Who's flu is it?

It's OUR flu!

An update on influenza A virus jumping between birds and mammals and humans

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-With special thanks to **Martha Nelson, NCBI, NLM, NIH,** for sharing the depths of her knowledge

Overview

- What is influenza A viruses (IAV) aka flu?
- Why it is important to know about IAV?
- Where are H5 IAV in the World/USA?
- Are pigs at risk?

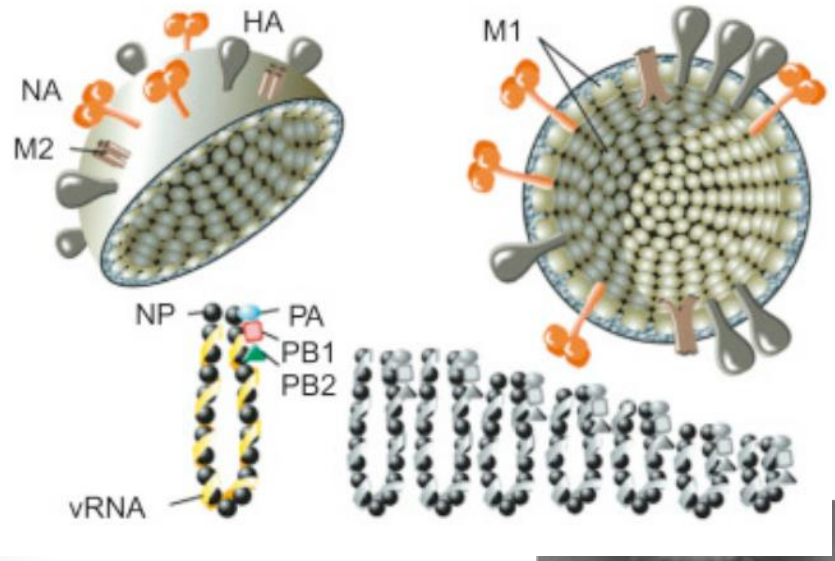
Know thy Enemy

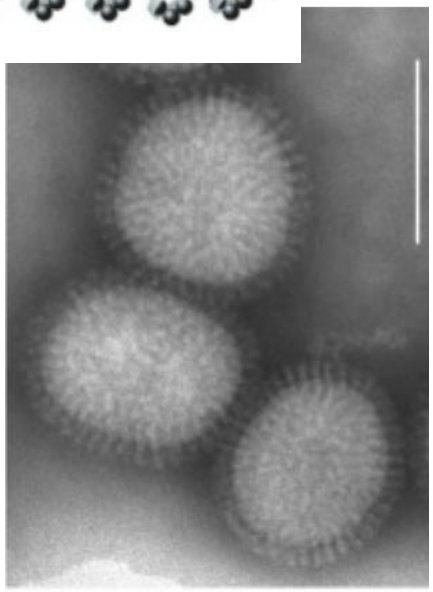
“If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.”

— Sun Tzu, The Art of War

WHAT ARE FLU VIRUSES?

Overview





Pictures from Chapter: Orthomyxoviridae In Fenner's Veterinary Virology (Fifth Edition), 2017

- Orthomyxovirus
  - Influenza A virus, Influenza B virus, Influenza C virus, Influenza D virus, Isavirus, Thogotovirus, Quanranjavirus
  - Cause disease of varying severity
    - subclinical to lethal
- Negative strand RNA genome
  - Change/mutate
- **Influenza A viruses**
  - Segmented genome
    - 8 segments
    - Encodes 10 (12) proteins
      - Reassort/"mix up" virus genome
      - Use proteins to infect and replicate
  - Surface proteins are immunogenic
    - Hemagglutinin (HA) (1 to 19)
      - Receptor binding
    - Neuraminidase (NA) (1 to 11)
      - Release and spread of progeny virions

WHERE DO FLU VIRUSES COME FROM?

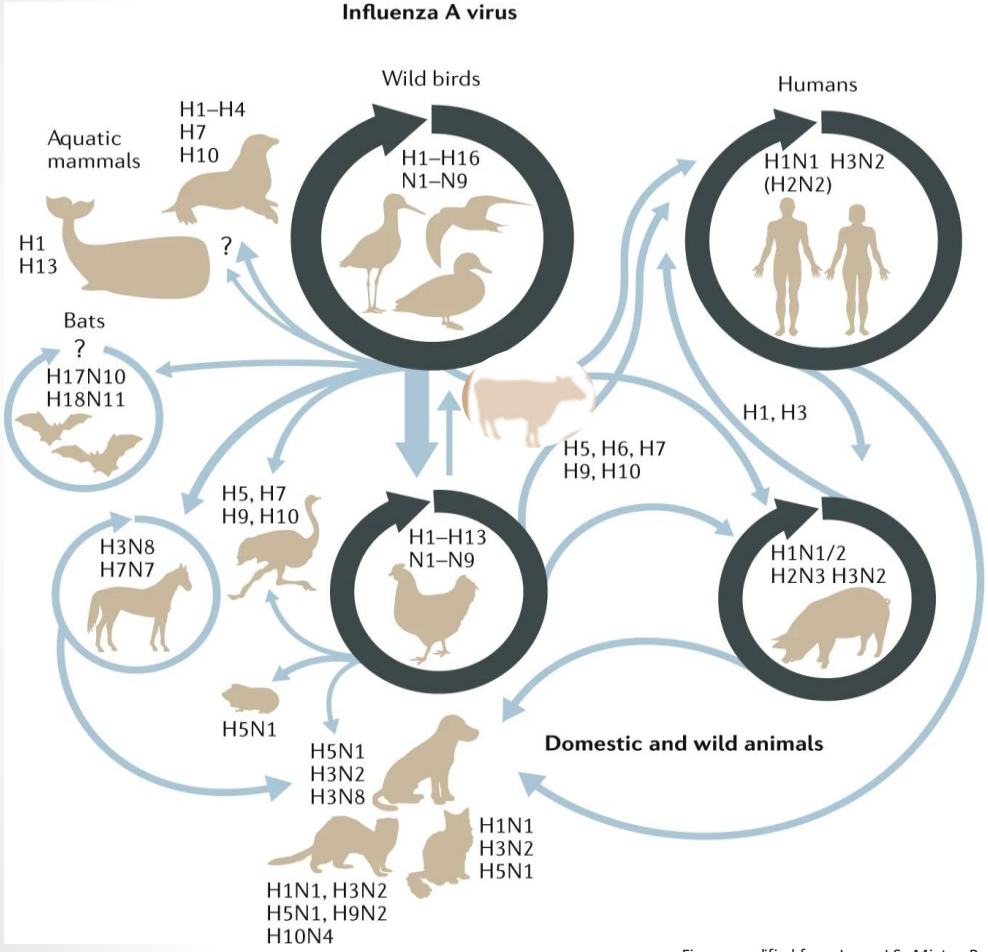
16 HA
9 NA in avians

H1N1 → **H16N9**

105 kinds in avians

H5 and H7 are pretty common. H5N1 is our concern today.

