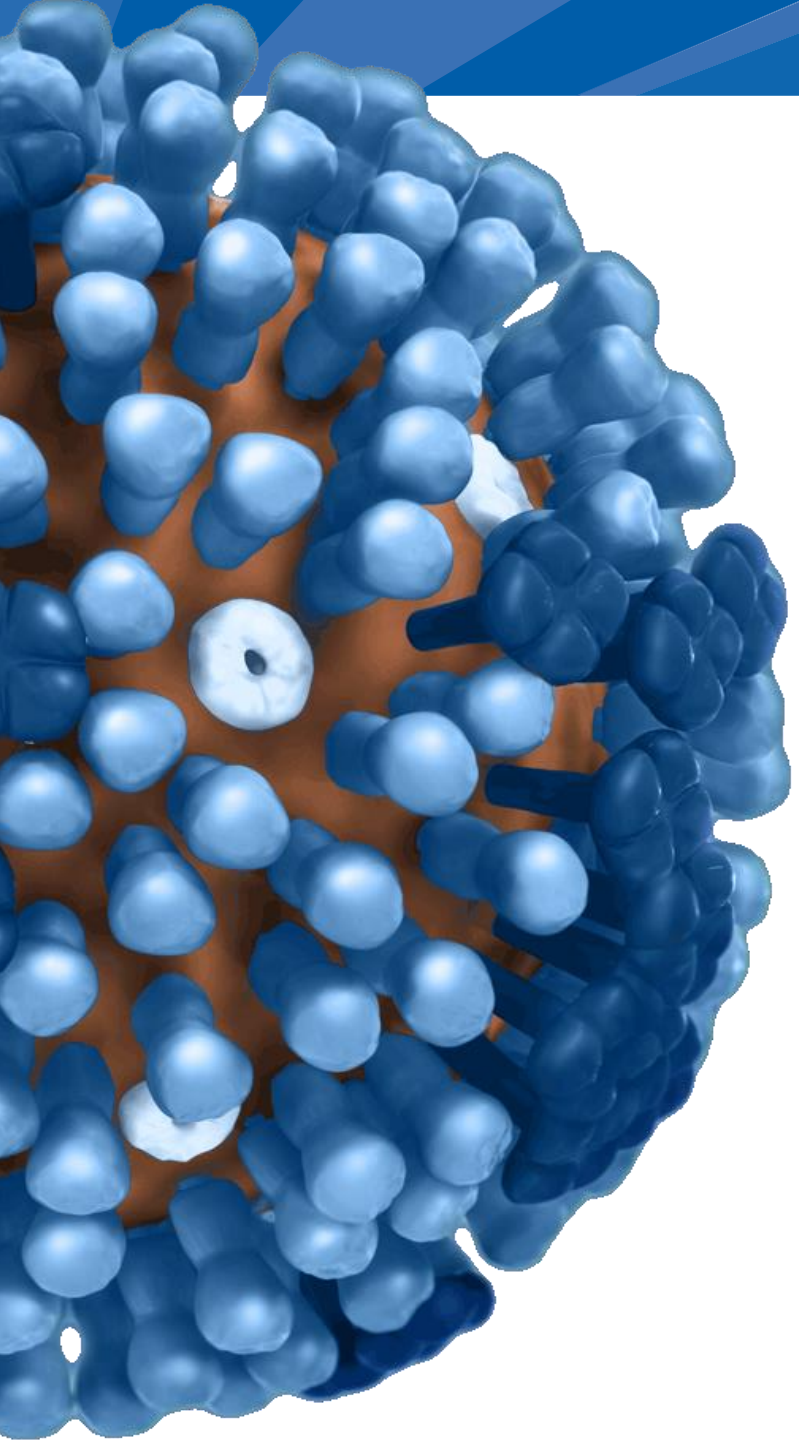


Influenza and Zoonoses Education Among Youth in Agriculture

Daniel B. Jernigan, MD MPH

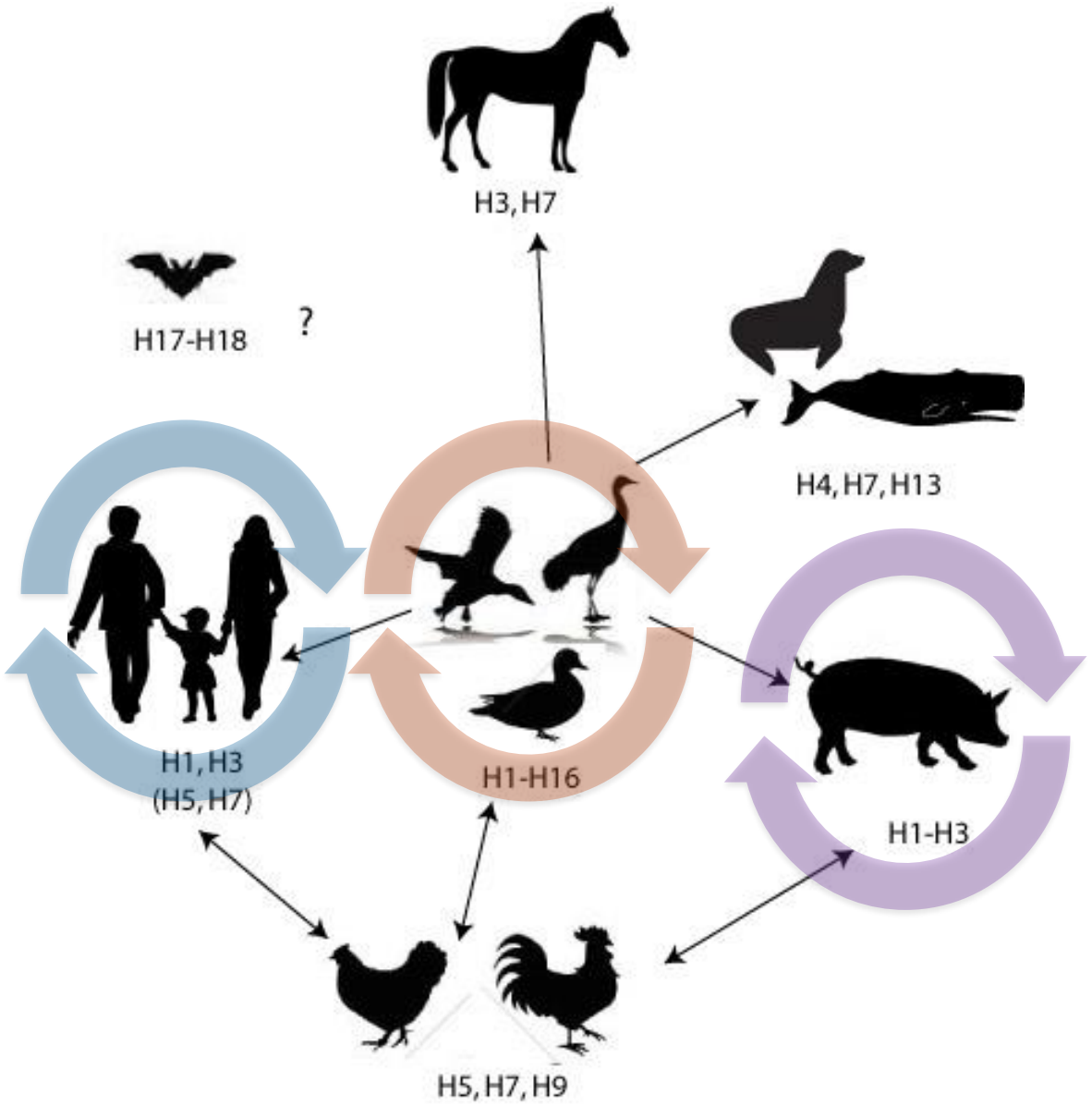
Director, Influenza Division

Centers for Disease Control and Prevention

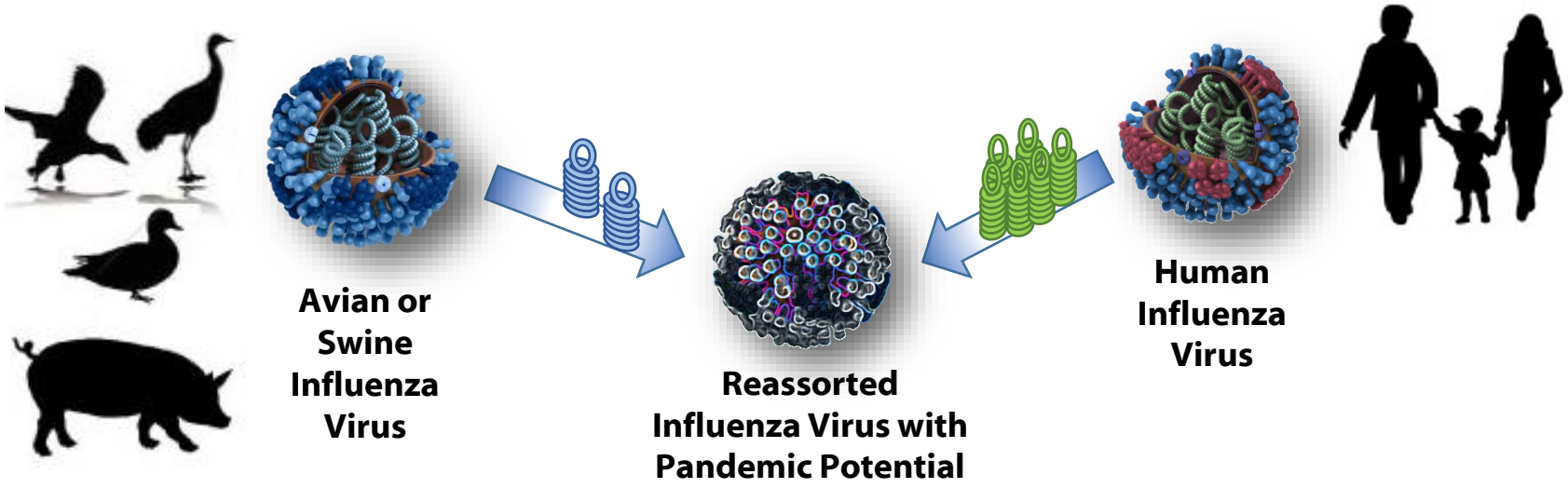
Oct 23, 2017

- 310 staff (24 global, 3 EIS Officers)
- WHO Collaborating Center for Influenza
- Responsible for:
