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Review Article

Bird flu: A comprehensive study

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Abstract

Bird flu is an infection caused by avian influenza viruses, which are of different types A, B and C. Type A avian influenza viruses are the most frequently associated with avian influenza epidemics and pandemics. There are 16 hemagglutinin (H1 to H16) and 9 neuraminidase types (N1 to N9) identified till date. A peculiar characteristic of influenza A viruses is their propensity for genetic change by two main processes: antigenic drift (small, gradual changes) and antigenic shift (abrupt, major change producing a novel influenza A virus subtype).There are various modes of transmission of human influenza including inhalation, direct or indirect (fomite) contact etc., can have manifestations ranging from mild to severe or fatal disease, depend on the viral subtype causing the disease. Avian influenza A (H5N1) results in high death rate amongst infants and young children.

The first outbreak of human infection by avian influenza viruses (H5N1) was observed in 1997 in Hong Kong. Since then a large number of outbreaks have been reported in different parts of the world. In fact, the spread of avian influenza H5N1 in various species including humans has lead to a current pandemic threat.

Human avian influenza infections in persons at high risk of exposure can be prevented by adopting a series of protective measures, anti-viral vaccination and health monitoring. Drugs currently available for the treatment or prophylaxis of influenza infections include the adamantanes (amantadine and rimantadine) and the newer class of neuraminidase inhibitors (zanamivir, oseltamivir and peramivir). However, vaccines are considered the first line of defense for reducing the excess morbidity and mortality that invariably accompany pandemics and a number of clinical trials are under way to test them.

Keywords: Bird flu, Avian influenza, Influenza A virus, High pathogenic avian influenza (HPAI), Human infection, Viral mutation

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1. Introduction

Bird flu, also known as avian influenza is a highly contagious and potentially deadly viral disease that affects birds. The virus can be transmitted to humans through close contact with infected birds, contaminated surfaces, or other infected animals. Bird flu outbreaks have been reported globally, causing significant economic losses in the poultry industry and posing a risk to human health.

1.1. Bird flu symptoms

In Birds symptoms are most especially for high pathogenicity infection types, sudden death is the first symptom, Mild swelling in the head, neck and eyes, Respiratory problems like coughing, sneezing, nasal discharge, and raspy breathing, Diarrhoea, Decrease in egg production or the production of strange eggs, Loss of coordination or walking difficulty and Cyanosis (bluish discoloration of comb and wattles)

In Humans symptoms can be mild or severe, Fever, Cough, Throat pain, Muscle pain, Headache, Fatigue, Respiratory distress or breathing difficulty, Pneumonia in highly critical cases, Conjunctivitis (in some cases) and Multi-organ failure or organ failure

Most often, close contact with infected species of birds or with environments contaminated by them, either singly or in combination, constitutes the source of human infection. Human-to- human transmission has been very rare but may occur through mutations that render the pathogen more transmissible in certain cases.[1-2] It also involves more severe diseases, which could include acute respiratory distress syndrome (ARDS), multiple organ failure, or death.

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2. Discussion

2.1. Characterization of bird flu (Avian Influenza)

AV isolate is classified based on the type of hemagglutinin (HA) and neuraminidase (NA) present on the surface of the virus. Through these proteins, subtyping was done that is important for diagnosing and controlling such outbreaks.

2.2. On the basis of pathogenicity

Low Pathogenic avian influenza (LPAI): The usual diseases in birds by these strains are mild or subclinical like wild birds or domestic poultry unnoticed most of the time.Most of the time, LPAI does not result in severe disease or mortality in poultry. However, specific LPAI strains can cause highly pathogenic forms under certain conditions.

Highly pathogenic avian influenza (HPAI): These strains cause severe disease and high mortality in infected birds, particularly among poultry.HPAI strains such as H5N1, H7N9, and H5N8 can lead to rapid mortality in birds, resulting in significant loss to the poultry industry. Most importantly, they are of great concern to human health because they risk transmitting to humans and other animal species

2.3. By Subtype (based on HA and NA proteins)

Hemagglutinin (HA): The 18 known HA subtypes ranges from H1 to H18, which are enough for making the virus successful by enabling it to bind with the host cell.