Flu viruses are shared



And so are Influenza B, C, and D viruses

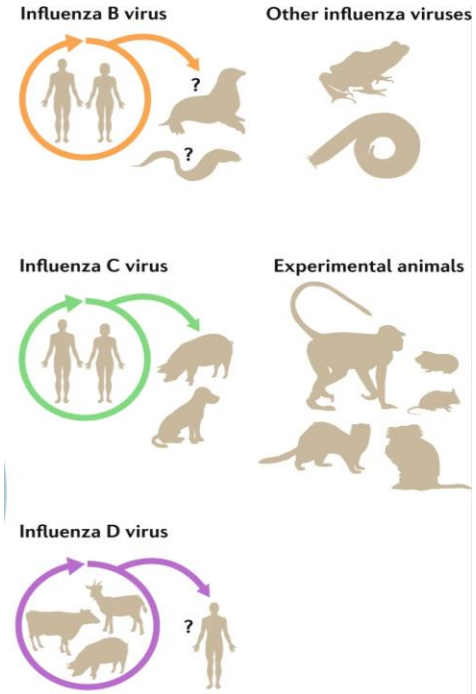
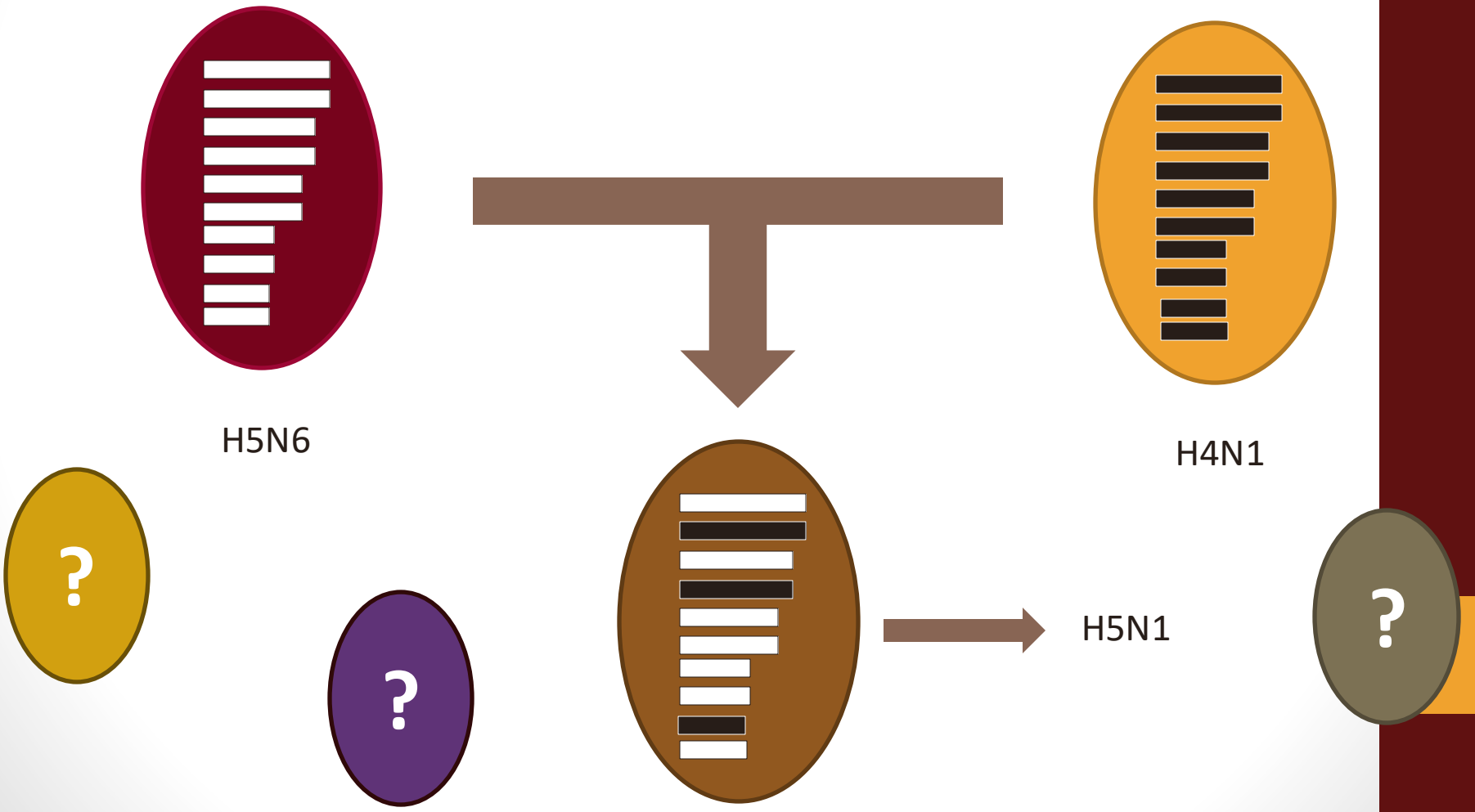


Figure modified from Long, J.S., Mistry, B., Haslam, S.M. *et al.* Host and viral determinants of influenza A virus species specificity. *Nat Rev Microbiol* **17**, 67–81 (2019). https://doi.org/10.1038/s41579-018-0115-z

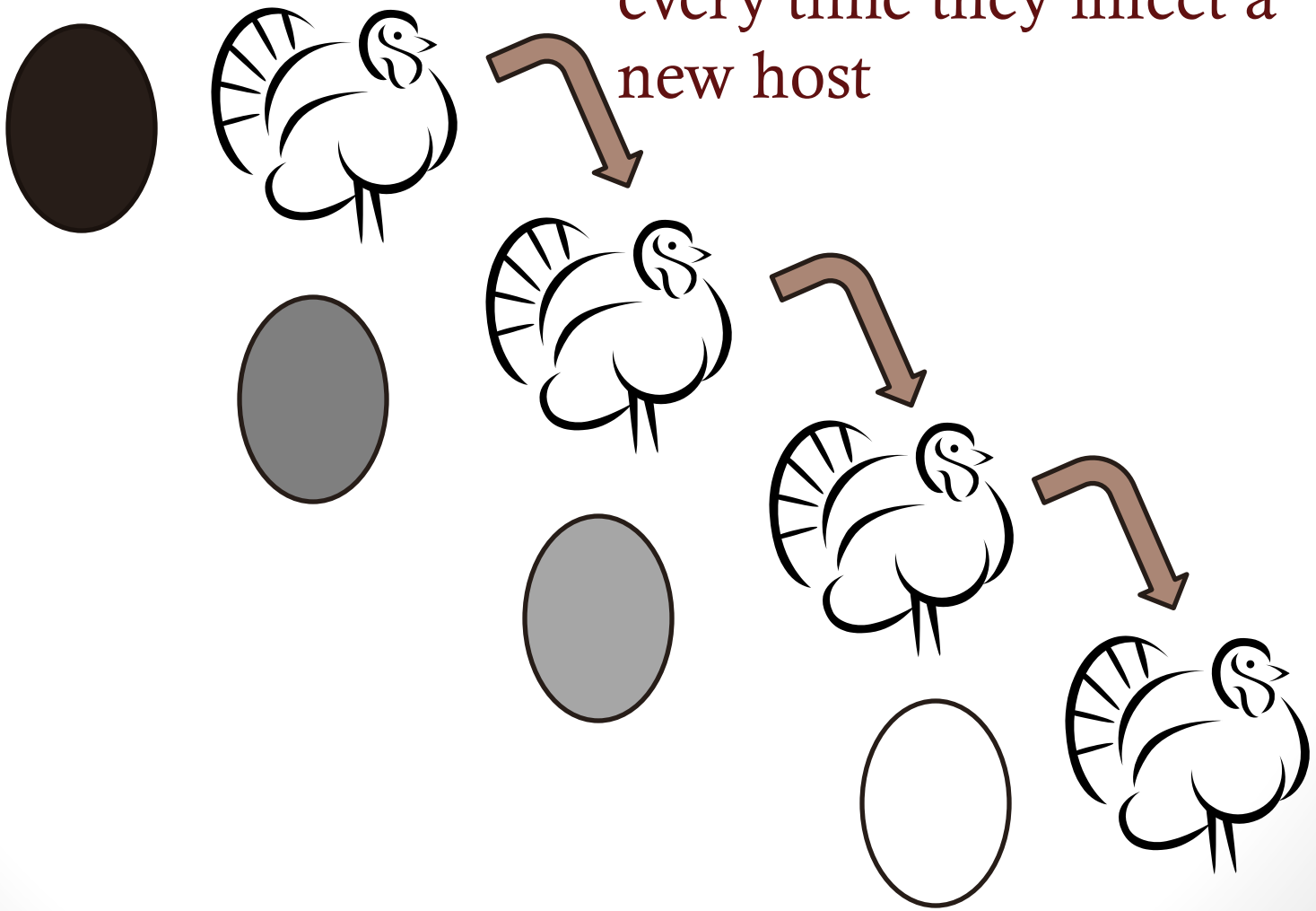
How do flu viruses change?