  - Surveillance
  - Prevention
  - Treatment
  - Readiness and Response

Influenza A Reservoirs - Interspecies Transmission

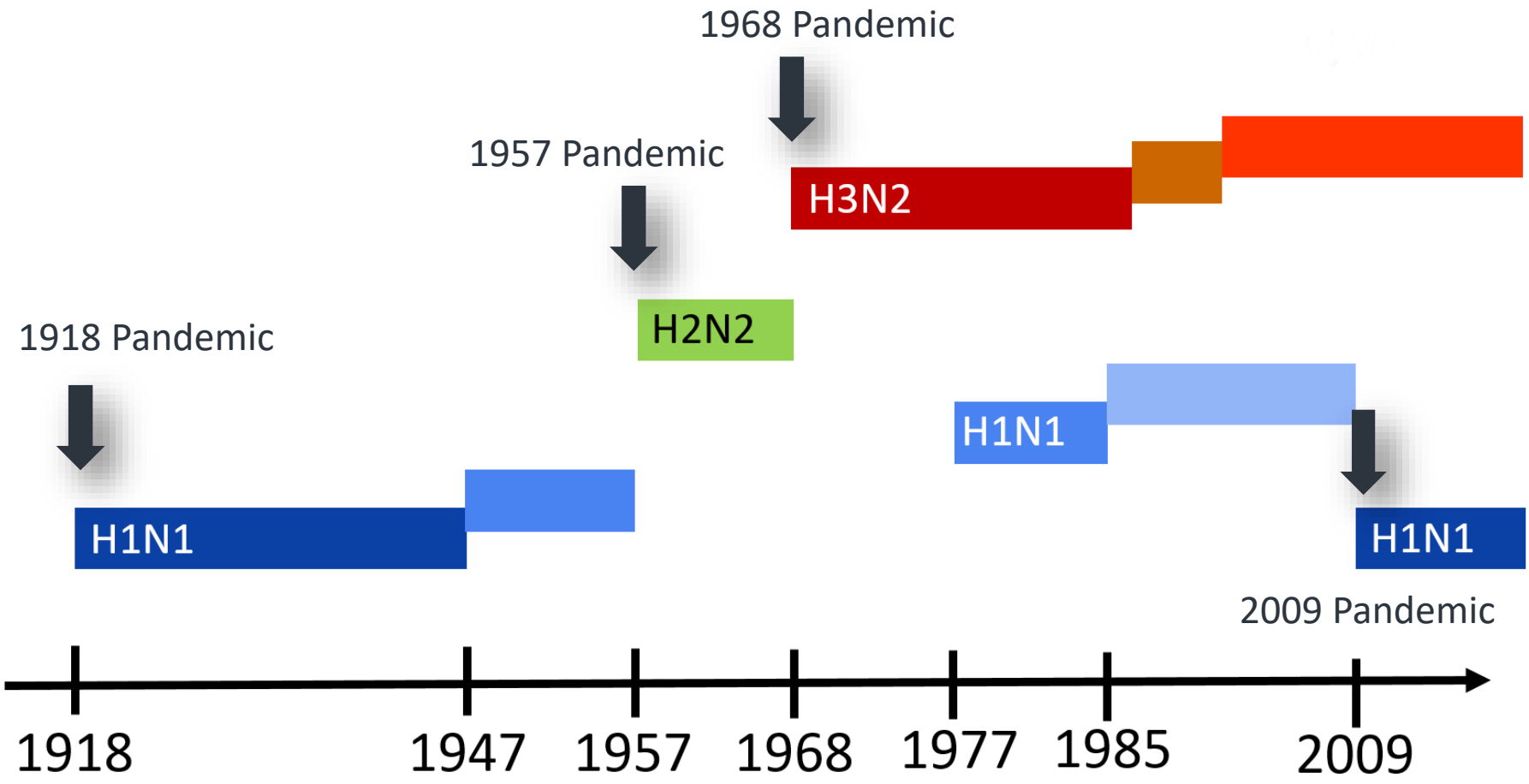


Shift: Reassortment of Influenza Viruses



- Human-adapted viruses can arise from reassortment to cause efficient and sustained transmission
- Four pandemics in last 100 years
- All have had genes from either avian or swine origin

