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Avian Influenza (Bird Flu) in the United States

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Avian Influenza (Bird Flu) in the United States

SUMMARY

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Avian influenza, sometimes referred to as "bird flu," is a disease caused by influenza A viruses. It can be highly contagious and has a history of infecting birds, wildlife, and humans. A subtype of avian influenza, H5N1, was first detected in 1996 in Guangdong Province in China and has been spread globally by migratory birds. A 2021 outbreak of H5N1 that originated in Europe has caused a panzootic in birds that spread to the United States in early 2022. H5N1 is widespread in wild birds and is responsible for outbreaks in poultry and dairy cattle in the United States. There have been reported cases of humans infected with H5N1 in the United States since 2024, mostly among dairy and poultry workers who contracted the disease from infected animals.

H5N1 is not known to spread easily from human to human, but its ability to adapt, mutate, reassort with other viruses, and infect different mammal species means that the potential for human-to-human transmission exists. Some Members of Congress have expressed concerns about the spread of H5N1 and its potential health effects on humans, as well as its possible negative economic impact on agriculture, especially in the poultry and livestock industries. Some Members also expressed concern about avian influenza when previous pandemics occurred.

Avian influenza is part of the *Orthomyxoviridae* family and is grouped into four main categories: A, B, C, and D. Type A viruses are known to infect birds and mammals (including humans), while Types B, C, and D are restricted to certain host ranges. Type A viruses include avian influenza, swine influenza, and canine influenza. Type A viruses have caused more documented global pandemics in human history than any other type of pathogen, including four pandemics since the beginning of the 20th century. Highly pathogenic avian influenza (HPAI) can cause high mortality rates in wild birds and poultry, while low pathogenic avian influenza (LPAI) typically causes few or no clinical signs. Avian influenza is globally spread by birds that fly long distances via migratory pathways. These pathways can also be conduits for the spread of avian influenza to mammals (including humans) from wild birds. H5N1 is responsible for a recent outbreak circling the globe. The virus has infected wild birds, some species of mammals (e.g., domestic cats, harbor seals, mountain lions), poultry, and livestock in the United States. Federal, state, and local agencies are responding to H5N1 in various ways, including monitoring the spread of H5N1; creating policies to address potential impacts in industries such as poultry; and contemplating countermeasures for addressing the disease in animals and potentially humans.

There are several issues that Congress might consider when addressing avian influenza in the United States: the effectiveness and coverage of existing biosurveillance practices and policies; the effectiveness of coordination among federal agencies; the status of international collaboration; research and data required to fill existing knowledge gaps; activities related to monitoring and planning for potential spillover of avian influenza to humans; and policies that lead to suppressing or eliminating avian influenza in the United States. Some of these policies include

- heightening surveillance and detection of infected organisms;
- increasing biosecurity measures to protect livestock and poultry from infected wild birds and mammals;
- limiting exposure of wildlife associated with humans (e.g., livestock, poultry, and pets) to H5N1;
- instituting rapid response and containment protocols of infected animals, including efforts to cull infected animals;
- creating and testing mitigation and treatment methods, such as vaccines and therapeutic remedies; and
- conducting research on mutations and genetic reassortment to provide insight into whether human-to-human transmission of the virus is imminent.

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Introduction

Avian influenza, sometimes referred to as "bird flu," is a disease caused by influenza A viruses. It can be highly contagious and has a history of infecting birds, wildlife, and humans (**Table 1**). Wild birds, mainly waterfowl, naturally carry this virus and have introduced it to regions around the world, including the United States.[1] Avian influenza is not a novel virus; it was first identified in the 1800s and has mutated into various subtypes since that time (**Appendix A**). A subtype of avian influenza, H5N1, was first detected in 1996 in Guangdong Province in China and has been spread globally by migratory birds. Influenza A viruses have been responsible for multiple outbreaks among animals and humans, including those in the United States.[2]

Table 1. Selected Pandemics Attributed to Influenza A

Date	Name	Description
1918-1919	Spanish flu	This pandemic, caused by the H1N1 influenza virus is estimated to have killed approximately 50-100 million people.
1957	Asian flu	This was an H2N2 virus that originated from an avian influenza A virus. The virus emerged in East Asia and spread around the world, causing an estimated 1.1 million deaths worldwide and 116,000 deaths in the United States.
1968	Hong Kong flu	The 1968 pandemic was caused by an influenza A (H3N2) virus. It was first detected in Hong Kong and later spread to other countries and the United States. The estimated number of deaths was 1 million worldwide and about 100,000 in the United States.
1977	Russian influenza pandemic	This virus is believed to be similar to those circulating in the 1950s. It is hypothesized that the virus had been kept frozen in a laboratory and accidently released.
1997		In May 1997, H5N1 was isolated from a 3-year-old boy in Hong Kong. Eighteen Hong Kong residents were infected with H5N1 influenza viruses, six of whom died.
2009	Swine flu	The 2009 H1N1 swine flu pandemic was caused by a reassortment of avian influenza that had been circulating in swine for at least 10 years. The precursor swine strains had segments of avian influenza tracing back 30 years. The Centers for Disease Control and Prevention (CDC) estimated that the United States had 60.8 million cases, of which 12,469 people died. The CDC estimated that between 151,700 and 575,400 people died worldwide from the pandemic.

Source: Taisuke Horimoto and Yoshihiro Kawaoka, "Pandemic Threat Posed by Avian Influenza A Viruses," *Clinical Microbiology Reviews*, vol. 14, no. 1 (2001); Samantha J. Lycett et al., "A Brief History of Bird Flu," *Philosophical Transactions of the Royal Society B*, vol. 374, no. 1775 (2019), https://doi.org/10.1098/rstb.2018.0257;

[1] Ruopeng Xie et al., "The Episodic Resurgence of Highly Pathogenic Avian Influenza H5 Virus," *Nature*, vol. 622, no. 7984 (October 18, 2023), pp. 810-817 (hereinafter Xie et al., "The Episodic Resurgence of Highly Pathogenic Avian Influenza H5 Virus").

[2] Thao-Quyen Nguyen et al., "Emergence and Interstate Spread of Highly Pathogenic Avian Influenza A(H5N1) in Dairy Cattle in the United States," *Science*, vol. 388, no. 6745 (April 2025) (hereinafter Nguyen et al., "Emergence and Interstate Spread of Highly Pathogenic Avian Influenza A(H5N1)").

and CDC, "2009 H1N1 Pandemic (H1N1pdm09 Virus)," 2019, https://archive.cdc.gov/www_cdc_gov/flu/pandemic-resources/2009-h1n1-pandemic.html.

One outbreak of H5N1 has caused a panzootic[3] in birds since 2021, which spread to the United States in early 2022. H5N1 is widespread in wild birds and is responsible for outbreaks in poultry and dairy cattle in the United States. Since the outbreak, the U.S. Department of Agriculture (USDA) reported H5N1 infections in over 1,074 herds of dairy cattle in 17 states across the United States as of May 21, 2025.[4] Further, there have been reported cases of humans infected with H5N1 in the United States since 2024, mostly among dairy and poultry workers who contracted the disease from infected animals, although some human cases have no known connections with the dairy and poultry industry (**Table 2**).[5]

Table 2. Confirmed U.S. Human Cases of H5N1 and Exposure Route

Confirmed Cases from 2024 Through January 5, 2025

State	Dairy Herds[a]	Poultry Farms and Culling Operations[a]	Other Animal Exposure[b]	Exposure Source Unknown	Total Cases
California	36	0	0	2	38
Colorado	1	9	0	0	10
Iowa	0	1	0	0	1
Louisiana	0	0	1	0	1
Michigan	2	0	0	0	2
Missouri	0	0	0	1	1
Nevada	1	0	0	0	1
Ohio	0	1	0	0	1
Oregon	0	1	0	0	1
Texas	1	0	0	0	1
Washington	0	11	0	0	11
Wisconsin	0	0	1	0	1
Wyoming	0	0	1	0	1
Total U.S.	**41**	**24**	**2**	**3**	**70**

Source: Centers for Disease Control and Prevention, "H5 Bird Flu: Current Situation," February 27, 2025, https://www.cdc.gov/bird-flu/situation-summary/index.html.

Notes: Data used in the table were downloaded on February 27, 2025.

a. Exposure is associated with commercial agriculture and related operations.

b. Exposure was related to other animals, such as backyard flocks, wild birds, or other mammals.

Although the current public health risk is low for humans, according to the Centers for Disease Control and Prevention (CDC), many scientists have expressed concern about the possibility of

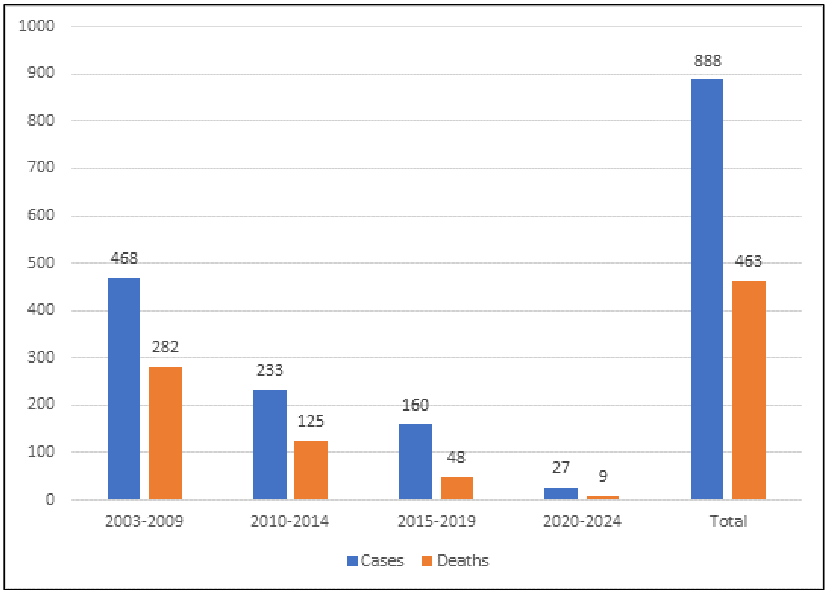
[3] *Panzootic* refers to an outbreak of a disease within nonhuman animals that spreads across a large region or worldwide. The equivalent term for a human disease outbreak is a *pandemic*.

[4] U.S. Department of Agriculture (USDA), "HPAI Confirmed Cases in Livestock Herds," January 16, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/hpai-confirmed-cases-livestock.

[5] Centers for Disease Control and Prevention (CDC), "H5 Bird Flu: Current Situation," May 30, 2025, https://www.cdc.gov/bird-flu/situation-summary/index.html.

H5N1 evolving and spreading among humans through airborne transmission.[6] Historically, H5N1 is associated with a high human mortality rate: more than 50% of reported cases before 2019 resulted in fatalities (**Figure 1**). Most of these previous human fatalities and cases were due to transmission of the virus from animals to humans, with some limited human-to-human transmission.

Figure 1. Number of Confirmed Human Cases and Deaths for Avian Influenza A (H5N1) Reported to World Health Organization, 2003-2024



Source: World Health Organization (WHO), *Cumulative Number of Confirmed Human Cases for Avian Influenza A(H5N1) Reported to WHO, 2003-2024*, March 28, 2024, https://cdn.who.int/media/docs/default-source/influenza/h5n1-human-case-cumulative-table/cumulative-number-of-confirmed-human-cases-for-avian-influenza-a(h5n1)-reported-to-who--2003-2024.pdf.

Notes: Most cases were reported in Egypt, Indonesia, and Vietnam (approximately 77% of the total).

Recent cases of human H5N1 infections appear to be the result of animal-to-human transmission but are usually not as severe as older H5N1 cases.[7] Some scientists note that the reasons for this difference are uncertain, but they do not know whether the low fatality rate in humans is due to host immunity, route of exposure, or mutations in the virus.[8] Of 70 people in the United States diagnosed since 2022 with H5N1, one died, according to the CDC.[9] Current strains of H5N1 are not found to spread easily from human to human; however, stakeholders are monitoring the situation for changes.[10] The potential for human-to-human transmission exists, according to

[6] Ranu S. Dhillon et al., "Steps to Prevent and Respond to an H5N1 Epidemic in the USA," *Nature Medicine*, vol. 31, no. 4 (April 2025), pp. 1063-1065 (hereinafter Dhillon et al., "Steps to Prevent and Respond to an H5N1 Epidemic in the USA"); and Yuying Liang, "Pathogenicity and Virulence of Influenza," *Virulence*, vol. 14, no. 1 (2023).

[7] Florian Krammer et al., "Highly Pathogenic Avian Influenza H5N1: History, Current Situation, and Outlook," *Journal of Virology*, vol. 99, no. 4 (March 27, 2005) (hereinafter Krammer et al., "Highly Pathogenic Avian Influenza H5N1: History").

[8] Michael G. Ison and Jeanne Marrazzo, "The Emerging Threat of H5N1 to Human Health," *The New England Journal of Medicine*, vol. 392, no. 9 (2025), pp. 916-918 (hereinafter Ison and Marrazzo, "The Emerging Threat of H5N1 to Human Health").

[9] CDC, "H5 Bird Flu: Current Situation," May 30, 2025, https://www.cdc.gov/bird-flu/situation-summary/index.html.

[10] As of May 23, 2025, there were no known cases of human-to-human transmission of H5N1, according to the CDC. (continued...)

scientists, because of the ability of the virus to adapt and infect several mammals and its ability to mutate and reassort with other viruses.[11]

The spread and evolution of H5N1 is a concern for many people because influenza A viruses have caused more documented global pandemics in human history than any other type of pathogen, including four pandemics (**Table 1**) since the beginning of the 20th century.[12] After causing a pandemic, these types of viruses usually establish themselves in human populations as seasonal flu viruses, causing millions of infections and thousands of deaths per year.[13] Scientists attribute influenza pandemics in 1957, 1968, and 2009 to reassortant viruses[14] that contained genetic segments from human seasonal flu viruses and animal influenza viruses.[15]

Although comparatively little is known about some other zoonotic diseases, such as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; the virus that caused COVID-19), there is a large body of knowledge about avian influenza viruses, including methods to dampen virus spread and vaccines to treat infections.[16]

Some Members of Congress have expressed concerns in hearings and letters to federal agencies about the spread of H5N1 and its potential health effects on humans, as well as its economic effects on agriculture, especially in the poultry and livestock industries.[17] For example, several Members asked about the impact of avian influenza on poultry flocks and the availability and price of eggs,[18] the potential for avian influenza to circulate among humans,[19] and communication between the federal government and stakeholders, among other issues.[20] Concern over avian influenza is not new to Congress. Congress has expressed interest in the origins and effects of diseases as pandemics have emerged. For example, the House Committee on International

See CDC, "H5 Bird Flu: Current Situation," May 30, 2025, https://www.cdc.gov/bird-flu/situation-summary/index.html.

[11] Krammer et al., "Highly Pathogenic Avian Influenza H5N1: History." See Appendix B for definitions of selected terms, including *reassortment*.

[12] Thomas P. Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals," *Nature*, vol. 637, no. 8045 (January 2025), pp. 304-313 (hereinafter Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals"); and Walter N. Harrington et al., "The Evolution and Future of Influenza Pandemic Preparedness," *Experimental and Molecular Medicine*, vol. 53 (2021), pp. 737-749 (hereinafter Harrington et al., "The Evolution and Future of Influenza Pandemic Preparedness").

[13] Krammer et al., "Highly Pathogenic Avian Influenza H5N1: History."

[14] A reassortant virus is created through reassortment, a process in which viruses with segmented genomes exchange genetic material during coinfection.

[15] Eefje J. A. Schrauwen and Ron A. M. Fouchier, "Host Adaptation and Transmission of Influenza A Viruses in Mammals," *Emerging Microbes and Infections*, vol. 3, no. 2 (2014).

[16] Krammer et al., "Highly Pathogenic Avian Influenza H5N1: History."

