Epidemiological Update
Avian Influenza A(H5N1) in the Americas Region

15 November 2024

The Pan American Health Organization / World Health Organization (PAHO/WHO) urges Member States to continue strengthening their cross-sectoral capacities for the detection and timely response to outbreaks in animal populations, including birds and mammals, as well as to potential human infections. In addition, PAHO/WHO invites Member States to share viruses with WHO Collaborating Centers in both the health and agricultural sectors to support risk analysis and to have candidate vaccine viruses.

Global Context

The avian influenza virus, which is usually transmitted among birds, has shown an increase in cases in mammals due to changes in its ecology and epidemiology *(1)*. The highly pathogenic avian influenza (HPAI) virus[1] (H5N1) currently circulating in the Americas belongs to a HPAI genotype resulting from a recombination that occurred in wild birds in Europe and low pathogenic strains in wild and domestic birds during its global spread *(2)*. Since 2020, the H5N1 subtype of clade 2.3.4.4b has caused an unprecedented number of deaths in wild birds and poultry in numerous countries in Africa, Asia, and Europe *(1)*. In 2021, the virus spread through waterfowl flyways to North America and, in 2022, to Central and South America *(1)*. By 2023, epidemic outbreaks in animals were reported from 14 countries and territories, mainly in the Americas *(1, 3)*.

The risk of infection in mammals and humans increases when there is contact with infected birds or exposure to contaminated environments *(3)*. Since 2022, 19 countries on three continents have reported outbreaks in mammals to the World Organization for Animal Health (WOAH) *(4)*. In recent years, there has been increased detection of A(H5N1) viruses in non-avian species worldwide, including terrestrial and marine mammals, both wild and domestic (companion and farmed). Although reports of transmission of clade 2.3.4.4b viruses among mammals worldwide are scarce, the current situation of contagion in dairy cattle in the United States of America, as well as massive deaths reported in marine mammals and infections in mink and fox farms in Europe, point to transmission among mammals, and further research is needed for its confirmation *(5)*.

Historically, between 2003 and 19 July 2024, a total of 896 cases and 463 deaths (51.7% case fatality) in humans caused by influenza A(H5N1) virus have been reported to the World Health Organization (WHO) globally, affecting 24 countries *(6)*. Between the beginning of 2021 and 14 August 2024, WHO has been notified of 35 detections of influenza A(H5N1) virus in humans, including five cases of avian influenza (H5) in people exposed to animals infected with influenza A(H5N1) virus. Of the total number of human cases reported during this period for

[1] Broadly speaking, the multiple strains of avian influenza virus can be classified into two categories according to the severity of disease presentation in poultry: low pathogenic avian influenza viruses (LPAI) and highly pathogenic avian influenza viruses (HPAI).

Suggested citation: Pan American Health Organization / World Health Organization. Epidemiological Update: Avian Influenza A(H5N1) in the Americas Region, 15 November 2024. Washington, D.C.: PAHO/WHO; 2024.

which the clade is known (n= 31 cases), 17 cases have been caused by viruses of clade 2.3.4.4b *(5)*.

Summary of the situation in the Americas Region

Since 2022 and as of epidemiological week (EW) 44 of 2024, a total of 19 countries and territories in the Americas Region have reported a total of 3,648 outbreaks[2] of avian influenza A(H5N1) in animals to WOAH (**Table 1**). Further details on outbreak identifications in domestic and wild mammals and birds in Argentina, the Plurinational State of Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, the Falkland Islands, Mexico, Panama, Paraguay, Peru, the United States, Uruguay and the Bolivarian Republic of Venezuela can be found in **Tables 2-3** and **Figures 1-5** *(4)*.

A total of 49 human infections caused by avian influenza A(H5) have been reported in four countries in the Americas between 2022 and as of 13 November 2024. Forty-seven cases were reported in the United States *(7)*, one case in Canada confirmed on 13 November 2024 *(8)*, one case in Chile reported on 29 March 2023 *(9)*, and one case in Ecuador reported on 9 January 2023 *(10)*.

During 2024 alone, 47 human cases have been reported in Canada and the United States, of which 33 have been reported in October and November 2024 *(7, 8, 11)*.

Situation by country and/or territory in outbreaks in birds

Between 2022 and as of EW 44 of 2024, a total of 19 countries and territories in the Americas Region reported 2,987 outbreaks of avian influenza in domestic and wild birds to WOAH. Of these outbreaks, 2,238 occurred in domestic birds and 749 in wild birds in the 19 countries (**Table 1**) *(4)*. As of EW 44 of 2024, seven countries and territories in the Americas (Brazil, Canada, Ecuador, Falkland Islands, Mexico, Peru, and the United States) have reported outbreaks in domestic and wild birds (**Table 2**) *(4)*.

The following is an alphabetical summary of the situation in countries and territories in the Americas Region that reported outbreaks of avian influenza A(H5N1) in birds during 2024.

In **Brazil**, between EW 1 and EW 44 of 2024, 15 outbreaks of avian influenza A(H5) have been confirmed in wild birds in the states of Espírito Santo, Rio de Janeiro, Rio Grande do Sul, and São Paulo *(4)*.

In **Canada**, between EW 1 and EW 44 of 2024, 33 HPAI A(H5N1) outbreaks in poultry and wild birds have been reported to WOAH in ten Canadian provinces, including Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Prince Edward Island, Quebec, and Saskatchewan *(4)*.

In **Ecuador**, between EW 1 and EW 44 of 2024, an outbreak of avian influenza A(H5N1) in backyard poultry was reported to WOAH. The outbreak was identified in Pastaza Province in February. Since then, no new outbreaks have been reported *(4)*.

[2] Note: Current figures represent the number of outbreaks, which may include multiple epidemiologically linked records and updates in reported case counts for each outbreak. This may result in lower counts than reported in previous publications. These figures reflect only officially verified outbreaks reported to the World Organization for Animal Health (WOAH), ensuring accuracy according to WOAH standards.

In the **Falkland Islands**, between EW 1 and EW 44 of 2024, WOAH was notified of eight outbreaks of avian influenza in birds, all related to wild birds *(4)*. The last outbreak reported was in October *(12)*.

In **Mexico**, between EW 1 and EW 44 of 2024, 13 outbreaks of avian influenza in wild and domestic birds were reported to WOAH. The outbreaks occurred in eight states in the country: Chihuahua, Guanajuato, Jalisco, Mexico, Michoacán, Oaxaca, Puebla, and San Luis Potosí *(4)*.

In **Peru**, between EW 1 and EW 44 of 2024, 59 outbreaks of HPAI A(H5) were reported to WOAH, mostly in backyard domestic poultry in ten departments: Ancash, Arequipa, Cajamarca, Cusco, Ica, Junín, La Libertad, Lambayeque, Lima, and Moquegua *(4)*.

In the **United States of America**, since the beginning of 2024, 126 outbreaks of avian influenza A(H5) virus in wild birds, commercial poultry and/or backyard poultry have been reported to WOAH in 28 states of the country[3] *(4)*. Between March and as of 5 November 2024, the United States authorities also report outbreaks of avian influenza A(H5) in commercial poultry in 48 states, affecting a total of 105,197,601 poultry *(7)*. During this same period, 51 jurisdictions have been identified with avian influenza A(H5) in wild birds, with a total of 10,528 detections in these birds *(7)*. In the past 30 days, outbreaks have been identified in 10 poultry flocks and 10 outbreaks in backyard flocks in California, Oregon, Washington, and Utah, affecting 4.42 million birds *(13)*.

Situation by country and/or territory in outbreaks in mammals

Between 2022 and as of EW 44 of 2024, eight countries and territories have reported 694 outbreaks of avian influenza A(H5N1) in mammals in Argentina, Brazil, Canada, Chile, the Falkland Islands, Peru, the United States of America, and Uruguay (**Table 1**) *(4)*. Four countries and territories in the Americas (Argentina, Canada, the Falkland Islands, and the United States of America) have reported 380 outbreaks of avian influenza in mammals during 2024 **(Table 2**) *(4)*.

The following is an alphabetical summary of the situation in countries and territories in the Americas Region that reported outbreaks of avian influenza A(H5N1) in mammals during 2024.

In **Argentina**, between EW 1 and EW 44 of 2024, an outbreak of avian influenza A(H5) in a South American sea lion in the province of Chubut was reported to WOAH. Since then, no new outbreaks have been reported *(4)*.

In **Canada**, between EW 1 and EW 44 of 2024, the provinces of Alberta, Nova Scotia, Prince Edward Island, and Quebec have reported six outbreaks in wild mammals. The last identified outbreak was reported in July 2024 *(4)*.

[3] California, Colorado, Florida, Idaho, Indiana, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Texas, Utah, West Virginia and Wisconsin.

In the **Falkland Islands**, between EW 1 and EW 44 of 2024, an outbreak of avian influenza was identified in a juvenile elephant seal in October 2024. The animal was found dead on Sea Lion Island *(12)*.

In the **United States of America**, since the beginning of 2024, 373 outbreaks in wild and domestic mammals have been reported to WOAH in 23 states[4] . Following the first notification of influenza A(H5N1) in dairy cattle in the country in March 2024, outbreaks have been identified in 16 states[5] , affecting 443 dairy herds as of 6 November 2024. In the past 30 days, 140 cases in dairy cattle have been reported in California, nine in Utah, and two in Idaho *(14)*. Additionally, avian influenza A(H5N1) virus has been detected in 28 domestic and wild mammalian species in the country. Detections include primarily red foxes (24%), house mice (20%), and domestic cats (13%) *(15)*.

Between 30 October and 6 November 2024, United States authorities announced the detection of avian influenza A(H5N1) in two pigs on a non-commercial backyard farm in Oregon, where the virus had previously also been identified in poultry. The viral load in the infected pigs was reported to be very low, and the genotype identified (D1.2) matched that found in the poultry samples *(16)*.

Situation by country and/or territory with human cases

The following is a summary of the situation in Canada and the United States of America with respect to human infections with avian influenza A(H5N1) during 2024. As of 13 November 2024, human cases of avian influenza A(H5N1) have been reported in Canada and the United States of America *(7, 8)*.

