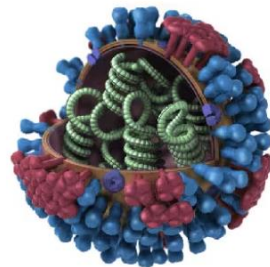




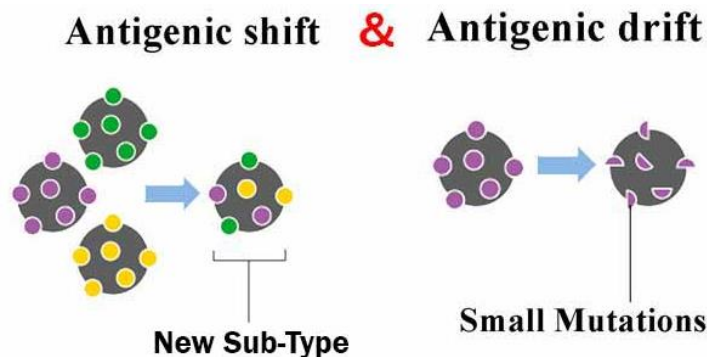
H5N1 influenza; background, update, and Illinois preparedness



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Variant influenza at a glance

- Influenza (flu) viruses constantly change and mutate. The changes can happen slowly over time or suddenly
- Slow changes are called **antigenic drift**. Every flu season, usually from October to May in the United States, different types of influenza A and B viruses are passed from person-to-person, causing illness and slowly genetically drifting
- Fast, sudden changes to flu viruses are called **antigenic shift**. This only affects influenza-A viruses and occurs when two flu viruses combine to form a virus with a new subtype or a mix of genes (including some from animals)

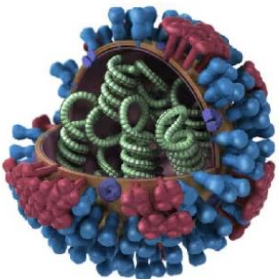


Influenza nomenclature

- Avian influenza is caused by a Type A influenza virus (influenza A)
- Avian-origin influenza viruses are broadly categorized based on a combination of two groups of surface proteins:
 - Hemagglutinin or “H” proteins H1–H16
 - Neuraminidase or “N” proteins N1–N9
- Each combination is considered a different subtype, and related viruses within a subtype may be referred to as a lineage
- Avian influenza viruses are classified as either “low pathogenic” or “highly pathogenic” based on their genetic features and the severity of the disease they cause in poultry

H5N1 to date

- 1996: “Highly pathogenic avian influenza H5N1” virus was first identified in domestic waterfowl in Southern China
 - A/goose/Guangdong/1/1996
- 2021: A new H5N1 virus belonging to clade 2.3.4.4b with a wild bird-adapted N1 NA gene emerges. Clade 2.3.4.4b H5N1 viruses became predominant by the end of 2021
- The virus is detected in wild birds in Canada and the United States in late 2021. In February 2022, the virus begins causing poultry outbreaks in the U.S.. Rare, sporadic human infections with this H5N1 virus are detected



Transmission

- Variant influenza A viruses have occurred occasionally in humans in the past, often after exposure to pigs at agricultural events
- Transmission of H5N1 is understood to be similar to seasonal influenza which primarily occurs through breathing in air with infected virus in it. Transmission may also occur by direct or indirect contact with milk, oral secretions, blood, organs, or fecal material from infected animals
 - Very high titers of H5N1 found in milk due to unique tissue tropism
- Prevention: Avoid un-protected contact with surfaces that appear to be contaminated with animal feces, raw milk, litter, or materials contaminated by birds or other animals with suspected or confirmed avian influenza virus infection