[17] For more information on the effects of H5N1 on the poultry industry, see CRS Report R48518, *The Highly Pathogenic Avian Influenza (HPAI) Outbreak in Poultry, 2022-Present*, by Lia Biondo.

[18] For example, see Sen. Charles Schumer, "Bird Flu," remarks in the Senate, *Congressional Record*, daily edition, vol. 171, no. 17 (January 27, 2025), p. S386.

[19] For example, see letter from Rep. Jamie Raskin and Rep. Robert Garcia to Hon. Xavier Becerra, Secretary, U.S. Department of Health and Human Services (HHS), December 13, 2024, https://oversightdemocrats.house.gov/sites/evo-subsites/democrats-oversight.house.gov/files/evo-media-document/2024-12-13.JBR%20Garcia%20to%20Becerra-HHS%20re%20HPAI%20-%20Public%20Health.pdf.

[20] For example, see letter from Rep. Donald S. Beyer Jr. et al. to Gary Washington, Acting Secretary, USDA, and Susan C. Monarez, Acting Director, CDC, February 4, 2025, https://beyer.house.gov/uploadedfiles/congressional_letter_-_help_virginia_bird_flu_response_-_02-04-2025.pdf.

Relations held a hearing in 2005 entitled "Avian Flu: Addressing the Global Threat," to gauge the potential for avian influenza to spread to the United States.[21]

This report provides an overview of avian influenza viruses, how they are named and classified (including H5N1), how they spread and evolve, and efforts by federal agencies to manage viruses. The report also discusses the current outbreak of H5N1 in the United States and some issues that Congress may wish to consider. There is a glossary of select terms in **Appendix B**.

Background on Influenza A and Avian Influenza

Influenza viruses are part of the *Orthomyxoviridae* family and are grouped into four main types: A, B, C, and D.[22] Type A viruses are known to infect a large variety of birds and mammals (including humans), whereas the other types (B, C, and D) are restricted to certain host ranges.[23] Influenza A viruses, which include all avian influenza viruses, have eight distinct genomic segments. Influenza A viruses are classified into subtypes based on the combinations of proteins on the virus surface.[24] Influenza A animal viruses infect various species and are named after their host animal, for example, avian influenza, swine influenza, or canine influenza.[25] Despite these categories, cross-species transmission of these viruses are common. Influenza A, for example, was responsible for the Spanish flu pandemic (1918-1919), which originated in the United States and killed an estimated 50-100 million people worldwide, as well as other outbreaks described in **Table 1**.

Avian influenza was originally referred to as a "fowl plague" and was first identified in Italy in 1878.[26] In the 20th century, the fowl plague was classified as a type A influenza virus.[27] In 1924, avian influenza infected poultry in the United States, causing severe losses in live bird markets in New York City. In the 1950s, phylogenetic studies showed that avian and human influenza viruses were related.[28] By this time, avian influenza had been reported in poultry in most of Europe, Russia, North America, South America, the Middle East, Africa, and Asia. Subsequently, there have been several outbreaks of avian influenza throughout the world. Scientists have also attributed an avian origin to subsequent human influenza viruses that caused outbreaks in 1957 and 1968.[29]

[21] U.S. Congress, House Committee on International Relations, *Avian Flu: Addressing the Global Threat*, 109th Cong., 1st sess., December 7, 2005, S.Hrg. 109-137.

[22] Andrew M. Q. King et al., ed. "Family – Orthomyxoviridae," in *Virus Taxonomy: Ninth Report of the International Committee on Taxonomy of Viruses*, pp. 749-761 (Elsevier, 2012), https://doi.org/10.1016/B978-0-12-384684-6.00061-6.

[23] Samantha J. Lycett et al., "A Brief History of Bird Flu," *Philosophical Transactions of the Royal Society B*, vol. 374, no. 1775 (2019), https://doi.org/10.1098/rstb.2018.0257 (hereinafter Lycett et al., "A Brief History of Bird Flu").

[24] World Health Organization (WHO), "Influenza (Avian and Other Zoonotic)," October 3, 2023, https://www.who.int/news-room/fact-sheets/detail/influenza-(avian-and-other-zoonotic).

[25] WHO, "Influenza (Avian and Other Zoonotic)," October 3, 2023, https://www.who.int/news-room/fact-sheets/detail/influenza-(avian-and-other-zoonotic).

[26] B. Lee Ligon, "Avian Influenza Virus H5N1: A Review of Its History and Information Regarding Its Potential to Cause the Next Pandemic," *Seminars in Pediatric Infectious Diseases*, vol. 16, no. 4 (2005), pp. 326-335 (hereinafter Ligon, "Avian Influenza Virus H5N1: A Review of Its History"); and CDC, "Highlights in the History of Avian Influenza (Bird Flu)," June 1, 2024, https://www.cdc.gov/bird-flu/avian-timeline/index.html.

[27] Ligon, "Avian Influenza Virus H5N1: A Review of Its History."

[28] Lycett et al., "A Brief History of Bird Flu."

[29] R. Fang et al., "Complete Structure of A/duck/Ukraine/63 Influenza Hemagglutinin Gene: Animal Virus as Progenitor of Human H3 Hong Kong 1968 Influenza Hemagglutinin," *Cell*, vol. 25, no. 2 (1981), pp. 315-323, (continued...)

Classification of Avian Influenza

Avian influenza A viruses are classified into two categories: highly pathogenic avian influenza (HPAI), which can cause severe clinical signs and possible high mortality rates in wild birds and poultry, and low pathogenic avian influenza (LPAI), which typically causes few or no clinical signs.[30] LPAI viruses have the ability to mutate into HPAI viruses. For example, an LPAI H5N2 that was circulating in chickens in the United States in 1983 became an HPAI within six months.[31]

Avian influenza is further classified into subtypes based on two surface proteins, hemagglutinin (H) and neuraminidase (N). Each of the subtypes are numerical combinations of H and N, such as H5N1, H7N2, and H7N8. The numbers represent a different subtype of each surface protein. (See the text box on nomenclature for more information.) Each distinct subtype evolves into clades and subclades (i.e., genetic groups separated according to DNA sequences).[32] For example, since the emergency of H5N1 lineage in China in 1996, the virus has evolved and been grouped into 10 clades and multiple subclades.[33] The recent outbreaks of H5N1 around the world are attributed to the 2.3.4.4b clade of H5N1.[34]

https://doi.org/10.1016/0092-8674(81)90049-0; and Judith R. Schäffr et al., "Origin of the Pandemic 1957 H2 Influenza A Virus and the Persistence of Its Possible Progenitors in the Avian Reservoir," *Virology*, vol. 194, no. 2 (1993), 781-788, https://doi.org/10.1006/viro.1993.1319. The subsequent two human pandemics (1957 and 1968) were not caused by completely avian-origin viruses but rather by reassortant viruses with avian origin (Lycett et al., "A Brief History of Bird Flu").

[30] World Organisation for Animal Health (WOAH), "What Is Avian Influenza?," 2025, https://www.woah.org/en/disease/avian-influenza/.

[31] Ligon, "Avian Influenza Virus H5N1: A Review of Its History"; and CDC, "1960-1999 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/1960-1999.html.

[32] A *clade* is a group of organisms (e.g., viruses) that evolved from a common ancestor. For avian influenza, it is the organization of the hemagglutinin gene highly pathogenic avian influenza, based on molecular analysis. "The mutation of the [hemagglutinin gene] has resulted in genetically divergent groups of virus strains termed clades such as 2.3.4.4b." Food and Agriculture Organization of the United Nations and WOAH, *Global Strategy for the Prevention and Control of High Pathogenicity Avian Influenza (2024–2033)*, 2025, p. 23, https://www.woah.org/app/uploads/2025/02/web-gf-tads-hpai-strategy-woah.pdf.

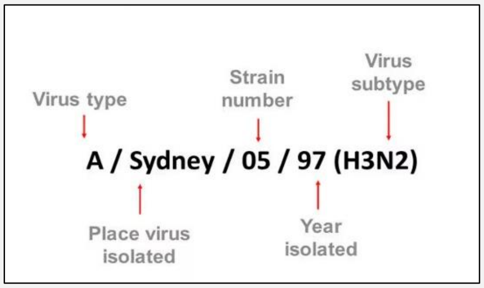
[33] Dong-Hun Lee et al., "Evolution, Global Spread, and Pathogenicity of Highly Pathogenic Avian Influenza H5Nx Clade 2.3.4.4," *Journal of Veterinary Science*, vol. 18, no. S1 (2017), pp. 269-280.

[34] Gina R. Castro-Sanguinetti et al., "Highly Pathogenic Avian Influenza Virus H5N1 Clade 2.3.4.4b from Peru Forms a Monophyletic Group with Chilean Isolates in South America," *Scientific Reports*, vol. 14 (February 13, 2024).

Nomenclature of Avian Influenza Virus

Influenza viruses have a standard nomenclature that includes the virus type; location at which it was isolated; isolate number; isolate year; and, for influenza A viruses, subtype (see **Figure 2**). Influenza A viruses are divided into subtypes based on two proteins on the surface of the virus: hemagglutinin (H) and neuraminidase (N). There are 18 different hemagglutinin subtypes and 11 different neuraminidase subtypes represented by H1 through H18 and N1 through N11; these impact the spread and severity of the virus. Many different combinations of H and N proteins are possible. Each combination is considered a different subtype and can be further broken down into different strains, for example, H5N1 and H7N9. Over time, a classification system was developed to distinguish between subtypes of influenza on the basis of the antigenic properties (characteristics of a molecule's ability to trigger an immune response) of their structural and surface proteins—specifically, the nucleoprotein (NP) (type) and hemagglutinin (HA) (subtype) and neuraminidase (NA) (subtype) proteins. HA provides a virus with the ability to attach to a host cell and is also the target for a host cell's immune response.

Figure 2. Nomenclature of Influenza Viruses



Source: CRS, adapted from U.S. Centers for Disease Control and Prevention, "Highlights in the History of Avian Influenza (Bird Flu)," June 1, 2024, https://www.cdc.gov/bird-flu/avian-timeline/index.html.

Transmission and Spillover of Avian Influenza Among Wildlife

Avian influenza is spread by wild birds that naturally carry different forms of the avian influenza virus. Wild birds, specifically waterfowl, from two orders, *Anseriformes* (i.e., ducks, geese, and swans) and *Charadriiformes* (i.e., gulls, terns, and sandpipers), are natural reservoirs of influenza A virus.[35] The avian influenza virus is thought to have low pathogenicity in these species. One study suggests that these types of birds have carried the virus without developing symptoms for thousands of years.[36] However, other species of birds that get infected by this virus can demonstrate a wide spectrum of reactions, ranging from mild illness to a highly contagious and rapidly fatal sickness that can result in severe epidemics among bird species. Avian influenza viruses can become highly pathogenic and cause high mortality in birds, nearing 100% mortality within 48 hours in some species, according to scientists.[37]

Avian influenza is globally spread by birds that fly long distances via migratory pathways. For example, one study that examined data between 2003 and 2012 found that the timing of H5N1 outbreaks in Eastern Asia followed wild bird migratory flyways.[38] Avian influenza can also be

[35] The order *Anseriformes* comprises about 180 species of birds, and the order *Charadriiformes* comprises about 390 species of birds. Reservoirs of an infectious agent are the habitats in which a virus can live, grow, and multiply. See CDC, "Lesson 1: Introduction to Epidemiology," May 18, 2012, https://archive.cdc.gov/www_cdc_gov/csels/dsepd/ss1978/lesson1/section10.html.

[36] Ligon, "Avian Influenza Virus H5N1: A Review of Its History."

[37] Ligon, "Avian Influenza Virus H5N1: A Review of Its History."

[38] Huaiyu Tian et al., "Avian Influenza H5N1 Viral and Bird Migration Networks in Asia," *Proceedings of the National Academy of Sciences, USA*, vol. 112, no. 1 (2014), pp. 172-177.

spread globally and regionally through the trade in infected poultry.[39] This can include trading between backyard chicken flocks.

Migratory pathways can be conduits for the spread of avian influenza to mammals from wild birds. Some scientists assert that infections of avian influenza in certain mammal species were found along flyways (**Figure 3**) used by migratory birds.[40] Several mammal species, including cattle and humans, were infected by avian influenza from birds and poultry in the current U.S. outbreak, which was first reported in 2022.[41] Avian influenza has spread from birds to mammals, sometimes through direct contact or in some cases through contact with contaminated fecal matter.[42] Scientists report that several terrestrial carnivores such as foxes, raccoons, and bobcats have been infected after scavenging dead, infected birds.[43] Marine mammal species such as sea lions, elephant seals, dolphins, porpoises, and sea otters have been infected with avian influenza, presumably from interactions with infected sea birds.[44] Overall, the mechanisms of viral spillover from birds to other organisms is not fully understood.[45] Some studies indicate that a viral adaptation to mammals might lead to an increased risk of transmission and disease.[46]

[39] M. Gauthier-Clerc et al., "Recent Expansion of Highly Pathogenic Avian Influenza H5N1: A Critical Review," *IBIS: International Journal of Avian Science*, vol. 149, no. 2 (2007), pp. 202-214.

[40] Stephanie Sonnberg et al., "Natural History of Highly Pathogenic Avian Influenza H5N1," *Virus Research*, vol. 178, no. 1 (2013) (hereinafter Sonnberg et al., "Natural History of Highly Pathogenic Avian Influenza H5N1").

[41] CDC, "H5 Bird Flu: Current Situation," May 30, 2025, https://www.cdc.gov/bird-flu/situation-summary/index.html.

[42] Sonnberg et al., "Natural History of Highly Pathogenic Avian Influenza H5N1."

[43] Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals."

[44] Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals."

[45] Timothy M. Uyeki, "Highly Pathogenic Avian Influenza A(H5N1) Virus Infection in a Dairy Farm Worker," *New England Journal of Medicine*, vol. 390, no. 21 (May 3, 2024), pp. 2028-2029.

[46] Catalina Pardo-Roa, "Cross-Species and Mammal-to-Mammal Transmission of Clade 2.3.4.4b Highly Pathogenic Avian Influenza A/H5N1 with PB2 Adaptations," *Nature Communications*, vol. 16 (March 6, 2025) (hereinafter Pardo-Roa, "Cross-Species and Mammal-to-Mammal Transmission of Clade 2.3.4.4b").

Figure 3. North American Bird Migration Flyways

Source: Audubon, "Birds on the Move," in *Audubon Adventures*, https://www.audubonadventures.org/migration_kids.htm (illustration by Thinkstock/Bluebird Design).

Note: Hawaii is part of the broader Pacific Flyway and is not shown on this map. The central portion of the Pacific Flyway extends across the ocean from New Zealand to islands like Hawaii and up through the Alaskan Arctic.

Some scientists contend that extensive mammal-to-mammal transmission of H5N1 could be an indicator of or precursor to human-to-human transmission and could justify heightened biosurveillance efforts.[47] Most mammalian cases of avian influenza result in *dead-end* infections, meaning there is no transmission among species or to other hosts, according to some scientists.[48] However, in some instances, scientists have reported mammal-to-mammal transmission within and between mammal species. For example, H5N1 virus was suspected to be transmitted among animals in fur farms (mink, arctic foxes, and raccoon dogs) in Europe within the last five years.[49] Mammal-to-mammal transmission was suggested in this case, as well as transmission through contamination from equipment, clothing, and carcasses. Mammal-to-mammal transmission was also suspected among sea lions in Peru and Chile, although uncertainty exists as to whether the infections were due to interactions with birds or mammals.[50] In other cases, however, transmission among mammals might happen through animal products such as raw milk or

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[47] Marcela M. Uhart, "Massive Outbreak of Influenza A H5N1 in Elephant Seals at Península Valdés, Argentina: Increased Evidence for Mammal-to-Mammal Transmission," *Nature Communications*, vol. 15 (2024).

[48] Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals."