Influenza A Viruses Since 1918



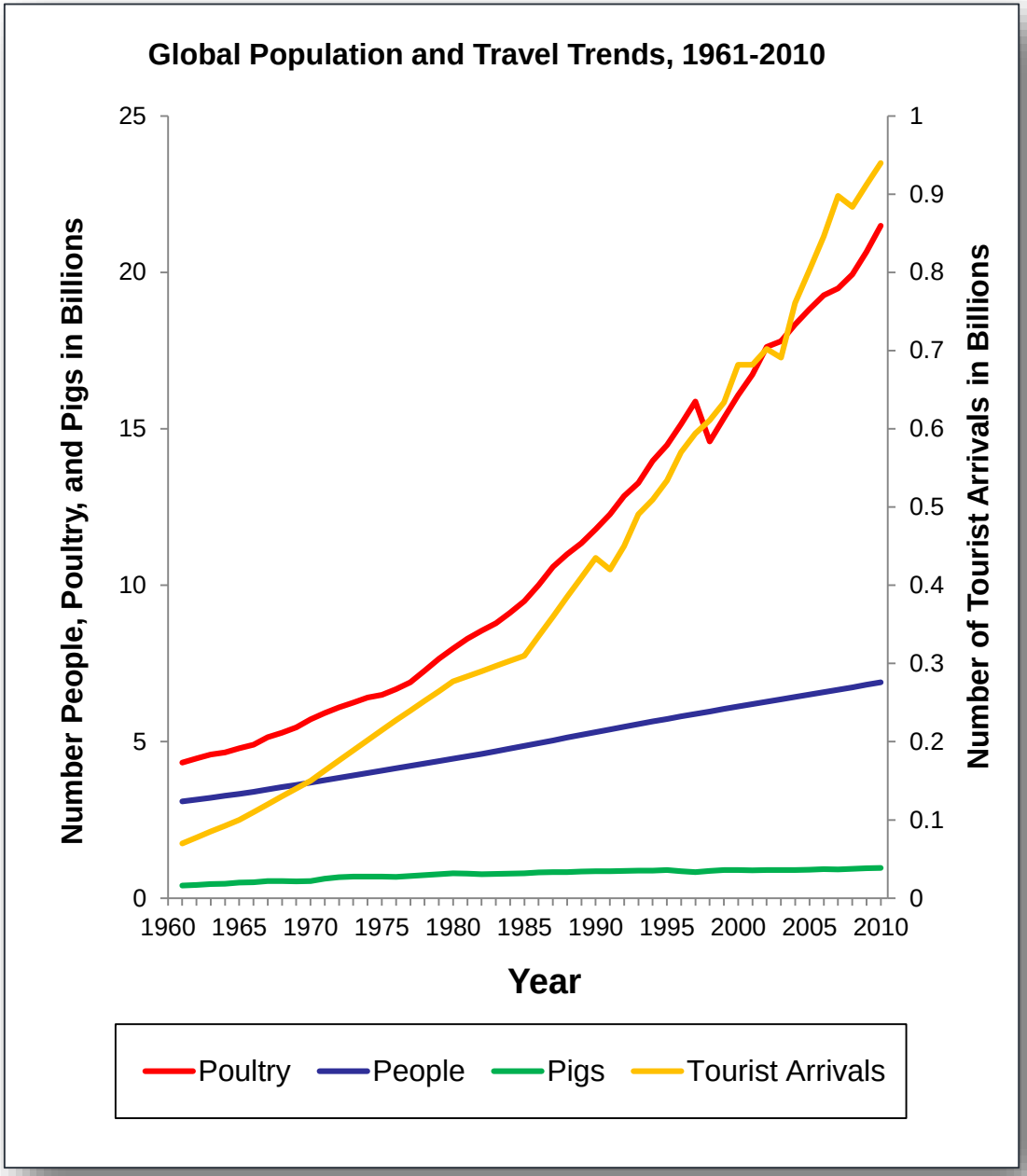
The world is increasingly

- Crowded
- Connected
- Converging

Jernigan, Strausbaugh. Emerging Infections, Textbook of Infectious Diseases, 2004
Institute of Medicine, Emerging Infections, 1992
Jernigan, Cox. Textbook of Influenza. 2013

Factors for Emerging Influenza Viruses

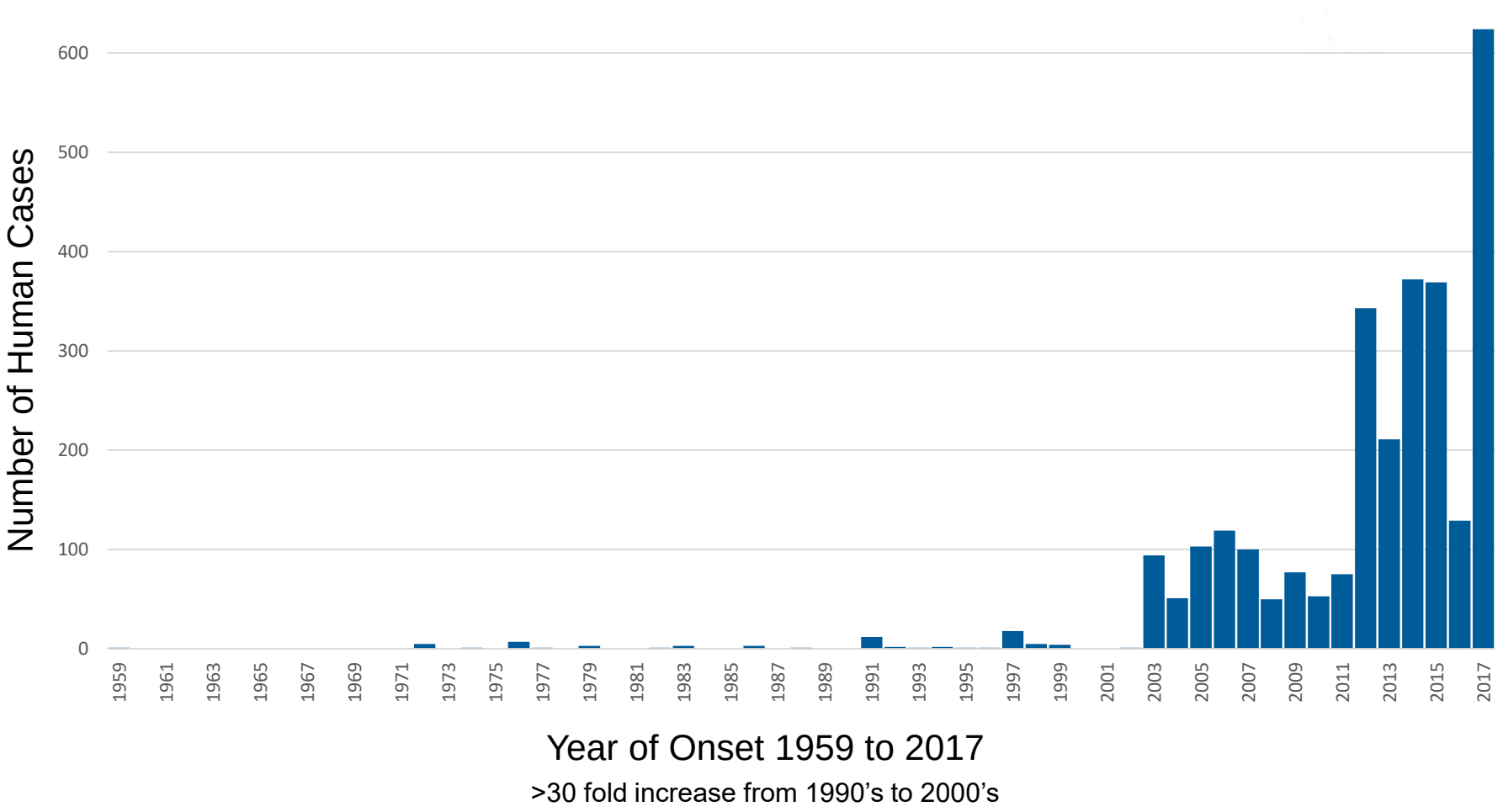
- Factors for emerging influenza virus:
  - People
  - Poultry
  - Pigs
  - Passengers



Jernigan, Cox. Textbook of Influenza. 2013.