- New viruses can be created when one host is infected with more than one flu virus = reassortment



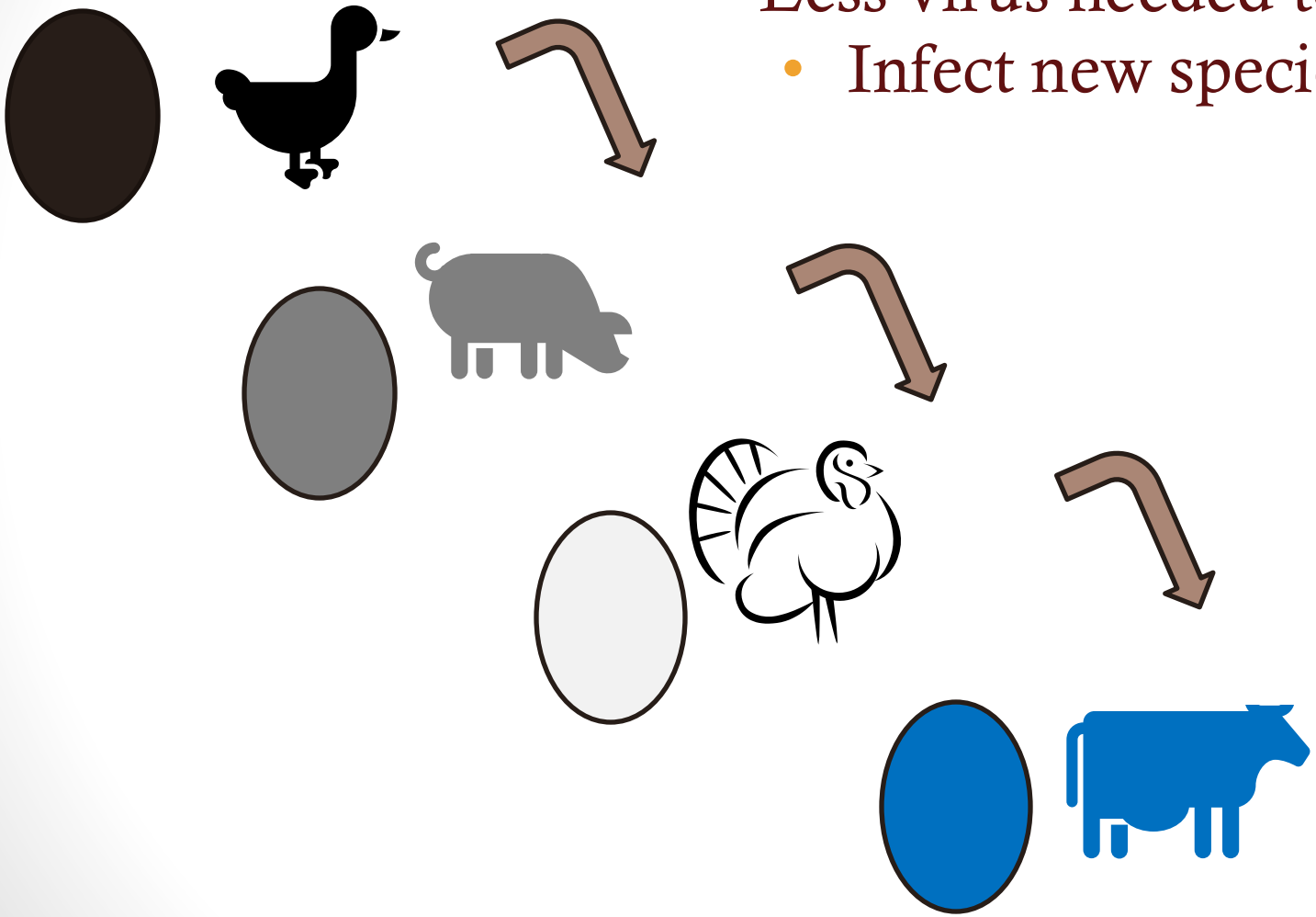
How do flu viruses change?

- Influenza viruses change every time they infect a new host



What happens?

- Become stronger OR weaker
  - Less virus needed to infect
    - Infect new species



Note – images are not to scale ☺

What is H5 and where did it come from?

Live tracking available

What is H5 and where is it in mammals?

Geographic location of mammal species affected by highly pathogenic influenza virus A(H5N1)

In previous waves of infection 2003–2019 (A)

In the current panzootic, 2020–2023 (B)