In **Canada**, on 14 November 2024, the Public Health Agency of Canada (PHAC) reported the confirmation of a human case of influenza A(H5N1), the first human case of influenza A(H5N1) acquired in the country. The case initially reported on 9 November by the B.C. Provincial Health Office was a teenager who developed symptoms on 2 November 2024 and was hospitalized and identified by laboratory testing as a presumptive positive for avian influenza A(H5). On 13 November, the PHAC National Microbiology Laboratory (NML) in Winnipeg confirmed the identification of influenza A(H5N1) in this case and genomic sequencing results indicated that the virus is related to the avian influenza A(H5N1) viruses from the ongoing outbreak in birds in British Columbia (influenza A(H5N1), clade 2.3.4.4b, genotype D1.1), the genome has an E627K mutation in the PB2 gene associated with mammalian adaptation and enhanced replication. This mutation has previously been observed in other human and mammalian infections. The investigation to date has not yet determined the source of infection of the case. This case has no known exposure to affected poultry farms in B.C. No additional human cases have been identified at the time of writing this alert. This case was identified through hospital-based influenza surveillance in British Columbia, has received medical treatment including antivirals and remains hospitalized in critical condition *(8)*.

In the **United States of America**, in 2024, as of 5 November, 46 human cases of influenza A(H5N1) have been confirmed in California (n= 21), Colorado (n= 10), Michigan (n= 2), Missouri (n= 1), Texas (n= 1), and Washington (n= 11). Of these cases, 25 have been linked to

[4] Alaska, California, Colorado, Idaho, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Montana, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, South Dakota, Texas, Utah, Vermont, Washington and Wyoming.
[5] California, Colorado, Idaho, Iowa, Kansas, Michigan, Minnesota, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, South Dakota, Texas, Utah and Wyoming.

exposure to sick or infected dairy cattle, whereas 20 are linked to exposure to poultry (**Table 4**) *(7, 17)*. The source of exposure for one case in Missouri could not be determined, and investigations have been completed, ruling out possible human-to-human transmission *(18)*. As of 15 November, human-to-human transmission of avian influenza A(H5N1) virus has not been reported *(7)*.

Between 24 March and as of 6 November 2024, targeted surveillance efforts for avian influenza A(H5) have monitored over 6,700 individuals for potential exposure to infected animals, with more than 340 undergoing testing for the avian influenza virus.

Table 1. Number of outbreaks in domestic and wild birds and mammals in the Americas Region reported to WOAH between 2022 and as of EW 44 of 2024.

Country/Territory	Number of outbreaks	In poultry		In mammals	
		Wild	Domestic	Wild	Domestic
Argentina	146	Yes	Yes	Yes	
Bolivia	38	Yes	Yes		
Brazil	166	Yes	Yes	Yes	
Canada	462	Yes	Yes	Yes	Yes
Chile	212	Yes	Yes	Yes	
Colombia	66	Yes	Yes		
Costa Rica	10	Yes	Yes		
Cuba	1	Yes	Yes		
Ecuador	38	Yes	Yes		
Falkland Islands	14	Yes		Yes	
Guatemala	1	Yes			
Honduras	4	Yes			
Mexico	143	Yes	Yes		
Panama	9	Yes	Yes		
Paraguay	5		Yes		
Peru	384	Yes	Yes	Yes	
United States	1,922	Yes	Yes	Yes	Yes
Uruguay	25	Yes	Yes	Yes	
Venezuela	2	Yes	Yes		
Total	**3,648**				

Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management; and Falkland Islands Department of Agriculture. Avian Influenza Information; Stanley: IFAD; 2024 [cited 4 November 2024]. Available in English at: https://falklands.gov.fk/agriculture/avian-influenza.

Table 2. Avian influenza outbreaks in birds and mammals in the Americas Region in 2024 as of EW 44.

Country/Territory	Number of outbreaks	In poultry		In mammals	
		Wild	Domestic	Wild	Domestic
Argentina	1			Yes	
Brazil	15	Yes			
Canada	39	Yes	Yes	Yes	
Ecuador	1		Yes		
Falkland Islands	10	Yes		Yes	
Mexico	13	Yes	Yes		
Peru	59	Yes	Yes		
United States	499	Yes	Yes	Yes	Yes
Total	**637**				

Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management; and Falkland Islands Department of Agriculture. Avian Influenza Information; Stanley: IFAD; 2024 [cited 4 November 2024]. Available in English at: https://falklands.gov.fk/agriculture/avian-influenza.

Table 3. Record of outbreaks in mammals in the Americas from 2022 to EW 44 of 2024.

Mammals	Argentina	Brazil	Canada	Chile	United States	Peru	Uruguay
Arctocephalus australis (two-hair fur seal)	Yes	Yes					Yes
Camelidae (alpaca)					Yes		
Canis latrans (coyote)					Yes		
Canis lupus familiaris (domestic dog)			Yes				
Capra hircus (domestic goat)					Yes		
Didelphis virginiana (Virginia opossum)					Yes		
Felis silvestris catus (domestic cat)			Yes		Yes		
Dairy cattle					Yes		
Halichoerus grypus (gray seal)			Yes		Yes		
Lontra canadensis (northern river otter)					Yes		
Lontra felina (sea otter)				Yes			
Lontra provocax (huillin)				Yes			
Lynx rufus (bobcat)					Yes		
Tuesday American (sable)					Yes		
Mephitis mephitis (skunk)			Yes		Yes		
Microtus ochrogaster (prairie voles)					Yes		
Mirounga leonina (southern elephant seal)	Yes						
Mus musculus (house mouse)					Yes		
Nasua nasua (cochi or South American coati)							Yes
Neogale vison (American mink)			Yes		Yes		
Otaria flavescens (South American sea lion)	Yes	Yes		Yes		Yes	Yes
Panthera leo (lion)						Yes	
Panthera pardus orientalis (Amur leopard)					Yes		
Panthera tigris (tiger)					Yes		
Pekania pennanti (fisher)					Yes		
Peromyscus sonoriensis (western deer mouse)					Yes		
Phoca vitulina / Halichoerus grypus (seal)			Yes		Yes		
Procyon lotor (raccoon)			Yes		Yes		
Puma concolor (cougar)					Yes		
Sciurus aberti (squirrel)					Yes		
Sus scropha (domestica) (pig)					Yes		
Sylvilagus audubonii (desert rabbit)					Yes		
Tursiops truncatus (bottlenose dolphin)					Yes		
Ursus americanus / U. arctos horribilis (bear)			Yes		Yes		
Ursus arctos (brown bear)					Yes		
Ursus maritimus (polar bear)					Yes		
Vulpes vulpes (fox)			Yes		Yes		

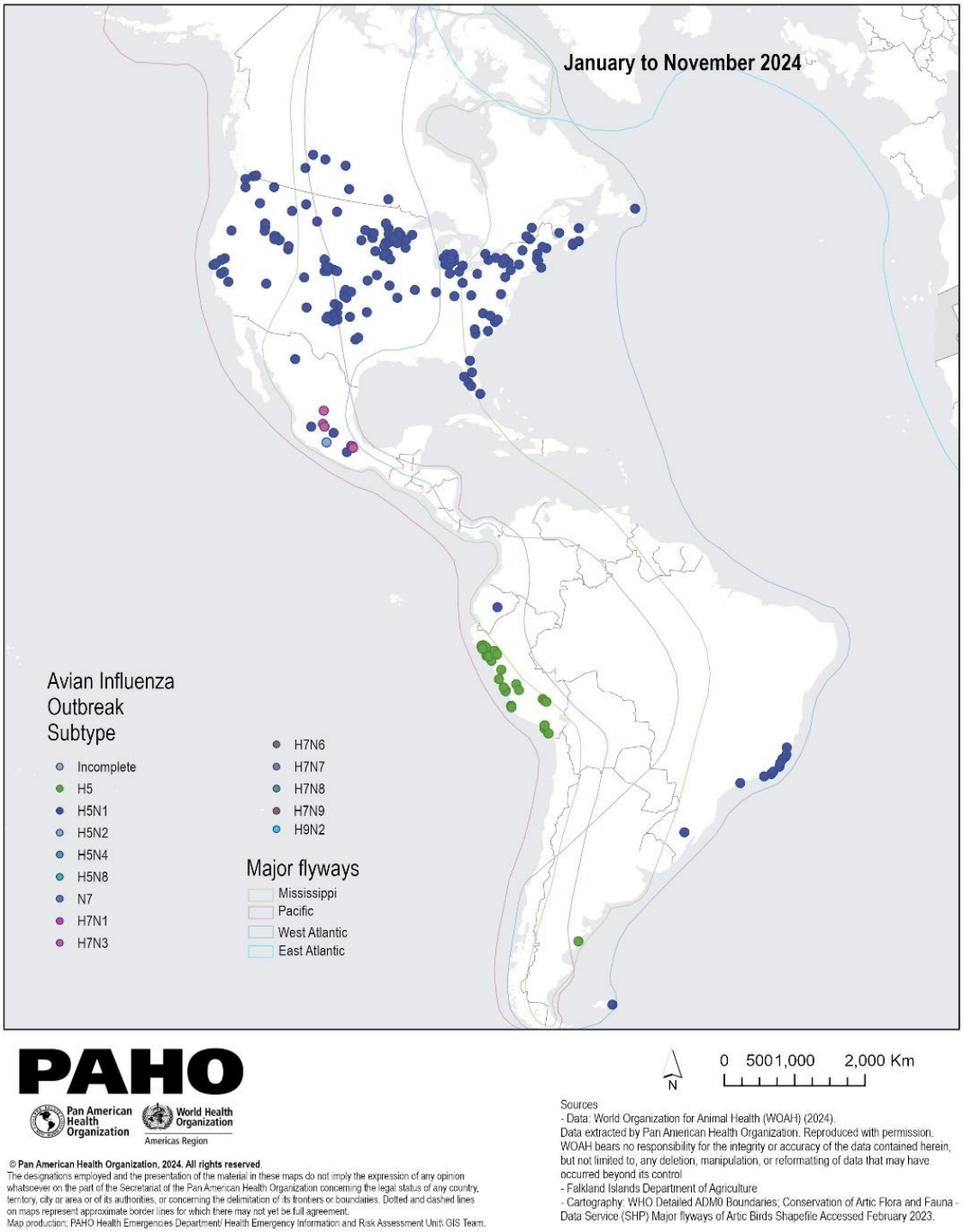
Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management; and United States Department of Agriculture, Animal and Plant Health Inspection Service. USDA APHIS. H5N1 Detection in Oregon Swine, Bovine Vaccine Candidate Progression. Washington, D.C.: USDA; 2024. Available from: https://www.aphis.usda.gov/news/agency-announcements/usda-animal-plant-health-inspection-service-shares-update-h5n1-detection.