Human Cases of Reported Novel Influenza A Infection, 1959-2017

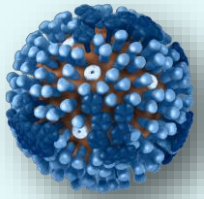
Includes Avian H4, H5, H6, H7, H9, H10 & Swine H1, H3 (not H1N1pdm09)



>30 fold increase from 1990's to 2000's

1. Freidl G, Meijer A, de Bruin E, et al. Influenza at the animal-human interface: a review of the literature for virological evidence of human infection with swine or avian influenza viruses other than A(H5N1). Euro Surveill. 2014 May 8;19(18).
2. Cumulative cases of H5N1 and H7N9. WHO and Chinese provincial reports.

- CDC Influenza Risk Assessment Tool (IRAT)
  - Ten elements of the virus, population immunity, and animal/human ecology are evaluated to develop a score

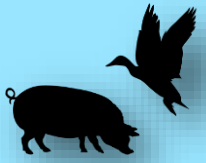


Virus

1. **Genomic variation**
2. **Receptor binding**
3. **Transmission in Laboratory animals**
4. **Antivirals and Treatment Options**

Population

5. **Existing Population Immunity**
6. **Disease Severity and Pathogenesis**
7. **Antigenic Relationship to Vaccine Candidates**

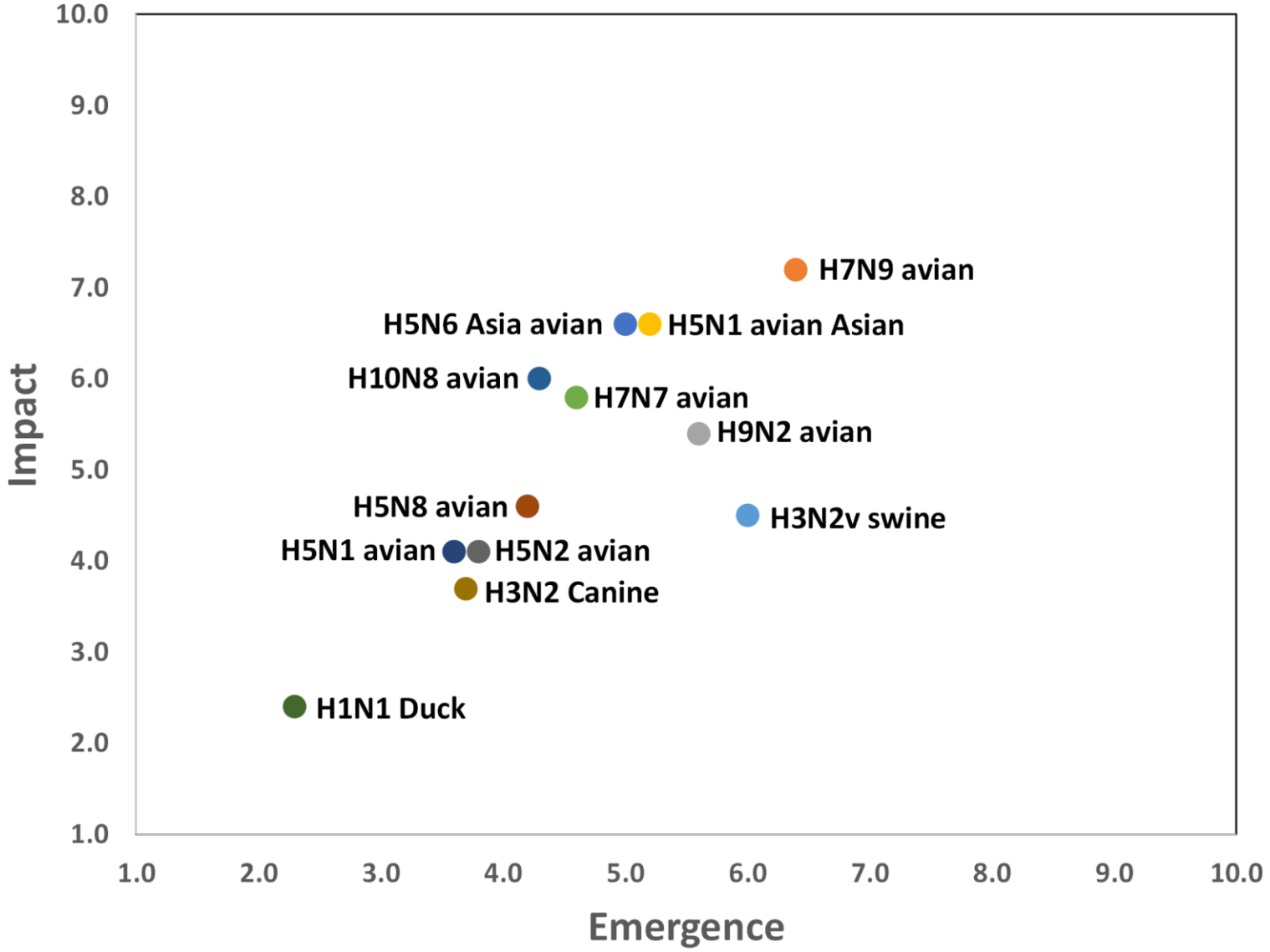


Ecology

8. **Global Geographic Distribution**
9. **Infection in Animals, Human Risk of Infection**
10. **Human Infections and Transmission**

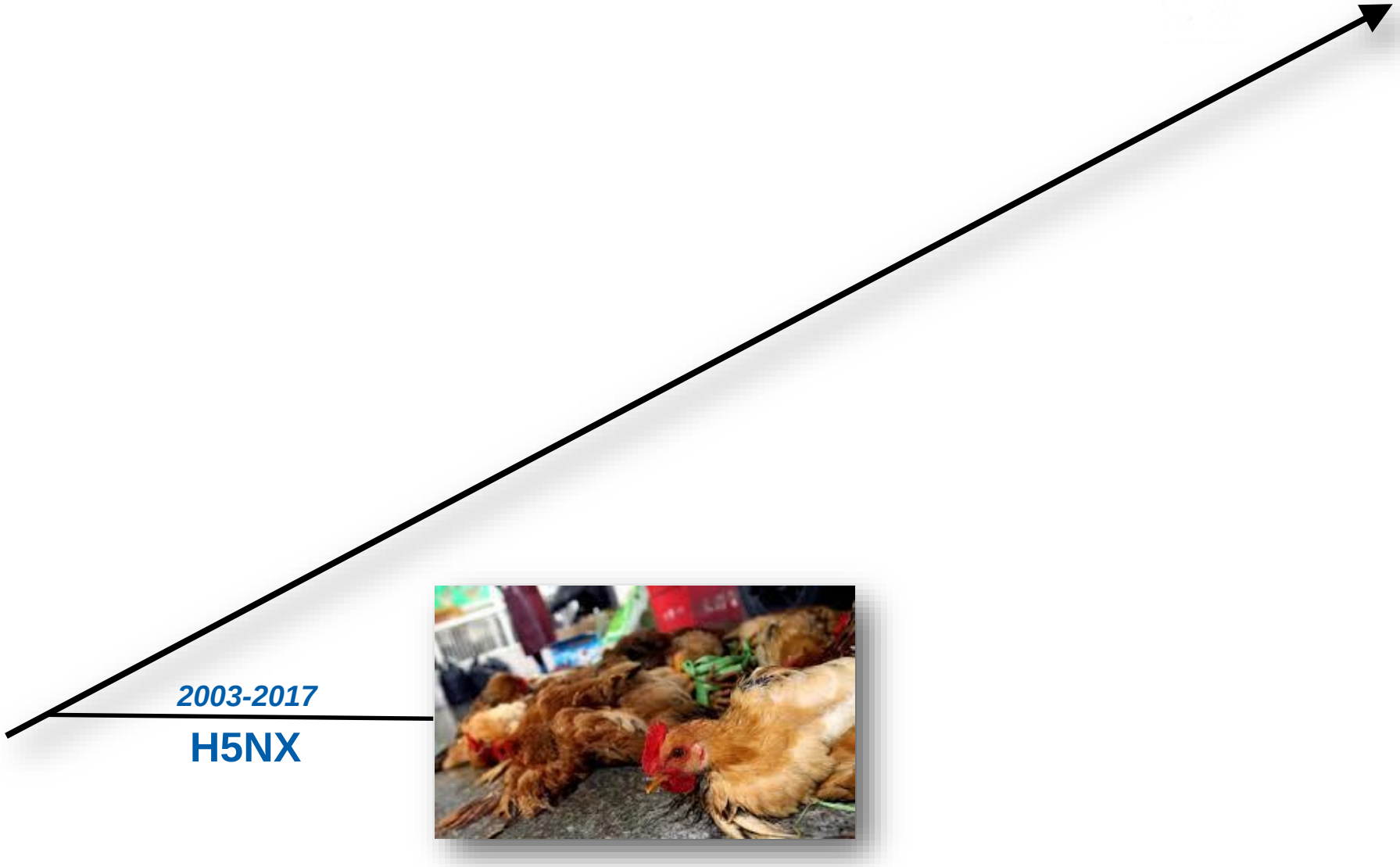
https://www.cdc.gov/flu/pandemic-resources/national-strategy/risk-assessment.htm