Neuraminidase (NA): The 11 known NA subtypes (N1 to N11) are enough to add mobility and subsidy to the virus and thus help it to de-bond new virulent particles in infected cells.

2.4. Important Subtypes in Avian Influenza

H5N1: Very dangerous strain and could cause fatal infections in human beings

H7N9: A very dangerous strain responsible for human pandemics.

H9N2: Low-pathogen strain that might sometimes infect human beings but may not be fatal most of the time.

H5N8 and H5N6: Strains associated with large outbreaks in humankind that rise through the infected birds brought to markets-health facilities became essential due to some potential human transmission.

3. Classification Zoonotic Infections

In avian flu most strains are zoonotic; they can sometimes spread from animal to human, but it is rare that human-human transmission occurs.[3]

Strains infecting humans: Like H5N1, human cases with H7N9 and H9N2 display severe signs and symptoms of illness. These strains are particularly important with regard to public health because mutations in their genetic material may occur to facilitate an easier way of humans being infected by humans and make pandemics less improbable

4. Treatment for Bird Flu or Avian Influenza

The treatment of bird flu will be dependent on whether the infection is happening in birds or humans and how severe is the disease.

4.1. In Birds

There is no particular antiviral therapy: Most birds are limited to antiviral drugs for the treatment of avian influenza. Prevention of the spread of the virus is the primary management for this illness.

4.1.1. Control measures

Culled: In several of the common cases, culling refers to the humane killing of the infected birds in order to prevent the spread of the infection to other animals.

Biosecurity measures: For control of virus spread, biosecurity activities, including equipment disinfection, isolation, animal movement control, and contacts among wild birds or domestic poultry, are strictly followed in farms and urban markets, to limit virus transmission.

Vaccination (may be allowed under restricted conditions): In several nations, vaccination of poultry against particular strains of avian influenza, like H5N1, is a preventive measure; however, vaccination is not the universal panacea for the potential threat of strain drift and trade restrictions in many countries.

4.2. In humans

In humans, the treatment options for avian flu include antivirals and support with enhancing early intervention to modify the intensity of diseases.

4.2.1. Antiviral medications

Oseltamivir (Tamiflu): effective neuraminidase inhibitor, should be given early when symptoms begin - within 48 hours of starting. It helps in reducing but blocks the spread of the virus by inhibiting its ability to replicate within the body.

Zanamivir (Relenza): Another neuraminidase inhibitor given when the virus is inhaled. Thus is used for quite the same effects of reduction in viral replication and duration of disease.

Baloxavir marboxil (Xofluza): This new antiviral fights viral replication, which has just started to be used on a limited scale for avian influenza.

Amantadine and Rimantadine: These antiviral drugs have been in use from the past but are rarely used as resistance is becoming transmitted to some strains of the virus while some other types of flu could still be used among all strains.[4]

4.2.2. Supportive care

In severe cases with respiratory distress, oxygen therapy should be administered in addition to it. If case recovers further, mechanical ventilation is usually used to manage severe pneumonia or ARDS. Moreover, any other available supportive means of treatment should be done besides fluid management and therapeutic antibiotics for secondary bacterial infection according to organ function.

4.2.3. Human vaccine

Such human vaccines are not available widely. Still, for preparing a vaccine against the new strains of H5N1 and H7N9, research and development are under way. Emergency vaccines can be developed and administered if outbreaks occur, especially in healthcare providers or where there are high numbers of people who are at high risk of exposure

5. **Prevention of Avian Influenza (Bird Flu)**

It entails the consolidation of these measures together aimed at reducing the risk of infection in birds, from human exposure, and the spread of the virus. The prevention efforts need to be concerted, allowing each one forward as a country, local, or global dot to enable successful prevention of bird flu.

5.1. In birds

5.1.1. Control for biosecurity measures

Isolation and monitoring: Diseased or at risk birds are promptly isolated unto themselves to deny communication with healthy birds.