[49] Lauri Kareinen et al., "Highly Pathogenic Avian Influenza A(H5N1) Virus Infections on Fur Farms Connected to Mass Mortalities of Black-Headed Gulls, Finland, July to October 2023," *Eurosurveillance*, vol. 29, no. 25 (June 20, 2024).

[50] Pardo-Roa, "Cross-Species and Mammal-to-Mammal Transmission of Clade 2.3.4.4b."

through consumption of carcasses of infected animals.[51] Lastly, in the United States, scientists attribute H5N1 infections in humans and cats to interactions with infected cattle and contaminated raw milk. According to scientists, infections could be spread from cattle to cattle through contaminated milking equipment.[52]

Avian Influenza Mutation and Reassortment

Influenza viruses are highly variable in terms of their interactions with one another, their hosts, and the environment.[53] When two or more viruses infect a single host at the same time, they can "swap" segments of their genome (i.e., genetic reassortment), resulting in a new hybrid virus.[54] These hybrid viruses can have new traits that lead to properties that affect transmissibility, virulence, and host variability.[55] H5N1 can also undergo mutations that may lead to new traits or characteristics that influence its transmission. According to scientists, monitoring and measuring changes in H5N1 are paramount for trying to understand whether H5N1 could gain or has gained the ability to transmit from human to human.[56] (The section "Spillover to Humans and Transmission Among Humans" provides additional information on human infections and possible routes of transmission.)

Scientists are concerned about the ability of H5N1 and H5Nx Clade 2.3.4.4b viruses to expand globally, spill over into mammals, and evolve through genomic reassortment and mutations.[57] The concern is centered on the potential of the virus to "evolve towards more efficient mammalian transmission and increase the risk of a global pandemic."[58] To determine the extent of the outbreak and how the virus is evolving, scientists are collecting samples from infected seabirds, birds of prey, backyard poultry, commercial poultry, marine and terrestrial mammals, and humans.[59] They extract and sequence viral ribonucleic acid (RNA) from these samples and compare strands for similarities and differences to hypothesize about the evolution and transmission of H5N1. Most of this work is being done with birds and mammals to determine how the virus has been, or is being, transmitted over time and space among species. This information is also being used to test the hypothesis that H5N1 has evolved into viral strains that allow for mammal-to-mammal transmission. Sustained mammal-to-mammal spread of H5N1 does not appear to be definitively verified; however, several studies provide evidence that it has

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[51] Massimo Galli et al., "H5N1 Influenza A Virus: Lessons from Past Outbreaks and Emerging Threats," *Le Infezioni in Medicini*, vol. 1 (2025), pp. 76-89 (hereinafter Galli et al., "H5N1 Influenza A Virus: Lessons from Past Outbreaks").

[52] For example, see Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals."

[53] Sonnberg et al., "Natural History of Highly Pathogenic Avian Influenza H5N1."

[54] Y. Kawaoka et al., "Avian-to-Human Transmission of the PB1 Gene of Influenza A Viruses in the 1957 and 1968 Pandemics," *Journal of Virology*, vol. 63, no. 11 (1989).

[55] Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals."

[56] Dhillon et al., "Steps to Prevent and Respond to an H5N1 Epidemic in the USA." Some scientists express concern when an avian flu virus coinfects a species that may be harboring another virus that can infect humans. They suggest that the resulting hybrid avian flu virus could evolve to enable human-to-human transmission.

[57] Mohammad Jawad Jahid and Jacqueline M. Nolting, "Dynamics of a Panzootic: Genomic Insights, Host Range, and Epidemiology of the Highly Pathogenic Avian Influenza A(H5N1) Clade 2.3.4.4b in the United States," *Viruses*, vol. 17, no. 3 (2025) (hereinafter Jahid and Nolting, "Dynamics of a Panzootic").

[58] Pardo-Roa, "Cross-Species and Mammal-to-Mammal Transmission of Clade 2.3.4.4b."

[59] For example, see Pardo-Roa, "Cross-Species and Mammal-to-Mammal Transmission of Clade 2.3.4.4b."

occurred among some species in certain cases, such as marine mammals in South America,[60] fur-producing species in European fur farms, and cattle.[61]

On the basis of these types of studies, scientists have identified two main variants of H5N1, which are being monitored in species in the United States: (1) B3.13, spreading mainly in cows in the United States, and (2) D1.1, found mostly in wild and domesticated birds, including poultry.[62] Scientists hypothesize that mutations in B3.13 could lead to H5N1 viruses that could more readily bind to human cells, potentially leading to human-to-human transmission.[63] For example, in one study of H5N1, scientists introduced several mutations into a viral HA protein and found that one mutation improved the ability of the virus to attach to receptors found on human cells.[64] In another study, some scientists reportedly identified mutations in B3.13 that appear in genes that encode certain viral proteins that make it easier to replicate in airway linings in cows and humans.[65] These mutations, according to the study, may make the virus better adapted to reside in human cells.[66]

The Rise of H5N1 Avian Influenza

H5N1 avian influenza is spreading throughout the world in wild birds, wildlife, marine mammals, and commercial poultry, dairy, and fur farms. H5N1 from Clade 2.3.4.4b is the dominant form of the currently spreading avian influenza virus.

H5N1 avian influenza virus was identified in chickens in Scotland in 1959 and then in turkeys in England in 1991.[67] In 1996, commercially farmed geese in the Guangdong Province of China contracted H5N1, presumably from wild birds. Infected geese led to outbreaks of H5N1 in chicken farms in Hong Kong in 1997, which also led to human infections and fatalities. All poultry in Hong Kong were killed in 1997 and 1998; however, several strains of H5N1 were later detected in wild and domesticated birds outside of these farms. Poultry outbreaks and human cases followed in 2003 in mainland China and countries in southeast Asia such as Vietnam and Thailand. Avian influenza viruses later were grouped into clades, including Clade 2.3.4.4b, which can be traced back to 2016, when it was found in domesticated poultry flocks in East and Southeast Asia.[68] The initial outbreaks of this clade were limited to avian species and caused losses in the poultry industry in the areas where infections were detected. Clade 2.3.4.4b was disseminated throughout the world in birds flying on migratory bird flyways and through global

[60] Pardo-Roa, "Cross-Species and Mammal-to-Mammal Transmission of Clade 2.3.4.4b."

[61] Leonardo C. Caserta et al., "Spillover of Highly Pathogenic Avian Influenza H5N1 Virus to Dairy Cattle," *Nature*, vol. 634 (July 25, 2024), pp. 669-676.

[62] Max Koslov, "Will Bird Flu Spark a Human Pandemic? Scientists Say the Risk Is Rising," *Nature*, vol. 638 (January 27, 2025), pp. 16-17.

[63] Nguyen et al., "Emergence and Interstate Spread of Highly Pathogenic Avian Influenza A(H5N1)."

[64] Several other changes in the virus would be needed for human-to-human transmission; the mutation studied would be a *stepping stone* mutation to transmission. See Ting Hui-Lin et al., "A Single Mutation in Bovine Influenza H5N1 Hemagglutinin Switches Specificity to Human Receptors," *Science*, vol. 386, no. 6726 (December 5, 2024), pp. 1128-1134.

[65] Vidhi Dholakia et al., "Polymerase Mutations Underlie Early Adaptation of H5N1 Influenza Virus to Dairy Cattle and Other Mammals," *BioRxiv* (preprint), January 6, 2025 (hereinafter Dholakia et al., "Polymerase Mutations Underlie Early Adaptation of H5N1").

[66] Dholakia et al., "Polymerase Mutations Underlie Early Adaptation of H5N1."

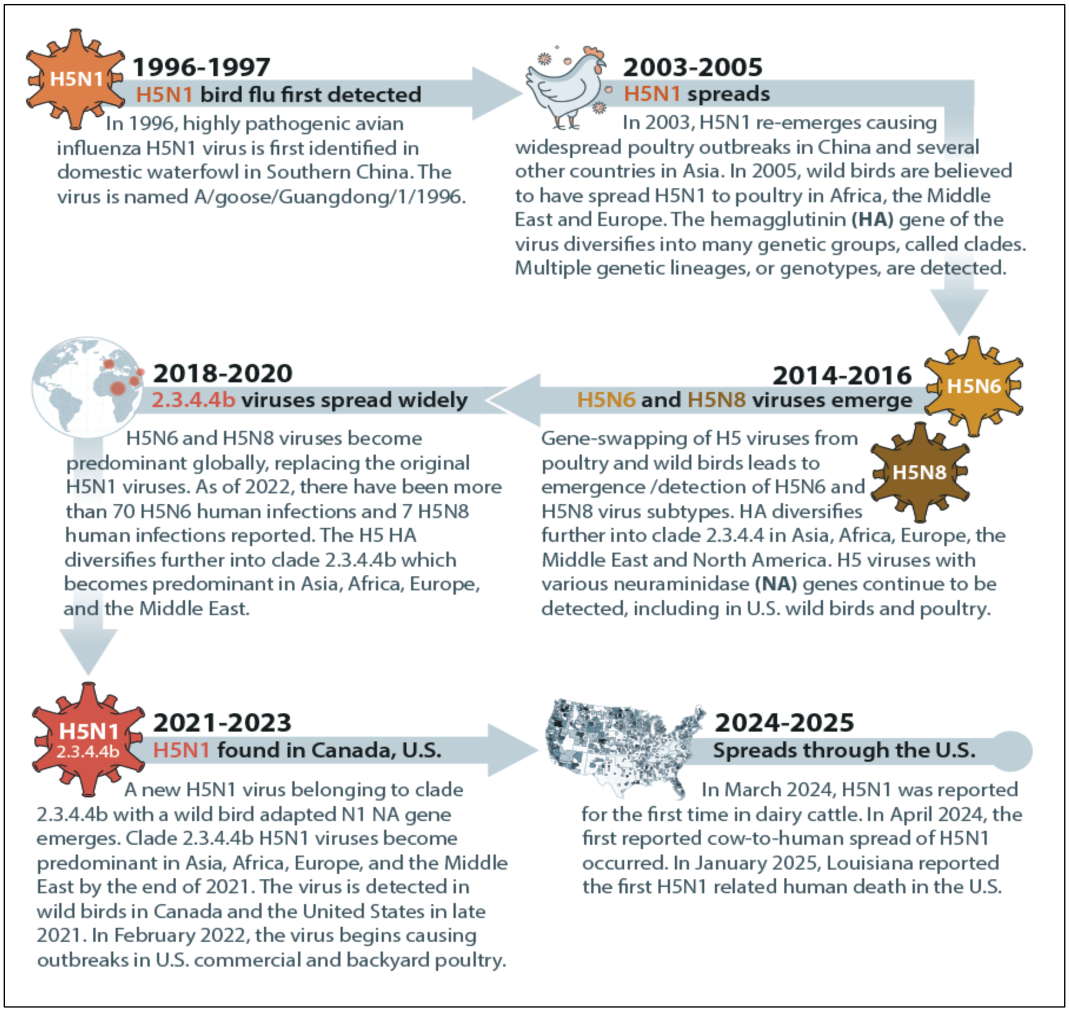
[67] Alejandro Mena et al., "The Impact of Highly Pathogenic Avian Influenza H5N1 in the United States: A Scoping Review of Past Detections and Present Outbreaks," *Viruses*, vol. 17, no. 307 (February 24, 2025) (hereinafter Mena et al., "The Impact of Highly Pathogenic Avian Influenza H5N1 in the United States").

[68] Xie et al., "The Episodic Resurgence of Highly Pathogenic Avian Influenza H5 Virus."

trade networks.[69] In late 2021, H5N1 Clade 2.3.4.4b was introduced to North America from Eurasia by birds flying within the East Atlantic Flyway, according to some scientists,[70] and spread to several wildlife species, including foxes, skunks, bears, bobcats, and raccoons, as well as cattle and humans.[71] **Figure 4** depicts the spread of avian influenza viruses since 1996.

Figure 4. Identification, Evolution, and Spread of Avian Influenzas

(1996-2025)



Source: CRS, adapted from Centers for Disease Control and Prevention, "Emergence and Evolution of H5N1 Bird Flu," June 6, 2023, https://archive.cdc.gov/www_cdc_gov/flu/avianflu/communication-resources/bird-flu-origin-infographic.html.

H5N1 Avian Influenza in the United States

Avian influenza has been active on and off in the United States for at least the last century. Scientists reported that the first outbreak of an HPAI in the United States occurred in 1924,

[69] Xie et al., "The Episodic Resurgence of Highly Pathogenic Avian Influenza H5 Virus."

[70] Xie et al., "The Episodic Resurgence of Highly Pathogenic Avian Influenza H5 Virus."

[71] Eric R. Burrough et al., "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*, vol. 30, no. 7 (July 2024).

causing severe losses of birds in markets in New York City.[72] By the 1950s, avian influenza was reported in poultry in most of Europe, Russia, North America, South America, the Middle East, Africa, and Asia.[73] (**Appendix A** provides a history of avian influenza events from 1878 through the current outbreak of H5N1.)

H5N1 Clade 2.3.4.4b began spreading throughout the United States in 2022. Evidence of H5N1 infections was found in wild birds, poultry, and scavenging birds such as vultures, among others.[74] From 2022 through May 2025, over 13,000 wild birds were found to be infected with H5N1 (**Figure 5**).[75] Wild bird samples are collected by the Animal and Plant Health Inspection Service (APHIS) Wildlife Disease Program and screened for avian influenza viruses. The data are analyzed and reported by the wild bird surveillance program. This program aims to be an early warning system for the introduction and distribution of avian influenza viruses in the United States.[76]

[72] CDC, "1880-1959 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/1880-1959.html.

[73] CDC, "1880-1959 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/1880-1959.html.

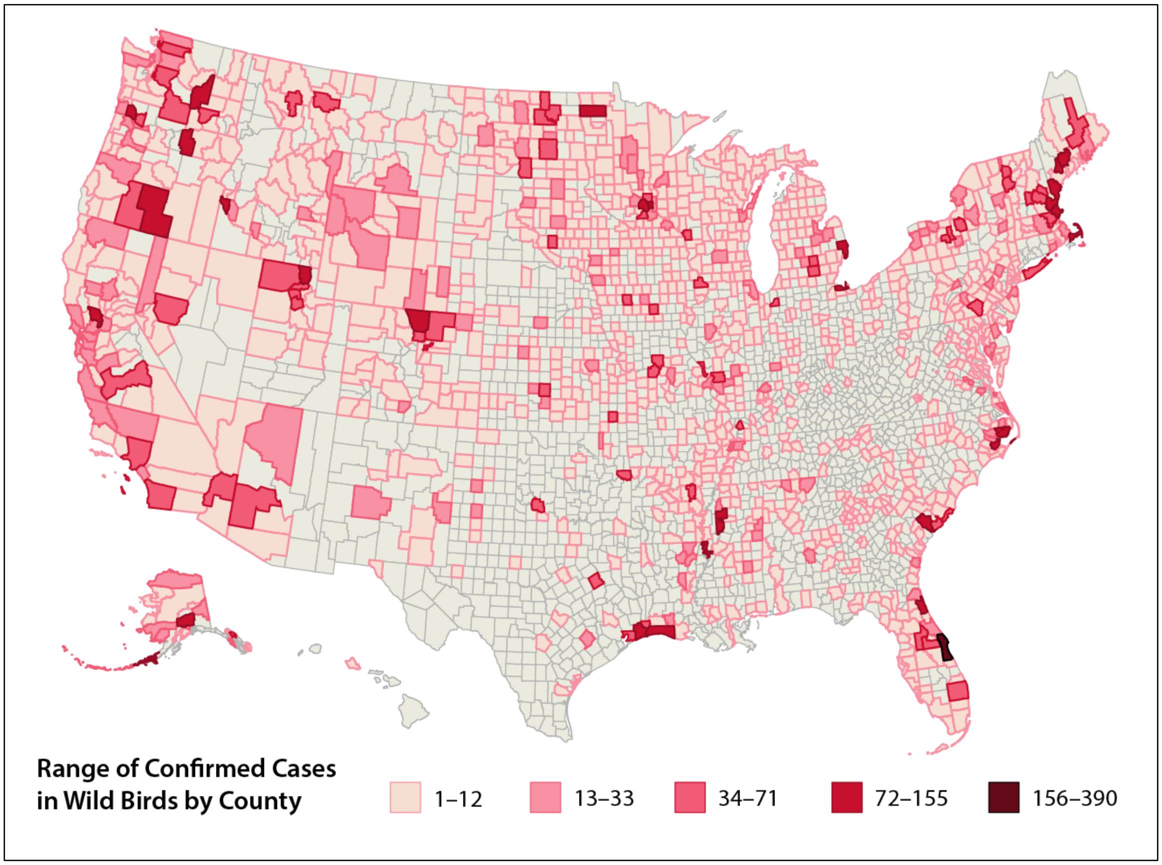
[74] Mena et al., "The Impact of Highly Pathogenic Avian Influenza H5N1 in the United States."