Influenza Risk Assessment – H7N9 Highest

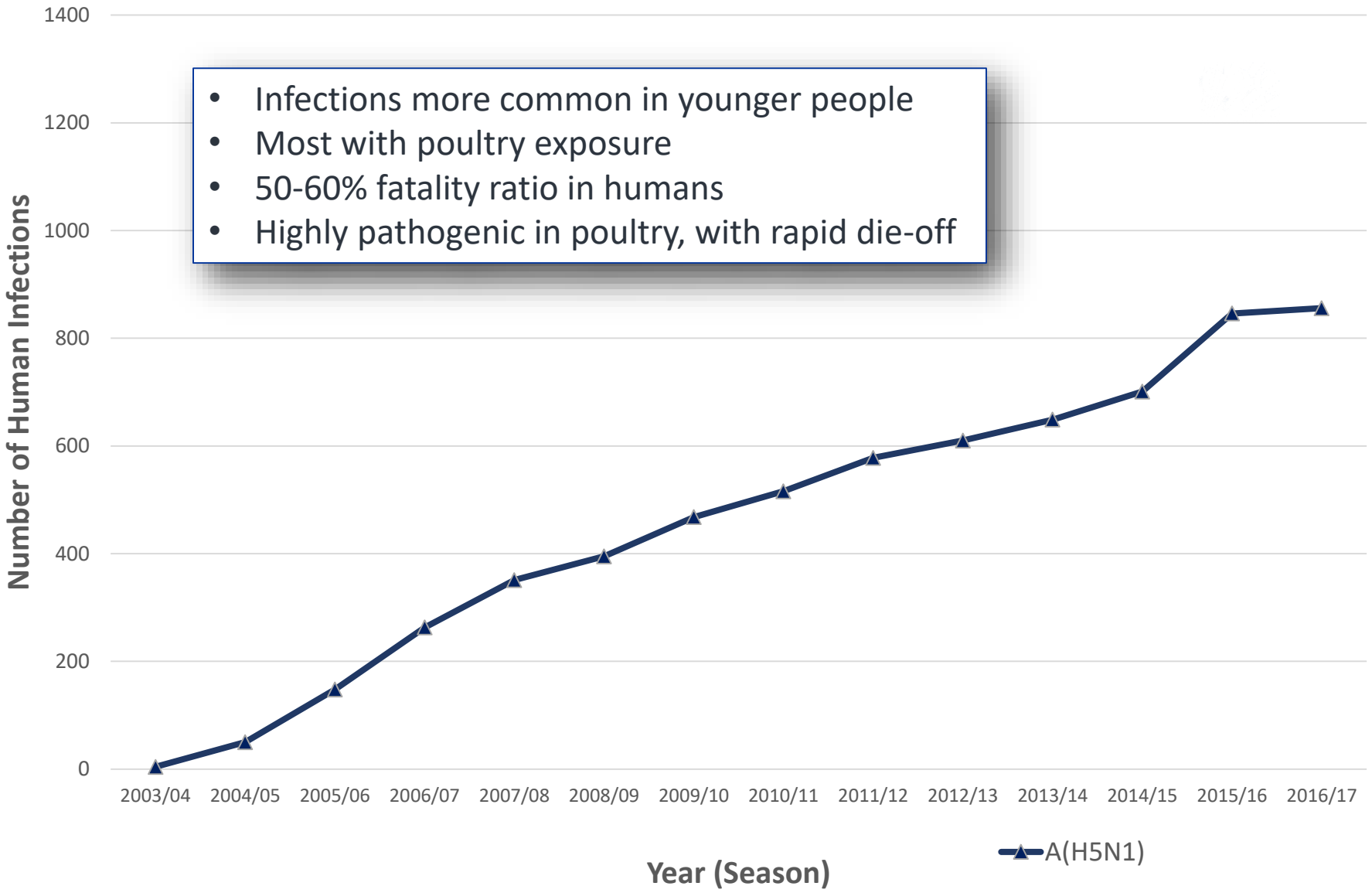


- H7N9 in China has maintained the highest score since 2013

CDC. https://www.cdc.gov/flu/pandemic-resources/monitoring/irat-virus-summaries.htm


2003-2017
H5NX

Cumulative Number of Human H5N1 Infections



- Infections more common in younger people
- Most with poultry exposure
- 50-60% fatality ratio in humans
- Highly pathogenic in poultry, with rapid die-off

Low Path vs High Path in Poultry

- Low Pathogenicity Avian Influenza (LPAI)
  - Poultry are generally asymptomatic
- Highly Pathogenic Avian Influenza (HPAI)
  - High fatality cause of rapid flock die-off
- Only H5 and H7 subtypes can be HPAI, and H5/H7 LPAI can spontaneously become HPAI

2003

H7N7

2003-2017

H5NX

2003

H7N7

2009

H1N1
Pandemic

2003-2017

H5NX

2011-2012

H3N2v

2003

H7N7

2009

H1N1 Pandemic

2003-2017

H5NX

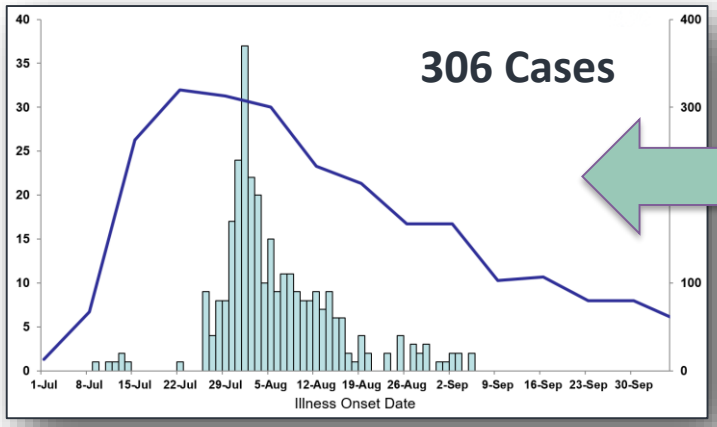
H3N2v – Human and Swine Virus Reassortant