Control of movement: Restricting how birds, their products, and equipment are transported is necessary for them to stop the virus from quickly going all over through farms in various areas.

Disinfection: It incorporates routine cleaning and disinfecting of items in the bird population, equipment, vehicles, and clothing, in an attempt to prevent the agent from contaminating.

Monitor and surveillance: Alerts are sounded concerning any sicknesses that become detectable early in poultry and the proliferation of birds by performing continuous surveillance.[5]

5.1.2. Vaccination

There are countries that vaccinate poultry for different specific types of AI like H5N1 or H9N2 within regions to thwart any outbreaks. As such, in vaccinated pigs, satisfactory prevention can occur; however, that does not mean it does not have limitations and that it is not 100% effective. It does not work on all rapidly evolving strains and takes international poultry trade restrictions into consideration as well.

5.2. In Humans

5.2.1. Avoiding contact with infected birds

Direct contact: People should avoid handling sick or dead poultry, particularly in regions where avian influenza outbreaks have been reported. Use protective gear (e.g., gloves, masks) when interacting with birds.

Poultry markets and farms: Workers in live bird markets, poultry farms, and slaughterhouses should take extra precautions, including using personal protective equipment (PPE) such as face masks, gloves, and goggles.

Proper Cooking of Poultry and Eggs:Safe cooking practices help eliminate the virus. Poultry and eggs should be cooked thoroughly to an internal temperature of at least 165°F (74°C), which is sufficient to kill the virus.

Avoid consumption of raw or undercooked poultry products, especially in regions with known avian influenza outbreaks.

5.2.2. Personal hygiene

Regular hand washing with soap and water, particularly after handling birds or coming into contact with their droppings or contaminated surfaces, helps reduce the risk of infection. Avoid touching the face, especially the eyes, nose, or mouth, after handling potentially contaminated items.

5.2.3. Antiviral medications

Prophylactic antiviral treatment (e.g., *oseltamivir* or *zanamivir*) may be recommended for individuals who are at high risk of exposure, such as poultry workers or healthcare workers during an outbreak.

6. **Vaccines (for humans)**

Currently, there are no widely available vaccines for human avian influenza. However, research is ongoing to develop vaccines for strains such as H5N1, H7N9, and others. In the event of a pandemic, emergency use vaccines may be developed and distributed.

Seasonal flu vaccination is also recommended to help reduce the burden on healthcare systems, as it helps distinguish between avian and seasonal influenza and prevents co- infection

7. **Public Tasks on Health**

Surveillance and Monitoring: Continuous surveillance of poultry, wild birds, and humans for avian influenza is critical to allow early detection and an immediate response. This includes monitoring in both high-risk areas such as poultry farms, as well as wildlife populations.

Culling of Infected Animals: One of the most effective strategies to control the spread of HPAI is culling of infected birds in disease outbreak scenarios. This is usually accompanied by stringent quarantine and movement control measures.

Community Awareness and Education: Public health authorities should educate communities about the risks associated with bird flu and provide guidelines for prevention. This includes education with regard to avoiding infected bird contact, good hygiene practice, and safe food preparation.

8. International Cooperation

Global Surveillance: International entities like the World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), and the OIE cooperate to monitor and control avian outbreaks globally. This effort is geared toward preventing cross-border spread of viruses.[6]

Information Sharing: Sharing of outbreak information between countries addresses the situation and maintains global surveillance, ensuring that measures are effectively applied.

9. Causes of Bird Flu (Avian Influenza)

Bird flu, or Avian Influenza, is a virus-induced infection caused by the Influenza A virus that most frequently targets birds, from chickens to all kinds of wild waterfowl. The process is grouped into outlying lines according to two key proteins that these viruses possess in order to strengthen: hemagglutinin and neuraminidase (NA).The causes of bird flu are as follows:

9.1. Avian influenza virus

Bird flu is mainly caused by flu virus of type A, perfectly adapted to birds. Concluding, this type of virus can be categorized into low pathogenic avian influenza (LPAI) and high pathogenic avian influenza (HPAI) with regards to the severity of the disease it causes in birds. HPAI viruses such as H5N1 or H7N9 are known for causing severe outbreaks, while LPAI viruses are generally of low threatendemic.