[75] U.S. Animal and Plant Health Inspection Service (APHIS), "Detections of Highly Pathogenic Avian Influenza in Wild Birds," May 13, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/wild-birds (hereinafter APHIS, "Detections of Highly Pathogenic Avian Influenza in Wild Birds").

[76] APHIS, "Detections of Highly Pathogenic Avian Influenza in Wild Birds."

Figure 5. Number of Confirmed Cases of Avian Influenza in U.S. Wild Birds

January 12, 2022-May 16, 2025



Source: CRS, using data taken from Animal and Plant Health Inspection Service, "Detections of Highly Pathogenic Avian Influenza in Wild Birds," May 16, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/wild-birds.

H5N1 has also spread among commercial and backyard poultry flocks in the United States. During this recent outbreak, APHIS first confirmed H5N1 in a commercial poultry flock in February 2022.[77] Since this detection until May 2025, APHIS has reported avian influenza in 1,705 commercial and backyard flocks in all states in the United States (**Figure 6**).[78] Over 170 million birds were reported to be infected by the virus during this time. The majority of infected birds, over 80 million in total, were in Iowa, California, and Ohio.[79] For additional information about H5N1 in poultry, see CRS Report R48518, *The Highly Pathogenic Avian Influenza (HPAI) Outbreak in Poultry, 2022-Present*, by Lia Biondo.

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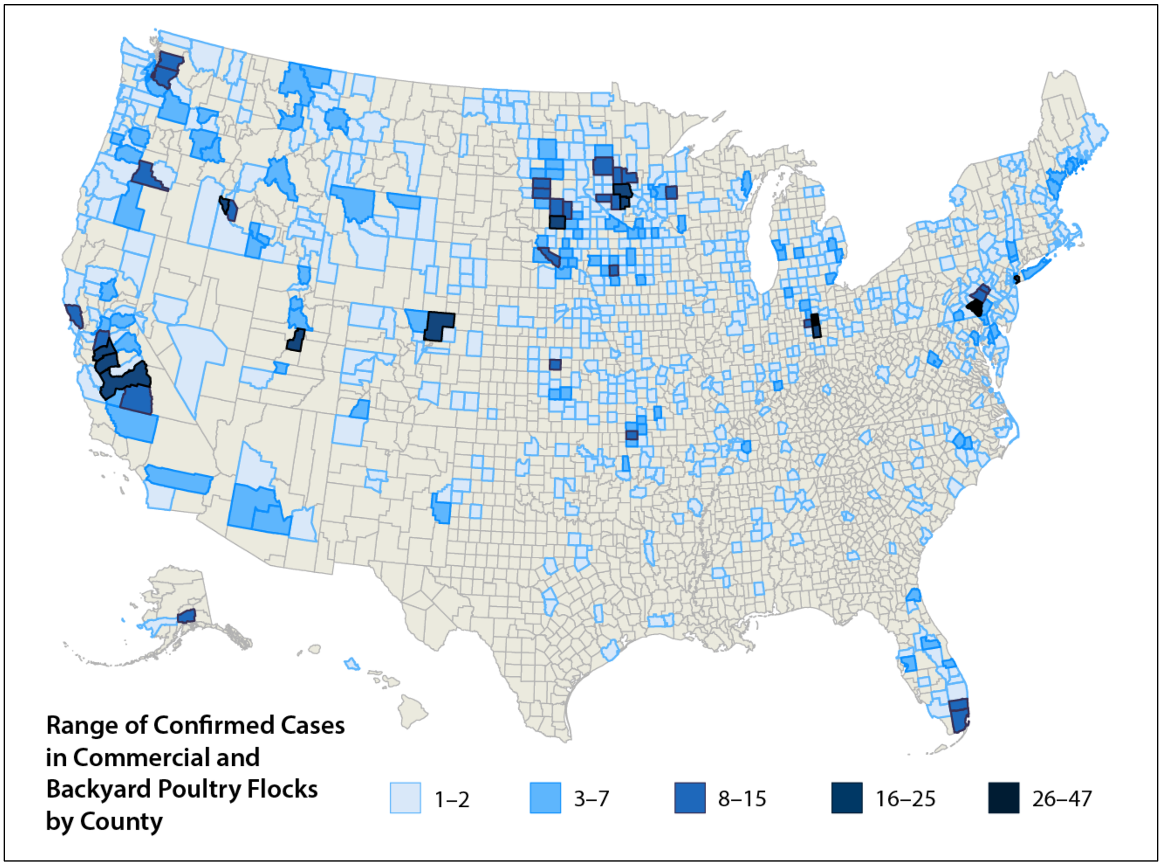
[77] APHIS, "Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks," March 17, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/commercial-backyard-flocks (hereinafter APHIS, "Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks").

[78] APHIS, "Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks."

[79] APHIS, "Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks."

Figure 6. Number of Confirmed Cases of Avian Influenza in U.S. Commercial and Backyard Poultry Flocks

February 8, 2022-May 30, 2025



Source: CRS, using data taken from Animal and Plant Health Inspection Service, "Confirmations of Highly Pathogenic Avian Influenza in Commercial and Backyard Flocks," May 30, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/commercial-backyard-flocks.

Notes: Poultry consists of egg layers, broilers, and turkeys. Testing did not delineate virus strains.

From 2022 to May 2025, there were 617 reported avian influenza infections in mammals in the United States (**Figure 7**).[80] Infections in mammals generally cause illness and, in some cases, death.[81] Reported infections in the United States were found in domestic cats, harbor seals, mountain lions, house and deer mice, skunks, racoons, and foxes.[82]

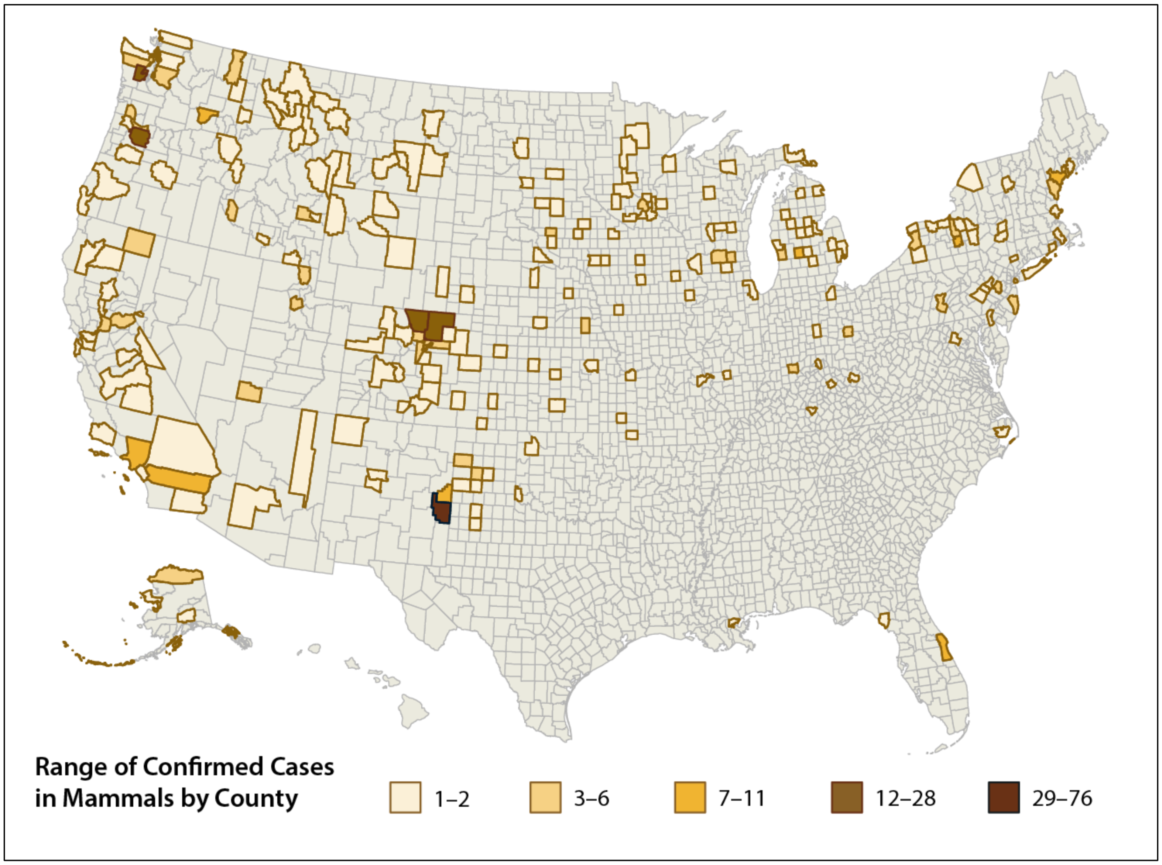
[80] APHIS, "Detections of Highly Pathogenic Avian Influenza in Mammals," May 15, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/mammals (hereinafter APHIS, "Detections of Highly Pathogenic Avian Influenza in Mammals").

[81] APHIS, "Detections of Highly Pathogenic Avian Influenza in Mammals."

[82] APHIS, "Detections of Highly Pathogenic Avian Influenza in Mammals."

Figure 7. Number of Confirmed Cases of Avian Influenza in U.S. Mammals

May 5, 2022-May 15, 2025



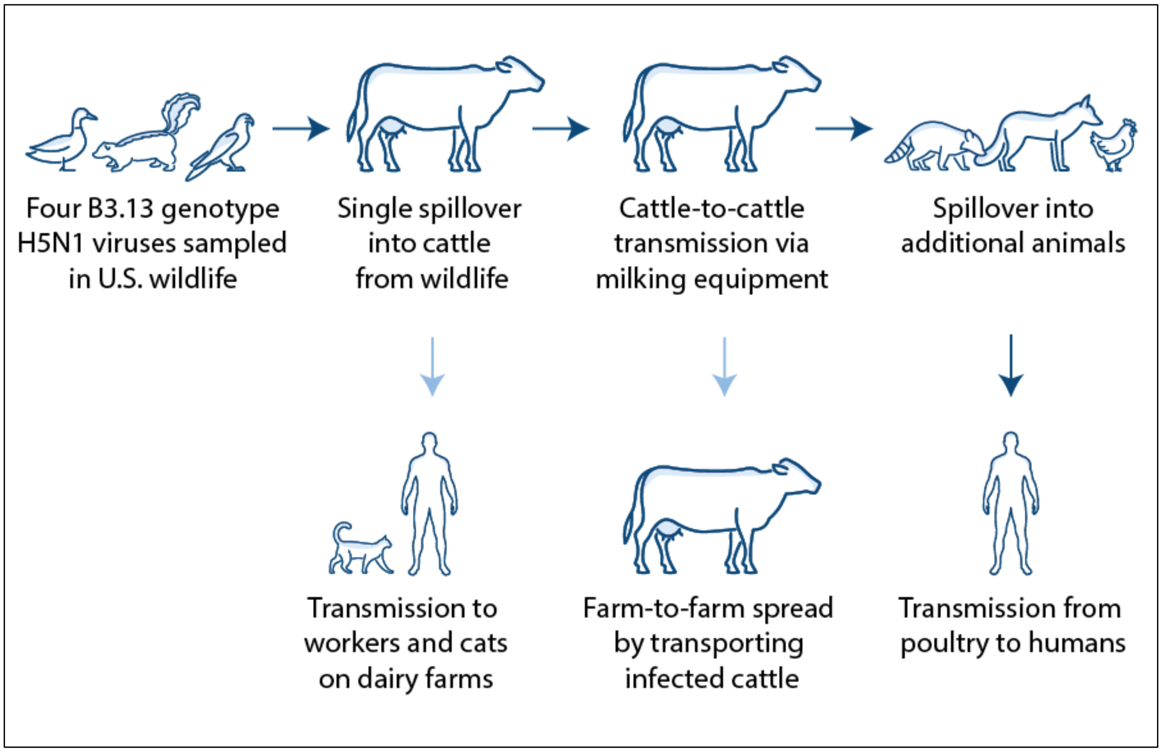
Source: CRS, using data taken from Animal and Plant Health Inspection Service, "Detections of Highly Pathogenic Avian Influenza in Mammals," May 15, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/mammals.

H5N1 was first reported in cattle in the United States in Texas in March 2024. The genotype that infected U.S. cattle was from B3.13 and is thought to have originated with a bird-to-cow transmission event earlier than the reported infection.[83] The virus continues to spread among dairy herds likely through interstate transport of infected animals, use of contaminated equipment, and other bird-to-cow transmission events (**Figure 8**).[84]

[83] Krammer et al., "Highly Pathogenic Avian Influenza H5N1: History."

[84] Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals."

Figure 8. Potential Pathways of Current Spread of H5N1 in the United States



Source: CRS, adapted from Thomas P. Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals," *Nature*, vol. 637, no. 8045 (January 2025), pp. 304-313 (figure on p. 308).

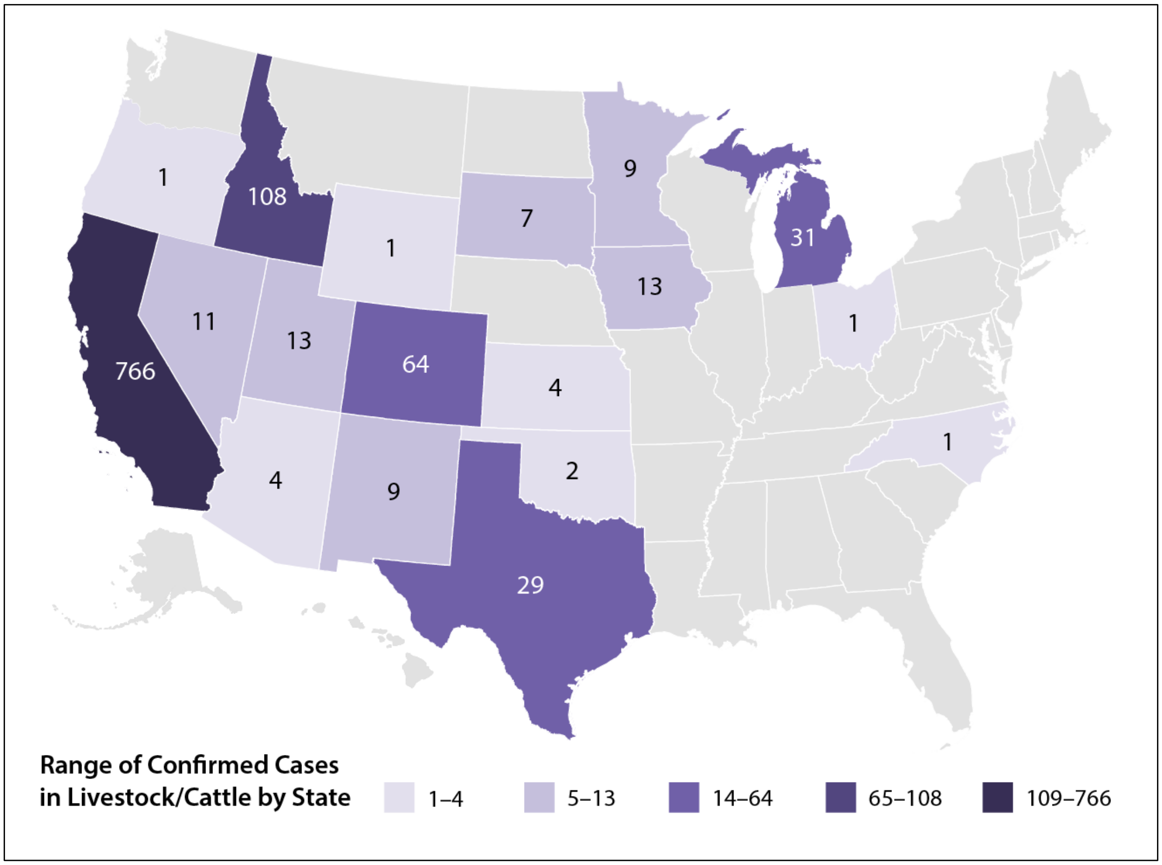
According to APHIS, there were 1,074 confirmed cases of HPAI in cattle in 17 states from March 2024 to May 2025.[85] Of this total, there were 766 reported cases in California (**Figure 9**).[86] For more information on cattle and avian influenza, see CRS In Focus IF12837, *H5N1 HPAI Continues to Spread in Dairy Herds*, by Joel L. Greene and Lia Biondo.