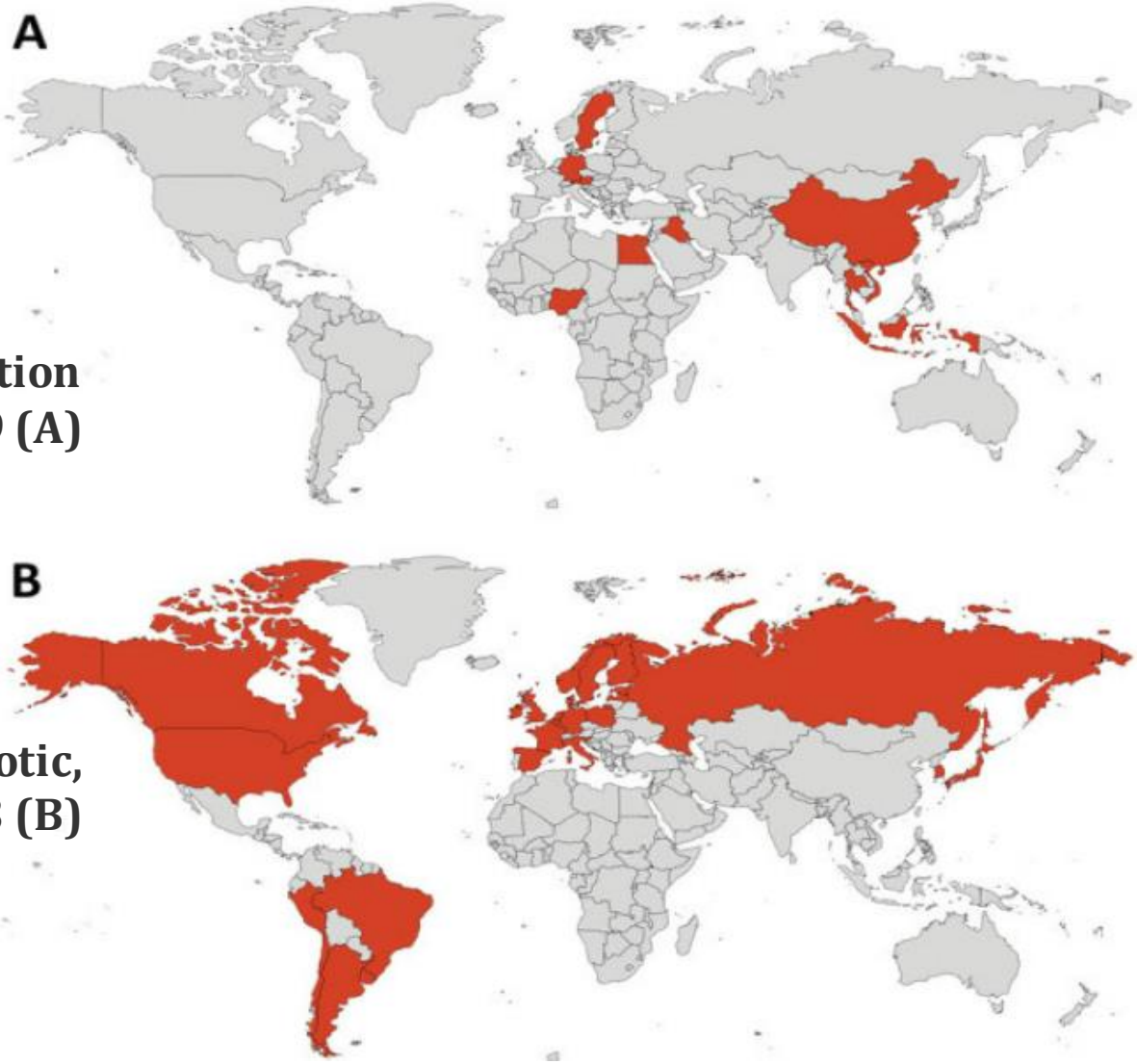
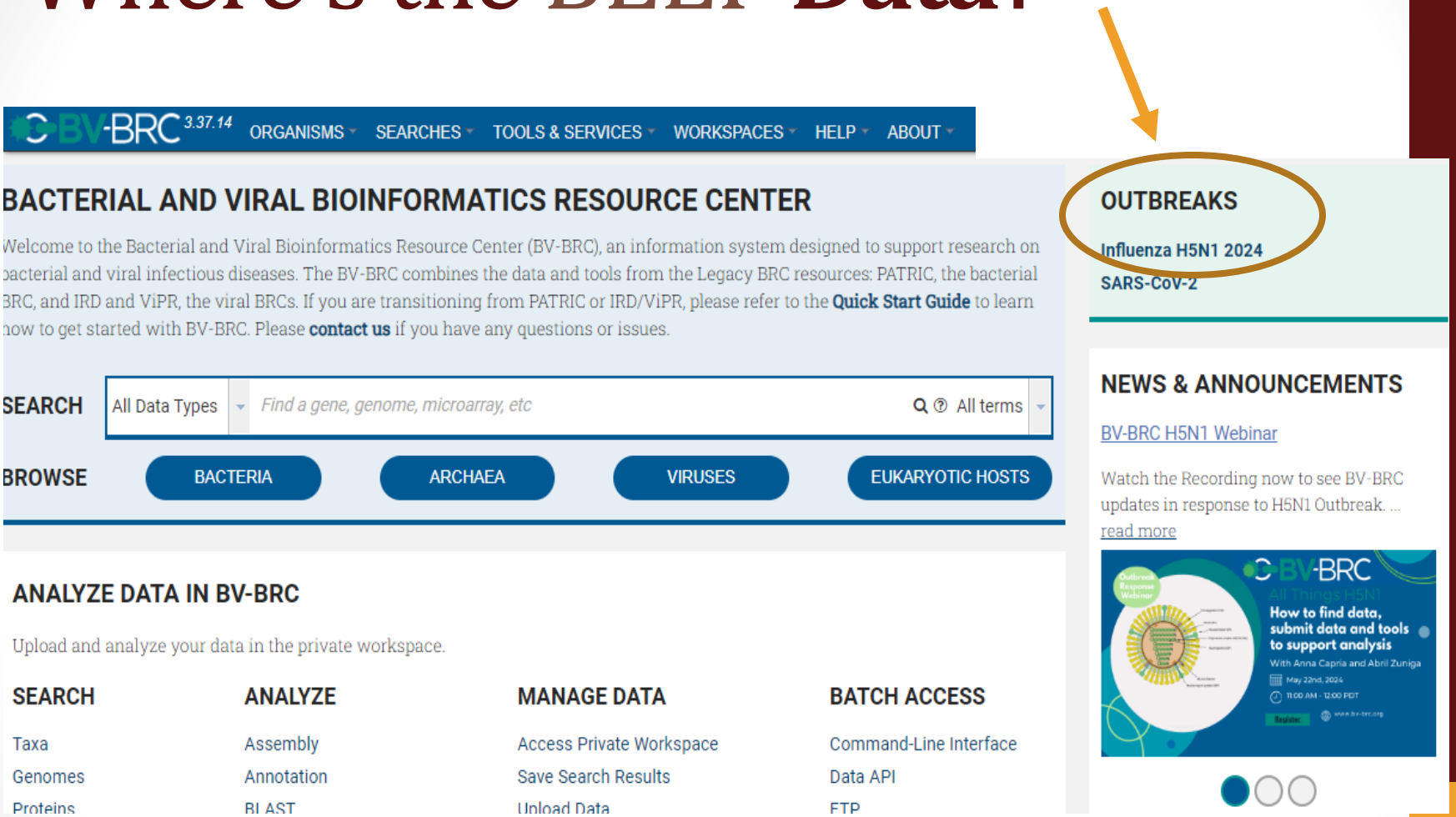