9.2. Transmission among birds

Direct contact: Direct contact with infected birds in a flock is one of the most common ways in which the virus spreads between them, either by themselves or through saliva, nasal secretions, and respiratory droplets.

Contaminated surfaces and equipment: The virus spreads indirectly by being carried on contaminated surfaces and equipment where it can be dealt with in water or feed. This is why the use of very strict biosecurity practices in poultry farms is important to infection control.

Wild birds: Wild birds, especially waterfowl (ducks, geese), act as natural virus reservoirs in which it may be found as a completely unnoticed part of the normal population. They can transfer the pathogen to domestic birds, for example, to domestic waterfowl, with which they come into contact directly.

9.3. Mutation of the virus

The mutation of a virus assumes a new type of firmer potential strands, which can be more threatening. Genetic factors of flu viruses such as antigenic shift or very minor forms of antigenic drift are bound rapid genetic changes, i.e., mutation in the viral genetic makeup, or sudden minor mutations. These changes may result in the emergence of new strains of the virus which can cause diseases in various hosts, so that even humans may catch it.

Genetic reassortments between different strains of the virus occasionally lead to the generation of new strains carrying altered properties of transmission capability of the virus or its virulence that can complete the episode status of a human pandemic.

9.4. Human interaction with infected birds

Close contact with infected poultry: Generally, humans are infected with the bird flu virus by the physical contact of any sick or dead bird, especially in areas where there have been outbreaks of large numbers of poultry.

Contamination of poultry products: Poultry products such as raw meat, eggs, and bug exuviae, particularly in the absence of proper cooking and handling, may be a source of human infection.

Bird markets and poultry farms: Activities at live bird markets, poultry farms, or slaughterhouses make an individual more susceptible simply because of every-day-exposure to birds; it may be due to the presence in such intensively populated avian areas along with bird droppings.

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10. **Evaluation**

This evaluation looks at several perspectives: public health, agriculture, economy, global surveillance, and future preparedness regarding the threat of bird flu: transmission and control as well as future outbreaks should be clear in evaluating them.

10.1. Impact on public health

Human health risks: Generally, bird flu infection occurs rarely in humans, but engenders severe disease and death in certain strains like H5N1, H7N9, and H5N8. It can cause pneumonia, acute respiratory distress syndrome (ARDS), and multi-organ failure in vulnerable populations.[8] The threat for the virus to mutate and adapt for human-to-human transmissibility remains a major concern in public health, as it could lead to pandemics with wide morbidity and mortality.

Health system strain: A substantial outbreak in humans would stress the health care systems tremendously, necessitating quick diagnosis, treatment, and isolation. Antiviral treatments are effective but useless unless given early since vaccines against bird flu strains that infect humans are still in research

10.2. Impact on agriculture and poultry industry

Poultry mortality: Avian flu outbreaks can result in the hasty deaths of poultry, because of the H5N1 type viruses that are particularly pathogenic. Economic losses can be monumental due to these losses such as avian flu in poultry. Birds may first be affected by the shock from sudden death followed by other symptoms such as dyspnea and decreased egg production, which can cost the poultry trade billions of dollars.

Economic loss: The economic loss resulted in avian flu outbreak a great damage to all the farmers, poultry producers and broader agricultural sector. Those measures result in high costs, like culling and quarantining infected flocks, along with movement restrictions, and even cost higher by trade restrictions imposed by other countries on poultry market.

Global trade disruptions: Disastrous outbreaks of bird flu result in bans on trading among the different countries in poultry products and further from international export to import. This could create a disruption in the flow of food and therefore reduce economic gain to some countries largely dependent on the export of poultry.