[85] APHIS, "Detections of Highly Pathogenic Avian Influenza in Livestock," April 8, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/hpai-confirmed-cases-livestock (hereinafter APHIS, "Detections of Highly Pathogenic Avian Influenza in Livestock").

[86] APHIS, "Detections of Highly Pathogenic Avian Influenza in Livestock."

Figure 9. Number of U.S. Confirmed Cases of Avian Influenza in Livestock

March 25, 2024-May 21, 2025



Source: CRS, using data taken from Animal and Plant Health Inspection Service, "HPAI Confirmed Cases in Livestock," May 21, 2025, https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/hpai-confirmed-cases-livestock.

Notes: See also CRS In Focus IF12837, *H5N1 HPAI Continues to Spread in Dairy Herds*, by Joel L. Greene and Lia Biondo.

H5N1 has infected humans in the United States, primarily from dairy herds and poultry farms. Scientists contend that H5N1 is infecting humans through their handling of dairy cows and poultry, as well as through milking equipment and potentially via consuming raw milk. Human infections in the United States have come from both the B3.13 and D1.1 genotypes of H5N1. There are 70 reported cases of H5N1, including one death in humans in the United States as of March 2025, according to the CDC (**Table 2**).[87]

Recent Selected Federal Actions to Address H5N1

In the United States, several federal agencies, as well as state and local agencies, are responding to H5N1. Federal departments involved include the USDA, Department of the Interior (DOI), and Department of Health and Human Services (HHS), among others. Federal agencies are conducting activities that range from monitoring the spread of H5N1 in wild birds, poultry flocks,

[87] CDC, "CDC A(H5N1) Bird Flu Response Update March 19, 2025," March 19, 2025, https://www.cdc.gov/bird-flu/spotlights/h5n1-response-03192025.html.

dairy herds, and humans to creating policies for addressing H5N1 in the United States. **Table 3** provides a summary of selected federal agency activities.

Table 3. Selected Federal Agencies and Their Activities to Address H5N1

Department and Agency	Description of Activities
U.S. Department of Agriculture (USDA)	On February 26, 2025, the USDA announced a "Five-Pronged Approach to Address Avian Flu." This strategy addresses the impact of avian influenza on the poultry industry in the United States (see the text box "USDA Five-Pronged Approach to Address Avian Flu" below).
Animal and Plant Health Inspection Service (APHIS)	APHIS is addressing H5N1 by monitoring and preventing the spread of H5N1 in poultry and other animals, including dairy cows. It is conducting research on the virus and developing vaccines for commercial poultry and livestock.[a]
U.S. Department of Health and Human Services (HHS)	HHS agencies have multiple initiatives and funding programs related to H5N1.[b]
Centers for Disease Control and Prevention (CDC)	The CDC conducts surveillance of public health, monitors human cases of H5N1, and provides guidance to state health departments on how to investigate suspected cases.[c] The CDC aims to understand the transmission pathways of the virus and develop strategies for prevention and treatment. The CDC reports monitoring data through its flu monitoring system. The CDC also receives reports from public health laboratories and performs tests in wastewater for the prevalence of H5N1. The CDC has a public health strategy for addressing H5N1 in humans. The strategy has several objectives, including • preventing infection and illness in people exposed to H5N1; • understanding human infection and illness with H5N1, including clinical, virologic, and epidemiologic characteristics; and • preparing for and mitigating the possibility of an H5N1 pandemic in humans.
National Institutes of Health (NIH)	NIH conducts and funds research on several aspects of H5N1, including • increasing the understanding of the biology of H5N1 viruses and factors that affect their transmission and efficacy, • developing and evaluating prevention strategies (e.g., vaccine development), • advancing treatments, and • creating and supporting strategies to detect H5N1. Through the National Institute of Allergy and Infectious Diseases, a research agenda was created in December 2024 to address H5N1 with these four objectives. The agenda contains specific sub-objectives, such as evaluating the science behind the outbreak of H5N1 in dairy cows and the possibility for human-to-human transmission of H5N1.[d]
Food and Drug Administration (FDA)	With respect to avian influenza, FDA is responsible for the safety of milk, dairy products, and animal feed supply. FDA tests these products for contamination from H5N1 and their safety for human and animal consumption. FDA also provides guidance to industry on measures to prevent the spread of H5N1 through their products.
U.S. Department of the Interior (DOI)	DOI has several initiatives that aim to monitor and study wildlife that might have contracted H5N1 on its trust lands.

Department and Agency	Description of Activities
U.S. Fish and Wildlife Service (FWS)	FWS is aiding in the surveillance of migratory birds that might have contracted H5N1 through efforts organized by the Interagency Steering Committee for Avian Influenza Surveillance in Wild Migratory Birds. FWS also monitors wild birds and aims to ensure biosecurity and safety on its trust lands, and assists in the collection of wild bird samples for testing.[e]
U.S. Geological Survey (USGS)	USGS conducts research into the ecology of avian influenza virus and surveillance for avian influenza viruses in wildlife. Specifically, the National Wildlife Health Center conducts research on the processes and environmental factors that affect the spread, distribution, and transmission of avian influenza in wild birds and poultry.[f]

Source: Compiled by CRS from sources cited below.

Notes: The information in this table summarizes selected efforts by federal agencies and should not be considered comprehensive.

a. For more information on the USDA response to H5N1, see CRS Report R48518, *The Highly Pathogenic Avian Influenza (HPAI) Outbreak in Poultry, 2022-Present*, by Lia Biondo.

b. CRS In Focus IF12895, *H5N1 Avian Influenza: The Human Health Response*, by Kavya Sekar, Amanda K. Sarata, and Hassan Z. Sheikh.

c. For more information on the CDC, see CRS In Focus IF12241, *The Centers for Disease Control and Prevention (CDC)*, by Kavya Sekar, and CRS In Focus IF12895, *H5N1 Avian Influenza: The Human Health Response*, by Kavya Sekar, Amanda K. Sarata, and Hassan Z. Sheikh.

d. National Institute of Allergy and Infectious Diseases (NIAID), *NIAID Research Agenda for 2024 H5N1 Influenza*, May 23, 2024, https://www.niaid.nih.gov/sites/default/files/niaid-h5n1-research-agenda.pdf.

e. U.S. Fish & Wildlife Service, "Avian Influenza," https://www.fws.gov/avian-influenza.

f. National Wildlife Health Center, "Avian Influenza Surveillance," U.S. Geological Survey, February 10, 2025, https://www.usgs.gov/centers/nwhc/science/avian-influenza-surveillance.

USDA Five-Pronged Approach to Address Avian Flu

On February 26, 2025, the USDA announced a "Five-Pronged Approach to Address Avian Flu." This strategy addresses the impact of avian influenza on the poultry industry in the United States. The approach includes

- investing up to $500 million in biosecurity measures for U.S. poultry producers, including expanding Wildlife Biosecurity Assessments to producers to reduce transmission of H5N1 from birds to poultry;
- increasing financial aid up to $400 million for farmers to repopulate poultry flocks;
- reducing regulatory burdens on the chicken and egg industry to stimulate innovation and reduce prices, including expanding the commercial supply for eggs, limiting culling during avian influenza outbreaks, and educating stakeholders on geographical price differences among eggs;
- exploring pathways toward vaccines, therapeutics, and other strategies for protecting egg-laying poultry; and
- considering import and export options for eggs to reduce costs for consumers and evaluating international best practices for safe egg production.

In an update to this strategy, the USDA noted that it has expanded biosecurity assessments, increased the indemnity rate for layer hens, evaluated solutions for disease management, invested $100 million in avian flu research and vaccine development, and explored import/export adjustments to stabilize supply.

Sources: U.S. Department of Agriculture, "USDA Invests Up to $1 Billion to Combat Avian Flu and Reduce Egg Prices," press release, February 26, 2025, https://www.usda.gov/about-usda/news/press-releases/2025/02/26/usda-invests-1-billion-combat-avian-flu-and-reduce-egg-prices; and U.S. Department of Agriculture, "USDA Update on Progress of Five-Pronged Strategy to Combat Avian Flu and Lower Egg Prices," press release, March 20, 2025, https://www.usda.gov/about-usda/news/press-releases/2025/03/20/usda-update-progress-five-pronged-strategy-combat-avian-flu-and-lower-egg-prices. For more information on the USDA response to H5N1, see CRS Report R48518, *The Highly Pathogenic Avian Influenza (HPAI) Outbreak in Poultry, 2022-Present*, by Lia Biondo.

There are also some interagency efforts that address specific aspects of avian influenza. For example, the Interagency Steering Committee for Surveillance for Highly Pathogenic Avian Influenza coordinates federal efforts for the surveillance of wild birds to detect avian influenza viruses in the United States. The committee consists of representatives from the USDA, U.S. Fish and Wildlife Service (FWS), U.S. Geological Survey (USGS), National Flyway Council, and Association of Fish and Wildlife Agencies.[88] In addition, the CDC, the USDA, and DOI released a framework called "One Health" in January 2025 to help individuals navigate health threats shared between people and animals. The approach acknowledges the interdependence of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) for addressing disease and aims to coordinate multiple sectors, disciplines, and communities to address health and ecosystem threats.[89] This effort also resulted in the creation of the United States One Health Coordination Unit. This federal entity is a platform for the CDC to work with the USDA, DOI, and other departments to exchange information and coordinate all One Health activities, including enhancing health-sustaining resources, emergency preparedness, and the prevention, detection, and response to zoonotic diseases.[90]

In the context of H5N1, a One Health approach could include surveillance and testing programs of wild birds and mammals that involve wildlife biologists, veterinarians, and public health officials or joint investigations into human cases of avian influenza that include tracing the source of the infection back to wildlife.

Considerations for Congress

Issues that Congress might consider when addressing avian influenza in the United States include the effectiveness and coverage of existing biosurveillance practices and policies; the effectiveness of coordination among federal agencies and nonfederal entities; the status of international collaboration; research and data required to fill existing knowledge gaps; activities related to monitoring and planning for potential spillover of avian influenza to humans; and policies that lead to suppressing or eliminating avian influenza in the United States.

Biosurveillance for H5N1

Conducting biosurveillance to monitor and record wildlife, poultry, and livestock infections of avian influenza is a priority for stakeholders.[91] Scientists assert that effective responses to avian influenza outbreaks rely on the rapid detection and identification of emerging strains of H5N1.[92] This requires extensive sampling of animal species that might be carrying H5N1 strains and could be considered intermediates host for human infections. Further, scientists note that sampling

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[88] U.S. Geological Survey, "What Is Avian Influenza?" https://geonarrative.usgs.gov/avianinfluenza/.

[89] CDC et al., *National One Health Framework to Address Zoonotic Diseases and Advance Public Health Preparedness in the United States*, 2025, https://www.cdc.gov/one-health/media/pdfs/2025/01/354391-A-NOHF-ZOONOSES-508_FINAL.pdf.

[90] CDC, "Federal One Health Coordination," February 14, 2025, https://www.cdc.gov/one-health/php/about/federal-one-health-coordination-1.html.

[91] Sergio A. Lambertucci et al., "The Threat of Avian Influenza H5N1 Looms over Global Biodiversity," *Nature Reviews Biodiversity*, vol. 1 (2025), pp. 7-9 (hereinafter Lambertucci et al., "The Threat of Avian Influenza H5N1 Looms over Global Biodiversity").

[92] For example, see European Food Safety Authority (EFSA) Panel on Animal Health and Animal Welfare (AHAW) et al., "Preparedness, Prevention and Control Related to Zoonotic Avian Influenza," *European Food Safety Authority Journal*, vol. 23, no. 1 (2025), Article e9191 (hereinafter EFSA AHAW et al., "Preparedness, Prevention and Control Related to Zoonotic Avian Influenza").

strains from human infections may also identify compatible H5N1 viruses and help contain their spread.[93] Some scientists assert that monitoring should be increased for marine birds and mammals, as well as terrestrial scavengers.[94] These are species most susceptible to infection and potential indicators of where the virus might be spreading. Further, they contend that monitoring should be increased along migratory flyways, especially in regions that are unaffected by the virus.[95] This could allow scientists to map the risk of H5N1 infection, prioritize surveillance efforts, and minimize the effects of the virus if it spreads to new regions.[96]

Other stakeholders might argue that existing surveillance actions by the federal government are sufficient to track the spread of avian influenza, citing APHIS, which stated that "the United States has the strongest avian influenza surveillance program in the world."[97] Most cases of H5N1 are found in domesticated birds and livestock as opposed to wild birds, leading some stakeholders to argue that increased monitoring of wildlife may not be as effective as biosurveillance on livestock. In response, some scientists note that certain studies found that preventive and control measures for infected wild birds (e.g., vaccines) could lower the incidence of disease outbreaks in poultry.[98]

Congress might consider whether current biosurveillance programs, particularly of wild birds, are sufficient to identify potential exposure pathways early enough to prevent transmission and continued spread to other animals, such as mammals, commercial poultry, and livestock. A related congressional oversight topic could be the effects of staff reductions at the USDA and other federal agencies on biosurveillance of H5N1 in livestock, wildlife, and humans. Options to increase biosurveillance, if desired, could include providing more resources for surveillance efforts through APHIS and FWS, and establishing early warning or identification networks across the country to provide real-time data to help identify infected animals and prevent future infections. Data collected during surveillance programs could also be used for broader research efforts. Legislative options could include expanding surveillance systems to monitor the prevalence of zoonotic diseases in humans. For example, H.R. 766 in the 119th Congress would authorize the National Wastewater Surveillance System to monitor a broad variety of pathogens, including avian influenza, to detect the prevalence of zoonotic diseases.[99] Section 6003(a)(3) of P.L. 117-2, the American Rescue Plan Act of 2021, authorized the Zoonotic Disease Initiative, a grant program focused on wildlife disease prevention and preparedness.[100]

The following are other potential topics for congressional oversight:

- The role of state and local governments in surveillance and response to H5N1, how this role does or does not support the federal response to H5N1, and what level of federal support these entities need to implement and report biosurveillance.

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[93] Harrington et al., "The Evolution and Future of Influenza Pandemic Preparedness."

[94] Lambertucci et al., "The Threat of Avian Influenza H5N1 Looms over Global Biodiversity."

[95] Lambertucci et al., "The Threat of Avian Influenza H5N1 Looms over Global Biodiversity."

[96] Lambertucci et al., "The Threat of Avian Influenza H5N1 Looms over Global Biodiversity."

[97] APHIS, "H5N1 Influenza," March 20, 2025, https://www.aphis.usda.gov/h5n1-hpai#detections-hpai.