Table 4. Cases of avian influenza A(H5) infections in the United States during 2024 through 8 November 2024.

State	Linked to livestock	Linked to poultry	Origin Unknown	Total by State
California	21	0	0	21
Colorado	1	9	0	10
Michigan	2	0	0	2
Missouri	0	0	1	1
Texas	1	0	0	1
Washington	0	11	0	11
Total	**25**	**20**	**1**	**46**

Source: United States Centers for Disease Control and Prevention. Avian Influenza H5. Atlanta: CDC; 2024. [cited 8 November 2024]. Available from: https://www.U.S. CDC.gov/bird-flu/situation-summary/index.html.

Figure 1. Historical avian influenza outbreaks by subtype and main migratory routes of wild birds between January and November 2024 in the Americas Region.

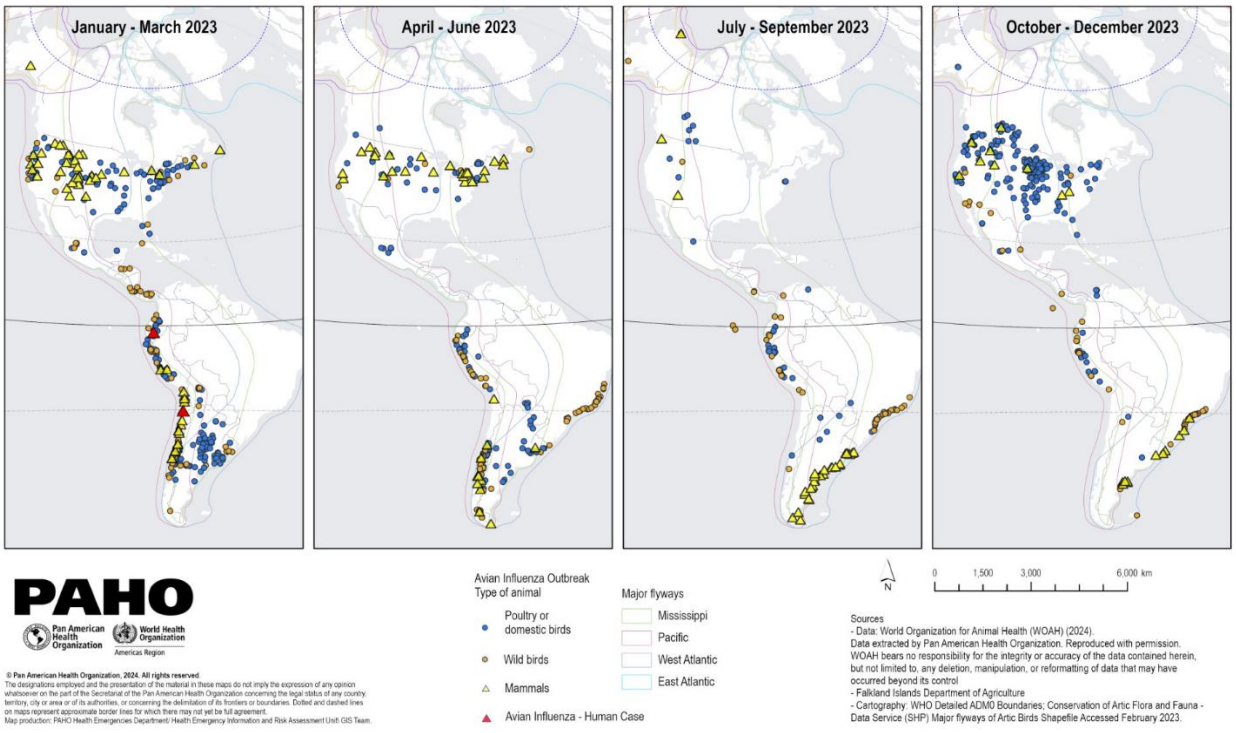


Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management.

Figure 2. Historical avian influenza outbreaks in 2024 as of EW 44 by species and main migratory routes of wild birds in the Americas Region**.**

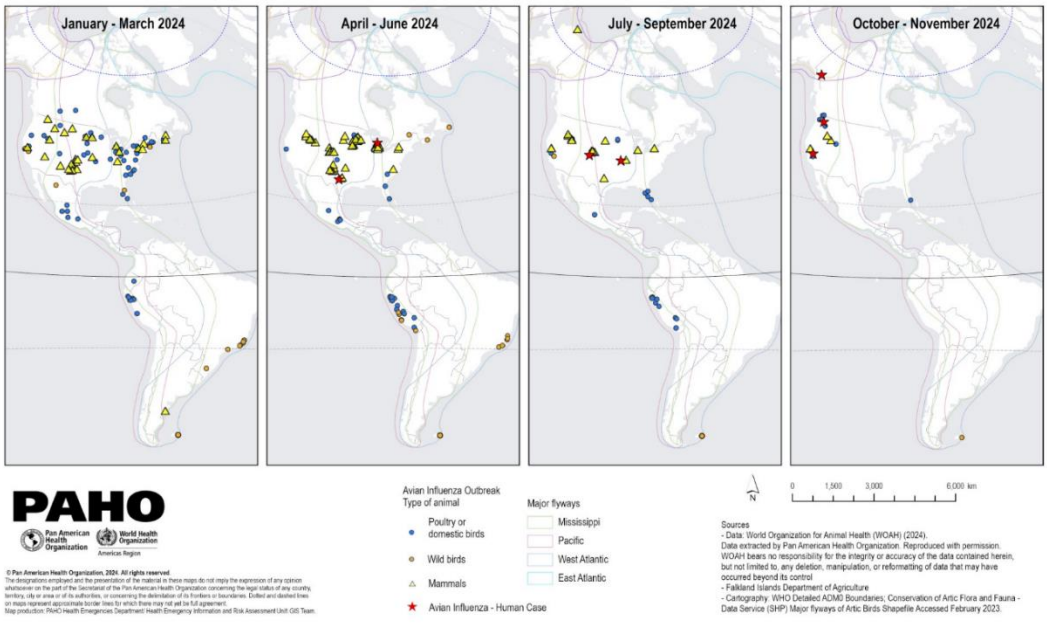
Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management.

Figure 3. Historical avian influenza outbreaks and main migratory routes of wild birds by type of animal during 2023 in the Americas Region.



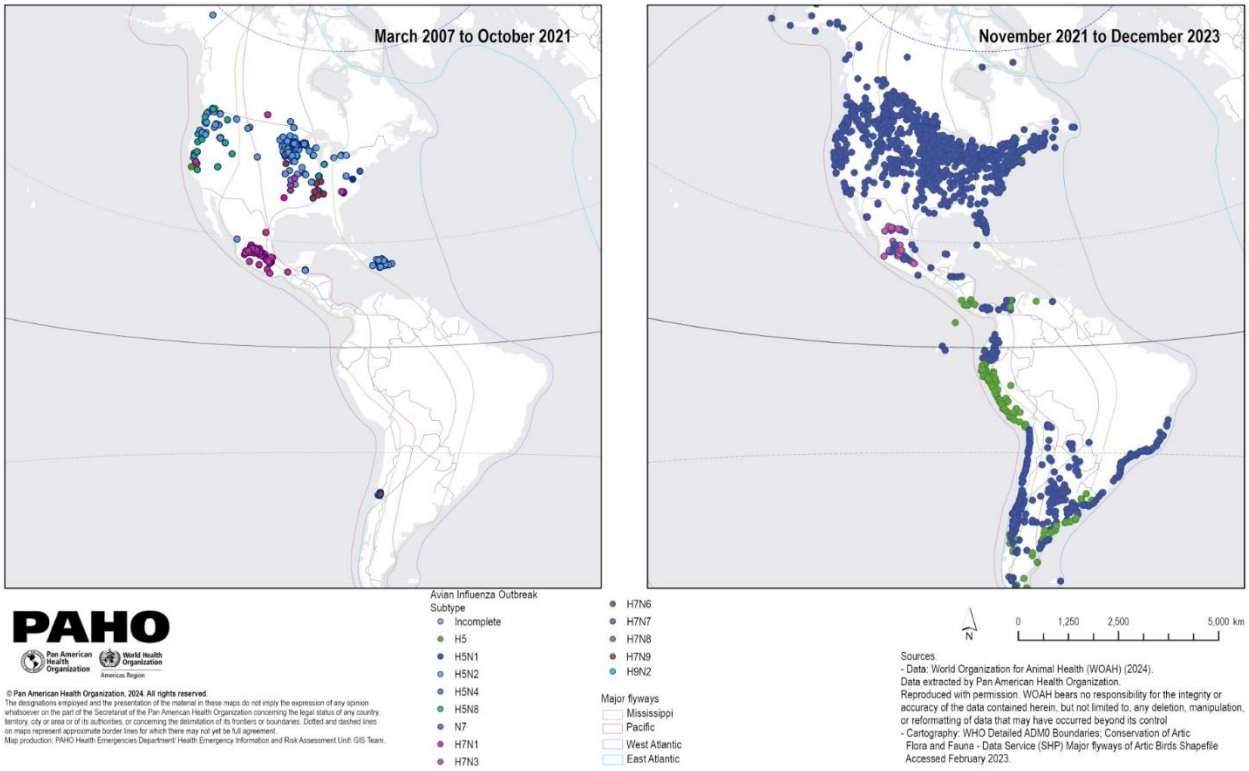
Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management.

Figure 4. Monthly history of avian influenza outbreaks and main migratory routes of wild birds by type of animal during 2024 in the Americas Region.



Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management.

Figure 5. Historical clustering of avian influenza outbreaks by subtype and main migratory routes of wild birds by type of animal between March 2007 and December 2023 in the Americas Region**.**



Source: Adapted from World Organization for Animal Health. Avian Influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management.

Recommendations for Member States

While largely affecting animals, avian influenza outbreaks pose continuing risks to public health. Together, the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), and the World Organization for Animal Health (WOAH) urge Member States to work collaboratively and intersectorally to preserve animal health and protect human health *(1, 3)*.

The sporadic cases of avian influenza A(H5N1) 2.3.4.4b clade virus detected in humans are mostly associated with direct contact with infected animals and contaminated environments. Current evidence reflects that the virus does not appear to be easily transmitted from one person to another. However, it is imperative to strengthen intersectoral surveillance to detect any possible changes in this situation *(3)*.