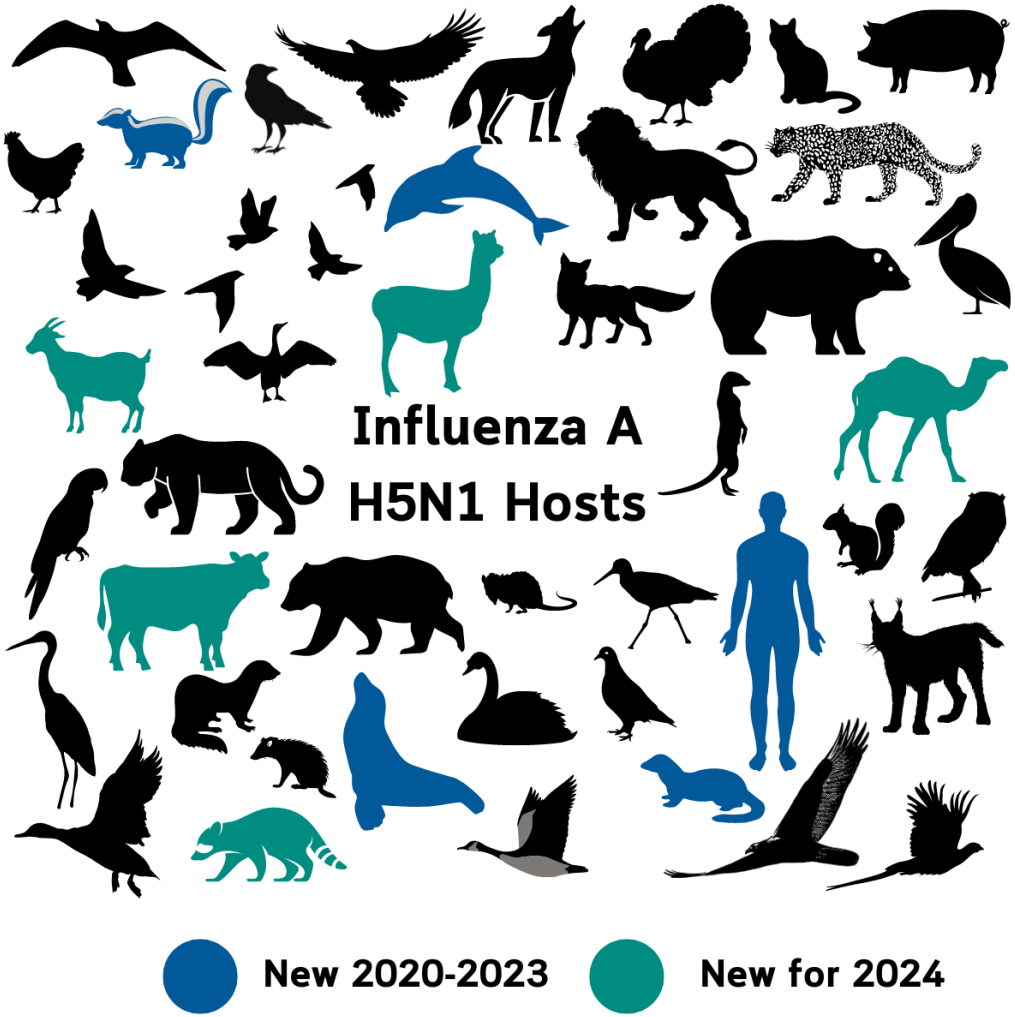
Figure 1 from 2024 Plaza, P. I., Gamarra-Toledo, V., Euguí, J. R., & Lambertucci, S. A. (2024). Recent Changes in Patterns of Mammal Infection with Highly Pathogenic Avian Influenza A(H5N1) Virus Worldwide. Emerg Infect Dis, 30(3), 444-452. doi.org/10.3201/eid3003.231098

Where's the ~~BEEF~~ Data?



www.bv-brc.org

What Species have been H5 infected?



www.bv-brc.org/outbreaks/H5N1/#view_tab=overview

H5N1 In Dairy Cattle: Update?

USDA

HPAI Confirmed Cases in Livestock Herds
as of August 19, 2024
Last reported confirmed detection Tuesday, August 13, 2024
Data updated weekdays by 12pm Eastern