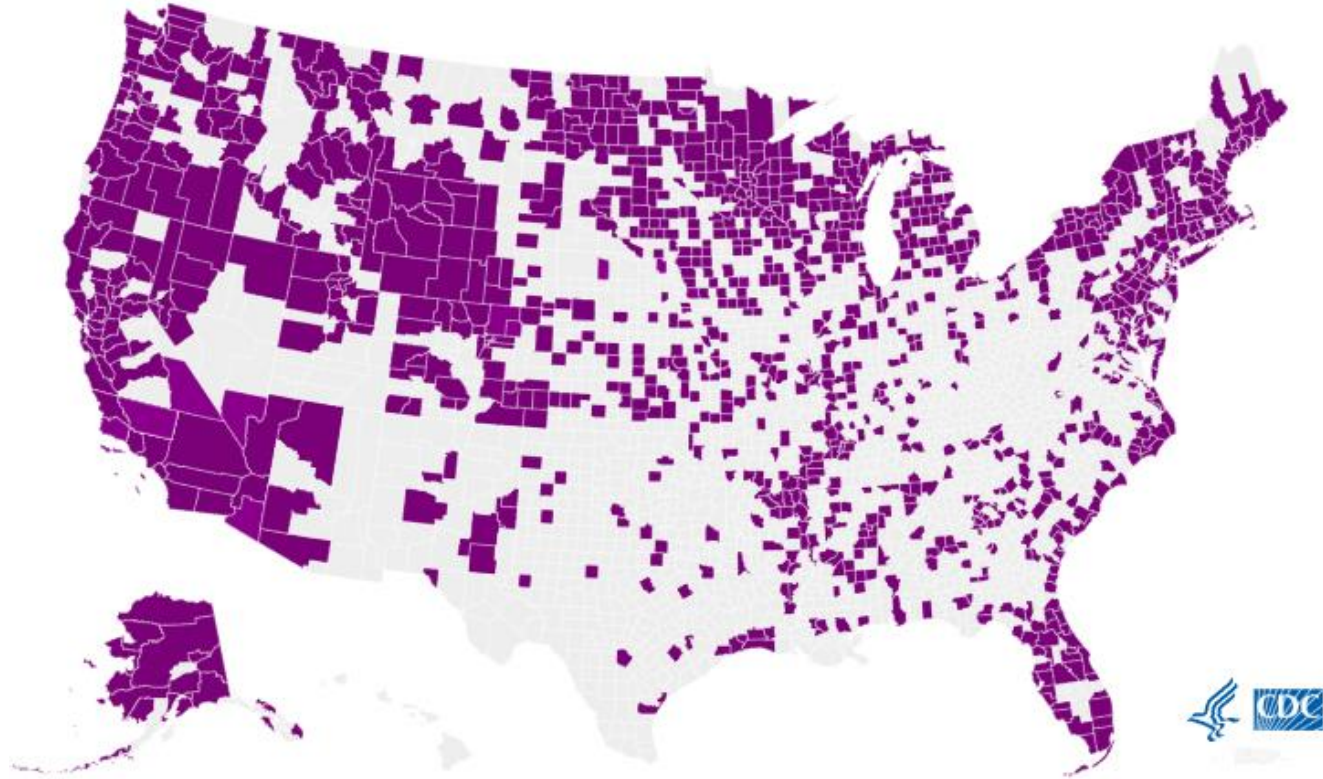
H5N1 clinical course

- The spread of bird flu viruses from one infected person to another has so far been very rare and limited, but the risk of a mutation changing this is omnipresent
- H5N1 infections in the US have been different between species:
 - Highly pathogenic in farmed poultry
 - Mixed pathogenicity in wild birds
 - Highly pathogenic in dairy farm cats - High milk titer exposures?
 - Mild to moderately pathogenic in dairy cows
 - Most affected animals reportedly recover with supportive treatment, and the mortality/culling rate has been low at 2% or less
 - Signs of illness have been reported in less than 10% of cows within a herd
- Mildly pathogenic in infected US human patients – mild respiratory symptoms and conjunctivitis
 - Healthy worker hypothesis....?
- Clinical signs of H5N1 infection in human patients:
Eye redness (conjunctivitis), mild flu-like upper respiratory symptoms, fever (though not always present), cough, sore throat, runny nose, muscle aches, headaches, fatigue, shortness of breath, and pneumonia requiring hospitalization.

H5N1 – Spring/Summer 2024

- CDC has confirmed 15 human H5N1 infections in the US since 2022
 - 10 following exposure to poultry (reported between 4/28/2022 and 7/25/2024)
 - 4 following exposure to dairy cows (reported between 4/1/2024 and 7/3/2024)
 - This is first instance of likely mammal-to-human transmission of H5N1
 - 1 recent case with no known animal exposures (reported 9/6/2024) - ??
- As of 9/10/2024, 14 states have reported outbreaks in cattle affecting 196 dairy herds. This number continues to grow, suggesting the virus is not being contained to currently infected herds
- No dairy herds or humans have ever tested positive for H5N1 in Illinois.