WOAH has specific recommendations on the avian influenza situation in birds and mammals. These recommendations advise countries to maintain intensified surveillance for the disease in domestic and wild birds, preventing the spread of the disease by implementing biosecurity measures *(19)*. WOAH recommends controlling the movement of susceptible domestic animals and their products and protecting people in close contact with sick animals. It is

crucial to monitor susceptible domestic and wild animals by investigating mortality increases in wild animals. In addition, timely reporting and sharing of avian influenza virus genetic sequences are essential for understanding the dynamics of the disease *(19)*.

PAHO/WHO urges Member States to work collaboratively and intersectorally to preserve animal health and protect public health. It is essential to implement avian influenza preventive measures at the source, establish protocols for detecting, reporting, and rapidly responding to animal outbreaks, and enhance surveillance of both animal and human influenza. Additionally, conducting epidemiological and virological investigations of animal outbreaks and human infections, sharing viral genetic information, promoting collaboration between animal and human health sectors, ensuring effective risk communication, and preparing for a potential influenza pandemic at all levels are essential actions *(20, 21)*.

The following are the main lines of recommendation for Member States with a One Health approach, which include coordination for intersectoral surveillance and response, as well as prevention measures and risk communication.

Intersectoral coordination

Preparedness for detection and response to public health emergencies requires the adoption of a holistic intersectoral and multidisciplinary approach. Cross-sectoral actions such as the establishment of standardized protocols that are inclusive of all relevant sectors, with well-established roles, facilitate information sharing and analysis, the development of a One Health response strategy that includes both human and/or animal risk, and the training of human resources. A viable, culture-driven coordination and systemic approach to emergency preparedness and health systems strengthening is essential before an event response is required. Integration of the One Health perspective and stakeholder roles is essential and should be promoted *(22)*.

High-level political commitment, stakeholder mapping and analysis, joint needs assessment, and the establishment of communication channels are key elements of multisectoral coordination for health emergency preparedness. These pillars should be implemented through a transparent, reliable, and accountable framework *(22)*.

Surveillance of human cases

Surveillance and follow-up of exposed persons and their contacts is recommended for early identification of cases or transmission events at the human-animal interface *(23)*. Because of the constantly evolving nature of influenza viruses, PAHO/WHO continues to emphasize the importance of strengthening severe acute respiratory infection (SARI) and influenza syndrome (ILI) surveillance, as well as strengthening event-based surveillance *(1)*.

This allows the detection of virological, epidemiological, and clinical changes associated with circulating influenza viruses that may impact human health. In addition to the active case-finding, contact identification and follow-up activities carried out during the epidemiological investigation of zoonotic events, it is advisable to alert and sensitize clinicians to consider the diagnosis of avian influenza and to strengthen existing surveillance systems in areas near poultry farms, areas where human cases and animal outbreaks have been reported, or where the source of infection is suspected *(24)*. To complement surveillance for SARI and ILI, PAHO/WHO recommends establishing early warning systems to detect unusual events and to have a more complete picture of the situation, and to conduct a joint and

coordinated risk assessment between the human, animal, and environmental sectors in a timely manner.

PAHO/WHO reiterates to Member States the need to maintain and strengthen seasonal and zoonotic influenza virus surveillance, including the immediate submission of human influenza samples caused by avian influenza to the WHO Collaborating Center (WHO-CC) at the United States Centers for Disease Control and Prevention (U.S. CDC).

Because information on the circulation of avian influenza A(H5N1) viruses is important for human influenza vaccine composition and to generate data for preparedness and response, countries are encouraged to share animal influenza samples with the WHO-CC at St. Jude Children's Hospital, which focuses exclusively on the threat posed to humans by zoonotic influenza viruses.

Laboratory diagnosis of human cases

Human sample collection

Samples should be collected by trained personnel in compliance with all biosafety standards, including the use of appropriate personal protective equipment (PPE) for respiratory viruses.

The recommended specimens are the same type of specimens used for routine influenza surveillance. The nasopharyngeal swab is the optimal specimen collection method for influenza diagnostic testing. However, a combined nasal and pharyngeal swab or aspirate specimen may be collected.

In the context of influenza A(H5) infection in humans recently described in the United States of America, it has been observed that it is possible to have a negative nasopharyngeal swab but a positive conjunctival swab *(25, 26)*. Therefore, in suspected cases or in persons exposed to influenza A(H5) with symptoms of conjunctivitis, it is suggested, in addition to the nasopharyngeal swab, to consider taking a conjunctival swab. It is essential to follow the established protocols and collect both nasopharyngeal and ocular samples in patients with conjunctivitis, for a complete evaluation of possible infection by the A(H5N1) virus *(27-31)*.

A sterile dacron/nylon swab should be used for specimen collection. Cotton-tipped and wooden-tipped swabs are not recommended as they interfere with specimen processing and inhibit molecular diagnostic reactions. Swabs should be placed in a viral transport tube containing 3 ml of sterile viral transport medium and transported in the same tube with viral transport medium (VTM).

Collection of specimens within four days of symptom onset is recommended for the highest yield of influenza virus and best detection. Sampling of asymptomatic contacts is not recommended unless deemed necessary according to national guidelines.

Samples should be kept refrigerated (4-8°C) and sent to the laboratory (central, national or reference laboratory) where they should be processed within 24-72 hours of collection. If samples cannot be shipped within this period, it is recommended to freeze at -70°C (or below) until samples are shipped (ensuring that the cold chain is maintained).

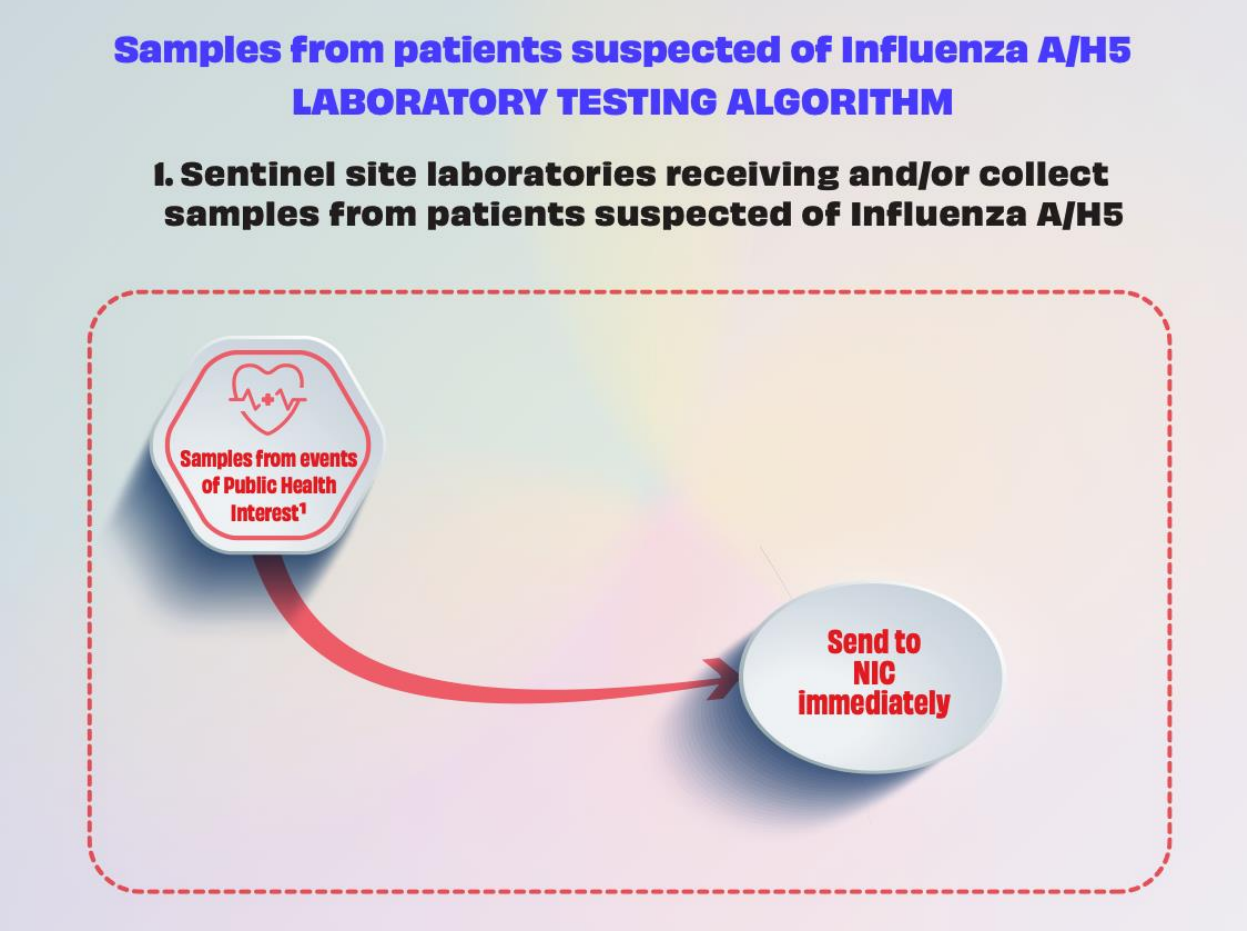
Sample flow and laboratory testing algorithm

In the Americas, all National Influenza Centers (NICs) and National Reference Laboratories (NRLs) for human influenza, as part of the WHO Global Influenza Surveillance and Response System (GISRS), use molecular diagnostic protocols and reagents developed and validated by the WHO-CC at U.S. CDC.

Upon identification of suspected cases of human infection with avian influenza A(H5), a respiratory specimen should be collected and submitted to the NIC or LNR for analysis (**Figure 6**) *(32)*.