Circulating H3N2 Human Influenza Virus

Circulating H3N2 Swine-Adapted Influenza Virus

In 1990's human H3N2 virus jumps to pigs and reassorts

Since 2012, swine-adapted H3N2 virus infects kids



H7N2

2017

2011-2012

H3N2v

2003

H7N7

2009

H1N1

Pandemic

2003-2017

H5NX

Emerging Influenza Viruses with Pandemic Potential

Influenza Division

H7N2

2017

H7N9

2013-17

2011-2012

H3N2v

2009

H1N1

Pandemic

2003

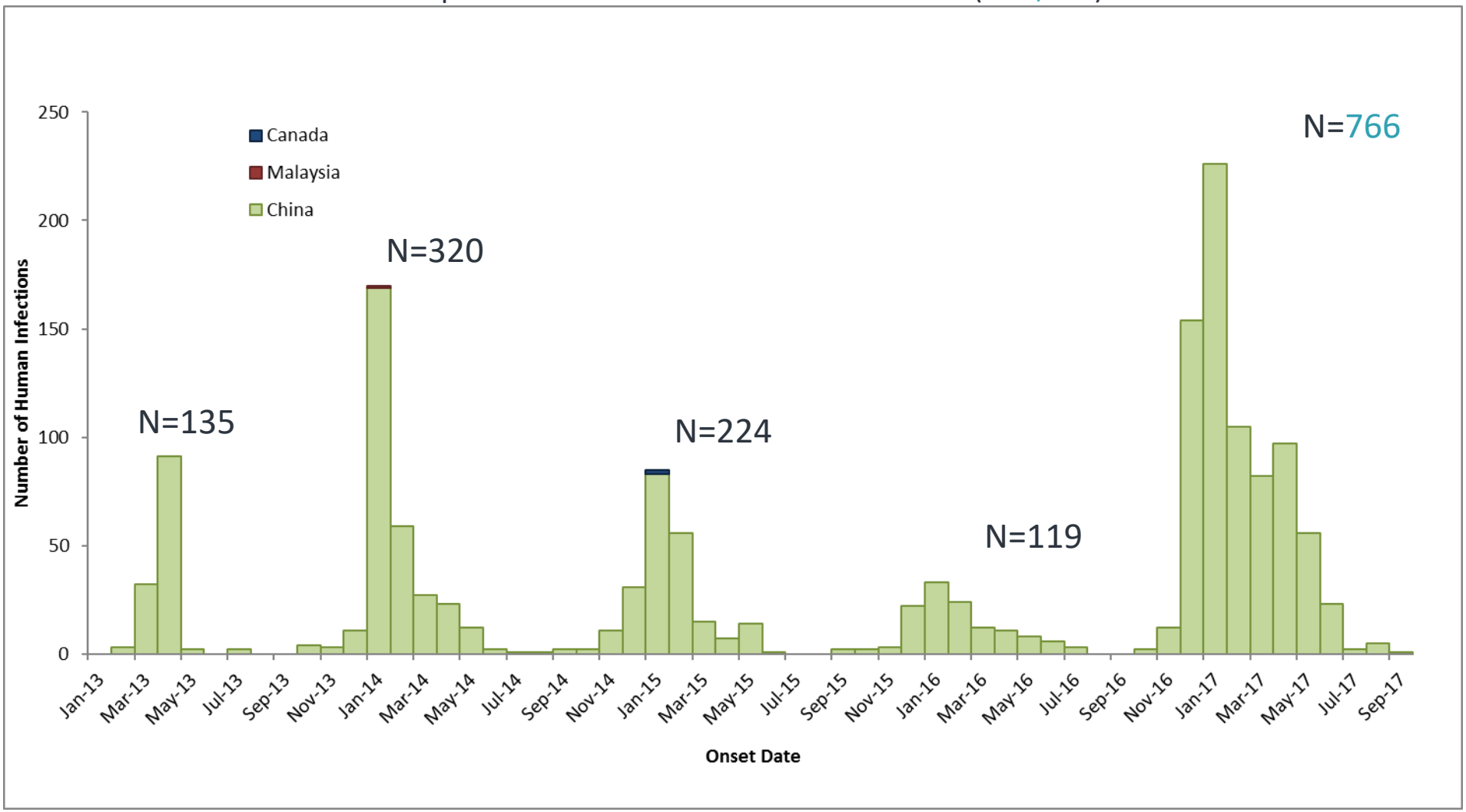
H7N7

2003-2017

H5NX

Human Infections of A(H7N9)

Epidemic Curve of Confirmed Avian Influenza A(H7N9) Virus Infections of Humans
Reported to WHO* 18 Feb 2013 – Present (N=1,564)†