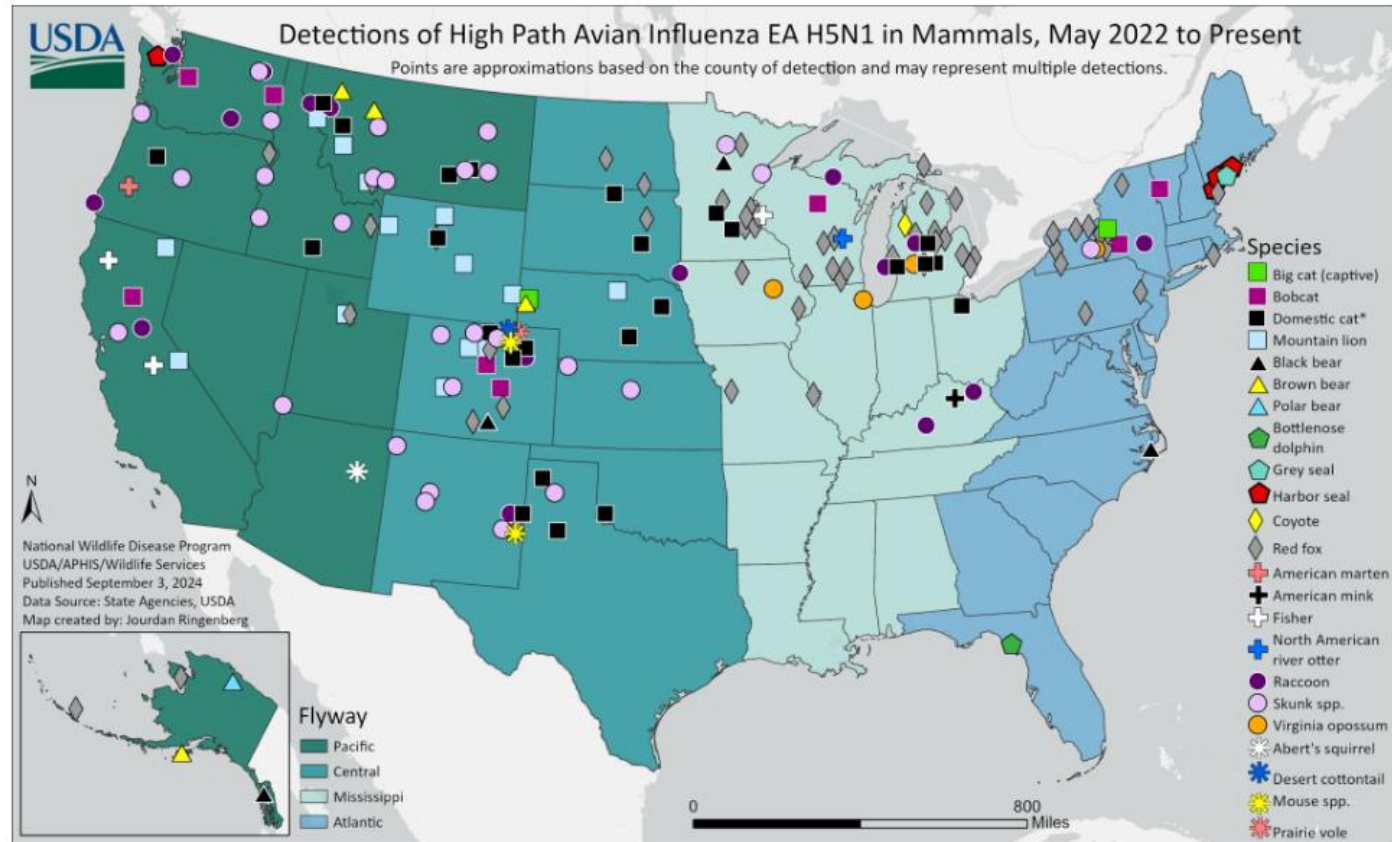
H5N1 Detections in US Wild Birds



- Wild birds can be infected with H5N1 and show no signs of illness. They can carry the disease to new areas when migrating, potentially exposing domestic poultry to the virus
- 9,831 wild birds have tested positive for H5N1 in the US
- 1,166 counties affected
- Last IL detection pre-outbreak in February 2024
 - Crow collected in Champaign County