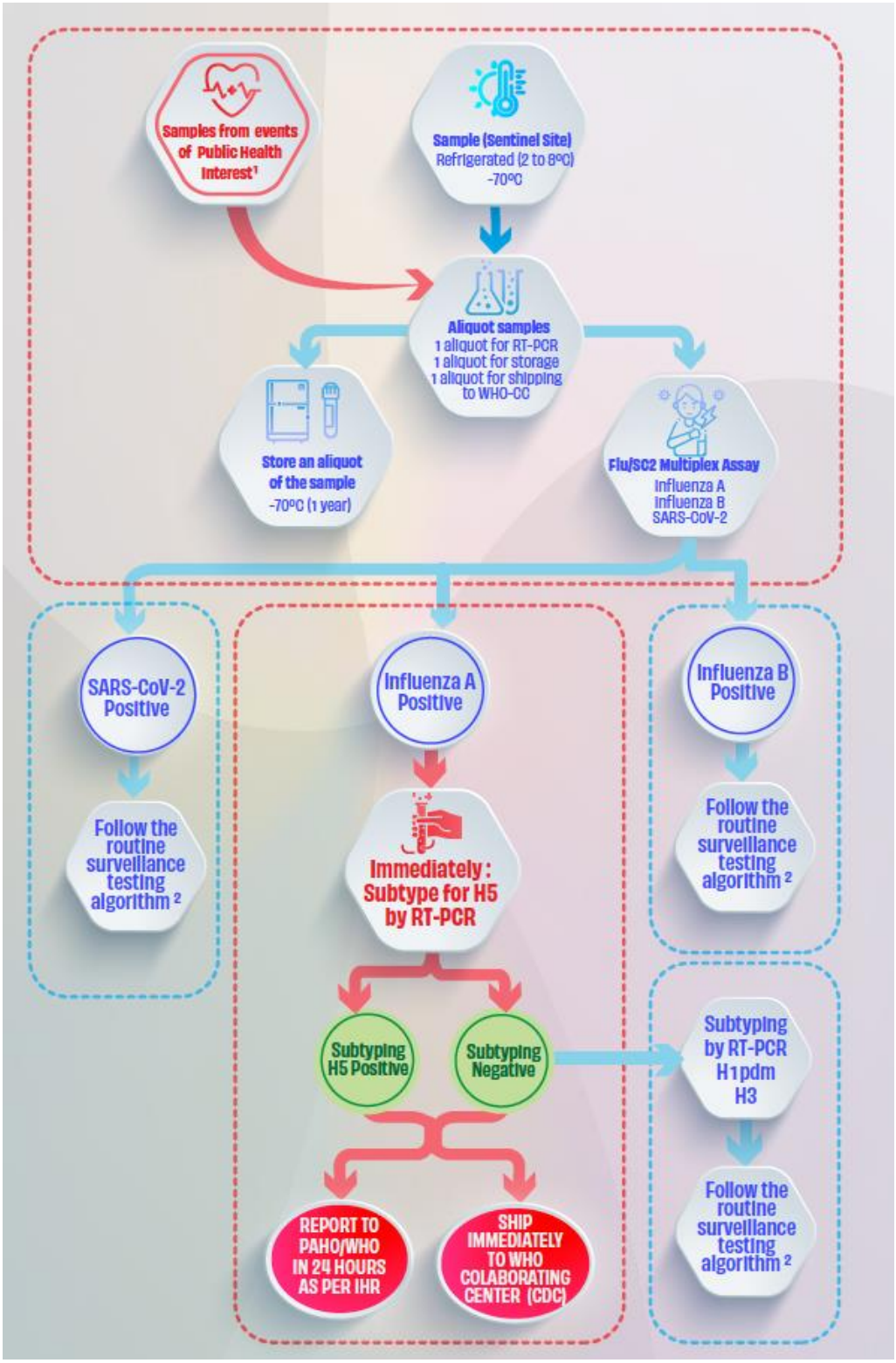
Specimens collected from suspected human cases exposed to birds or humans infected with avian influenza A(H5) should be tested for influenza. Influenza A positive specimens should be further subtyped for H5 (**Figure 7**) *(32, 33)*.

Figure 6. Sample flow for samples of suspected cases of Influenza A(H5) at sentinel sites and decentralized laboratories.



Source: Pan American Health Organization. Samples from suspected Influenza A(H5) patients - Laboratory testing algorithm. 2 December 2022. Washington, D.C.: PAHO; 2022. Available from: https://www.paho.org/en/documents/samples-patients-suspected-influenza-ah5-laboratory-testing-algorithm.

Figure 7. NIC analyzing samples of suspected cases of Influenza A(H5)



Source: Pan American Health Organization. Samples from suspected Influenza A(H5) patients - Laboratory testing algorithm. 2 December 2022. Washington, D.C.: PAHO; 2022. Available from: https://www.paho.org/en/documents/samples-patients-suspected-influenza-ah5-laboratory-testing-algorithm.

Laboratory reagents

U.S. CDC kits for real-time reverse transcriptase-polymerase chain reaction (qRT-PCR) detection of influenza viruses are available through the International Reagent Resource (IRR).

For influenza detection and subtyping of influenza A(H5), the following kits and controls for molecular detection are available:

- Influenza SARS-CoV-2 Multiplex Assay (RUO) (500 reactions) (Catalog No. FluSC2PPB-RUO), dried primers and probes
- Influenza SARS-CoV-2 Multiplex Assay Positive Controls Kit (RUO) (500 reactions) (Catalog No. FluSC2PC-RUO)
- U.S. CDC Real-Time RT-PCR Influenza Virus A(H5) (Asian Lineage) Subtyping Panel (VER 4) (RUO) (Catalog No. FluRUO-13)
- U.S. CDC Influenza A(H5N1) (Asian Lineage) Real-Time RT-PCR Positive Control with Human Cell Material (RUO) (Catalog No. VA2715)

Interpretation of results

The U.S. CDC kit markers (targets) for detection of influenza A/H5 subtype are as follows: INFA (M), H5a (HA), H5b (HA) and RP.

When using the U.S. CDC influenza A(H5) subtyping kit:

- Samples positive for INFA, H5a and H5b markers are considered **positive for influenza A(H5).**
- Samples positive for a single H5 marker are considered **presumptive for influenza A(H5).**

In both cases, specimens should be submitted to a WHO-CC for further characterization or confirmation (in the case of presumptive results). However, a positive specimen for influenza A(H5) (both marker positive) should be reported immediately.

PAHO/WHO is currently working to support Member States in preparing for and responding to influenza A(H5). For additional assistance, contact laboratoryresponse@paho.org.

Shipment of samples

U.S. CDC is the WHO-CC in the Americas Region for receiving human samples positive for avian influenza A(H5).

International and air shipment of human specimens to the WHO-CC at the U.S. CDC must meet all international standards in accordance with the International Air Transport Association (IATA), with special documents required for transport to the United States that are different from the documents for routine shipment of seasonal influenza specimens.

It is important to note that specimens should **not** be submitted to U.S. CDC as routine influenza specimens. PAHO should be contacted to coordinate shipment to the WHO-CC at laboratoryresponse@paho.org.

Response to human cases

Upon detection of human infection, early notification is essential for investigation and implementation of appropriate measures including isolation and early treatment of the case, active search for other cases associated with the outbreak, and identification of close contacts for appropriate management and follow-up *(24)*.

It is recommended that the human health sector, the animal health sector, and the environmental sector work together on risk analysis at the human-animal-environment interface. It is recommended that, upon detection of suspected avian influenza (HPAI or LPAI) in animals, the animal health and environmental sectors should alert and summon health personnel in the areas where transmission is occurring, and where there is a greater probability of infection in persons exposed to these viruses, to be attentive to symptoms compatible with influenza syndrome, and to participate in investigations of persons exposed to infected animals. In addition, when avian influenza is suspected in humans, it is recommended that the health sector alert and summon animal health and environmental personnel to investigate possible cases in domestic and wild animals to detect possible sources of infection *(20)*.

Member States are encouraged to promote awareness messages to the general public to avoid contact with sick or dead animals, contact with animals at farms and animal markets, entering areas where animals may be slaughtered, contact with any surface that appears to be contaminated with animal feces, and slaughtering or eating sick animals. As well as messages for anyone exposed to animals infected, or possibly infected, with avian influenza A(H5N1) virus to seek immediate medical attention if they develop symptoms and to report such exposure. Additionally, it is important to alert clinicians to the risk of zoonotic infection in patients exposed to birds or animals, especially in areas with confirmed or suspected circulation of the influenza A(H5N1) virus, in areas with limited animal surveillance, and in any type of occupational exposure *(5)*.

Case research

In the presence of a confirmed or suspected human infection caused by an influenza virus with pandemic potential, including an avian virus, it is recommended:

- A thorough epidemiological investigation of the history of animal exposure, travel and ill contacts should be carried out. The investigation should not be delayed, even if confirmatory laboratory results are awaited.
- Epidemiological investigation should include early identification of unusual respiratory events, which could signal person-to-person transmission of the new virus.
- Clinical specimens collected at the time and place where the case occurred should be tested and sent to the WHO-CC for characterization within one week of detection.
- Standard infection prevention and control (IPC) procedures and standard precautions should always be applied and appropriate PPE should be used according to risk (based on the most likely modes of transmission) to protect the health of investigators. PPE should be used when in contact with symptomatic persons and in situations where person-to-person transmission is suspected.
- The epidemiological investigation should include information from official veterinary services and the private sector (animal production) on the origin of the animals and

records of movements on and off the premises. This information will help define the scope (location) of investigations in humans exposed to infected animals.

- Information from official veterinary services could provide guidance on possible influenza events (both notifiable and non-notifiable) occurring in the area and farms related to the event.
- For more information regarding the investigation of non-seasonal influenza cases, the World Health Organization's "Protocol for Investigating Non-Seasonal Influenza and Other Emerging Acute Respiratory Diseases" is available from: https://apps.who.int/iris/handle/10665/329895 *(24)*.

Notification of human cases

- A **confirmed case** of human infection with avian influenza should be reported **immediately** through two channels: to the WHO Regional Contact Point for the International Health Regulations (IHR) through the National IHR Focal Point (NFP), and to the GISRS administered by PAHO and WHO (flu@paho.org). The report should include all available results of the epidemiological investigation of the case and the virological characteristics of the virus.
- A suspected case of human infection with avian influenza should be reported **immediately** to the GISRS (flu@paho.org), and information on the suspected case may be shared with the WHO IHR Regional Contact Point, as this is an unusual event. The report should include all available results of the epidemiological investigation of the case and the characteristics of the virus.