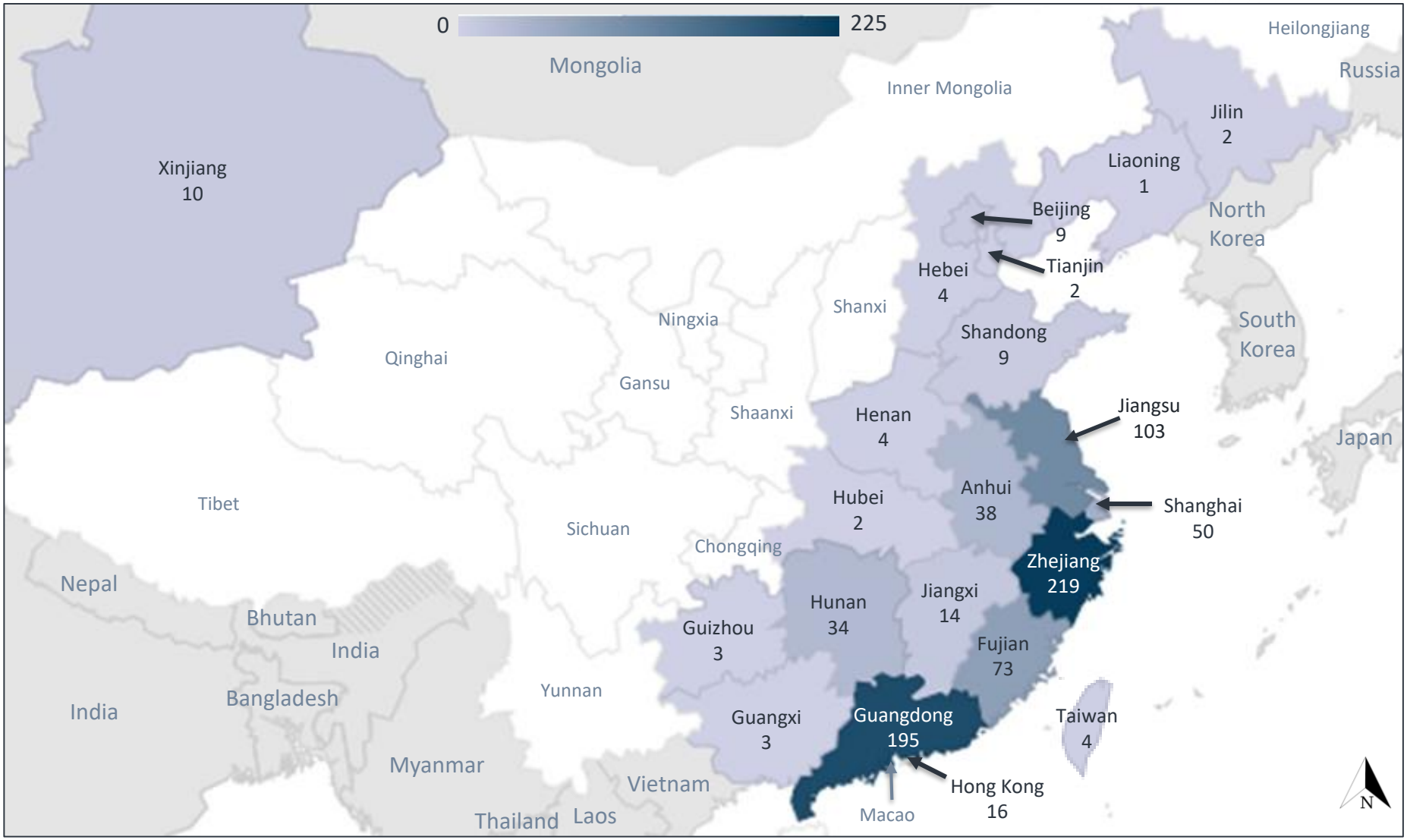


*Publically reported and pending public release: publically released infections in Disease Outbreak News (http://www.who.int/csr/don/en/) or Human-Animal Interface Monthly Report (http://www.who.int/influenza/human_animal_interface/en/) and those pending public release reported through IHR mechanism
†Date of onset missing for 6 case-patients

Blue text denotes new information

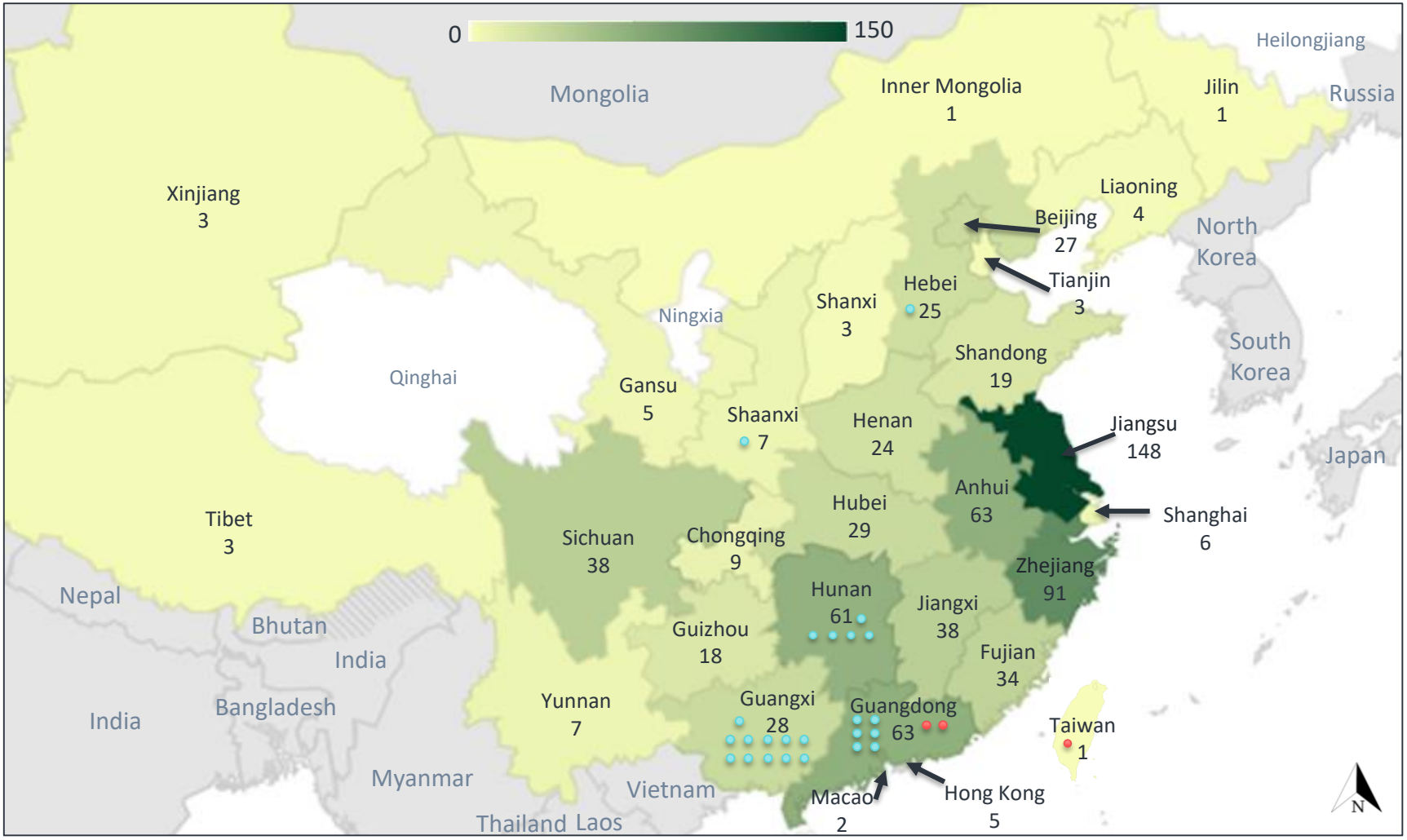
Geographic Distribution of 1st through 4th Epidemic Waves

Human A(H7N9) Infections Reported (N=795)



Geographic Distribution

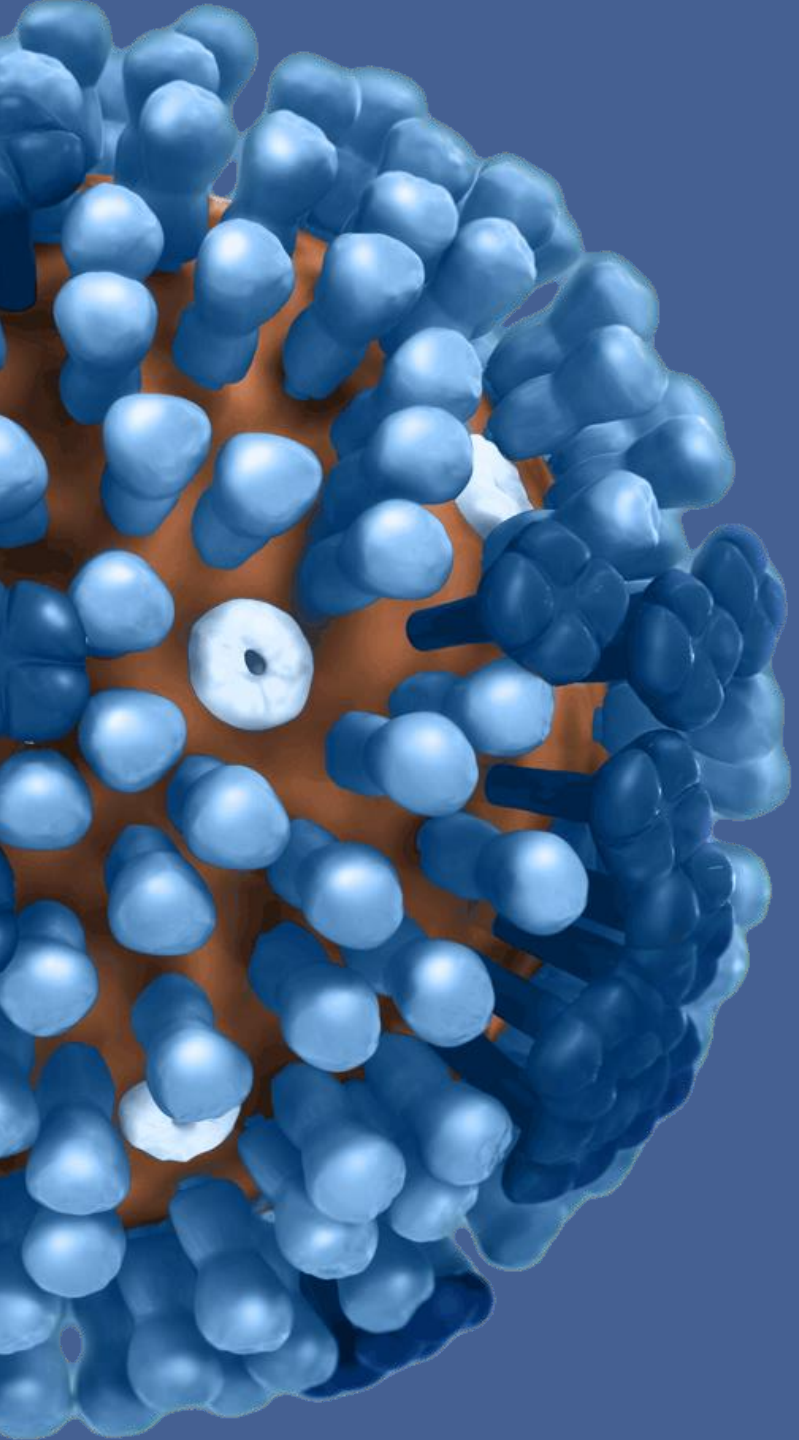
Geographic Distribution of 5th Epidemic Confirmed Avian Influenza A(H7N9) Virus Infections of Humans, Reported to WHO or in Chinese Provincial or Hong Kong CHP Press Releases, October 1, 2016-September 30, 2017 (N=766)*