10.3. Impact on wildlife

Wild Avian Flu Reservoir-Distribution through wild fowl, especially waterfowls, acts as the live reservoir of viruses causing avian influenza. Through these migratory patterns, the distribution of the virus continues over very large areas, including the new areas domesticated with regard to the poultry population. Most wild birds remain silent carriers and do not show signs of the disease, but effectively infect the domestic birds, thus causing poultry farm outbreaks.

Ecosystem Disruption: In a few cases, a deadly effect on wildlife caused by bird flu can badly disrupt the entire ecosystems. It negatively affects harmful bird species due to high death in migration. The virus could change the balance in certain bird populations, for one thing, affecting migratory habitats.[9]

10.4. Potency of control and prevention measures

Surveillance systems: International surveillance programs, like those of the World Health Organization (WHO), Food and Agriculture Organization (FAO), and World Organisation for Animal Health (OIE), have been proved to very effectively monitor and identify outbreaks of bird flu, as well as allow the surveillance and timing of the occurrence of the first cases. Early detection remains crucial in preventing a massive outbreak and minimizing the impact of the virus on both human and animal populations.

Vaccination: The application of vaccination in poultry has been the chief strategy in controlling bird flu outbreaks in some territories, but there are still challenges in vaccine effectiveness against rapidly mutating strains and in taming wild bird reservoirs. In humans, vaccine research is in progress, and its availability remains part of plans for the future.

Culling and quarantine: Culling the affected birds, imposing contemptuously stringent quarantine, and effectively controlling any outbreak are considered important, although implementation is costly and potentially has social economic impacts.[10] These may not even be successful if the virus enhances mutations making them more transmittable to humans.

Public health preparedness: Public health systems have upped their game in preparedness and implement improved response plans, such as the antiviral drugs *oseltamivir* (Tamiflu) and *zanamivir* (Relenza). Yet there remain gaps in the development, introduction, and delivery of vaccines, as well as harmonization and prompt management of novel strains of the virus.

10.5. Environmental and ecological considerations

Transmission to wild birds and their domestic counterparts: Environmental conditions like the migrating routes of water fowls and wetlands are necessary to bring together wild birds and poultry in the area infected with the virus, leading to increasing risks of disease outbreaks, particularly in cases where poultry farming is on a much intensive scale.

Impact of ecology on biodiversity: The prevalence of avian influenza among wild birds will seriously affect the biodiversity among limited populations or species already facing some ecological stressors. For example, the virus can cause severe mortality in several endangered bird species, again with serious implications for their fortune.[11]

10.6. Global cooperation and challenges

International Co-operation: The most crucial collateral in managing bird flu is global collaboration. WHO, FAO, and OIE, they consider themselves quite important in that regard. These organizations come into the picture by coordinating surveillance, information sharing, and the provision of technical assistance. As soon as the threat to human health changes, there is a timely reaction to emerging strains.

The Challenge of ascertaining the spread: The avian influenza is obviously expounded in a vast network of migratory routes of wild birds in numerous other obstacles. It had established itself so well mostly with during the worldwide interconnectedness in global poultry trade despite the entrenchment of the disease control regime themselves. Mutations are quickly effected through the capacity to change simultaneously in these areas.

11. Detection of Bird Flu (Avian influenza)

The monitoring approach to detection: Bird flu detection is thus defined as the discovery of the presence of the avian influenza virus (AIV) in birds, animals, or humans.[12] It is pertinent to realize that timely and efficient detection is the key to averting broad outbreaks of the disease, controlling the spread of the virus and ultimately ameliorating the public and economic repercussions. Various diagnostic methods are used to detect the virus in birds, humans, and samples from the environment.

12. Detection in Birds (Poultry and Wild birds)

12.1. Clinical surveillance

Clinical signs: Observations made by veterinarians and animal health worker of poultry include sudden death, respiratory distress, swelling of the head or neck, and decreased egg production. All the above symptoms may indicate the potential effects of AIV if highly pathogenic strains are considered.