Animal surveillance, diagnosis and response

The FAO, WHO, and WOAH urge countries to prevent avian influenza at its source to facilitate a rapid response. The implementation of a comprehensive surveillance program, including wild birds and poultry, both backyard and commercial, is essential for early detection. Targeted risk-based surveillance strategies should be combined with a strengthening of general surveillance. The FAO, WHO, and WOAH also urge the inclusion of influenza A(H5) infection in differential diagnoses for non-avian species, including livestock and other farm animals, as well as domestic and captive-bred wildlife populations at high risk of exposure to A(H5) viruses. Highly pathogenic avian influenza events in all animal species, including unusual hosts, should be reported to WOAH and other international bodies *(5)*. In this regard, awareness-raising among trained stakeholders and the community in general, particularly in rural areas, is key to promoting prevention and health surveillance. The information collected can allow modeling of the spread and strengthen risk analyses to increase their accuracy *(1, 20, 21)*.

Avian influenza is included in the WOAH list of notifiable diseases by the competent authorities. This includes notification of infections with HPAI viruses, infections in birds other than poultry with highly pathogenic influenza A viruses, and infections in domestic and captive wild birds with low pathogenic avian influenza viruses, provided that natural transmission has been demonstrated in humans and is associated with severe consequences *(34)*.

At the regional level, there are veterinary laboratories with the capacity to detect and type the virus in both serological and molecular samples. A proficiency testing round is being

conducted by the WOAH regional reference laboratory in Campinas, São Paulo, Brazil, with the support of PANAFTOSA-PAHO/WHO at the present time. Previously, the round conducted in 2021 proved a good aptitude of the participating laboratories to perform serological (ELISA, HI and AGID) and molecular (RT-qPCR) diagnostic tests in order to reach a final diagnosis of avian influenza. This round included Argentina, Bolivia, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, Paraguay, Peru, and Uruguay, in addition to Brazil as the coordinating laboratory. Other veterinary services laboratories participated in other proficiency tests in 2022 with excellent results, for example, those developed by the WOAH reference laboratory of the United States Department of Agriculture (USDA) Ames, Iowa, United States, in which the Diagnostic Laboratory of Vesicular Diseases of Panama participated, or coordinated by GD Laboratory as is the case of the National Service of Health, Safety and Agrifood Quality of Mexico.

Surveillance strategies combine serological and molecular techniques to detect both previous exposure to the virus and the current presence of the virus, which is crucial for early detection. In poultry, virus subtyping in birds focuses primarily on identifying Influenza A virus subtypes H5 or H7. These analyses, which allow differentiating the presence of highly pathogenic avian influenza, are sufficient to support field actions. The collection of nervous tissue samples from wild birds during the investigation of suspicious outbreaks is highlighted to optimize pathogen detection.

The regional reference laboratory in Campinas, Brazil, is assisting in diagnostic confirmation and subtyping in South American countries. Full virus sequencing is being carried out with the support of other laboratories including the USDA WOAH reference laboratory in Ames, Iowa, United States.

Shipment of samples

It is recommended that samples from animals detected with the virus be submitted for analysis, data generation and reference material for the development of human vaccines for zoonotic influenza response. For this purpose, animal samples should be sent to the WHO-CC at St. Jude Children's Hospital. Special documents are required for transport to the United States, and all international standards must be met.

For more information on logistics and shipping of human or avian influenza A(H5) samples, please contact PAHO/WHO at laboratoryresponse@paho.org.

Sequencing and genomic surveillance

Sequencing

The submission of animal or human influenza A(H5) positive samples to the appropriate WHO-CC **should be prioritized** for antigenic and genomic characterization of the sample.

For this reason, measures should be taken to avoid running out of samples, such as reserving an aliquot of the sample for shipment to the CC-WHO prior to initiating virus sequencing processes.

For laboratories that have sequencing capabilities, in addition to sending the positive sample to the Collaborating Center, they are encouraged to sequence the viruses to generate genomic data, and to share the sequences in a timely manner on the GISAID global platform.

The publication of sequences in GISAID requires the use of the nomenclature recommended by the WHO *(35)*:

- The format for humans is:
  [influenza type]/[region]/[internal reference number]/[year of collection].
  E.g.: A/Wisconsin/2145/2001

- For all other animal hosts:
  [type of influenza]/[host]/[region]/[internal reference number]/[year of collection].
  E.g.: A/chicken/Rostov/864/2007

Genomic Surveillance

Human influenza A(H5) virus: Since the beginning of 2020, the influenza A(H5) viruses reported to WHO as infecting humans are of the 2.3.4.4b genetic group. Virus sequences from these human cases have (to date) shown no markers of mammalian adaptation or resistance to antivirals, including oseltamivir and baloxavir *(36)*. The results of sequence analyses available for human cases in the United States confirmed avian influenza A(H5N1) virus clade 2.3.4.4b, closely related to the B3.13 genotype detected in dairy cattle, suggesting direct animal-to-human transmission *(3)*. Both the viruses detected in cows and in two human cases maintain mainly genetic characteristics of avian influenza viruses, genetic changes that would make them more apt to infect or transmit between humans *(37)*. No known markers for antiviral resistance against influenza were found in the available sequences of influenza A(H5N1) viruses from human cases *(38)*.

Animal influenza A(H5) virus: Clade 2.3.4.4b that was introduced in late 2021 into North America by wild birds has spread across the continent throughout 2022 and 2023. Worldwide circulation of the virus has led to opportunities to generate multiple genotypes with varied clinical signs. Through routine monitoring and viral sequencing, few sequences with markers of mammalian adaptation were found. These mutations probably occurred after transmission to the mammalian host and do not appear to be transmitted forward *(39)*. The information currently available for avian influenza cases in dairy cattle in the United States do not show new mutations possibly associated with further transmission to humans *(3)*. Available sequences for the 2.3.4.4b gene cluster of avian and mammalian viruses indicate that markers associated with reduced susceptibility to antivirals are rare *(40)*. FAO, WHO, and WOAH recommend sharing avian influenza virus genetic sequences and associated metadata in publicly available databases *(5)*.

Zoonotic influenza vaccine candidate viruses: The WHO Global Influenza Surveillance and Response System (GISRS), in collaboration with the veterinary and animal health sector, including the WHO/FAO Network of Expertise on Animal Influenza (OFFLU), periodically evaluates candidate vaccine viruses for pandemic preparedness purposes. The list of candidate zoonotic influenza vaccine viruses, including A(H5N1) viruses and potency test reagents, is updated on the WHO website *(5)*. Although most of the dairy cattle viruses in the 2.3.4.4b broth have amino acid substitutions at antigenic sites, they react well antigenically to at least one of the 2.3.4.4b candidate vaccine viruses (CVVs) *(39)*. CVVs for influenza A(H5) of the 2.3.4.4b gene pool are determined and available *(38)*.

Regular genetic and antigenic characterization of contemporary zoonotic influenza viruses is also published on the WHO website. An update on A(H5N1) viruses of clade 2.3.4.4b identified in dairy cattle in the United States has also been made available *(5)*.

This includes a candidate A(H5N8) virus, in fact, A/Astrakhan/3212/2020, as well as an A(H5N1) virus, A/chicken/Ghana/AVL-76321VIR7050-39/2021 and the novel candidate A(H5N1) virus clade 2.3.2.1c, A/Cambodia/SVH240441/2024 *(38)*. The vaccine virus A/Astrakhan/3212/2020 is closely related to the recently detected circulating influenza A(H5) strains *(39)*.

Risk communication and community participation

Risk communication is a fundamental component of preparedness and response to health emergencies, especially those with pandemic or epidemic potential *(41)*. Early and transparent communication with populations, as well as clear messages about behaviors and preventive measures to be adopted by communities, is vital to reduce transmission. In addition, adequate risk communication will help to reduce rumors, myths and misinformation related to the outbreak and will allow populations to make the right decisions to reduce the risk of contagion *(42)*.

The FAO, WHO, and WOAH urge countries to communicate the risk of avian influenza by alerting and training health care workers and persons occupationally exposed to the virus on how to protect themselves *(1)*. The general public, and those exposed to sick and/or dead animals, should also be informed to encourage prompt notification of the competent authorities. Guidance should be provided to seek medical attention in case of discomfort and to communicate to their health care provider about any exposure to animals *(1)*. A differentiated communication strategy should be considered according to the audience (e.g., livestock and backyard producers, rural communities, ordinary citizens, wildlife stakeholders, indigenous groups, etc.) *(42)*.

PAHO/WHO recommends that Member States take the following actions among their risk communication preparedness measures in the event of an outbreak of avian influenza *(42)*:

- Delegate an individual or team responsible for risk communication to review existing risk communication plans or strategies in pandemic or epidemic contexts and make adjustments or updates necessary to strengthen preparedness and response to an eventual outbreak. WHO has guidelines for risk communication plans related to respiratory diseases.
- Gather existing information and/or conduct joint public health, animal health and environmental qualitative and/or rapid quantitative assessments to understand the characteristics of the communities most at risk, communication patterns and channels, language, religion, influencers. This information is vital in order to formulate appropriate preparedness and response actions for risk communication.
- Generate trust through early, transparent and timely communication, with dissemination through multiple platforms, methods and channels. To maintain public confidence, it is also key to communicate even in the midst of uncertainty, clarifying what is known and what is not.
- Identify communities with whom to work on risk communication actions and allow them to participate in their implementation, to ensure that interventions are collaborative and that the community takes ownership of the communication

processes. Community involvement will contribute to the adoption of preventive behaviors.

- Broadcast messages to the public on symptom identification and prevention, particularly to populations with greater potential for exposure to the virus: rural environments, farmers, farm workers, backyard poultry owners. Messages should be broadcast on the channels and through the platforms consulted by each type of audience.
- Activate social listening for rumors and misinformation through digital platforms and other relevant information exchange channels (hotlines, web portals, etc.), to respond to possible false messages circulating among the public and adapt messages according to the needs detected by this monitoring.

Prevention measures for birds and animals

According to WOAH, the implementation of strict biosecurity and hygiene measures are essential to prevent outbreaks of avian influenza in animals. These include ensuring that poultry and other domestic animals susceptible to avian influenza infection do not have contact with wild birds, ensuring sanitary conditions in production areas, clothing and personnel, and reporting bird diseases and deaths, and suspicions of avian influenza infection in other domestic animals, to animal health services. If infection in poultry or other domestic animals is detected, the current regulations applied by the animal health authority should be followed to contain, control and rapidly eradicate the disease. These actions result in a significant decrease in environmental viral contamination *(5)*.

