



2024 Influenza A Virus HPAI H5N1 Outbreak Weekly Report June 12, 2024

Introduction

In March 2024, several cases of highly pathogenic avian influenza A (HPAI) H5N1 virus were confirmed in dairy cattle in Texas, with cases spreading to at least eight other states (<https://www.biorxiv.org/content/10.1101/2024.05.01.591751v1>). In addition, a human case of influenza from the same clade and genotype was also diagnosed in a dairy worker from Texas around the same time. As part of an effort to track this outbreak, the United States Department of Agriculture (USDA) Agricultural Research Service (ARS) and the USDA National Veterinary Services Laboratories (NVSL) have been working to collect and sequence samples from additional cattle as well as avian species and other animals that also appeared to be infected with HPAI that might be related to the virus from the Texas dairy cattle. The genomic sequences of each virus isolate (consisting of the eight genomic segments sequenced for each individual isolate) are assembled from the sequenced short read data, and after undergoing quality control, are submitted to the GenBank sequence repository where they become publicly available. To enhance the ability of the USDA to rapidly submit sequences to GenBank, personnel from the Bacterial and Viral Bioinformatics Resource Center (BV-BRC) have been collaborating with USDA scientists to assist them with the submission of assembled HPAI genomic sequences to GenBank.

The BV-BRC provides a database of complete and partially sequenced microbial genomes from both viral and bacterial pathogens. This data is derived from the GenBank repository and includes metadata obtained from the GenBank record as well as associated NCBI BioProject, BioSample, and SRA repository records. All this metadata provides users with the ability to search for specific datasets from the BV-BRC web site using the filtering and sorting features built into BV-BRC web-retrieval tools. To provide rapid access to sequences and other data and information from the 2024 HPAI outbreak, the BV-BRC provides an outbreak-specific web page with links to this information: (https://www.bv-brc.org/outbreaks/H5N1/#view_tab=overview).

This report provides statistics on the public availability of HPAI H5N1 genomic sequences historically, and especially from isolates collected since 2024 in North America.

Updates

- On May 30, the US reported a second case of human H5N associated with the dairy cow outbreak in Michigan (<https://www.cdc.gov/media/releases/2024/p0530-h5-human-case-michigan.html>), bringing the total number of dairy cattle-associated 2024 human cases to three. Sequences of the genomes from these human isolates can be found in the [BV-BRC database](#). Note that only two segments (HA-4 and NA-6) from the second human case in Michigan are currently available.

Statistics (As of June 10, 2024)

The numbers provided below are obtained from the BV-BRC database. These numbers should be equivalent to those available from GenBank with the exception that newly submitted sequences may take a few days to be available from the BV-BRC database. For the 2024 outbreak, where we have isolate-specific information, we report the number of isolates along with the number of sequenced genomic segments (generally 8 per isolate). These numbers include sequences generated by the USDA and submitted to GenBank by both the USDA and BV-BRC, USDA sequences assembled by the BV-BRC from SRA data not yet submitted to GenBank, and sequences submitted to GenBank from all other sources.

Influenza A sequence counts from the BV-BRC database

Outbreak Report	All Influenza A Sequences	All H5N1 Sequences	2024 H5N1 Sequences
May 22	1,061,803	53,046	2,395 (298 isolates)
May 29	1,065,779	54,648	2,579 (320 isolates)
June 12*	1,082,514	57,317	5,148 (643 isolates)

*The BV-BRC genomic database links provided for the most recent totals will provide numbers as of the time the link is followed. Therefore, these numbers will increase over time.

Influenza A sequences from SRA and not yet submitted to GenBank

On June 7, 2024 the BV-BRC began a search for influenza A sequence data that had been submitted as raw data into the NCBI SRA (sequence read archive) database, but had not yet been assembled and submitted to GenBank. The search was for records deposited in 2024 (though not necessarily collected in 2024). The results of that search were as follows:

Influenza A Virus Records in SRA and GenBank Released in 2024

- 90,630 Total GenBank records for Influenza A virus from 2024
- 3,229 Total SRA records for Influenza A virus from 2024
- 901 SRA records are linked to GenBank records
- 2,328 SRA records are not linked to GenBank records

The BV-BRC downloaded the 2,328 SRA records and ran them through our influenza A assembly pipeline using the IRMA assembler. These genomic sequences have been uploaded into the BV-BRC database and can be accessed through the [BV-BRC Genome tab](#). The remaining unassembled SRA records produced errors during the assembly process. These will have to be resolved before the assembled sequences can be added to our analysis and the BV-BRC database.