[98] Masato Hatta et al., "An Influenza mRNA Vaccine Protects Ferrets from Lethal Infection with Highly Pathogenic Avian Influenza A(H5N1) Virus," *Science Translational Medicine*, vol. 16, no. 778 (2024).

[99] The National Wastewater Surveillance System was implemented by the CDC in September 2020. The system aimed to coordinate and increase capacity to track the presence of SARS-CoV-2, the virus that causes COVID-19, in wastewater samples collected across the country.

[100] U.S. Fish & Wildlife Service, "American Rescue Plan Act Zoonotic Disease Grant Program," 2023, https://www.fws.gov/project/american-rescue-plan-act-zoonotic-disease-grant-program.

- How individuals with backyard flocks could use information networks to protect and monitor their flocks for avian influenza. This topic could include federal outreach programs such as those administered by the USDA Cooperative Extension System to identify other animal populations raised by smallholders not currently seen as potential vectors for disease.[101] Congress might also consider whether state and local programs should be federally supported to conduct such work.

Federal Agency Coordination

In the United States, several federal agencies are addressing various aspects of avian influenza. Coordination among these agencies should be a priority, according to several scientists who support the One Health approach to addressing zoonotic viruses such as avian influenza.[102] Some Members of Congress contend that coordination among federal agencies to address avian influenza is critical to control its spread and that apparent contradictions in strategies to lower avian influenza among federal agencies might indicate a lack of coordination.[103] In May 2024, 16 U.S. Senators wrote to the Secretary of Agriculture and expressed support for a collaborative federal response to increase pathogen surveillance and inform farmers, ranchers, and veterinarians of the latest developments and mitigation efforts.[104]

Other stakeholders might contend that current coordination among federal agencies to address avian influenza is sufficient. For example, the "Five-Pronged Approach" to control avian influenza recently promulgated by the USDA commits $1 billion to implementing this approach.[105] This initiative is focused on the poultry industry, however. The One Health approach, in contrast, might include other species and additional federal agencies such as FWS and the CDC.

Current policies and coordination among federal agencies to address H5N1 and other forms of avian influenza could be a subject for congressional oversight. If Congress determined that more or better coordination were required, legislative options could include providing new authorities and/or funding for federal agencies to facilitate and direct coordination, establishing an executive office to address avian influenza, and authorizing a federal task force with decisionmaking authority to lead efforts to combat the current outbreak and any future outbreaks when needed.

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[101] National Institute of Food and Agriculture, "Cooperative Extension System," 2025, https://www.nifa.usda.gov/about-nifa/how-we-work/extension/cooperative-extension-system.

[102] Jahid and Nolting, "Dynamics of a Panzootic."

[103] Letter from Raja Krishnamoorthi, Ranking Member of the Subcommittee on Health Care and Financial Services, et al., to Hon. Robert F. Kennedy Jr., HHS Secretary, April 1, 2025, https://oversightdemocrats.house.gov/sites/evo-subsites/democrats-oversight.house.gov/files/evo-media-document/2025-04-01-gec-krishnamoorthi-et-al-to-jfkjr-re-bird-flu.pdf.

[104] For example, see letter from Sen. Amy Klobuchar et al. to Hon. Tom Vilsack, Secretary of Agriculture, May 1, 2024, https://www.klobuchar.senate.gov/public/_cache/files/6/7/676a55eb-4f22-4de6-9f7e-ca4314cce98d/A60BA7F007F2918BB694829DCABF8D5F.24.5.1-letter-to-secretary-vilsack-regarding-avian-flu.pdf.

[105] USDA, "USDA Invests Up to $1 Billion to Combat Avian Flu and Reduce Egg Prices," press release, February 26, 2025, https://www.usda.gov/about-usda/news/press-releases/2025/02/26/usda-invests-1-billion-combat-avian-flu-and-reduce-egg-prices; and USDA, "USDA Update on Progress of Five-Pronged Strategy to Combat Avian Flu and Lower Egg Prices," press release, March 20, 2025, https://www.usda.gov/about-usda/news/press-releases/2025/03/20/usda-update-progress-five-pronged-strategy-combat-avian-flu-and-lower-egg-prices.

New Authorities for Federal Agencies

If Congress determined that current levels of federal and nonfederal coordination to address H5N1 were insufficient, a range of options could be considered, including the following:

- Directing agencies to enter into cooperative agreements with other federal or nonfederal agencies to address avian influenza.
- Requiring submission of a crosscut budget that would show funding for activities addressing H5N1.[106] A crosscut budget is often used to present budget information from two or more agencies whose activities are targeted at a common policy goal and may allow Congress to examine whether these activities are complementary or duplicative, for example.
- Establishing a program related to H5N1 similar to the Networking and Information Technology Research and Development (NITRD) Program, which coordinates the activities of multiple agencies to tackle multidisciplinary, multi-technology, and multisector research and development needs.[107]

Executive Office for Avian Influenza

Another legislative option could be to establish a White House office to coordinate activities to inform future policies and actions to fight avian influenza or assign this function to an existing office. An example could be to utilize the Office of Pandemic Preparedness and Response (OPPR) for such activities.[108] The primary function of the office is to

> [p]rovide advice, within the Executive Office of the President, on policy related to preparedness for, and response to, pandemic and other biological threats that may impact national security, and support strategic coordination and communication with respect to relevant activities across the Federal Government.[109]

By law, OPPR is tasked with coordinating federal activities in order to "prepare for, and respond to, pandemic and other biological threats" as well as other responsibilities prescribed in P.L. 117-328. OPPR is required to submit a report every two years, in part, on current and emerging pandemic and other biological threats that pose a significant level of risk to national security as well as the roles and responsibilities of the federal government in preparing for, and responding to, such threats to the President; the Senate Committee on Health, Education, Labor and Pensions; and the House Committee on Energy and Commerce. On January 20, 2025, President Trump issued National Security Presidential Memorandum/NSPM-1, "Organization of the National Security Council and Subcommittees," which named the director of the OPPR Policy as a member on the National Security Council.[110]

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[106] Crosscut budgets can assist in making data from multiple agencies more understandable and could be used to inform congressional oversight committees, participating agencies, and stakeholders. A crosscut budget may be used to track funding for a theme (e.g., addressing avian influenza), list program accomplishments, measure progress toward achieving program goals, or compare similar activities conducted by various agencies. For more information, see CRS Report RL34329, *Crosscut Budgets in Ecosystem Restoration Initiatives: Examples and Issues for Congress*, by Pervaze A. Sheikh and Clinton T. Brass.

[107] Networking and Information Technology Research and Development (NITRD) Program, "About the NITRD Program," 2025, https://www.nitrd.gov/about-nitrd/.

[108] Established under the Consolidated Appropriations Act, 2023 (P.L. 117-328), Title II, Subtitle A, §2104.

[109] Consolidated Appropriations Act, 2023 (P.L. 117-328, §2104(b)).

[110] National Security Presidential Memorandum-1, "Organization of the National Security Council and (continued...)

Congress may consider a similar office focused on addressing avian influenza or an office that has a broader mandate that would identify, coordinate, prepare for, and respond to novel, adapted, or currently circulating zoonotic viruses. Some stakeholders might oppose this approach if they view the office as creating an additional layer of bureaucracy that might delay actions needed to address H5N1 by agencies with specialized expertise and "on-the-ground" presence, such as surveillance and response activities. This concern likely would depend on the structure and authority given to the office.

Federal Task Force

Congress might also consider creating a federal task force to address H5N1. A federal task force could have several duties that support a One Health approach to zoonotic diseases:

- identify opportunities to leverage federal resources with state or local resources and increase coordination among federal and nonfederal stakeholders;
- create a federal plan to contain H5N1 that could include strategies for research, biosurveillance, and containment and prevention protocols;[111]
- provide technical assistance and scientific resources to nonfederal stakeholders to address H5N1;
- organize federal agency activities to reduce overlap and be the point of contact for international collaborative efforts to eliminate H5N1;
- create a crosscut budget to show how federal funding is being spent on H5N1 and the authorities used for implementing activities; and
- solicit and address recommendations from stakeholders on how to improve the federal response to H5N1.

A task force also could provide Congress with a single entity over which it could exercise oversight for H5N1, rather than having to oversee the individual agencies.

Multiagency efforts that focus on coordination, such as a federal task force, may pose some challenges. For example, if consensus from all task force members were to be needed for activities to progress, one task force member could slow or stop efforts. Further, a task force would not have the authority to allocate funding to rapidly support response efforts. Congress could address this potential issue by providing funding for broad objectives, thereby giving the entity more discretion to direct funding to certain projects or activities deemed a high priority. Another option could be to appropriate funding to a single agency and grant that agency transfer authority to send funds to other agencies where activities need to be implemented.[112]

International Collaboration to Address Avian Influenza

Congress might consider the role of the United States in international organizations and programs associated with emerging disease identification and monitoring. H5N1 is spreading throughout the world, primarily through migratory birds and transport of infected animals. There are several

Subcommittees," January 20, 2025, https://www.whitehouse.gov/presidential-actions/2025/01/organization-of-the-national-security-council-and-subcommittees/.

[111] For example, under the Great Lakes Restoration Initiative, there is a federal task force that creates an action plan every four years to guide restoration and coordinates work among federal agencies to implement the plan. See 33 U.S.C. §1268(c)(7).

[112] For an example related to restoration in the Great Lakes, see 33 U.S.C. §1268(c)(7)(D)(ii).

international efforts to address avian influenza, focusing on monitoring, gathering, and reporting data on infections, research, and strategies for addressing the disease (**Table 4**).

Table 4. Selected International Organizations and Their Efforts to Address H5N1

Organization	Description
World Health Organization (WHO)	The WHO coordinates efforts to respond to H5N1 with other countries and international organizations. WHO efforts include surveillance and reporting of human cases of H5N1, providing technical assistance to countries, and preparing guidelines for prevention and control. It also advises on research to address the virus. In January 2025, President Trump issued Executive Order 14155, which stated that the United States intends to withdraw from the WHO.[a]
World Organisation for Animal Health (WOAH)	The WOAH focuses on animal health and provides guidance to member countries on the diagnosis, control, and prevention of H5N1 in animals. It also provides technical assistance and training and coordinates scientific studies. The United States is a member country.
Food and Agriculture Organization (FAO)	FAO addresses the impact of H5N1 on animal health and food security. FAO assists member countries to strengthen biosecurity measures against H5N1 and develop and implement national preparedness plans for H5N1. FAO also studies and reports the potential economic and food security impacts of H5N1 outbreaks. The United States is a member country.
Pan American Health Organization (PAHO)	The PAHO collaborates with countries in the Americas to increase and improve surveillance of H5N1; provide technical support to detect, treat, and investigate human infections of H5N1; and improve the capacity of labs to diagnose and monitor genetic changes of H5N1. The United States is a member country.

Sources: WHO, "What Research Is Important to Prepare and Respond to H5N1Influenza Outbreaks," press release, March 19, 2025; WOAH, "Avian Influenza," press release, 2025; FAO, "The Spread of H5N1 Highly Pathogenic Avian Influenza Calls for Stepped Up Action, FAO Says," press release, March 17, 2025; PAHO, *Avian Influenza*, 2025.

a. Executive Order 14155 of January 20, 2025, "Withdrawing the United States from the World Health Organization," 90 *Federal Register* 8361, January 29, 2025.

Some scientists contend that international collaboration is needed to improve biosurveillance and sharing of information on the extent and spread of avian influenza.[113] Further, they assert that international collaboration is needed to share data and insights on the spread of H5N1, given the global nature of migratory bird patterns, an indicator of viral spread.[114] They note that some organizations are working to improve information sharing and surveillance, but they lack financial resources, infrastructure, and ability to test and monitor organisms in developing areas. One scientist emphasizes that the possibility of unseen H5N1 transmission spreading among farmworkers or mammal populations in developing countries is higher than for developed countries. This may occur because of fear of a government presence, which could be detrimental to understanding the transmission of the disease, and lack of sufficient resources for testing.[115]

Other stakeholders argue that participation in certain international organizations may not be advantageous because of the ineffectiveness of the organization and potential politicization of the

[113] Food and Agriculture Organization of the United Nations, "The Spread of H5N1 Highly Pathogenic Avian Influenza Calls for Stepped Up Action, FAO Says," press release, March 17, 2025; and Lambertucci et al., "The Threat of Avian Influenza H5N1 Looms over Global Biodiversity."

[114] Mena et al., "The Impact of Highly Pathogenic Avian Influenza H5N1 in the United States."

[115] Peacock et al., "The Global H5N1 Influenza Panzootic in Mammals."

organization's actions. For example, the United States has stated that it intends to withdraw from the World Health Organization (WHO) because of its handling of the COVID-19 pandemic and the alleged politicization of its actions.[116]

Congress might consider whether federal participation in international efforts to address and monitor H5N1 is necessary to positively impact detection and tracking. Some potential advantages of participating in international efforts related to H5N1 might include receiving monitoring data of migratory birds carrying the virus from other countries into the United States, being aware of new strains of H5N1 in real time from around the globe, and participating in efforts to lower and control the spread of the disease at a global level. Some disadvantages might include the cost of paying dues for participation and the potential failure to control the virus because of ineffectual leadership and inadequate efforts. Congress might also consider the implications of the Administration's intent to withdraw from the WHO, pursuant to Executive Order 14155, "Withdrawing the United States from the World Health Organization," and its potential impacts on U.S. pandemic preparedness for zoonotic diseases such as avian influenza.[117]

Research and Data Collection

Several scientists contend that conducting research and collecting data on avian influenza viruses is a key step toward controlling them in wildlife, commercially raised animals, and humans.[118] Some scientists assert that research into how H5N1 evolves, spreads, and can be controlled is essential to address the effects of the virus. Selected research tasks recommended by scientists include the following:

- Studying the biology and evolution of H5N1 and factors that influence their ability to transmit and cause disease (e.g., how the H5N1 adapts and evolves), including studying mutations that might make it easier for the virus to infect humans or be spread through human-to-human transmission.[119]
- Gaining a better understanding of infections and pathogenesis in cattle, small ruminants, swine, and poultry.[120]
- Developing a better understanding of transmission among wildlife species that live around humans.[121]
- Developing prevention and mitigation strategies (e.g., vaccines) to counter H5N1 and advancing treatments to address H5N1 (e.g., vaccines, antivirals, diagnostic

[116] Executive Order 14155 of January 20, 2025, "Withdrawing the United States from the World Health Organization," 90 *Federal Register* 8361, January 29, 2025.

[117] Executive Order 14155 of January 20, 2025, "Withdrawing the United States from the World Health Organization," 90 *Federal Register* 8361, January 29, 2025.

[118] For example, see Galli et al., "H5N1 Influenza A Virus: Lessons from Past Outbreaks."

[119] National Institute of Allergy and Infectious Diseases (NIAID), *NIAID Research Agenda for 2024 H5N1 Influenza*, May 23, 2024, https://www.niaid.nih.gov/sites/default/files/niaid-h5n1-research-agenda.pdf.

[120] HHS, "U.S. Highly Pathogenic Avian Influenza A(H5N1) Research Priorities: October 2024," October 2024, https://www.hhs.gov/programs/public-health-safety/us-highly-pathogenic-avian-influenza-a-h5n1-research-priorities-october-2024/index.html (hereinafter HHS, "U.S. Highly Pathogenic Avian Influenza A(H5N1) Research Priorities").

[121] National Academies of Sciences, Engineering, and Medicine, *Potential Research Priorities to Inform U.S. Readiness and Response to Avian Influenza A (H5N1), Proceedings of a Workshop—in Brief*, 2024, https://nap.nationalacademies.org/read/28581/chapter/1#14 (hereinafter National Academies of Sciences, Engineering, and Medicine, *Potential Research Priorities for Avian Influenza A*).

tests).[122] Developing strategies to detect H5N1and prevent transmission, especially in developing countries where resources for this work are minimal.