WOAH encourages national authorities to consider the development of compensation schemes for farm owners and producers whose production was affected by the measures implemented by the authorities *(34)*. According to WOAH, the use of HPAI vaccination in poultry is a decision of the national animal health authorities, in coordination with poultry producers, and should be adapted to the epidemiological and socioeconomic context of the countries *(43)*. Avian influenza vaccination alone should not be considered as a sustainable solution to control avian influenza and should be part of comprehensive disease control strategies *(34)*.

Prevention measures in humans

People at risk of contracting infections are those directly or indirectly exposed to infected birds and other animals (domestic, wild or captive), for example, individuals who maintain close and regular contact with infected domestic animals, or during slaughter, or during the cleaning and disinfection of affected farms. For this reason, the implementation of good animal husbandry and hygiene practices is recommended when handling animal products, such as the use of appropriate PPE and other protective measures to prevent zoonotic transmission in these operators *(5, 36)*.

Since people exposed to the virus in work environments or who have contact with infected or potentially infected animals are at higher risk, it is recommended that the necessary preventive and personal protective measures be taken to prevent possible infection. PPE should be properly donned, worn and removed, and disposed of or decontaminated in a safe manner. Individuals who need to use PPE should be trained in their proper use in various environmental conditions *(5, 44)*.

Research continues to determine the risk to humans of consuming raw or unpasteurized milk contaminated with influenza A(H5N1) virus. FAO and WHO recommend consuming pasteurized milk because of the potential health risks associated with various zoonotic pathogens *(5)*.

Clinical management

Timely, evidence-based clinical management and prevention of complications in patients with zoonotic influenza infection are critical elements. PAHO/WHO recommends that Member States update their treatment guidelines based on the updated WHO guidelines, which include the management of severe and non-severe influenza, as well as the use of antiviral drugs to prevent influenza virus infection in exposed persons. In addition, it includes baseline risk estimates for hospitalization and death obtained from observational studies and defines patients at high or extremely high risk of developing severe influenza *(45, 46)*.

Seasonal influenza vaccination in context of avian influenza

Although the seasonal influenza vaccine is not designed for the prevention of zoonotic influenza in humans, vaccination would help to reduce the risk of co-infection and possible genomic recombination of avian and human viruses, which could result in new strains with pandemic potential *(48, 49)*.

WHO recommends vaccination against seasonal influenza in persons at risk of influenza A (H5) virus infection, especially in areas with avian influenza circulation in animals. This recommendation applies to workers in the poultry and livestock industry, veterinary services personnel involved in disease surveillance and control, as well as persons who may be in contact with birds, workers in wildlife care centers, and those in the field who perform tasks involving the handling of these animals *(48)*.

Vaccination with seasonal influenza vaccines should be used in combination with other control measures, such as infection prevention and control measures and the use of personal protective equipment, to reduce the risk of zoonotic infection in these populations *(48)*.

Some vaccines for **human use** against avian influenza A(H5) are licensed, but their use is restricted. Since the risk of zoonotic infection remains low, WHO does not recommend vaccination of the population with these vaccines in the interpandemic period *(48)*.

References

1. Food and Agriculture Organization of the United Nations. Ongoing avian influenza outbreaks in animals pose risk to humans – Situation analysis and advice to countries from FAO, WHO, WOAH, 12 July 2023. Rome: FAO; 2023. Available from: https://www.fao.org/animal-health/news-events/news/detail/ongoing-avian-influenza-outbreaks-in-animals-pose-risk-to-humans/en.
2. Byrne MP, James J, Mollett BC, Meyer SM, Lewis T, Czepiel M, et al. Investigating the Genetic Diversity of H5 Avian Influenza Viruses in the United Kingdom from 2020-2022. Microbiol Spectr 11, e0477622 (2023). Available from: http://doi.org/10.1128/spectrum.04776-22.
3. World Health Organization. Disease outbreak news: Avian influenza A(H5N1) - United States of America. 9 April 2024. Geneva: WHO; 2024. Available from: https://www.who.int/emergencies/disease-outbreak-news/item/2024-DON512.
4. World Organization for Animal Health. World Animal Health Information System. Animal health data: Avian influenza. Paris: WOAH; 2024 [cited 4 November 2024]. Available from: https://wahis.woah.org/#/event-management.
5. World Health Organization, Food and Agriculture Organization of the United Nations, & World Organization for Animal Health (2024). Updated joint FAO/WHO/WOAH assessment of recent influenza A(H5N1) virus events in animals and people. WHO, FAO, WHOA; 2024. Available from: https://www.who.int/publications/m/item/updated-joint-fao-who-woah-assessment-of-recent-influenza-a(h5n1)-virus-events-in-animals-and-people.
6. World Health Organization. Cumulative number of confirmed human cases for avian influenza A(H5N1) reported to WHO, 2003-2024, 19 July 2024. Geneva: WHO; 2024. Available from: https://www.who.int/publications/m/item/cumulative-number-of-confirmed-human-cases-for-avian-influenza-a(h5n1)-reported-to-who-2003-2024 - 5.
7. United States Centers for Disease Control and Prevention. H5 Bird Flu: Current Situation. Atlanta: CDC; 2024 [cited 8 November 2024]. Available from: https://www.U.S.CDC.gov/bird-flu/situation-summary/index.html.
8. Public Health Agency of Canada. Statement from the Public Health Agency of Canada: Update on Avian Influenza and Risk to Canadians. Ottawa: PHAC; 2024. Available from: https://www.canada.ca/en/public-health/news/2024/11/update-on-avian-influenza-and-risk-to-canadians.html.
9. Ministry of Health of Chile. MINSAL informa primer caso humano de gripe aviar en Chile. 29 de marzo del 2023. Santiago: MINSAL; 2023. Available from: https://www.minsal.cl/minsal-informa-primer-caso-humano-de-gripe-aviar-en-chile/.
10. Ministry of Public Health of Ecuador. Entidades sanitarias mantienen activa vigilancia ante caso de gripe aviar. 10 January 2022. Quito: MSP; 2022. Available from: https://www.facebook.com/photo/?fbid=555571356609961&set=a.253584503475316
11. United States of America International Health Regulations National Focal Point (IHR NFP). Official notifications of human cases of avian influenza A(H5N1) in the United States of America 2024. Washington D.C.; 2024. Unpublished.

12. Falkland Islands Department of Agriculture. Avian Influenza Information. Stanley: IFAD; 2024 [cited 4 November 2024]. Available from: https://falklands.gov.fk/agriculture/avian-influenza.

13. United States Department of Agriculture, Animal and Plant Health Inspection Service. Confirmed detections of highly pathogenic avian influenza in commercial and backyard flocks. Washington, D.C.: USDA; 2024 [cited 8 November 2024]. Available from: https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/commercial-backyard-flocks.

14. United States Department of Agriculture, Animal and Plant Health Inspection Service. Confirmed cases of highly pathogenic avian influenza in livestock. Washington, D.C.: USDA; 2024 [cited 8 November 2024]. Available from: https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/hpai-confirmed-cases-livestock.

15. United States Department of Agriculture, Animal and Plant Health Inspection Service. Confirmed cases of highly pathogenic avian influenza in mammals. Washington, D.C.: USDA; 2024 [cited 8 November 2024]. Available from: https://www.aphis.usda.gov/livestock-poultry-disease/avian/avian-influenza/hpai-detections/mammals.

16. United States Department of Agriculture, Animal and Plant Health Inspection Service. USDA Animal and Plant Health Inspection Service Shares Update on H5N1 Detection in Oregon Swine, Bovine Vaccine Candidate Progression. Washington, D.C.: USDA; 2024. Available from: https://www.aphis.usda.gov/news/agency-announcements/usda-animal-plant-health-inspection-service-shares-update-h5n1-detection.

17. United States Centers for Disease Control and Prevention. Centers for Disease Control and Prevention response to H5N1 avian influenza. Atlanta: CDC; 2024 [cited 8 November 2024]. Available from: https://espanol.U.S. CDC.gov/bird-flu/spotlights/h5n1-response-11012024.html.

18. United States Centers for Disease Control and Prevention. U.S. CDC Report on Missouri H5N1 Serology Testing. Atlanta: CDC; 2024. Available from: https://www.cdc.gov/bird-flu/spotlights/missouri-h5n1-serology-testing.html.

19. World Organization for Animal Health. Statement on avian influenza and mammals. 17 February 2023. Paris: WOAH; 2023. Available from: https://www.woah.org/en/statement-on-avian-influenza-and-mammals/.

20. Pan American Health Organization / World Health Organization. Strengthening the intersectoral work for influenza at the human-animal interface in the Americas Region: technical questions and answers. 19 May 2023. Washington, D.C.: PAHO/WHO; 2023. Available from: https://www.paho.org/en/documents/strengthening-intersectoral-work-influenza-human-animal-interface-region-americas .

21. Pan American Health Organization / World Health Organization. Report of the Regional Consultation for the Strengthening of Intersectoral Work in the Human-Animal Interface of Influenza. March 2023. 22 March 2023. Washington, D.C.: PAHO/WHO; 2023. Available from: https://www.paho.org/en/documents/report-regional-consultation-strengthening-intersectoral-work-human-animal-interface.

22. World Health Organization. Multisectoral preparedness coordination framework: best practices, case studies and key elements of advancing multisectoral coordination for health emergency preparedness and health security. Geneva: WHO; 2022. Available from: https://iris.who.int/handle/10665/332220.

23. World Health Organization. Public health resource pack for countries experiencing outbreaks of influenza in animals. Geneva: WHO; 2023. Available from: https://iris.who.int/handle/10665/372248.

24. World Health Organization. Protocol to investigate non-seasonal influenza and other emerging acute respiratory diseases. 2 October 2018. Geneva: WHO; 2018. Available from: https://iris.who.int/handle/10665/275657.

25. United States Centers for Disease Control and Prevention. Highly Pathogenic Avian Influenza A (H5N1) Virus Infection Reported in a Person in the U.S. 1 April 2024. Atlanta: CDC; 2024. Available from https://www.cdc.gov/media/releases/2024/p0401-avian-flu.html.

26. United States Centers for Disease Control and Prevention U.S. CDC Reports. Second Human Case of H5 Bird Flu Tied to Dairy Cow Outbreak. 24 May 2024. Atlanta: CDC; 2024. Available from: https://www.cdc.gov/media/releases/2024/s0522-human-case-h5.html.

27. United States Centers for Disease Control and Prevention. Laboratory Testing and Specimen collection. 4 January 2024. Atlanta: CDC; 2024 [cited 4 June 2024]. Available from: https://www.U.S.CDC.gov/adenovirus/specimen-collection.html .