The SRA samples were collected between 2013 and 2024. Of the 290 H5N1 samples, 289 were collected in 2024. Of these, 2 were deposited by Iowa State, and 287 were deposited by the USDA. The results of the SRA assembly process was as follows:

SRA samples assembled by the BV-BRC

Subtype	Samples	Segments Assembled
H1N1	657	5141
H1N7	9	72
H3N2	462	3676
H5N1	290	2320
H6N7	9	72
Unknown	56	328
Total	1,483	11,609

SRA samples by Subtype and Year

Subtype	Year	Segments
Unknown	Total:	328
	2013	3
	2022	44
	2023	243
	2024	35
	-	3
H1N1	Total:	5141
	2013	8
	2019	144
	2022	95
	2023	3126
	2024	1696
	-	72
H1N7	Total:	72
	2023	72
H3N2	Total:	3676
	2013	999
	2022	294
	2023	1225
	2024	1158
H5N1	Total:	2320
	2023	8
	2024	2312
H6N7	Total:	72
	2023	72
Total		11609

These tables summarize all sequences available as of June 10, 2024 and includes both GenBank and SRA-derived isolates.

H5N1 US virus isolates collected and sequenced in 2024, by host and US states:

Host	# Samples
American Crow	3
American white pelican	1
American Wigeon	1
Bald Eagle	3
Blackbird	2
CAGO	1
Canada Goose	3
Cat	2
Chicken	59
Common Grackle	1
Common Raven	2
Cow	378
Crow	5
Domestic Cat	32
Duck	2
Ganada Goose	1
Goat	30
Goose	9
Grackle	3
Great Horned Owl	1
Great horned owl/	1
Harris Hawk	1
Harris-Hawk	1
Hawk	5
Hooded Merganser	1
Human	2
Mallard	2
Mountain Lion	4
Mute Swan	2
Pefa	1
Peregrine Falcon	1
Pigeon	2
Raccoon	4
Red Fox	5
Red Tailed Hawk	3
Redhead duck	3
Ruddy Turnstone	1
Sanderling	8
Skunk	18
Snow Goose	6
Turkey	30
Turkey Vulture	2
Western Gull	2
Western Sandpiper	1
Wood duck	1

State	# Samples
California	8
Colorado	1
Idaho	6
Illinois	2
Indiana	5
Iowa	1
Kansas	15
Maryland	2
Michigan	25
Minnesota	21
Missouri	7
Montana	4
New Mexico	32
North Carolina	12
Ohio	30
Oklahoma	1
Oregon	3
South Carolina	3
South Dakota	21
Texas	139
USA	294
Utah	2
Virginia	6
Washington	7

Phylogenetic Analysis

- The latest phylogenetic trees for all eight segments can be accessed using the URL below, which includes all human isolates with available sequence data.
https://www.bv-brc.org/outbreaks/H5N1/#view_tab=phylogenetics

News

Title	Date	Source
H9N2 avian flu infects children in India, China	June 11	CIDRAP
USDA reports more H5N1 detections in mice and cats	June 11	CIDRAP
Bird flu: Australia records first human case of H5N1	June 10	The BMJ
Study shows 'not surprising' fatal spread of avian flu in ferrets	June 10	CIDRAP
Huge amounts of bird-flu virus found in raw milk of infected cows	June 5	Nature
Elephant seal outbreak marks first transnational spread of highly pathogenic avian influenza in mammals	June 5	PHYS.org
Information for Farm Workers Exposed to H5N1 Bird Flu in Dairy Cows	June 5	CDC
Avian Influenza A (H5N2) - Mexico	June 4	WHO
Avian flu strikes more Minnesota poultry farms	June 4	CIDRAP
H5 influenza wastewater dashboard launches	June 3	CIDRAP
Unpasteurized (Raw) Milk and Highly Pathogenic Avian Influenza	June 3	CDC
Bird Flu Virus Infections in Humans Avian Influenza	May 30	CDC
Outbreak of Highly Pathogenic Avian Influenza A(H5N1) Viruses in U.S. Dairy Cattle and Detection of Two Human	May 30	CDC
US nears deal to fund Moderna's bird flu vaccine trial, FT reports	May 30	Reuters
To probe outbreak, BSL-3 labs plan to infect cows with flu virus	May 10	Science
Feds announces assistance for US farmers affected by H5N1 avian flu	May 10	CIDRAP
Updates on Highly Pathogenic Avian Influenza (HPAI)	May 10	FDA

Publications

Title	Date	Source
Sialic Acid Receptor Specificity in Mammary Gland of Dairy Cattle Infected with Highly Pathogenic Avian Influenza A(H5N1) Virus.	June 11	Emerging Infectious Disease
Influenza virus uses mGluR2 as an endocytic receptor to enter cells	June 7	Nature
N-glycosylation on hemagglutinin head reveals inter-branch antigenic variability of avian influenza virus H5-subtypes	June 5	International Journal of Biological Macromolecules
Avian influenza viruses in New Zealand wild birds, with an emphasis on subtypes H5 and H7: Their distinctive epidemiology and genomic properties	June 3	PLOS One

Avian Influenza A(H5N1) Virus among Dairy Cattle, Texas, USA	Early Release	CDC
Deep mutational scanning of H5 hemagglutinin to inform influenza virus surveillance	Pre-print	bioRxiv
Rapid mortality in captive bush dogs (Speothos venaticus) caused by influenza A of avian origin (H5N1) at a wildlife collection in the United Kingdom	May 27	Emerging microbes and infections