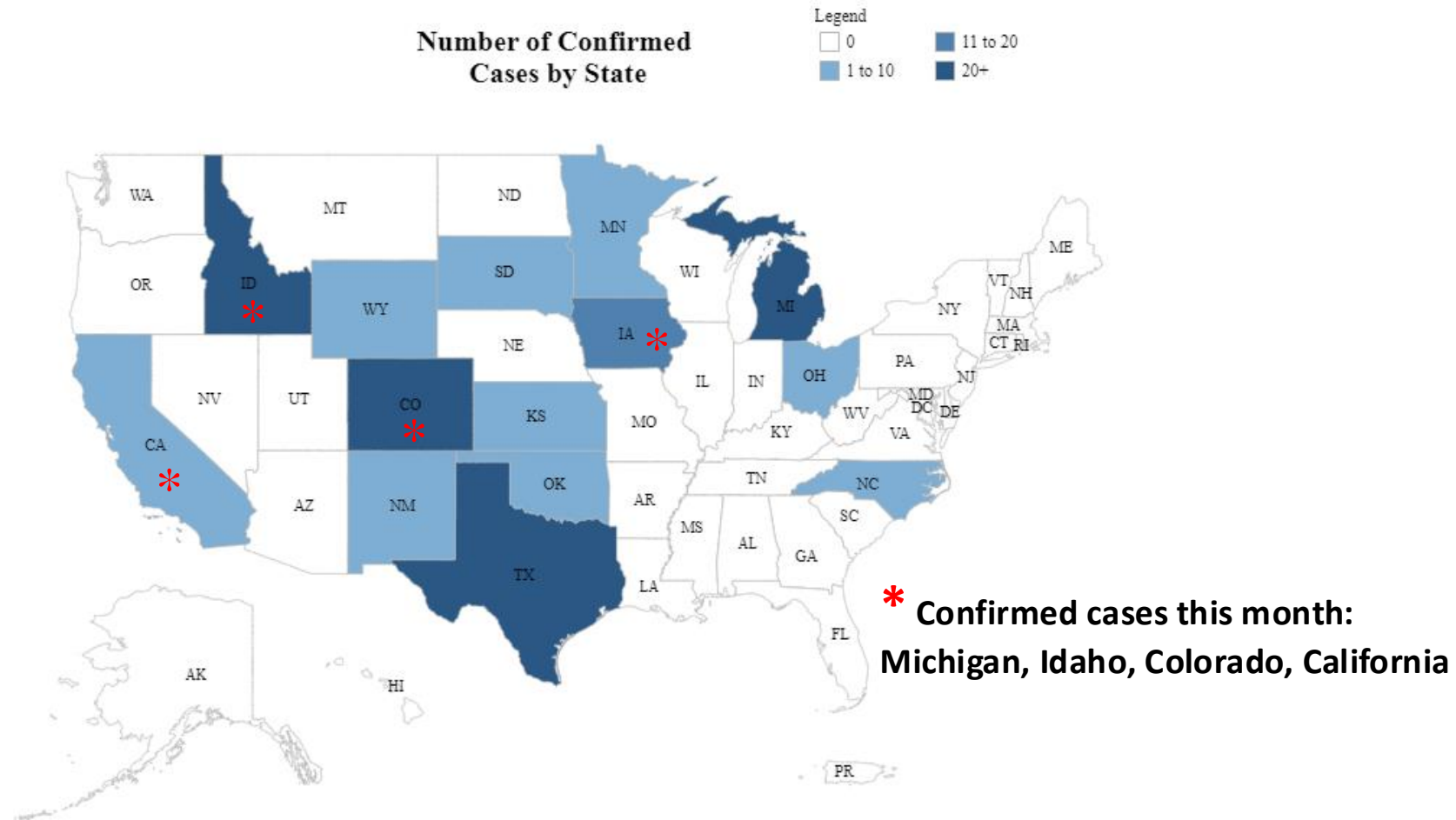
H5N1 detections in US mammals

May 2022 - present



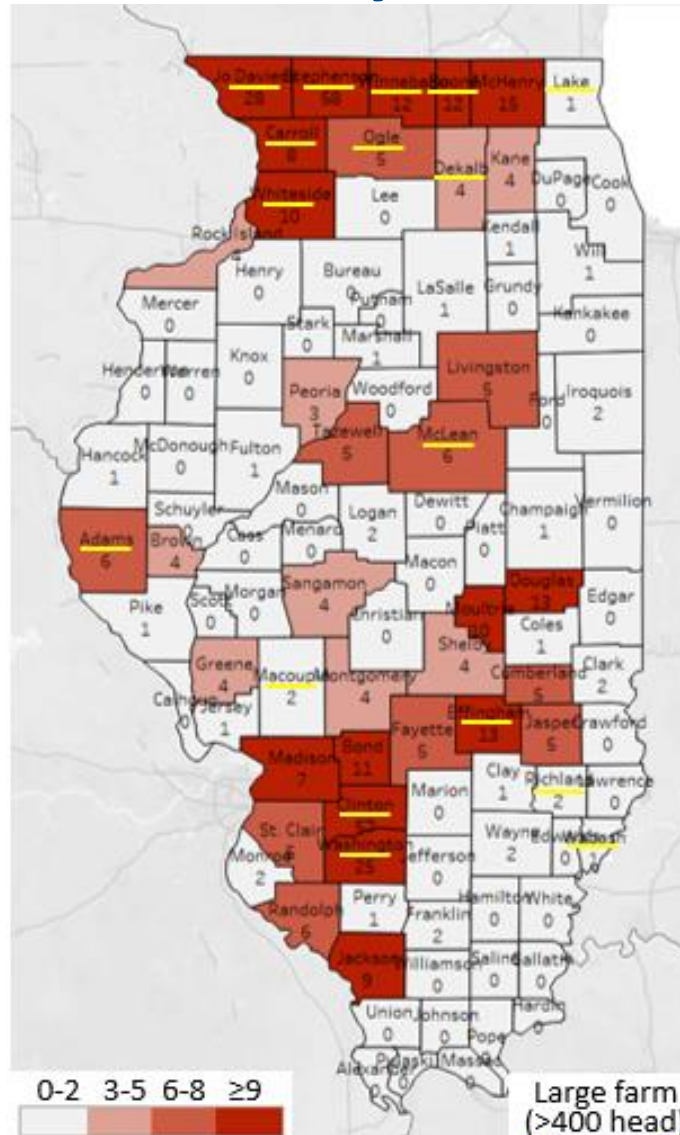
- Samples tested at National Wildlife Health Center in Madison, WI
 - Only IL detection pre-outbreak in October February 2022
- Virginia Opossum collected in Cook County

H5N1 confirmed livestock cases



- Most recently found on 08-30-24 in Colorado
- Samples tested at the National Veterinary Services Laboratories (NVSL) in Ames, IA

Number of bovine dairy farms per county - Illinois



Signs of influenza in dairy cattle



- Decrease in food consumption with decrease in rumination
- Clear nasal discharge
- Drop in milk production
- Tacky or loose feces
- Lethargy
- Dehydration
- Fever
- Thicker concentrated colostrum-like milk

H5N1 Prevention on the Dairy Farm

<u>Exclude</u>	If possible, exclude sick/dying waterfowl from farm
<u>Remove</u>	Remove any dead birds using proper PPE.
<u>Report</u>	Report to IL Dept of Ag any dairy cattle suspected of having H5N1
<u>Minimize/stop</u>	Minimize/stop cattle movement onto farm
<u>Dump</u>	Do not drink raw milk or feed to other livestock or pets

The Role of Public Health with H5N1 in dairy cattle



If positive herd, identify human contacts who have been exposed. Exposed workers would not be quarantined.



Exposed contacts would be monitored until 10 days after their last exposure. If they should become symptomatic -> isolation and testing.