Download Data

Choose time period
Total Outbreak

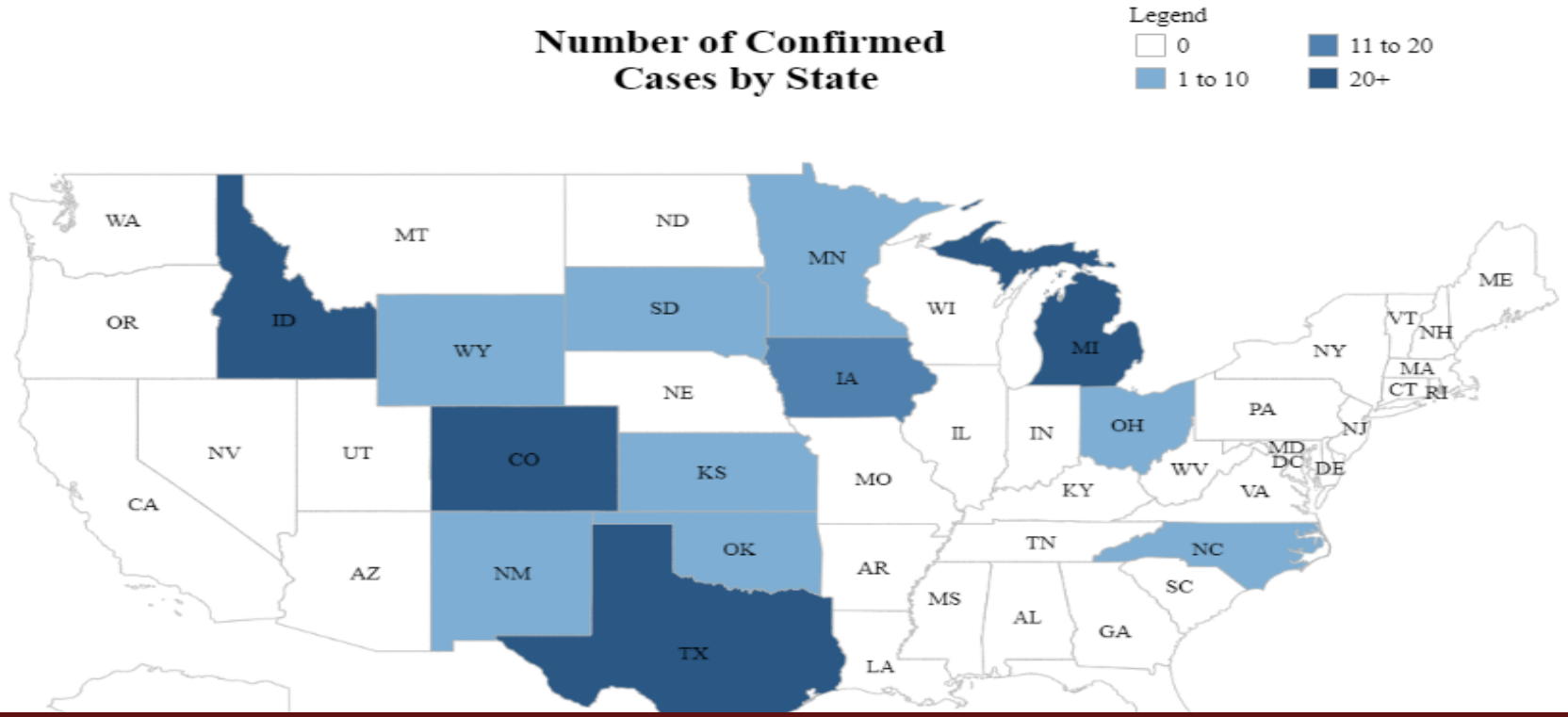
Click for International Exports

Situational Update

Confirmed Cases Total Outbreak
192

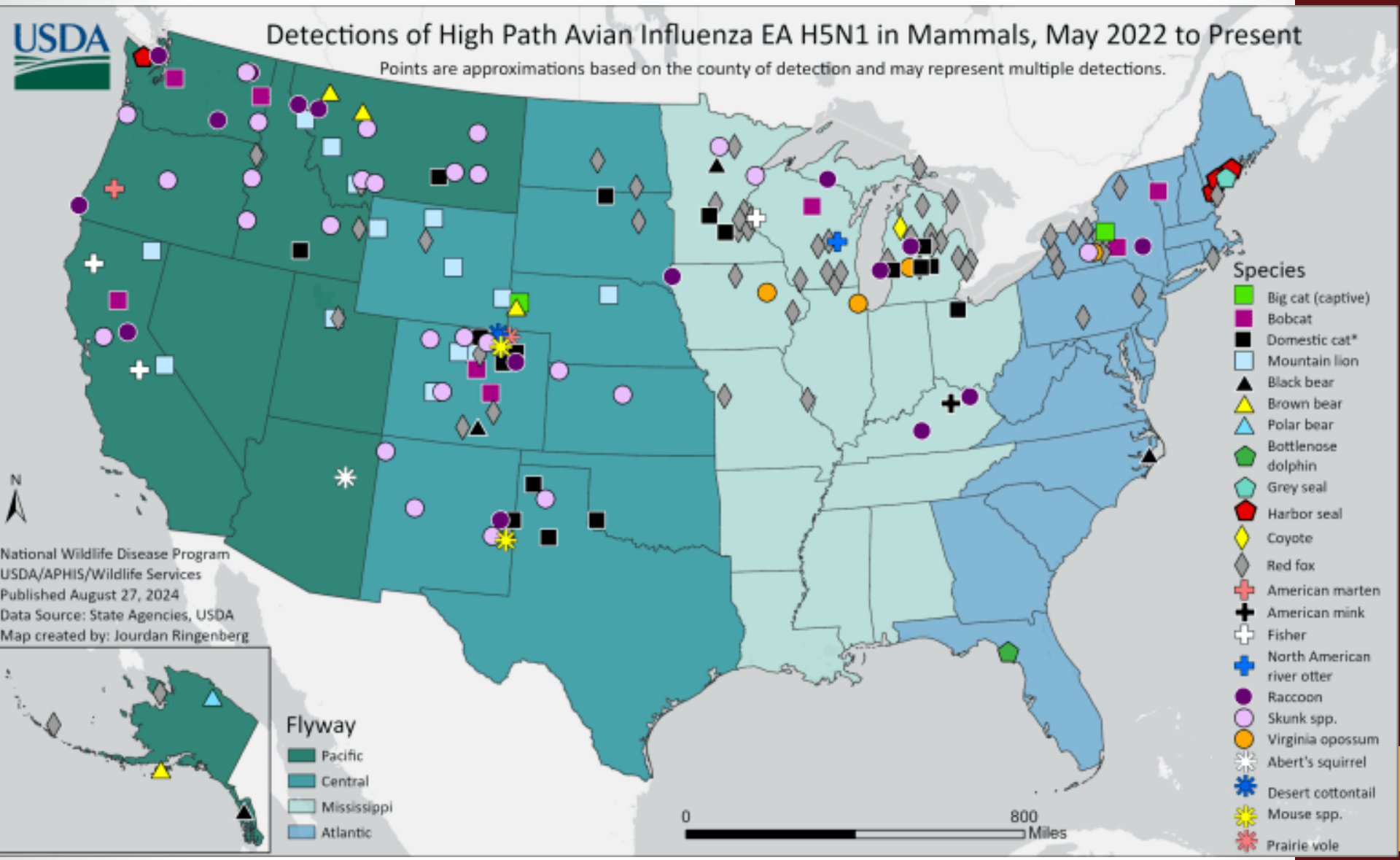
States Affected Total Outbreak
13

Number of Confirmed Cases by State



https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/livestock AS OF AUGUST 19, 2024

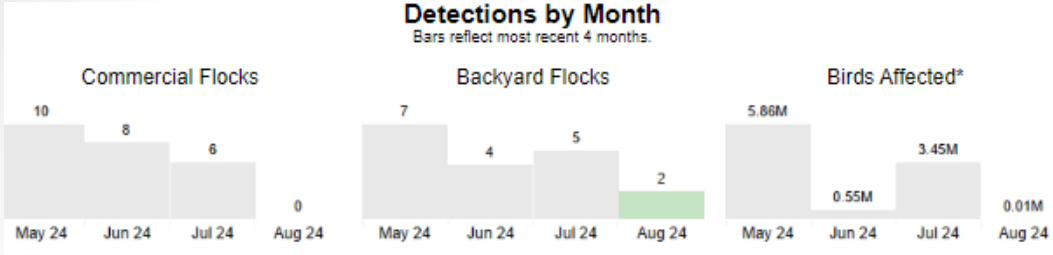
Detections of Highly Pathogenic Avian Influenza in Mammals

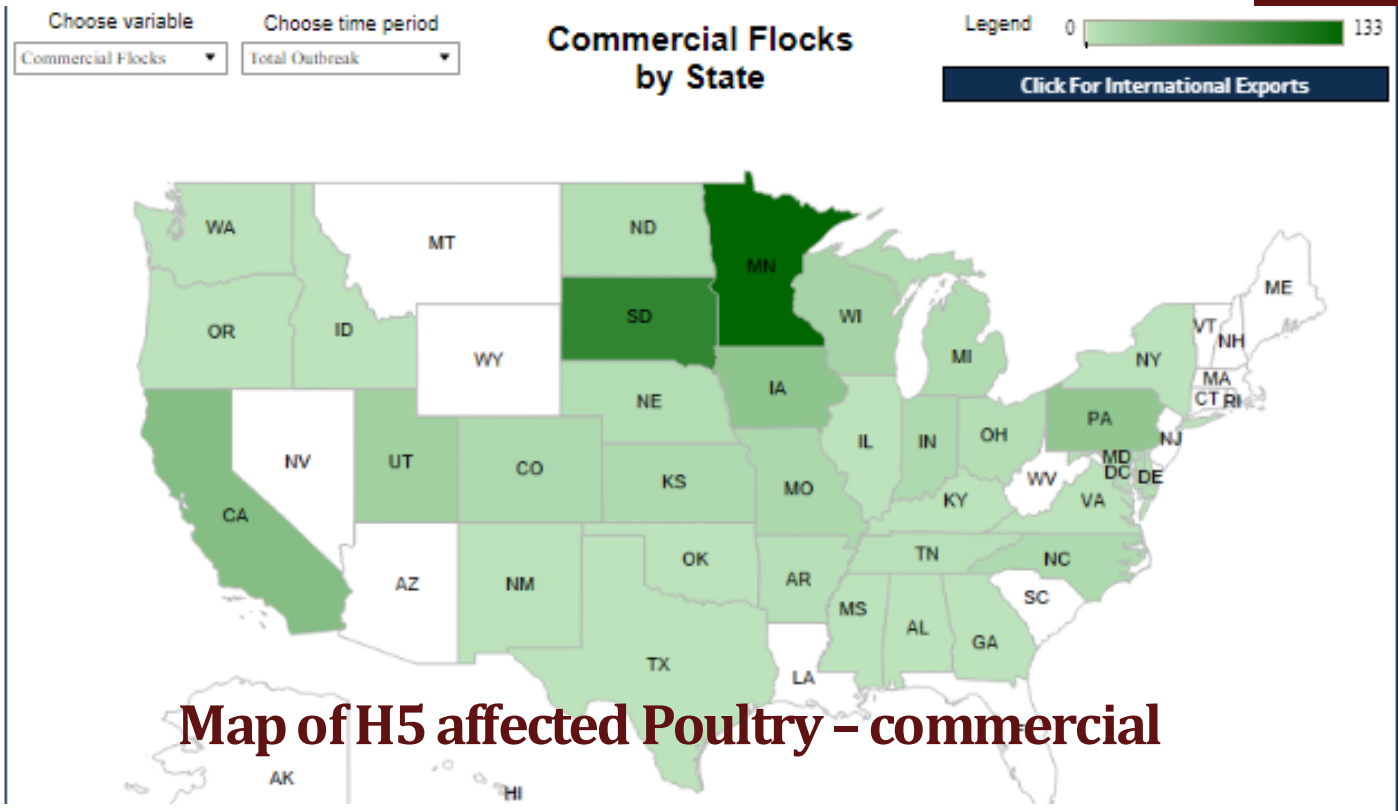


As of August 27, 2024 from https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/mammals

HPAI 2022/2023 Confirmed Detections

as of August 29, 2024
Last reported detection Tuesday, August 20, 2024
Data updated weekdays by 12pm Eastern





Map of H5 affected Poultry – commercial

https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/commercial-backyard-flocks

When did the H5 cow problem start?