- Estimating the potential for H5N1 to create a human pandemic.[123]

Certain research that investigates how viruses evolve to become more transmissible or virulent has raised biosafety and biosecurity concerns.[124] These discussions began, in part, in 2011-2012 around a set of studies funded by the National Institutes of Health (NIH) on respiratory transmission of H5N1.[125] These particular types of studies became known as "gain-of-function" (GOF) research and led to various federal oversight policies to address biosafety and biosecurity of such research, including a temporary moratorium on certain GOF research in 2014.[126] Since then, policymakers, scientists, and the public have debated the magnitude of potential risks and benefits of GOF and other life sciences research involving pathogens, how to weigh those risks and benefits appropriately, and to what extent community engagement and transparent decisionmaking should have a role in determining those risk and benefits. These discussions have led to various federal policies being developed and updated over the years.[127] These include, most recently, the Trump Administration's Executive Order 14292, "Improving the Safety and Security of Biological Research," released on May 5, 2025, which includes the Administration's intention to revise or replace the *United States Government Policy for Oversight of Dual Use Research of Concern and Pathogens with Enhanced Pandemic Potential*, which was scheduled to take effect on May 6, 2025.[128]

In addition to funding research, some stakeholders also suggest funding the creation of a system to characterize and catalog emerging viruses and their evolution.[129] Such a system would compile genetic sequences of viruses collected from all over the world and use bioinformatics[130] tools to evaluate the zoonotic potential of new mutations or combinations of new mutations of avian influenza viruses. A system of this type could address scientists' concerns about the limitations on assessing emerging mutations in H5N1.[131] Further, some scientists and policy analysts note that

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[122] HHS, *U.S. Highly Pathogenic Avian Influenza A(H5N1) Research Priorities*.

[123] National Academies of Sciences, Engineering, and Medicine, *Potential Research Priorities for Avian Influenza A*.

[124] CRS Report R47114, *Oversight of Gain-of-Function Research with Pathogens: Issues for Congress*, by Todd Kuiken.

[125] Kelsey Lane Warmbrod et al., "COVID-19 and the Gain of Function Debates: Improving Biosafety Measures Requires a More Precise Definition of Which Experiments Would Raise Safety Concerns," *EMBO Reports*, vol. 22, no. 10 (2021).

[126] Office of Science and Technology Policy, *U.S. Government Gain-of-Function Deliberative Process and Research Funding Pause on Selected Gain-of-Function Research Involving Influenza, MERS, and SARS Viruses*, October 17, 2014.

[127] CRS Report R48155, *Oversight of Laboratory Biosafety and Biosecurity: Current Policies and Options for Congress*, by Todd Kuiken.

[128] Office of Science and Technology Policy, *United States Government Policy for Oversight of Dual Use Research of Concern and Pathogens with Enhanced Pandemic Potential*, May 2024; and Executive Order 14292 of May 5, 2025, "Improving the Safety and Security of Biological Research," 90 *Federal Register* 19611, May 8, 2025, https://www.federalregister.gov/documents/2025/05/08/2025-08266/improving-the-safety-and-security-of-biological-research.

[129] EFSA AHAW et al., "Preparedness, Prevention and Control Related to Zoonotic Avian Influenza."

[130] Bioinformatics "is a scientific subdiscipline that involves using computer technology to collect, store, analyze and disseminate biological data and information, such as DNA and amino acid sequences or annotations about those sequences." See National Institutes of Health, "Bioinformatics," June 2, 2025, https://www.genome.gov/genetics-glossary/Bioinformatics.

[131] Ison and Marrazzo, "The Emerging Threat of H5N1 to Human Health."

supporting the collection of data in developing countries is needed to understand the evolution of viruses and fill in gaps in our knowledge of how they change.[132]

Congress might consider whether funding is needed for domestic and international efforts to collect, study, and report viral data. Such funds could support existing research programs and strategies but focus them on H5N1 through agencies such as NIH, APHIS, and USGS or support the creation of new research initiatives focused on H5N1. Another option would be to elevate the importance of studying H5N1 by directing agencies to give research proposals for its study a higher priority than they currently receive. For example, H.R. 2868 in the 119th Congress would include the study of HPAI as a high-priority research and extension area under Title 7, Section 5925(d), of the *U.S. Code* for the Secretary of Agriculture.

While some Members of Congress may support this approach domestically and internationally, others might assert that international efforts to collect data and report findings should be the responsibility of the individual countries where an outbreak is occurring or that current research efforts into zoonotic viruses such as avian influenza are sufficient to control and eliminate the virus.

Spillover to Humans and Transmission Among Humans[133]

Currently, the number of human cases of H5N1 in the United States is low (70), and it has primarily been spread by contact with infected animals (see **Table 2**). As discussed previously (see the text box "Nomenclature of Avian Influenza Virus"), hemagglutinin provides a virus with the ability to attach to a specific receptor in a host's cell. The hemagglutinin of avian influenza recognizes avian-type receptors. While humans can become infected with an avian influenza, typically via contact with an infected animal, without changes in the hemagglutinin of that particular virus, human-to-human transmission does not currently occur. Reassortment can occur when a host is coinfected with multiple influenza viruses, which may accelerate viral evolution, resulting in a virus that is more infectious to humans. Reassortment is believed to have occurred in the influenza pandemics in 1918, 1957, 1968, and 2009.[134]

In a recent human case of H5N1 in Louisiana, where it is believed that the patient contracted H5N1 from contact with poultry on the patient's property, the CDC analyzed samples from the patient's lungs for evidence of changes in the hemagglutinin compared with samples collected in wild birds and poultry in Louisiana. While changes were identified that suggest that the virus may have enhanced ability to infect humans, it is believed that these changes occurred within the patient after infection rather than being transmitted at the time of infection.[135] According to the CDC,

> Of note, virus sequences from poultry sampled on the patient's property were nearly identical to the virus sequences from the patient but did not have the mixed nucleotides identified in the patient's clinical sample, strongly suggesting that the changes emerged during infection as virus replicated in the patient. Although concerning, and a reminder that A(H5N1) viruses can develop changes during the clinical course of a human infection,

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[132] For example, see CRS Report RL33219, *U.S. and International Responses to the Global Spread of Avian Flu: Issues for Congress*, by Tiaji Salaam-Blyther.

[133] For additional information on the human health response to H5N1, see CRS In Focus IF12895, *H5N1 Avian Influenza: The Human Health Response*, by Kavya Sekar, Amanda K. Sarata, and Hassan Z. Sheikh.

[134] Ting-Hui Lin et al., "A Single Mutation in Bovine Influenza H5N1 Hemagglutinin Switches Specificity to Human Receptors," *Science*, vol. 386, no. 6726 (December 2024), pp. 1128-1134.

[135] Johns Hopkins Bloomberg School of Public Health, "Bird Flu Is Raising Red Flags Among Health Officials," January 14, 2025, https://publichealth.jhu.edu/2025/bird-flu-is-raising-red-flags-among-health-officials.

> these changes would be more concerning if found in animal hosts or in early stages of infection (e.g., within a few days of symptom onset) when these changes might be more likely to facilitate spread to close contacts. Notably, in this case, no transmission from the patient in Louisiana to other persons has been identified.[136]

Understanding how and when this adaptation, or reassortment, occurs can aid in prevention and preparedness efforts. Scientists have conducted experiments with viruses to better understand how they evolve. Certain types of these experiments have raised biosafety and biosecurity concerns. How to evaluate the risks and benefits of such experiments, whether to ban such research, or whether alternative methods could be investigated has been debated.[137]

Congress may consider the implications if H5N1, or another avian influenza virus, evolves and becomes transmissible between humans. What federal investments or policies may be needed to identify, abate, and address such a change in the virus's ability to infect humans? Further, Congress might debate whether the United States has in place sufficient programs, policies, and resources to address an outbreak of H5N1 in humans in places where human-to-human transmission is prevalent.

Eliminating or Suppressing Avian Influenza

Sustained H5N1 wild-bird epizootics repeatedly spill over to and back from domestic bird populations, increasing zoonotic and pandemic risks for wildlife and humans. Vaccinations and culling of infected birds and wildlife are the two main approaches for controlling influenza viruses.[138] Culling is commonly used to curb avian influenza in poultry, and millions of poultry have been culled to stamp out avian influenza outbreaks in the past. For example, in the 2014-2015 outbreak in the United States, over 50 million birds were depopulated (this figure includes birds that were culled and those that succumbed to the disease) on 232 infected premises.[139] However, in the current outbreak, continuous culling might be unsustainable because H5N1 is persistent in wild birds throughout the country.[140] Scientists propose several strategies that the United States and other countries could implement to limit the spread and impact of H5N1. Some of these strategies include the following:

- heightening surveillance and detection of infected organisms, especially wild birds along migratory flyways and infected mammals;
- improving biosecurity measures to protect livestock and poultry from infected wild birds and mammals, such as restricting farm access, lowering exposure of livestock and poultry to wild birds, ensuring that no milk enters the market from sick cows, and requiring that handlers use personal protective equipment (PPE);[141]

[136] CDC, "Genetic Sequences of Highly Pathogenic Avian Influenza A(H5N1) Viruses Identified in a Person in Louisiana," December 26, 2024, https://www.cdc.gov/bird-flu/spotlights/h5n1-response-12232024.html.

[137] CRS Report R47114, *Oversight of Gain-of-Function Research with Pathogens: Issues for Congress*, by Todd Kuiken.

[138] Jahid and Nolting, "Dynamics of a Panzootic."

[139] USDA, *Final Report for the 2014–2015 Outbreak of Highly Pathogenic Avian Influenza (HPAI) in the United States*, August 11, 2016, https://www.aphis.usda.gov/media/document/2086/file.

[140] Xie et al., "The Episodic Resurgence of Highly Pathogenic Avian Influenza H5 Virus."

[141] Tomas Perez-Acle et al., "Are We Cultivating the Perfect Storm for a Human Avian Influenza Pandemic?," *Biological Research*, vol. 57 (2024), Article 96 (hereinafter Perez-Acle et al., "Are We Cultivating the Perfect Storm for a Human Avian Influenza Pandemic").

- limiting exposure of wildlife associated with humans (e.g., livestock, poultry, and pets) to H5N1;
- conducting rapid response and containment of infected animals, including efforts to cull infected poultry and possibly other species;
- creating and testing mitigation and treatment methods, such as vaccines and therapeutic remedies; and
- researching mutations and genetic reassortment that might give scientists insight into the possibilities of mammal-to-mammal transmission and mammal-to-human transmission.

Congress might consider how the United States will control and eliminate avian influenza and whether current efforts to achieve this objective are sufficient. As the number of wildlife species and domesticated pets that test positive for H5N1 increases, so too does the potential for spread into humans and further potential for the virus to mutate into a more transmissible or virulent form. Congress might consider how federal programs or other policies might reduce these contact points between humans and infected species (beyond poultry and livestock) to help reduce the potential for spread and mutation between humans.

Stakeholders have offered options for Congress to consider to fortify the U.S. response toward eliminating H5N1 and other strains of avian influenza before it becomes a pandemic for humans. These include the following, in addition to options described above:

- rapid monitoring, testing, and research to get real-time data analysis on the spread and evolution of the virus[142] and efficient transmission of data to domestic and international databases;[143]
- funding to support research, implementation of biosecurity measures,[144] and on-farm and field testing,[145] such as protecting farm workers through PPE and isolating livestock and poultry from wild birds that might be carrying H5N1;[146] and
- conducting outreach to the public on the risks of handling wild birds, consuming raw milk, and raising backyard chicken flocks.

[142] Dhillon et al., "Steps to Prevent and Respond to an H5N1 Epidemic in the USA."

[143] Perez-Acle et al., "Are We Cultivating the Perfect Storm for a Human Avian Influenza Pandemic?"

[144] Dhillon et al., "Steps to Prevent and Respond to an H5N1 Epidemic in the USA."

[145] Perez-Acle et al., "Are We Cultivating the Perfect Storm for a Human Avian Influenza Pandemic?"

[146] Noah Kojima et al., "Building Global Preparedness for Avian Influenza," *The Lancet*, vol. 403, no. 10443 (June 8, 2024), pp. 2461-2465.

Appendix A. Chronology of Significant Global Events Related to Avian Influenza and Influenza A

Table A-1. Chronology of Significant Global Events Related to Avian Influenza and Influenza A

Information Compiled from Centers for Disease Control and Prevention (CDC) Websites Unless Otherwise Noted

Date	Event
1878	In 1878, the term "fowl plague" was used to describe the poultry disease observed in Italy and other European countries. "Fowl plague" was then differentiated from fowl cholera in 1880. Though these are the oldest bird flu references date, it is believed that prior to these references the disease had already been in existence for a long time, perhaps for hundreds of years.
1894	There are reports of subsequent outbreaks in poultry of HPAI in 1894 and 1901 in Italy, which spread with the poultry stock of an itinerary poultry merchant to eastern Austria and Germany and later to Belgium and France.
1901	The cause (etiology) of HPAI in domestic poultry was identified as a virus, though influenza viruses were not isolated until the 1930s.
1918	[The Spanish flu was caused by H1N1 influenza virus and is estimated to have killed approximately 50 million people.]
1924	The first outbreak of HPAI in poultry in the United States occurred during the fall and winter of 1924–1925. The disease first appeared to have caused severe losses in live bird markets in New York City.
1950s	By the mid-1900s, HPAI had been [documented] in poultry in most of Europe, Russia, North America, South America, Middle East, Africa and Asia.
1957	[A pandemic commonly referred to as the "Asian flu" emerged. This was a H2N2 virus that was a combination of reassortant viruses with avian origin. The virus emerged in East Asia and spread around the world, causing an estimated 1.1 million deaths worldwide and 116,000 deaths in the United States.]
1959	The first HPAI A(H5N1) virus was isolated following an outbreak in chickens in Scotland.
1961	An outbreak in wild birds (common tern) in South Africa suggests wild birds as a possible reservoir for avian influenza A viruses.
1967	Researchers proposed a relationship between human and avian influenza A viruses after a study showed a relationship between the 1957 human pandemic influenza virus and an influenza A virus isolated from a turkey.
1968	The 1968 pandemic was caused by an influenza A (H3N2) virus [composed] of two genes from an avian influenza A virus, including a new H3 hemagglutinin, but also contained the N2 neuraminidase from the 1957 H2N2 virus. In addition, the 1968 H3N2 pandemic [resulted from a reassortment] between the seasonal human influenza A(H2N2) virus and a low pathogenic avian influenza A virus. It was first detected in Hong Kong in July, and noted in the United States by September 1968. The estimated number of deaths was 1 million worldwide and about 100,000 in the United States. Though indications on the potential role of bird flu on the origin of human pandemics had been present for nearly a decade, it wasn't until 1968 that avian influenza A virus infections in wild birds in the United States, Australia, and Russia were confirmed using blood tests.