Provide PPE information with considerations for the effects of high heat, needing breaks and water to keep cool



Offer Tamiflu to those who have had an animal exposure without proper PPE or those exposed to a human case of H5N1



H5N1 updates from the past week

- **August 30:** 3 dairies in central California detected H5N1 flu virus and have been quarantined
- **September 6:** The first case of the bird flu with “no immediate known animal exposure” was confirmed in a Missouri resident who was hospitalized, recovered and had no known work-related exposure to sick animals.
 - **Investigations are under way** –
Bird feeder? Indoor/outdoor cat? Raw milk consumption?

Cat-and-mouse

- The finding of neurologically ill farm cats was a key puzzle piece in the first identification of the H5N1 outbreak
- Colorado and 3 other states have reported a significant number of feline H5N1 infections including 1 or 2 in a reportedly “indoor-only” housecats
 - Snuck out? Fomites? Raw Milk? Mice?
- Colorado and New Mexico are also reporting very large numbers of infected mice
- Mice, birds, and cats are very common on dairy farm

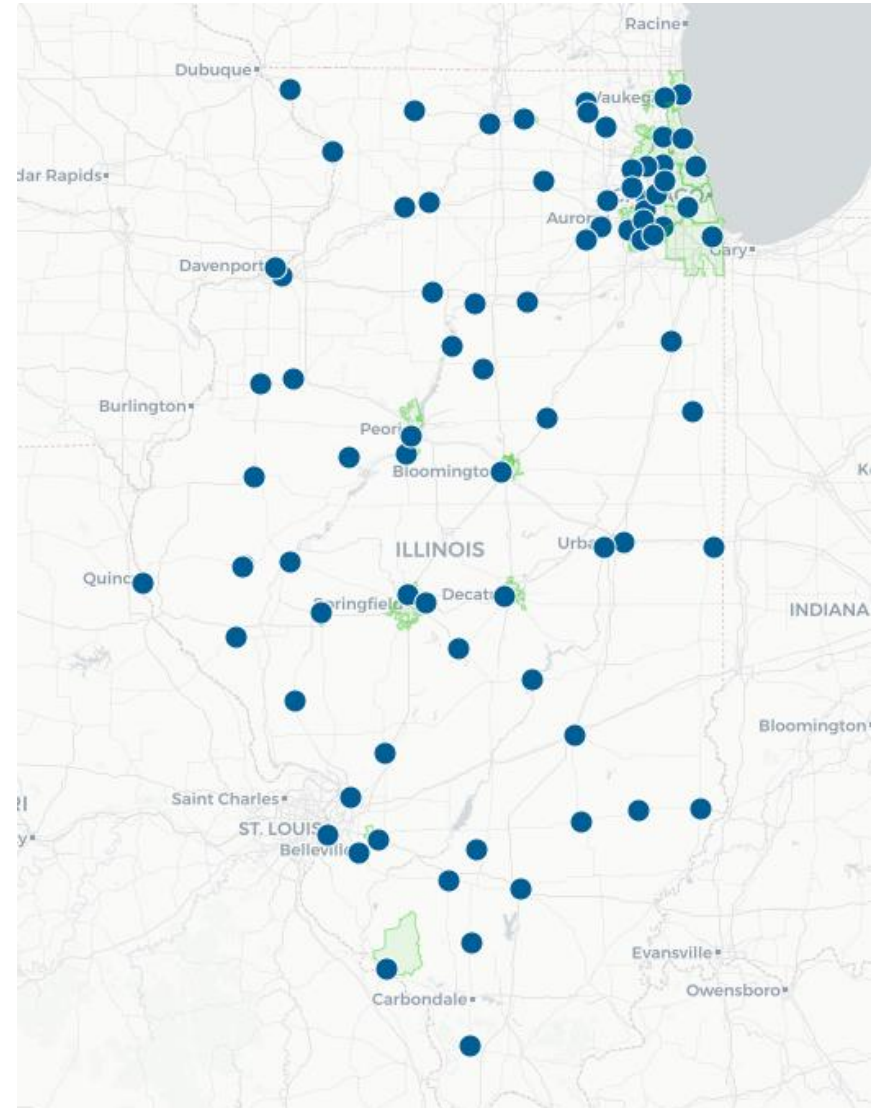
	A	B	C	D	E	F
1	State	County	Date Collected	Date Detected	Strain	species
2	Colorado	Larimer	7/24/2024	7/29/2024	EA H5N1	Domestic cat
3	Colorado	Larimer	7/16/2024	7/22/2024	EA H5N1	Domestic cat
4	Colorado	Larimer	7/14/2024	7/22/2024	EA H5N1	Domestic cat
5	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	Deer mouse
6	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	Deer mouse
7	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	Deer mouse
8	Colorado	Weld	7/13/2024	7/23/2024	EA H5	Deer mouse
9	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	Deer mouse
10	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	House mouse
11	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	House mouse
12	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	House mouse
13	Colorado	Weld	7/13/2024	7/23/2024	EA H5N1	House mouse
14	Colorado	Weld	7/12/2024	7/23/2024	EA H5N1	Deer mouse
15	Colorado	Weld	7/12/2024	7/23/2024	EA H5N1	Deer mouse
16	Colorado	Weld	7/12/2024	7/23/2024	EA H5N1	Deer mouse
17	Colorado	Weld	7/12/2024	7/23/2024	EA H5N1	Deer mouse
18	Colorado	Weld	7/12/2024	7/23/2024	EA H5	Deer mouse
19	Colorado	Weld	7/12/2024	7/23/2024	EA H5N1	Deer mouse
20	Colorado	Weld	7/12/2024	7/23/2024	EA H5N1	Deer mouse
21	Colorado	Weld	7/12/2024	7/23/2024	EA H5N1	Deer mouse
22	Colorado	Larimer	7/12/2024	7/22/2024	EA H5N1	Domestic cat
23	Colorado	Weld	7/11/2024	7/22/2024	EA H5N1	Desert cottontail
24	Colorado	Weld	7/11/2024	7/22/2024	EA H5N1	Deer mouse
25	Colorado	Weld	7/11/2024	7/22/2024	EA H5N1	House mouse
26	Colorado	Weld	7/11/2024	7/22/2024	EA H5N1	House mouse
27	Colorado	Weld	7/11/2024	7/22/2024	EA H5N1	House mouse
28	Colorado	Weld	7/11/2024	7/22/2024	EA H5N1	House mouse
29	Colorado	Weld	7/11/2024	7/22/2024	EA H5N1	Prairie vole
30	Colorado	Adams	5/30/2024	6/24/2024	EA H5N1	Domestic cat
31	Colorado	Morgan	5/25/2024	6/6/2024	EA H5N1	Domestic cat