Post-mortem examinations: Full necropsy of infected birds enables the visualization of characteristic signs of the disease, such as hemorrhages in various organs, especially the respiratory system.[13]

12.2. Laboratory testing

Reverse transcription polymerase chain reaction (RT-PCR): This wide-spectrum molecular technique is used for avian influenza virus detection in bird samples such as swabs from the throat or cloaca and tissues from diseased or dead birds. It can be used to amplify the genetic material of the virus, making it easy to identify that specific virus.

The specific subtype of the virus can be determined, which is essential for the pathway of pathogenicity (i.e. low vs. high).

13. Virus Isolation

This type involves taking samples from birds, coupled with culturing on cell lines (usually avian cells) to isolate, grow and make large quantities of the virus. The virus will be further characterized for the specific subtype and pathogenicities after growing. It is a very time-consuming procedure and needs to have specialized laboratory facilities. Serological examination:

ELISA: The commercial ELISA was conducted to find antibodies produced against avian influenza virus within the bird's serum, showing the frequency with which the bird was exposed. Such an assay is ideal for widespread flock surveillance in poultry or to trace any infection in clinically inapparent birds.[14]

HI (hemagglutination inhibition): An HI test was carried out to detect antibodies in the sera of the birds by determining the ability of the sera to prevent agglutination of red blood cells by the virus. It can help to determine exposure to a particular strain of avian influenza in the past.

On the contrary, environmental swabbing; hence, even other sample types: water sources, feed, surfaces and waste (faeces), has to be done on poultry farms or those sites visited much by wild birds. For testing and demonstration purposes, all samples can similarly be tested using RT- PCR for identity of environmental virus.

14. Diagnosis of humans

14.1. Clinical diagnosis

Symptoms: Clinical signs of avian influenza in human beings are similar to that of seasonal influenza where diagnosis begins with virus detection. Symptoms of bird flu in humans include high fever, cough or sore throat, myalgia, and respiratory distress. Extreme cases result in pneumonia, acute respiratory distress syndrome (ARDS), and organ failure.[1]

Exposure history: It is diagnosed in the context of important issues such as the patient's history of exposure to infected birds and the possible environment where the virus might have been present, for instance, poultry farms or live bird markets.

14.2. Laboratory testing

RT-PCR (for human): RT-PCR could also be employed as part of diagnosis through which Avian Influenza virus can be diagnosed in human respiratory samples like throat swabs or sputum. The test is highly sensitive and able to detect RNA of Avian Influenza virus and confirms diagnosis and gives the virus a subtype that it belongs to or even a differentiation as to what virus type it is= H5N1 or H7N9.

Viral Culture: Viral culture could be done in some cases, but it is more labour intensive and less often practiced due to the speed and sensitivity of RT-PCR methods and their specificity.

Serological Testing: In a certain way maybe, the serology tests could detect the antibodies against the avian influenza in the person's blood sample.

15. Global Situation Networks

Global partnerships: Agencies such as the World health organization (WHO), the Food and agriculture organization (FAO), and the World organization for animal health (OIE) allow for the sharing of data, commonality in the testing methods, and coordinated action in case of outbreaks.

Early warning systems: There are advanced monitoring systems and networks in place to detect bird flu outbreaks among human beings and animals early. This includes bird migration pattern monitoring systems, surveillance at live bird markets, and the continuous reporting by affected countries.[16]

16. Conclusion

Bird flu or avian influenza is an important global health and agricultural problem; due to severe disease potential in poultry and humans today, it attracts concerning attention. Influenza A viruses lead to this disease, either they are virulent or not - and most particularly dangerous is H5N1 and H7N9 strains with high pathogenicity status. Even though the diseases in humans are rare, the possibility of these viruses turning infectious, and spreading much moreres copiously from human to human could become a potential major pandemic threat. Early detection and effective identification of the virus are important for mitigating the outbreak conditions. Rapid diagnosis techniques, such as RT-PCR, virus isolation, and serological tests obtain this detection from birds, people, and the environment. Surveillance in migratory and domestic bird populations places a key role in preventing the virus from spreading to people.