28. Sabage LE, Sun YJ, Wolf J, Sabage J, Mazzo A, Santos, et al. Conjunctival Swabs Reveal Higher Detection Rate Compared to Schirmer Strips for SARS-CoV-2 RNA Detection in Tears of Hospitalized COVID-19 Patients. J. Clin. Med. 2022, 11, 6929. Available from: https://doi.org/10.3390/jcm11236929.

29. Gijs M, Veugen JMJ, Wolffs PFG, Savelkoul PHM, Tas J, van Bussel BCT, et al. In-depth investigation of conjunctival swabs and tear fluid of symptomatic COVID-19 patients, an observational cohort study. Transl Vis Sci Technol. 2021;10(12):32. Available from: https://doi.org/10.1167/tvst.10.12.32.

30. World Health Organization. Eastern Mediterranean Regional Office. Specimen collection and transport for microbiological investigation. Cairo: WHO EMR; 1995. Available from: https://iris.who.int/handle/10665/119529.

31. Caribbean Regional Standard Methods Drafting Group. Caribbean Regional Microbiology Standard Operating Procedure, Eye Swabs and Canalicular Pus - SOP No: CRM-SOP 23, Port of Spain: CAREC; 2007. Available from: https://www.cmedlabsfoundation.com/wp-content/uploads/2020/07/microbiology/tech_methods/EyeSwabs_CanaliculerPus.pdf.

32. Pan American Health Organization / World Health Organization. Samples from suspected Influenza A(H5) patients - Laboratory testing algorithm, 2 December 2022. Washington, D.C.: PAHO/WHO; 2022. Available from: https://www.paho.org/en/documents/samples-patients-suspected-influenza-ah5-laboratory-testing-algorithm.

33. World Health Organization. International Health Regulations 2005. 3rd Edition. 1 January 2016. Geneva: WHO; 2016. Available from: https://www.who.int/publications/i/item/9789241580496.

34. World Organisation for Animal Health, What is Avian Influenza? Paris: WOAH; 2024 [cited 14 November 2024]. Available from: https://www.woah.org/en/disease/avian-influenza/.

35. Pan American Health Organization / World Health Organization. Technical note: Influenza virus nomenclature. January 11, 2023. Washington, D.C PAHO/WHO; 2023. Available from: https://www.paho.org/en/documents/technical-note-influenza-virus-nomenclature.

36. World Health Organization. Assessment of risk associated with recent influenza A(H5N1) clade 2.3.4.4b viruses. 21 December 2022. Geneva: WHO; 2022. Available from: https://www.who.int/publications/m/item/assessment-of-risk-associated-with-recent-influenza-a(h5n1)-clade-2.3.4.4b-viruses.

37. World Health Organization. Genetic and antigenic characteristics of zoonotic influenza A viruses and development of candidate vaccine viruses for pandemic preparedness. September 2024. Geneva: WHO; 2024. Available from: https://cdn.who.int/media/docs/default-source/influenza/who-influenza-recommendations/vcm-northern-hemisphere-recommendation-2023-2024/20230224_zoonotic_recommendations.pdf .

38. US Centers for Disease Control and Prevention Technical Update: Genetic Sequence Summary Analysis of a Highly Pathogenic Avian Influenza A(H5N1) Virus Identified in an Individual in Michigan, 24 May 2024. Atlanta: U.S. CDC; 2024 [cited 24 May 2024]. Available from: https://www.cdc.gov/bird-flu/spotlights/h5n1-technical-update-052524.html

39. Rimondi A, Vanstreels RET, Olivera V, Donini A, Lauriente MM, Uhart MM. Highly pathogenic avian influenza A(H5N1) viruses from multispecies outbreak, Argentina, August 2023. Emerg Infect Dis. 2024 Apr. Available from: https://doi.org/10.3201/eid3004.231725.

40. World Health Organization. Assessment of risk associated with recent influenza A(H5N1) clade 2.3.4.4b viruses. 21 December 2022. Geneva: WHO; 2022. Available from: https://www.who.int/publications/m/item/assessment-of-risk-associated-with-recent-influenza-a(h5n1)-clade-2.3.4.4b-viruses .

41. World Health Organization. Risk Communication and Community Engagement (RCCE) Action Plan Guidance COVID-19 Preparedness and Response. Geneva: WHO; 2020. Available from: https://www.who.int/publications/i/item/risk-communication-and-community-engagement-(rcce)-action-plan-guidance.

42. Pan American Health Organization / World Health Organization. Creating a communication strategy for pandemic influenza, 12 July 2009. Washington, D.C.: PAHO/WHO; 2009. Available from: https://www.paho.org/en/documents/creating-communication-strategy-pandemic-influenza.

43. World Organisation for Animal Health. Statement: Avian influenza vaccination: why it should not be a barrier to safe trade. December 28, 2023. Paris: WOAH; 2023. Available from: https://www.woah.org/en/avian-influenza-vaccination-why-it-should-not-be-a-barrier-to-safe-trade/ .

44. World Health Organization. Practical interim guidance to reduce the risk of infection in people exposed to avian influenza viruses, 5 June 2024. Geneva: WHO; 2024. Available from: https://doi.org/10.2471/B09116.

45. US Centers for Disease Control and Prevention. Interim Guidance for Employers to Reduce Exposure to Novel Influenza A (Such as H5N1 Bird Flu) for People Working with or Exposed to Animals. Atlanta: U.S. CDC; 2024. Available from: https://www.cdc.gov/bird-flu/prevention/worker-protection-ppe.html.

46. World Health Organization. Clinical management of influenza. Geneva: WHO; 2024 [cited 14 November 2024]. Available from: https://www.who.int/teams/health-care-readiness/clinical-management-of-influenza/.

47. World Health Organization. Clinical practice guidelines for influenza. Geneva: WHO; 2024. Available from: https://www.who.int/publications/i/item/9789240097759.

48. World Health Organization. Meeting of the Strategic Advisory Group of Experts on Immunization, April 2009: recommendations on the use of licensed human H5N1 influenza vaccines in the interpandemic period. 12 June 2009. Geneva: WHO; 2009. Available from: https://www.who.int/publications/i/item/WER8424.

49. World Health Organization. Global influenza Strategy 2019-2030. 15 March 2019. Geneva: WHO; 2019. Available from: https://www.who.int/publications/i/item/9789241515320.

Useful links

- World Health Organization. Zoonotic Influenza A Virus outbreak toolbox. Geneva; WHO; 2024. Available from: https://www.who.int/emergencies/outbreak-toolkit/disease-outbreak-toolboxes/zoonotic-influenza-a-virus-outbreak-toolbox.
- Pan American Health Organization / World Health Organization. Re Report of the Regional Consultation for the Strengthening of Intersectoral Work in the Human-Animal Interface of Influenza. March 2023. Washington D.C.: PAHO/WHO; 2023. Available from: https://www.paho.org/en/documents/report-regional-consultation-strengthening-intersectoral-work-human-animal-interface.
- Pan American Health Organization / World Health Organization. Call to action to establish the Intersectoral Commission for the Prevention and Control of Zoonotic Influenza in the Americas. Washington D.C.: PAHO/WHO; 2024. Available from: https://www.paho.org/en/news/26-3-2024-call-action-establish-intersectoral-commission-prevention-and-control-zoonotic.
- World Health Organization. Pandemic Influenza Risk Management: A WHO guide to inform and harmonize national and international pandemic preparedness and response. Geneva; WHO; 2017. Available from: https://iris.who.int/bitstream/handle/10665/259893/WHO-WHE-IHM-GIP-2017.1-eng.pdf.
- World Health Organization. A checklist for respiratory pathogen pandemic preparedness planning. Geneva: WHO; 2023. Available from: https://iris.who.int/handle/10665/374876.
- World Health Organization. Preparedness and Resilience for Emerging Threats (PRET). Geneva; WHO; 2023. Available from: https://www.who.int/initiatives/preparedness-and-resilience-for-emerging-threats#top.

- World Health Organization. Summary of key information: practical to countries experiencing outbreaks of A(H5N1) and other subtypes of avian Influenza. First edition, July 2016. Geneva; WHO; 2016. Available from: https://www.who.int/publications/i/item/WHO-OHE-PED-GIP-EPI-2016.1.
- World Health Organization. Global Influenza Programme: Pandemic influenza preparedness. Geneva: WHO; 2023. Available from: https://www.who.int/teams/global-influenza-programme/public-health-preparedness.
- World Health Organization. Avian influenza virus and other influenza viruses of zoonotic origin. Geneva: WHO; 2023 [cited 25 May 2024]. Available from: https://www.who.int/news-room/fact-sheets/detail/influenza-(avian-and-other-zoonotic).
- World Health Organization. Strengthening global health security at the human-animal interface. Geneva: WHO; 2023 [cited 25 May 2024]. Available from: https://www.who.int/activities/strengthening-global-health-security-at-the-human-animal-interface.
- Food and Agriculture Organization of the United Nations. Global Avian Influenza Viruses with Zoonotic Potential situation update. Rome: FAO; 2023 [cited 25 May 2024] Available from: https://www.fao.org/animal-health/situation-updates/global-aiv-with-zoonotic-potential/en.
- World Organisation for Animal Health. Statement on avian influenza and mammals, 13 February 2023. Paris: WOAH; 2023. Available from: https://www.woah.org/es/declaracion-sobre-la-influenza-aviar-y-los-mamiferos/.
- Pan American Health Organization / World Health Organization. Epidemiological alerts and updates. Avian Influenza. Washington D.C.: PAHO/WHO; 2024. Available from: https://www.paho.org/en/epidemiological-alerts-and-updates?d%5Bmin%5D=&d%5Bmax%5D=&topic=63069.
- World Health Organization. Influenza at the human-animal interface summary and assessment. 5 October 2022. Geneva: WHO; 2022. Available from: https://www.who.int/publications/m/item/influenza-at-the-human-animal-interface-summary-and-assessment-5-oct-2022.
- Pan American Health Organization / World Health Organization. Epidemiological Update - Outbreaks of Avian Influenza caused by Influenza A(H5N1) in the Americas Region, 9 August 2023. Washington D.C.: PAHO/WHO; 2023. Available from: https://www.paho.org/en/documents/epidemiological-update-outbreaks-avian-influenza-caused-influenza-ah5n1-region-americas-0.