IDPH H5N1 preparedness and planning

- Generating and releasing education materials for agricultural workers on the H5N1 disease process, workplace hazards, and the correct use of PPE
- Participating in national awareness and planning calls
- Coordinated PPE release/pre-positioning to IL dairy farms with IL farm bureau
- Maintaining very close communication with IDPH dairy program and the Illinois Department of Agriculture
- Multi-Agency (IDPH, IDoA, IDNR, H5N1) preparedness tabletop exercise
- Monitoring for potential spread via wastewater surveillance/epidemiology

Illinois Wastewater Surveillance System

- 75 sites in IL
 - Working to expand state-wide coverage
- Overseen by The Discovery Partners Institute (DPI)
 - Collaboration between the University of Illinois System and the Illinois Department of Public Health
- Aims to detect pathogens in wastewater to provide an early alert for pandemic preparedness

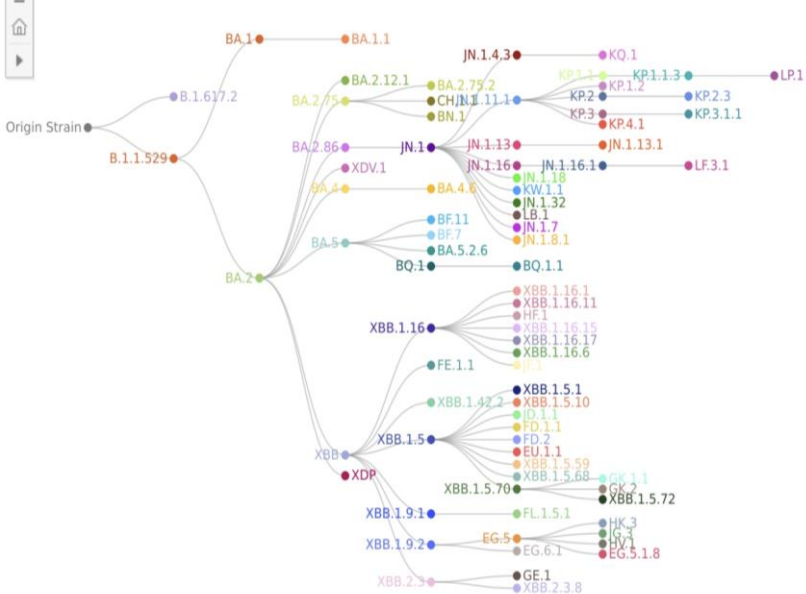


Illinois Wastewater Surveillance System

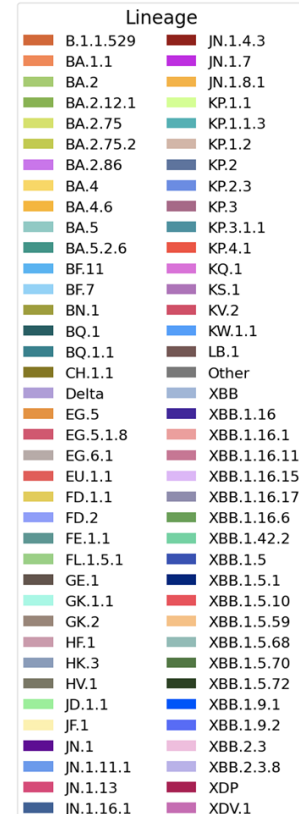
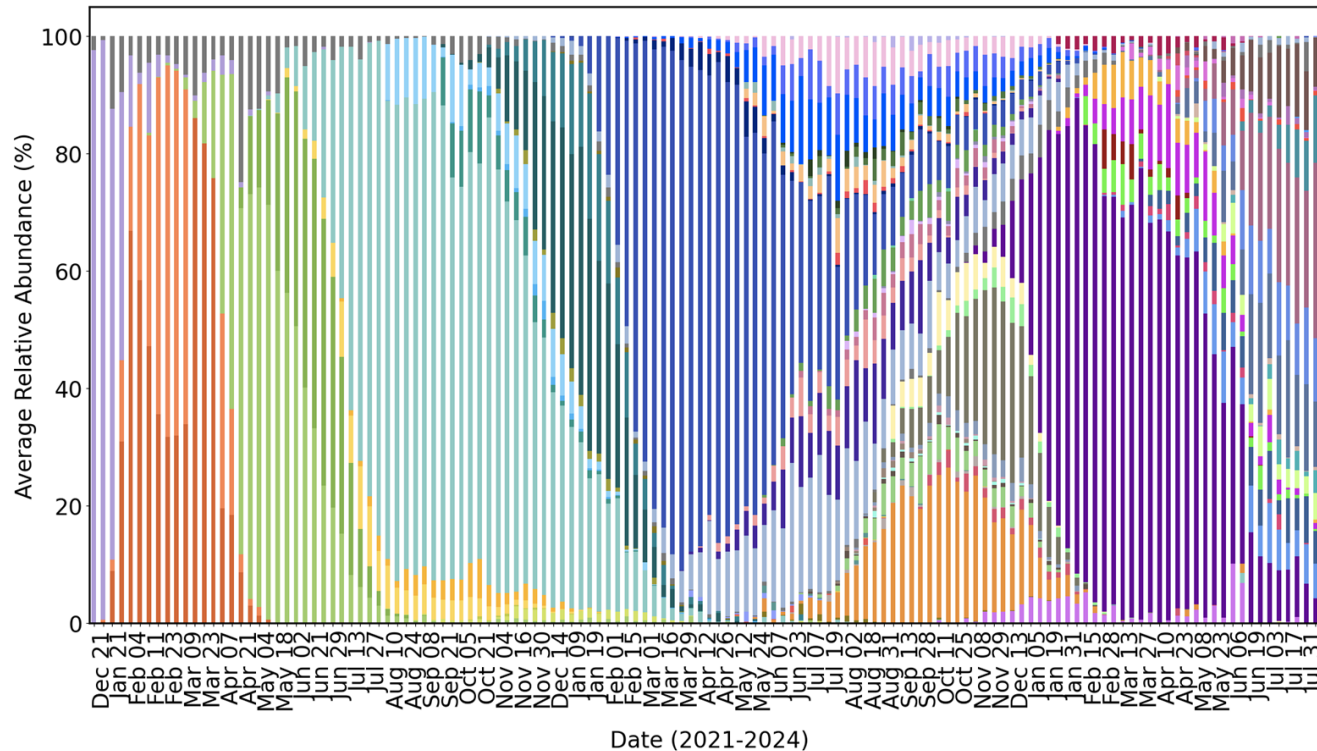
- Founded in May 2021, for state-wide monitoring of COVID-19
- Wastewater treatment plants from across the state submit samples twice weekly
- Multiplexed Digital PCR (dPCR) to monitor COVID-19, RSV, and Influenza A and B
- Samples are processed and analyzed at the University of Illinois at Chicago and then sent to Argonne National Laboratory for genetic sequencing and analysis to identify COVID variants
- DPI and Northwestern University partnering to interpret and present the data in unique ways. Meet weekly with IDPH CD surveillance staff

Illinois Wastewater Surveillance System

COVID variant tracking



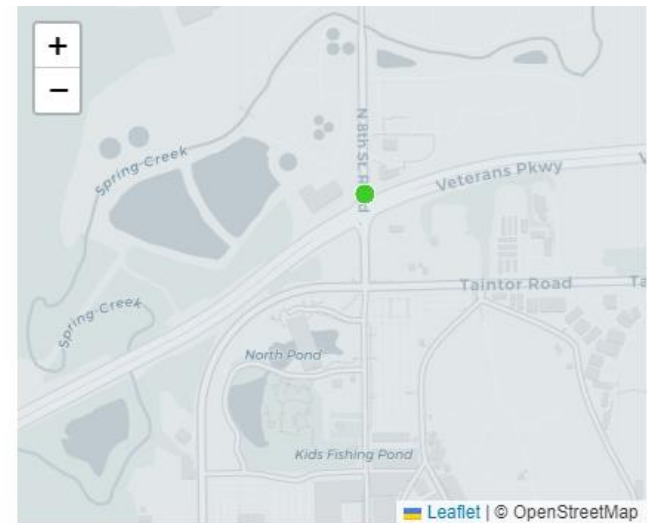
Illinois Statewide SARS-CoV-2 Variants in Wastewater