1983	In April 1983, an LPAI H5N2 virus circulated in chickens in the United States. Later that year, this virus had evolved into a highly pathogenic strain causing high mortality in affected flocks.
1996	HPAI H5N1 virus first identified in farmed waterfowl (geese) in Southern China in 1996.
1997	HPAI H5N1 virus outbreaks were detected in poultry in Hong Kong, and zoonotic (animal to human) transmission led to 18 human infections with six deaths. These were the recognized first H5N1 human infections with fatal outcomes.
2002	[HPAI was first detected in South America, in commercial poultry in Chile.]
2004	An outbreak of bird flu due to an H7N3 virus occurred among poultry in Canada. Within days, the virus causing this outbreak had changed from low to high pathogenicity. [During the same year], the United States experienced a poultry outbreak of a North American lineage HPAI H5N2 virus that was restricted to one farm.
2003-2005	Wild birds spread HPAI H5N1 virus to poultry in Africa, the Middle East[,] and Europe, and the HPAI H5N1 virus's HA surface protein diversified into numerous clades (related groups), and viruses reassorted into multiple genetic lineages (genotypes) that were detected around the world.
2009	A novel influenza A H1N1 virus emerged in humans. It was detected first in the United States and spread quickly across the United States and the world. This new H1N1 virus contained a unique combination of swine, avian[,] and human influenza genes not previously identified in animals or people. This virus was designated as influenza A (H1N1)pdm09 virus.
2010s	Multiple HPAI H5 viruses were identified with new NA subtypes (e.g., H5N2, H5N3, H5N6, H5N8 and H5N9) following reassortment (gene swapping) with wild bird lineages among wild birds and/or domestic poultry.
2014	HPAI H5N6 and H5N8 viruses emerged. Reassortment (gene-swapping) of H5 viruses with wild bird lineages led to the emergence and detection of H5N6 and H5N8 virus subtypes ... in Asia, Europe, and North America. In January 2014, the first human infection [of] HPAI H5N1 ... was reported in Canada in a traveler returning from China. In December [of] 2014, [USDA] reported HPAI H5N2 and H5N8 viruses in [U.S.] wild birds in several states.
2015	[In January, HPAI H5N1 was identified in a wild bird sample taken in 2014. It is believed that the virus was a reassortment of the Asian lineage H5 combined with an N1 NA from a North American wild bird. Between January and June HPAI H5 outbreaks were reported across 21 states and Canada in commercial poultry flocks.]
2016	Avian influenza HPAI H5N8 virus was detected in two seals stranded on the Baltic coast of Poland in 2016 and 2017.
2017	Outbreaks of HPAI H5N8 ... in domestic poultry and wild birds [were reported] in Europe, Asia, and parts of Africa.
2018	HPAI H5N6 and H5N8 ... become the predominant type of bird flu circulating among birds in Asia, Africa, the Middle East, and Europe.
2019	861 human cases of H5N1 virus infection and 455 deaths had been reported from 17 countries since November 2003.

2020	Reassortment ... between poultry and wild bird viruses led to the emergence of HPAI H5N1 with the NA viruses with an N1 NA from wild birds. [It was] first identified in Europe [and then] spread across Europe and into Africa, the Middle East and Asia. Five human cases of HPAI H5N6 virus infection were reported in China. [In the fall,] HPAI H5N8 virus was detected in several swans, seals, and a fox in the United Kingdom. In December, HPAI H5N8 was isolated from an asymptomatic poultry worker in Russia.
2021	[Additional] reports of HPAI H5N8 ... in seals [from] the United Kingdom, Germany, and Denmark. In March ... Laos reported its first human infection with HPAI H5N6 in a child who first became mildly ill in February following contact with infected poultry. In May ... HPAI H5N1 virus was detected in wild fox kits [juvenile foxes] at a rehabilitation center in the Netherlands, during an outbreak of HPAI in wild birds. [This was followed in December by reported infections] in wild foxes in Estonia. China reported 36 [human cases of] HPAI H5N6 virus with 18 deaths [in 2021].
2022 (January)	HPAI H5N1 clade 2.3.4.4b virus infection was reported in an asymptomatic 80-year-old man who raised ducks that became sick in England in late December 2021. First HPAI H5N1 virus (clade 2.3.4.4b) infection in wild birds in the United States since 2016 was reported by USDA/APHIS.
2022 (February)	Peru reported HPAI H5N1 virus infections in sea lions following deaths of hundreds of sea lions that began in January. USDA/APHIS announced an HPAI H5N1 outbreak in turkeys in a commercial poultry facility, marking the first HPAI detection in commercial poultry in the United States since 2020.
2022 (March)	Cambodia reported a case of LPAI H9N2 virus infection in a young child who was hospitalized for one day.
2022 (April)	The first human case of HPAI H5N1 virus was reported in the United States. The first human infection with low pathogenic avian influenza A H3N8 virus was reported in China. [Between January and April], China reported seven cases of HPAI H5N6 virus infection following poultry exposures, with severe or critical illness, including one death. [In this same time period,] China reported four cases of LPAI H9N2 virus infection, three in children and one in an adult, all with mild illness.
2022 (May)	Sporadic HPAI H5 virus infections in mammals were ... reported in several U.S. states and Canadian provinces[,] as well as in other countries.
2022 (May)	China reported a case of LPAI H10N3 virus infection in a man without known poultry exposure who became critically ill but recovered.
2022 (June-July)	HPAI H5N1 virus was ... detected in ten seals in Maine.
2022 (May-September)	At least eight U.S. states ... detected HPAI H5 virus in fox kits. [Other mammals also began to test positive for H5, including] two bobcats in Wisconsin, a coyote pup in Michigan, raccoons in Washington and Michigan, skunks in Idaho and Canada, and Mink in Canada.
2022 (May-September)	China reported four human cases of HPAI H5N6 virus infection after poultry exposures, with severe or critical illness, including one death.
2022 (May-September)	China reported four cases of LPAI H9N2 virus infection in children, including one who was hospitalized.
2022 (September)	Spain reported a human case of HPAI H5N1 in an asymptomatic poultry worker who was working at a poultry farm with a confirmed outbreak of H5N1.
2022 (October)	Vietnam reported a case of human infection with HPAI A(H5) virus in a child who became critically ill following exposure to infected backyard poultry. HPAI H5N1 viruses of clade 2.3.4.4b caused infections and some deaths among mink on a farm in northwest Spain.

2022 (November)	Spain reported a second human case of HPAI H5N1 in an asymptomatic poultry worker at the same poultry farm. China reported a human case of HPAI H5N1 virus infection following poultry exposure in an adult who developed critical illness and died.
2022 (October-November)	H5N1 virus infections [were] reported in [additional] mammals, including sea lions in New England and Peru, and bears, wild foxes, and skunks in Canada, the United States, and other countries.
2022 (October-November)	China reported four cases of LPAI H9N2 virus infection ... three mild cases in children, and one case of severe illness in an adult.
2022 (November-December)	H5N1 virus infections were reported in bears in Alaska, Nebraska, and Montana.
2023 (January)	Ecuador reported its first human infection with HPAI A(H5) in a child who became critically ill following exposure to infected backyard poultry.
2023 (February)	Cambodia Ministry of Health reported two human infections with HPAI H5N1 virus, including one fatal case.
2023 (December)	HPAI A(H5N1) virus was found to have infected a polar bear for the first time. This also was the first time an Arctic animal died from HPAI A(H5N1) virus. HPAI A(H5N1) virus infections were reported in elephant and fur seals in the Antarctic.
2024 (March)	[In Minnesota,] HPAI A(H5N1) virus ... infections were reported for the first time in goat kids (juvenile goats) on a farm, where a poultry flock had tested positive for the same virus. H5N1 bird were reported for the first time in dairy cows on farms in Kansas and Texas.
2024 (April)	A person in the United States tested positive for highly pathogenic avian influenza H5N1 bird flu. This would be the first reported cow-to-human spread of H5N1 bird flu.
2024 (May)	CDC reports the second (May 22) and third (May 30) cases of H5N1 bird flu virus infection in people who had exposure to infected dairy cows in Michigan. [On May 28,] USDA confirmed the first H5N1 bird flu virus infections in alpacas on the same premises where a poultry flock had tested positive for the same virus earlier that month.
2024 (July)	CDC confirms the fourth case of H5N1 bird flu virus infection in a person who had exposure to infected cows in Colorado.
2024 (September-October)	[First human H5N1 case in the United States (Missouri) reported with no known exposure to animals.[a] First confirmed H5N1infecction reported in a pig in Oregon on a farm co-located with poultry that had also tested positive for H5N1.[b]]
2025 (January)	[H5N9 reported in a California duck farm.[c] Louisiana reports the first H5N1-related human death in the United States.[d]]
2025 (May)	[Since 2022, 13,025 wild birds have tested positive for avian influenza, and 169,296,749 poultry have been affected by avian influenza.[e] Since March 2024, 1,063 dairy herds have been affected by avian influenza.[f]]

Source: Primary sources are Centers for Disease Control and Prevention (CDC), "1880-1959 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/1880-1959.html; CDC, "1960-1999 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/1960-1999.html; CDC, "2000-2009 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/2000-2009.html; CDC, "2010-2019 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/2010-2019.html; CDC, "2020-2024 Highlights in the History of Avian Influenza (Bird Flu) Timeline," April 30, 2024, https://www.cdc.gov/bird-flu/avian-timeline/2020s.html. Additional sources are listed below.

Notes: HPAI = highly pathogenic avian influenza; LPAI = low pathogenic avian influenza; HA = hemagglutinin; NA = neuraminidase; APHIS = Animal and Plant Health Inspection Service.

a. Michaela Simoneau et al., "The United States Needs to Step Up Its Response to Bird Flu," Center for Strategic and International Studies, December 19, 2024, https://features.csis.org/US-bird-flu-response/.

b. U.S. Department of Agriculture (USDA), "Federal and State Veterinary Agencies Share Update on HPAI Detections in Oregon Backyard Farm, Including First H5N1 Detections in Swine," press release, October 30, 2024, https://www.aphis.usda.gov/news/agency-announcements/federal-state-veterinary-agencies-share-update-hpai-detections-oregon.

c. Reuters, "US Reports First Outbreak of H5N9 Bird Flu in Poultry," January 27, 2025, https://www.reuters.com/business/healthcare-pharmaceuticals/us-reported-first-outbreak-h5n9-bird-flu-poultry-woah-says-2025-01-27/.

d. Louisiana Department of Health (LDH), "LDH Reports First U.S. H5N1-Related Human Death," press release, January 6, 2025, https://ldh.la.gov/news/H5N1-death.

e. CDC, "H5 Bird Flu: Current Situation," May 30, 2025, https://www.cdc.gov/bird-flu/situation-summary/index.html.

f. CDC, "H5 Bird Flu: Current Situation," May 30, 2025, https://www.cdc.gov/bird-flu/situation-summary/index.html.

Appendix B. Glossary of Selected Terms

Table B-1. Glossary of Selected Terms

Term	Definition
Avian influenza	A highly contagious viral disease affecting both domestic and wild birds "caused by viruses divided into multiple subtypes (i.e. H5N1, H5N3, H5N8 etc.) whose genetic characteristics rapidly evolve."[a]
Biosurveillance	A process that detects and characterizes outbreaks of disease in people, plants, and animals. It monitors the environment for bacteria, viruses, and other biological agents that cause disease.[b]
Clade	A group of organisms that evolved from a common ancestor. For avian influenza, it is the organization of the hemagglutinin gene highly pathogenic avian influenza based on molecular analysis. "The mutation of the [hemagglutinin gene] has resulted in genetically divergent groups of virus strains termed clades such as 2.3.4.4b."[c]
Endemic	A disease outbreak consistently present but limited to a particular region or country.[d]
Epidemic	"An unexpected increase in the number of disease cases in a specific geographical area."[e]
Epizootic	Outbreak of a disease in an animal population.
H5N1	"One of several influenza viruses that causes a highly infectious respiratory disease in birds called avian influenza, or bird flu. Can also cause a range of diseases in human, from mild to severe, and in some cases [death]."[f]
Highly pathogenic avian influenza (HPAI)	Avian influenza "that can cause severe clinical signs and possible high mortality rates."[g]
Influenza A virus	*Alphainfluenzavirus influenzae* is a pathogen that infects birds and some mammals. Influenza "A viruses are divided into subtypes based on two proteins on the surface of the virus: hemagglutinin (H) and neuraminidase (N). There are 18 different hemagglutinin subtypes and 11 different neuraminidase subtypes (H1 through H18 and N1 through N11, respectively)." [It is the only influenza virus] known to cause flu pandemics.[h]
Low pathogenic avian influenza (LPAI)	Avian influenza "that typically causes little or no clinical signs."[i]
Mutation	A mutation occurs when there is a change to the genetic material of a virus (e.g.; DNA or RNA) as it replicates inside a host cell. Viruses mutate to adapt to their surroundings, enabling them to move more efficiently from host to host (transmissibility).[j] A mutation can result in a new variant of the virus.
Mutation rate	"The number of new mutations in the genome of a virus over a unit of time, usually one generation."[k]
Pandemic	"An epidemic occurring worldwide or over a very wide area, crossing international boundaries, and usually affecting a large number of people."[l] "The WHO declares a pandemic when a disease's growth is exponential."[m]
Panzootic	"A widespread outbreak of a disease affecting several kinds of animals."[n]
Pathogen	An agent that causes disease, especially a living organism such as a virus, bacterium, or fungus.
Reassortment	A process where viruses co-infecting a cell exchange segments of their genomes, which results in a novel virus.[o]
Spillover	Transmission of a pathogen from an animal to a human.

Transmission	The process by which a pathogen passes from a source of infection to a new host.
Variant	Any change to the genetic sequence of a virus that occurs when a virus replicates. These changes can affect transmission, severity, treatment and immunity. Also referred to as a *viral mutant*, *variant*, or *strain*.[p]
Zoonosis or zoonotic disease	Any disease or infection that is naturally transmissible vertebrate animals to humans.

Source: CRS, using material from sources listed below.

Notes:

a. World Organisation for Animal Health (WOAH), "What Is Avian Influenza?" 2025, https://www.woah.org/en/disease/avian-influenza/.

b. Michael M. Wagner, "Introduction," in *Handbook of Biosurveillance*, ed. Michael M Wagner et al. (Elsevier, 2006).

c. Food and Agriculture Organization of the United Nations and WOAH, *Global Strategy for the Prevention and Control of High Pathogenicity Avian Influenza (2024–2033)*, 2025, p. 23, https://www.woah.org/app/uploads/2025/02/web-gf-tads-hpai-strategy-woah.pdf.

d. Columbia University Irving Medical Center, "Epidemic, Endemic, Pandemic: What Are the Differences?," February 19, 2021, https://www.publichealth.columbia.edu/news/epidemic-endemic-pandemic-what-are-differences.

e. Columbia University Irving Medical Center, "Epidemic, Endemic, Pandemic: What Are the Differences?," February 19, 2021, https://www.publichealth.columbia.edu/news/epidemic-endemic-pandemic-what-are-differences.

f. World Health Organization (WHO), "Influenza: A(H5N1)," May 16, 2024, https://www.who.int/news-room/questions-and-answers/item/influenza-h5n1.

g. WOAH, "What Is Avian Influenza?," 2025, https://www.woah.org/en/disease/avian-influenza/.

h. Centers for Disease Control and Prevention, "Types of Influenza Viruses," September 18, 2024, https://www.cdc.gov/flu/about/viruses-types.html.

i. WOAH, "What Is Avian Influenza?," 2025, https://www.woah.org/en/disease/avian-influenza/.

j. Mahdee Sobhanie, "How Do Virus Mutations Happen, and What Do They Mean?," Ohio State University Wexner Medical Center, December 14, 2021, https://wexnermedical.osu.edu/our-stories/virus-mutations-what-do-they-mean.

k. Itamar Caspi et al., "Mutation Rate, Selection, and Epistasis Inferred From RNA Virus Haplotypes Via Neural Posterior Estimation," *Virus Evolution*, vol. 9, no. 1 (2023).

l. Sara Agnelli and Ilaria Capua, "Pandemic or Panzootic—A Reflection on Terminology for SARS-CoV-2 Infection," *Emerging Infectious Diseases*, vol. 28, no. 12 (2022).

m. Columbia University Irving Medical Center, "Epidemic, Endemic, Pandemic: What Are the Differences?," February 19, 2021, https://www.publichealth.columbia.edu/news/epidemic-endemic-pandemic-what-are-differences.

n. Sara Agnelli and Ilaria Capua, "Pandemic or Panzootic—A Reflection on Terminology for SARS-CoV-2 Infection," *Emerging Infectious Diseases*, vol. 28, no. 12 (2022).

o. John Steel and Anice C. Lowen, "Influenza A Virus Reassortment," in *Influenza Pathogenesis and Control - Volume I. Current Topics in Microbiology and Immunology*, ed. Richard W. Compans and Michael B. A. Oldstone (Springer, 2014), pp. 377-401.

p. Titus Divala, "What Is a Variant? An Expert Explains," Wellcome, October 18, 2023, https://wellcome.org/news/what-variant-expert-explains.

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