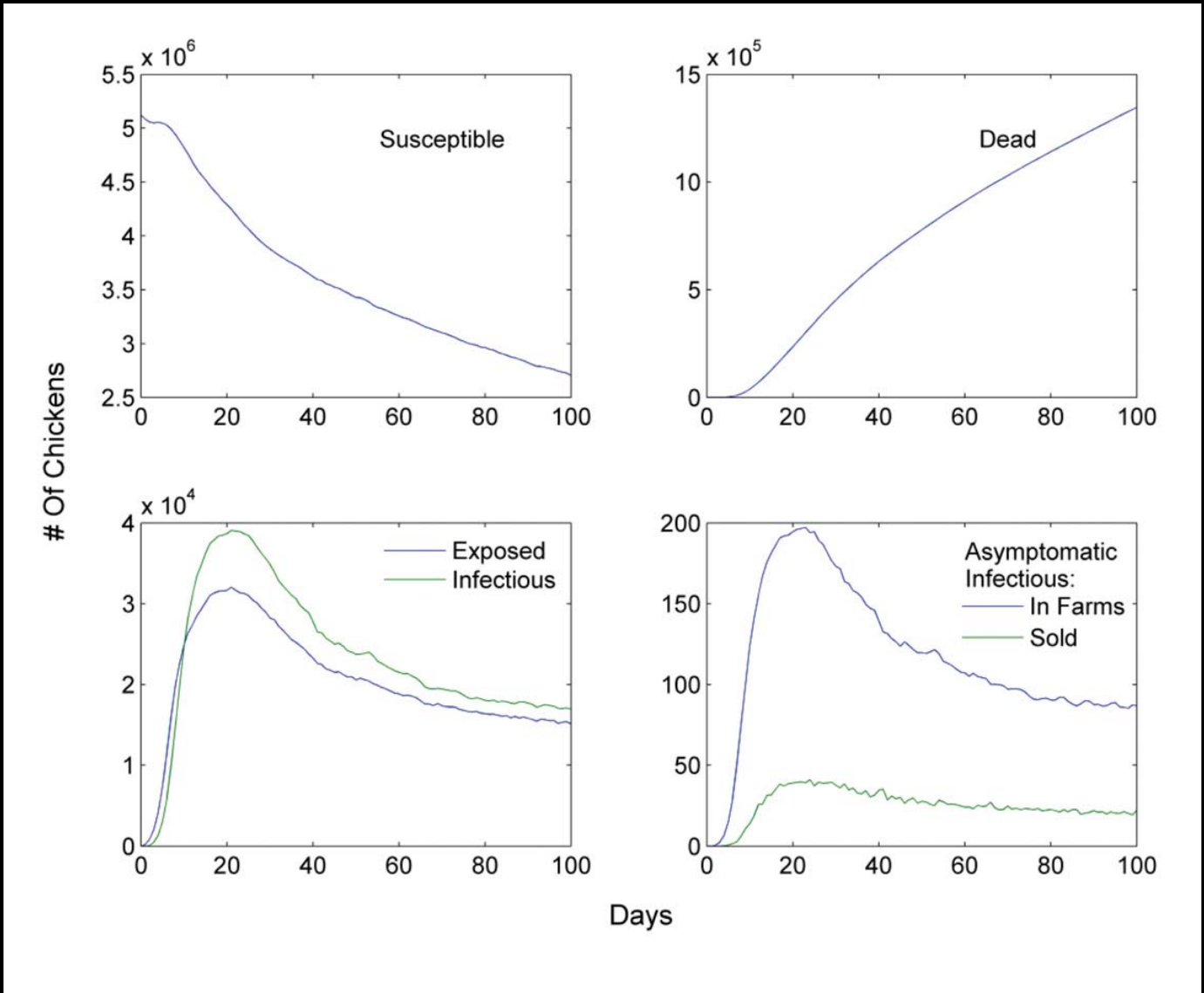


Farms with at least one infectious chicken

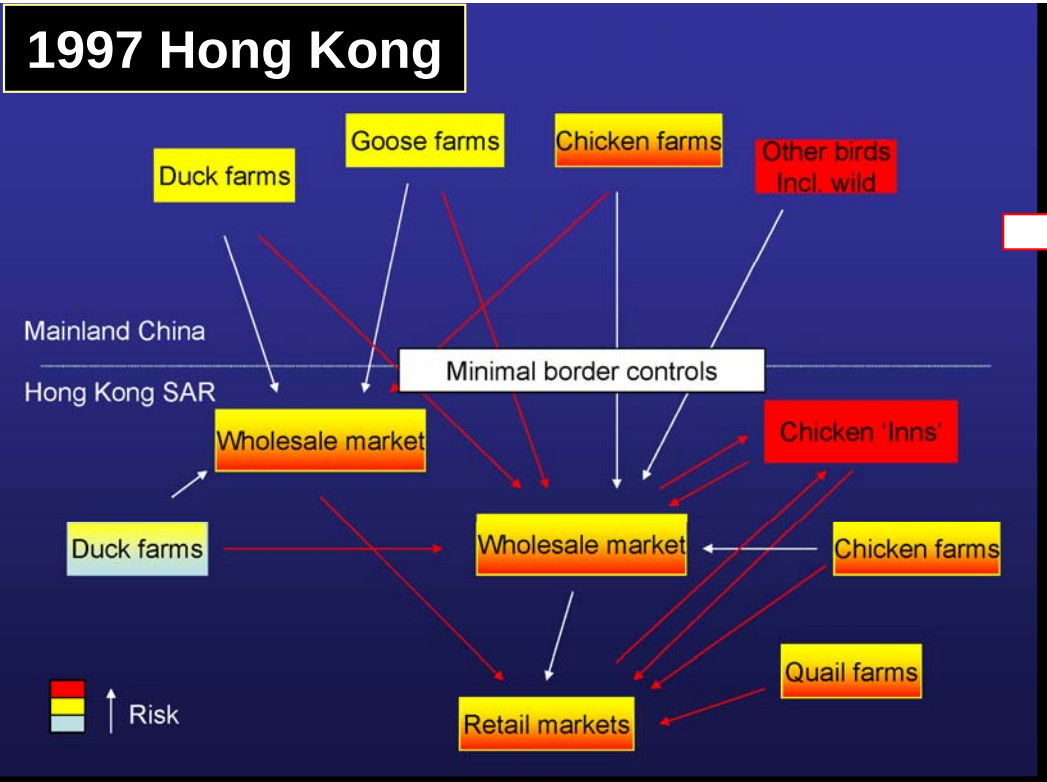


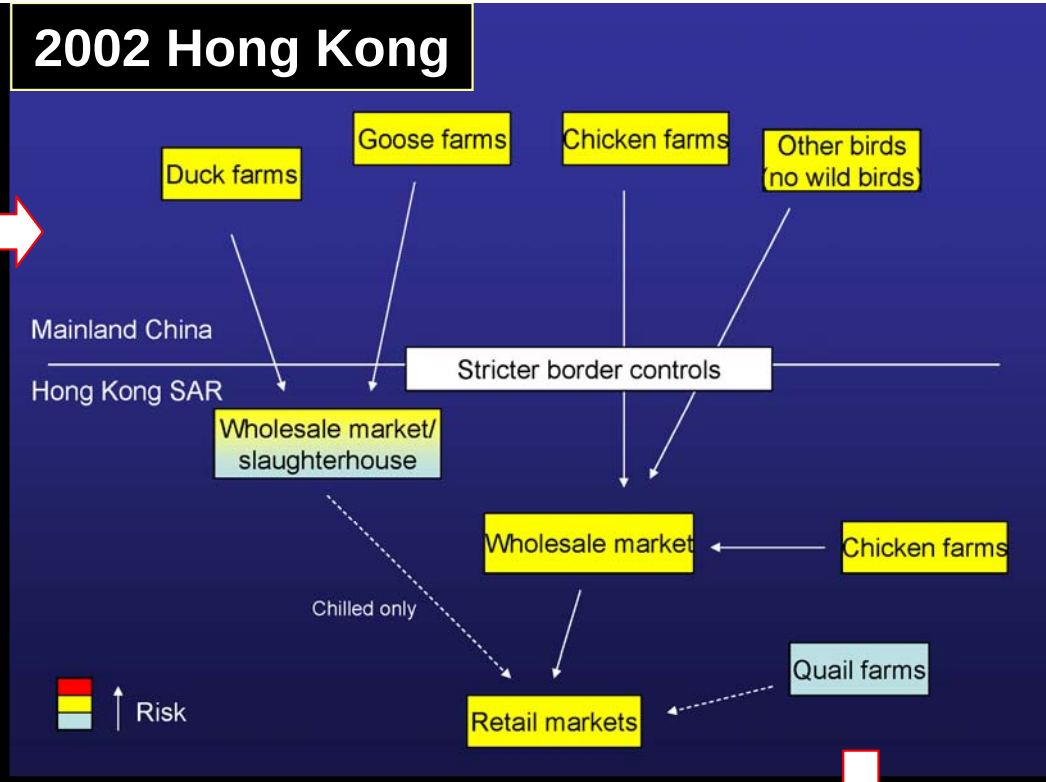
Source of infection

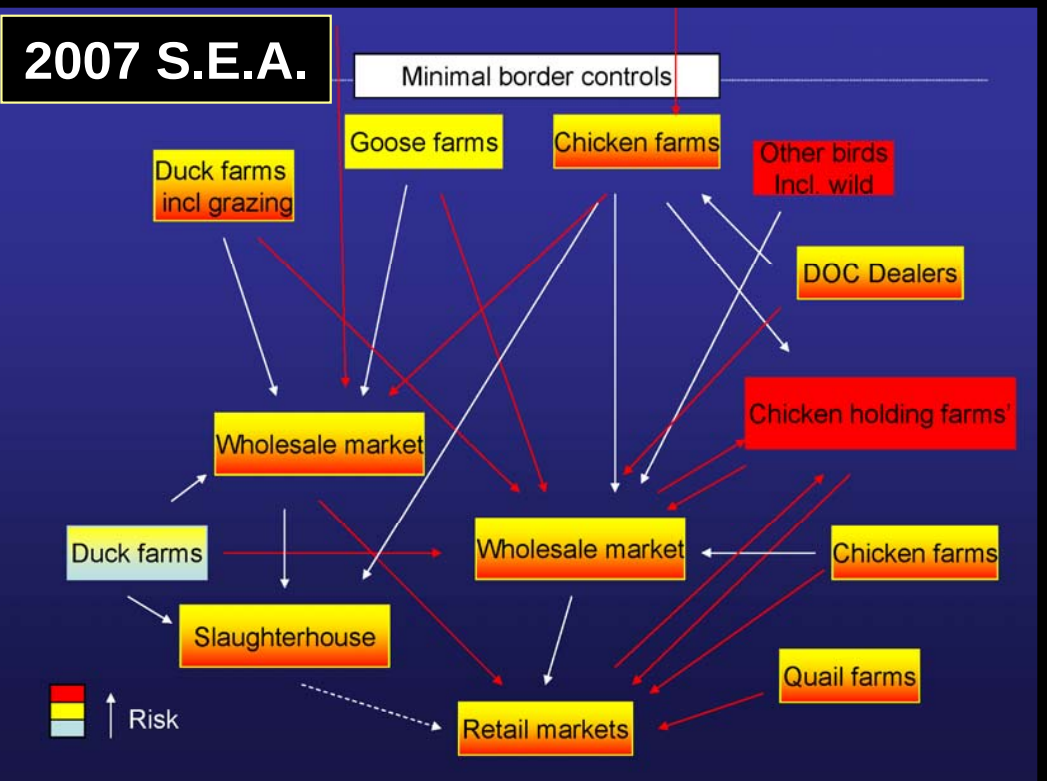
States of Chicken Populations