Spring Creek Wastewater Treatment Plant

Springfield, IL 62707

Population served: 100000



Managed by

Sangamon County Water Reclamation District

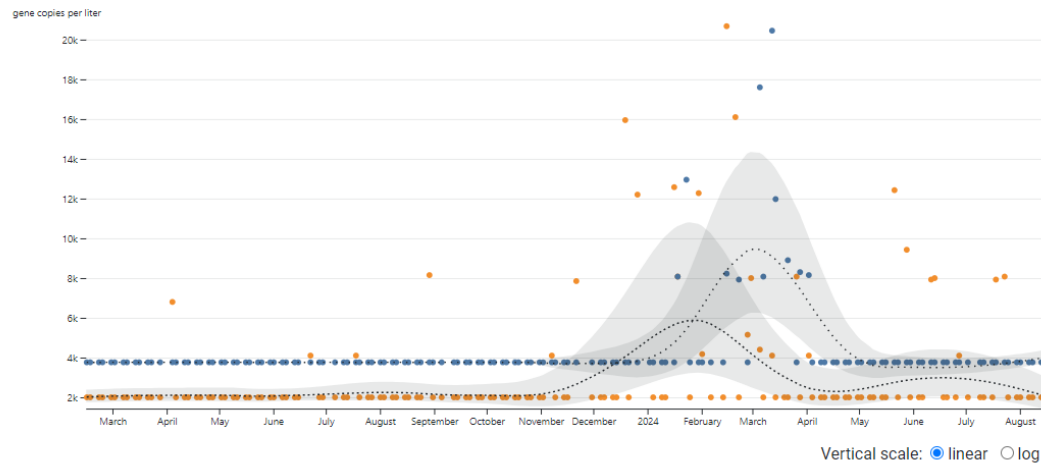
RSV SARS-CoV-2 Influenza

Influenza Measurements in Wastewater

Samples are collected at wastewater treatment plants from across the state and analyzed at our lab in Chicago. Results are posted and updated weekly. Numbers on the y-axis represent influenza A/B viral remnants in gene copies/liter. Dates on the x-axis are dates the samples were collected.

Last collected: 8/15/2024

Influenza A Influenza B



[Download data](#) [About the data](#)

Monitoring for the threat of H5N1

NWSS (national wastewater surveillance system)

IDPH and the CDC monitors influenza trends by detecting influenza A in wastewater

CDC flags locations with Flu-A levels in the 80th percentile or higher compared to last flu season

Limitations: Detects influenza A (but not the subtype). Cannot distinguish potential human vs. animal sources

Illinois Wastewater Surveillance System

- Illinois has received a total of 7 CDC “flags” for high Flu-A counts. Each time we meet with LHD to inform and discuss
 - Increasing surveillance in localities with elevated counts -> No evidence of human or animal transmission
- “Flagged” plants have never shown sustained high signals – very intermittent and hard to interpret
 - Flagged plants often along significant bodies of water – wild birds?
- Working with academic partners to assay wastewater samples for H5 specifically instead of Influenzas-A narrowly
- Working to subsequence (H and N subtypes) out of wastewater – difficult from an analytic perspective

The (hind) end



Questions?

IDPH communicable disease section:
(217)-782-2016; Matthew.Leslie@illinois.gov

S1 – Viral Genetics

- Genome comprises of single-stranded, eight negative-sense viral RNAs segments
- Viral genome encodes for eleven proteins including some accessory proteins
- These eight segments are named and presented from the largest to shortest, as follows: PB2, PB1, PA, hemagglutinin (HA), nucleoprotein (NP), neuraminidase (NA), matrix (M), non-structural (NS)
- These proteins have different functions during the viral replication process. Thus, viral genome segmentation is the basis for reassortments, and recombination as evolutionary mechanisms commonly found in influenza viruses.

S2 - H and A

- Hemagglutinin (HA) and Neuraminidase (NA) are important viral proteins playing fundamental roles in viral replication⁸ and are used for Influenza virus classification.
- HA is a relevant protein for viral entry into target cells, therefore it is the main target for neutralizing antibodies and vaccine development.
- NA is a tetrameric protein with enzymatic activity that allow viral release from infected cells following replication
- In addition to their relevance in viral replication, these proteins are used for viral classification purposes. Hence, there are sixteen (16) HA and nine (9) N

S3 – Low path / High Path

- Avian influenza is classified into low and highly pathogenic avian influenza viruses based on the HA cleavage site and the clinical severity of infections in chickens
- Most avian influenza viruses harboured by wild birds correspond to low pathogenicity avian influenza viruses (LPAIVs) causing asymptomatic or mild infections in poultry
- Some H5 and H7 lineages are known to produce a severe infection leading to massive death when domestic birds are infected and, specially H5 subtypes, causing death in their wild bird hosts.
- The co-circulation of Low- and High-pathogenicity AIVs in wild bird species is a contributing factor for the emergence of novel Influenza viruses with distinctive features.
- Since the emergence of the HPAIV H5N1 GS/Gd lineage in China in 1996, the virus has evolved into ten clades and multiple subclades. The 2.3.4.4b clade, represents the main influenza virus type causing the current outbreak around the world

S4 - Past avian flus

- Avian influenza [A\(H7N9\) virus](#) and highly pathogenic avian influenza (HPAI) [A\(H5N1\)](#) and A(H5N6) viruses have been responsible for most human illness from avian influenza viruses reported worldwide to date.

S5 – Dairy cow detection

How would a dairy herd be identified as H5N1 in IL?

Herd owner would see signs of H5N1 in the cattle and call vet

Required reporting of any dairy herd with suspect or confirmed H5N1

Vet would call the IL Dept of Ag for testing approval at the College of Vet Med diagnostic lab in Urbana IL

If “non-negative” would go to USDA Ames Iowa for confirmation