- Human Infections of A(H7N9) with HPAI mutation reported to WHO
- Human Infections of A(H7N9) with HPAI mutation identified by China CDC or Taiwan CDC

* LPAI human infections are by Province of Reporting; HPAI human infections are by Province of Exposure, province of exposure not reported for one HPAI human infection

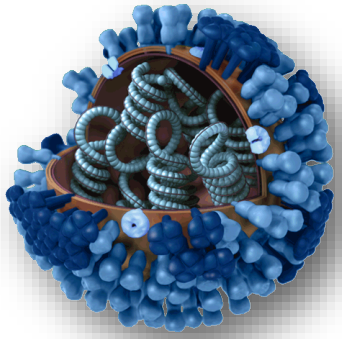
Blue text denotes new information



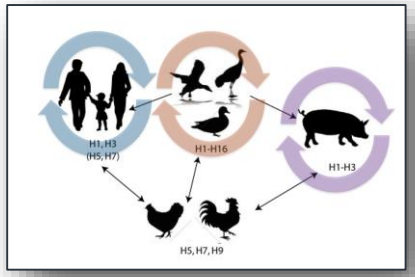
Conclusions

Conclusions

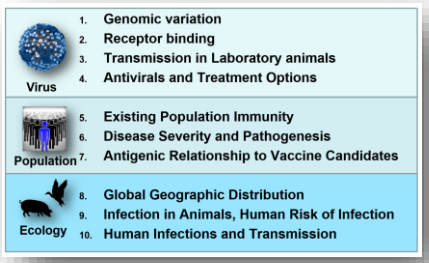
- Influenza viruses are constantly changing, requiring ongoing surveillance and frequent vaccine virus changes

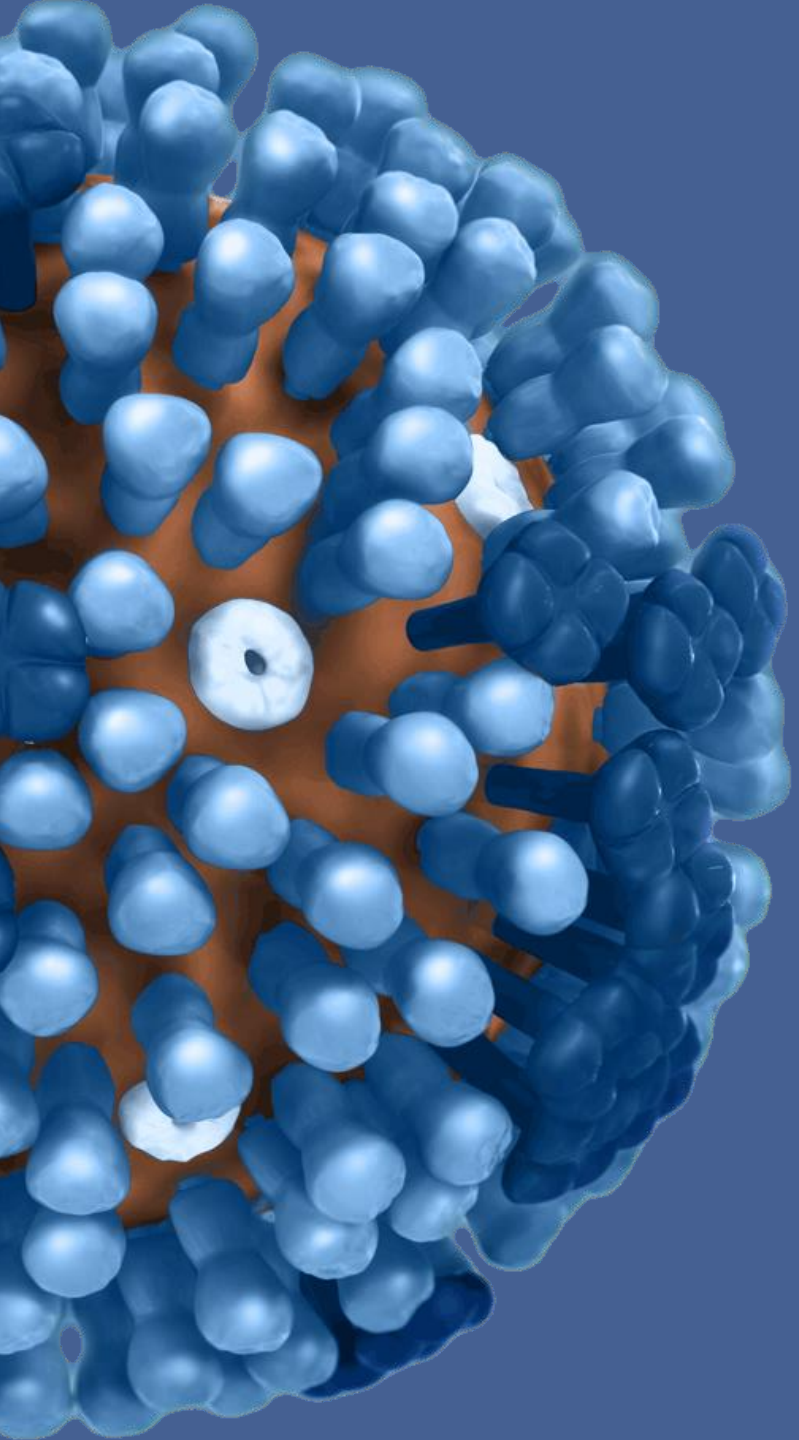


- Youth working with agricultural animals can be a positive activity and is also an important interface where infection can be mitigated or prevented.



- It is important to:
  - Share project successes and best practices
  - Communicate the findings
  - Set priorities for important future work





Thank You

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WHO

BARDA

ICU

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T Maines

S Sambhara

V Dugan

D Iuliano

E Azziz-Baumgartner

J Bresee

S Olsen

A Fry

C Reed

L Brammer

B Flannery

M Biggerstaff

A Budd

B Neuhaus

E Eisenberg

S Shepard

E Eisenberg