- Spring 2024, 9 infected states
  - TX, KS, MI, NM, ID, OH, NC, SD, CO
  - 30-50K heifers moving per week from TX and the panhandle region.
    - Easy place to raise calves
      - hot dry environment
  - This is no longer spread solely due to movement of lactating cows.
  - The US moves livestock all the time.

What does H5 flu look like in Cattle?

- LACTATING DAIRY COWS
  - Decreased appetite,
  - Lethargy,
  - Increased respiratory secretions,
  - High temperatures (up to 105°F or 40.56°C),
  - Abnormal bowel movements, and
  - >4.75% of the herd had clinical signs and were being treated in the hospital pens.
    - *FROM: Oguzie, J. U., Marushchak, L. V., Shittu, I., Lednicky, J. A., Miller, A. L., Hao, H....Gray, G. C. (2024). Avian Influenza A(H5N1) Virus among Dairy Cattle, Texas, USA. Emerging Infectious Diseases, 30(7), 1425-1429. https://doi.org/10.3201/eid3007.240717.*

- GENERAL TIMELINE
  - 4-6 days peak incidence
  - Taper at 10-12 days
  - Milk production recovery ~ 45 days but not all cows
  - Bulk tank PCR negative 45-60 days
    - *FROM: Burrough, E. R., Magstadt, D. R., Petersen, B., Timmermans, S. J., Gauger, P. C., Zhang, J....Main, R. (2024). Highly Pathogenic Avian Influenza A(H5N1) Clade 2.3.4.4b Virus Infection in Domestic Dairy Cattle and Cats, United States, 2024. Emerging Infectious Diseases, 30(7), 1335-1343. https://doi.org/10.3201/eid3007.240508.*

What does H5 look like in Dairy Workers?

- Cases 1 (NEJM) & 2 (CDC) direct contact with clinically infected cows in Texas and Michigan
  - Did not wear eye protection
  - No respiratory issues in first two cases
  - Conjunctivitis (no vision change) resolved in a several days
- Case 3 (CDC) direct contact with clinically infected cows in Michigan
  - Respiratory symptoms
  - No conjunctivitis
- ***Same flu as found in dairy cows and poultry***

Protect Yourself From H5N1 When Working With Farm Animals

H5N1 is a bird flu virus that could make you sick. Wear recommended personal protective equipment (PPE) when working directly or closely with sick or dead animals, animal feces, litter, raw milk, and other materials that might have the virus.

Wash hands with soap and water, then put on PPE in this order:

1. Fluid-resistant coveralls
2. Waterproof apron, if needed for job task
3. NIOSH Approved® Respirator (e.g., N95® filtering facepiece respirator or elastomeric half mask respirator)
4. Properly-fitted unvented *or* indirectly vented safety goggles or face shield
5. Head cover or hair cover
6. Gloves
7. Boots

Scan to learn how to put on and take off a respirator

While wearing PPE

- Use separate designated clean areas, one for putting on PPE and one for taking off PPE.
- Avoid touching your eyes, mouth, and nose after touching any contaminated material.
- Do not eat, drink, smoke, vape, chew gum, dip tobacco, or use the bathroom.

Follow these steps to safely remove PPE

1. Remove the apron, if worn
2. Clean and disinfect boots
3. Remove boots
4. Remove coveralls
5. Remove gloves
6. Wash hands with soap and water or alcohol-based hand rub
7. Remove goggles or faceshield and then remove respirator
8. Remove head cover or hair cover
9. Wash hands again with soap and water or alcohol-based hand rub

After removing PPE

- Shower at the end of the work shift.
- Leave all contaminated clothing and equipment at work.
- Watch for symptoms of illness while you are working with potentially sick animals or materials. Continue watching for symptoms for 10 days after finishing working. If you get sick, tell your supervisor and talk with a doctor.

Reusable and disposable PPE

- While removing PPE, dispose of all disposable PPE appropriately and set aside reusable PPE
- Clean and disinfect reusable PPE after every use

Scan to find more PPE and worker safety information

CDC NIOSH

April 2024

13 humans with H5

4 humans with H1 or H3

- Protect the Mucosa
  - Eyes, nose, mouth
- Gloves and handwashing
- Wear protections with contact or close exposure:
  - Sick, dead birds or other animals
  - Feces, milk, litter from sick birds, other animals

CDC Current situation updates re:
animal-to-human flu transmission (zoonoses):

H5 = https://www.cdc.gov/bird-flu/h5-monitoring/index.html

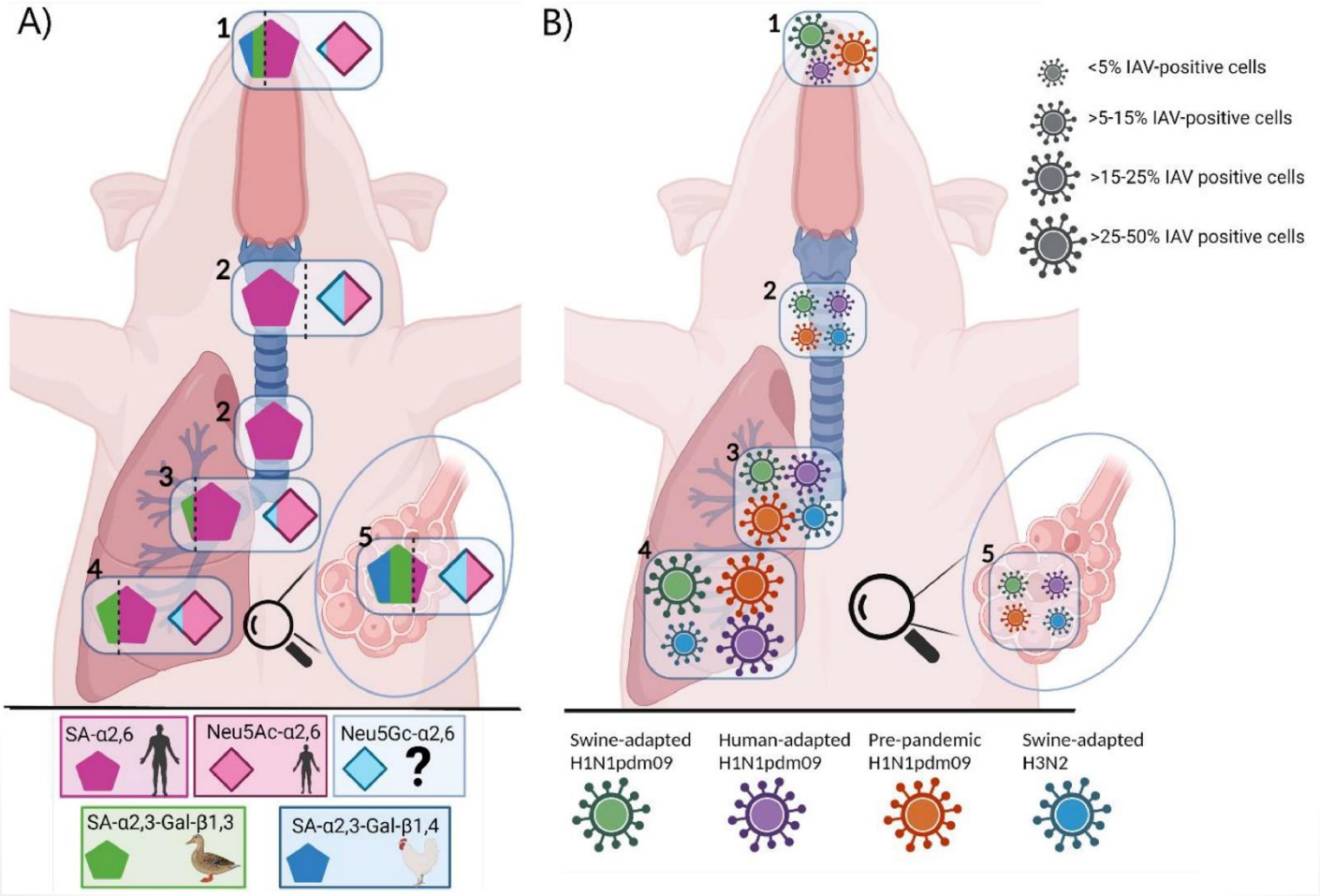
H1 or H3 = https://www.cdc.gov/swine-flu/about/index.html