Biosecurity practices, vaccinations, and culling were some of the following steps taken for controlling outbreaks in poultry, with public health preparedness being significant in minimizing human infections. Such measures have, however, not been able to completely control the virus, especially with the expected rapid mutation and wild birds being natural reservoirs. The challenges that come with trying to make complete control over the disease are that the mutation can be quick and it can jump between species. Despite solutions to avian influenza being that mixture of certain early detection, prevention, and global cooperation, vigilance, research, preparedness, and new conventional measures will be critical yet important next steps to make public health and poultry industry resilient to future pandemics. Future development of vaccines, antivirals, and improvement in global surveillance for bird flu will be crucial to mitigate the risks.

17. Conflict of Interest

None.

18. Source of Funding

None.

References

1. NSW government (NSW).Bird flu (avian influenza) Fact Sheet.(2024) Accessed at: https://www.health.nsw.gov.au/Infectious/factsheets/Pages/avian-influenza.aspx.
2. World health organisation (WHO). Bird Flu. (2024) Accessed at: https://www.who.int/news-room/questions-and-answers/item/influenza-avian.
3. Koutsakos M, Katherine Kedzierska K, Subbarao K. Immune Responses to Avian Influenza Viruses. J Immunol. 2019; 202 (2): 382–91.
4. NSW government (NSW). (2015). Avian Influenza Information for Private Veterinarians. Available at:https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/1607673/Avian-Influenza-Information-for-Private-Veterinarians-A-guide-to-case-management-FINAL.pdf.
5. Webster RG, Govorkova EA. H5N1 influenza continuing evolution and spread. *N Engl J Med*. 2006;355(21):2174–7.
6. Hoye BJ, Munster VJ, Nishiura H, Klaassen M, Fouchier RAM. Surveillance of Wild Birds for Avian Influenza Virus. *Emerg Infect Dis*. 2010;16(12):1827–34.
7. World Organisation for Animal Health (OIE). Avian Influenza.(2022). Accessed at: https://www.woah.org/en/disease/avian-influenza/.
8. Pantin-Jackwood MJ, Swayne DE. Pathogenesis and pathobiology of avian influenza virus infection in birds. Rev Sci Tech . 2009;28(1):113–36.
9. Webby RJ, Webster RG. Emergence of influenza A viruses. *Philos Trans R Soc Lond B Biol Sci*. 2001;356(1416):1817–28.
10. Mostafa A, Abdelwhab EM, Mettenleiter TC, Pleschka S. Zoonotic Potential of Influenza A Viruses: A Comprehensive Overview. *Viruses*. 2018;10(9):497.
11. Highly Pathogenic Avian Influenza A(H5N1) in Wild Birds and a Human, British Columbia, Canada, 2024. Available at: https://wwwnc.cdc.gov/eid/article/31/6/24-1862_article.
12. European Centre for Disease Prevention and Control (ECDC). (2017). Antiviral treatment for avian influenza. Available at: https://www.ecdc.europa.eu/en/seasonal-influenza/prevention-and-control/antivirals.
13. U.S. Geological Survey (USGS). What are the different types of avian influenza? What do the numbers next to H and N mean?. Available at: https://www.usgs.gov/faqs/what-are-different-types-avian-influenza-what-do-numbers-next-h-and-n-mean.
14. World Organisation for Animal Health (WOAH), 2025. Avian Influenza. [online] Available at: https://www.woah.org/en/disease/avian-influenza/.

15. Food and Agriculture Organization of the United Nations (FAO), 2025. Global strategy for the prevention and control of high pathogenicity avian influenza (2024–2033). Accessed at: https://openknowledge.fao.org/items/4c4f67c1-c8c7-401b-9d04-720493406c19
16. World Health Organization (WHO), 2013. Real-time RT-PCR Protocol for the Detection of Avian Influenza A(H7N9) Virus.Accessed at: https://www.who.int/publications/m/item/real-time-rt-pcr-protocol-for-the-detection-of-avian-influenza-a(h7n9)-virus.

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