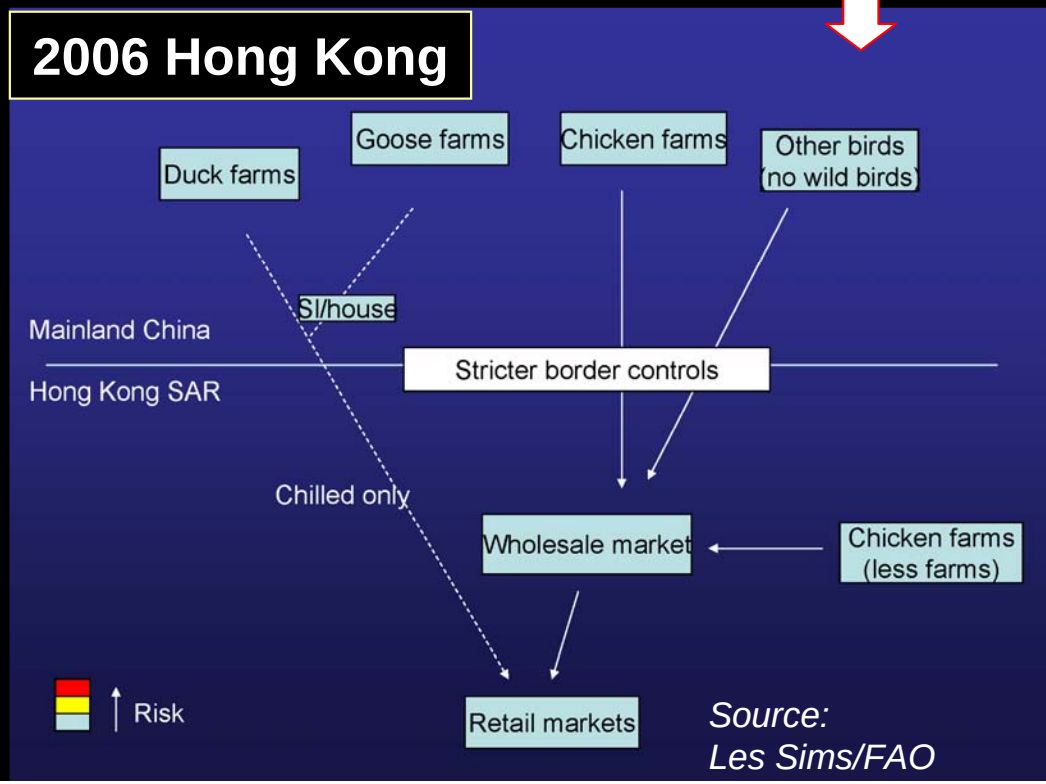


Asymptomatic infected chickens may be sold to unaware customers at markets.









Source: Les Sims/FAO

Novel Swine Influenza Virus Reassortants in Pigs, China

Yuhai Bi,[1] Guanghua Fu,[1] Jing Chen,[1]
Jinshan Peng, Yipeng Sun, Jingjing Wang,
Juan Pu, Yi Zhang, Huijie Gao, Guangpeng Ma,
Fulin Tian, Ian H. Brown, and Jinhua Liu

During swine influenza virus surveillance in pigs in China during 2006–2009, we isolated subtypes H1N1, H1N2, and H3N2 and found novel reassortment between contemporary swine and avian panzootic viruses. These reassortment events raise concern about generation of novel viruses in pigs, which could have pandemic potential.

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THANK YOU