Are pigs at risk? YES

Danish research -Pigs are HIGHLY SUSCEPTIBLE to flu

- **All types of flu receptors from nose to lung**

Kristensen et al(2024) Virus Res, 340, 199304 .doi.org/10.1016/j.virusres.2023.199304



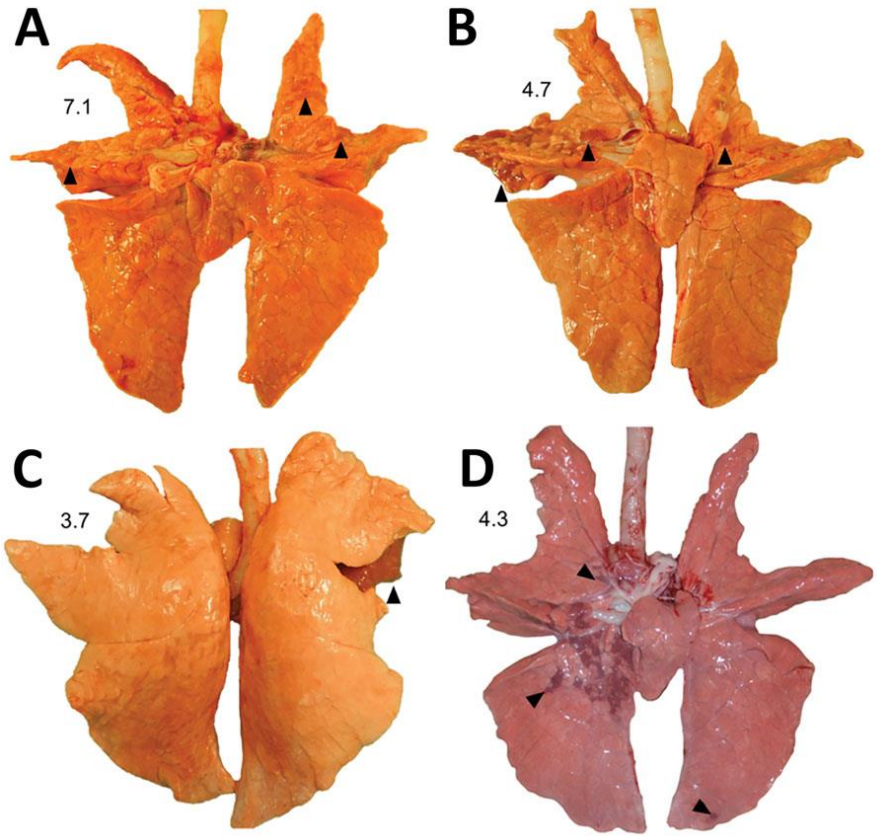
Are pigs at risk? YES

US research -Pigs H5 flu challenged with 2 strains of birds and 2 of mammals

- **All 4 infected pigs, some spread, and the disease varied**

Arruda, B., Baker, A. L. et al (2024). *Emerg infect dis*, *30*(4), 738–751. doi.org/10.3201/eid3004.231141

A) Multifocal pulmonary consolidation (arrowheads) in pig 777 infected with A/turkey/MN/22, necropsied at 3 days postinoculation (dpi).
B) Multifocal pulmonary consolidation (arrowheads) in pig 796 infected with A/bald eagle/FL/22 necropsied on 5 dpi.
C) Locally extensive pulmonary consolidation (arrowheads) in pig 58 infected with A/raccoon/WA/22 necropsied on 3 dpi.
D) Multifocal pulmonary consolidation (arrowheads) of pig 78 infected with A/redfox/MI/22 necropsied on 3 dpi

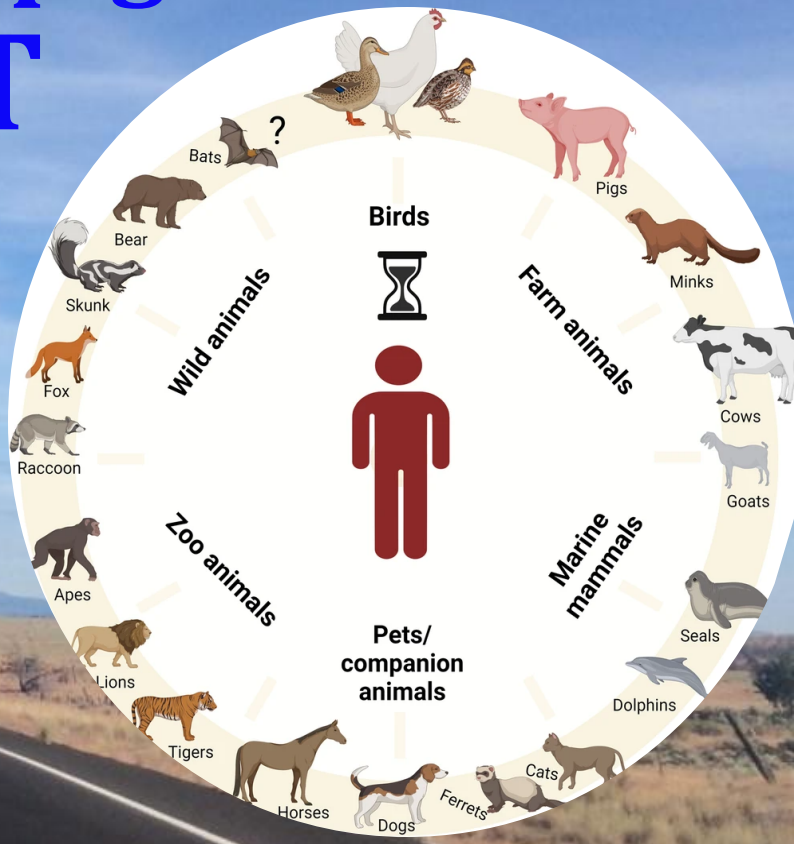


AND…Pigs readily change/reassort the flu virus

Ma et al. (2008) J. Mol. Genet. Med. 3, 158–166 (2008). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2702078/

Reassortment can lead to outbreaks in pigs and maybe pandemics

OUR Shared flu is concerning BUT biosecurity, vaccines, pig flow knowledge and GRIT can keep us off the dangerous road



OPEN ACCESS FIGURE from Abdelwhab, E.M., Beer, M. (2024). doi.org/10.1038/s44298-024-00039-z

Thank you

NIFA, APHIS, NIH, NPB, MDA, FPRF-NARA, UMN, OSU

Questions:

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