ISSN: 3048-8397

Bio Vet Innovator Magazine
(Fueling The Future of Science…)
Volume 3 (Issue 8) AUGUST 2026
OPEN ACCESS
World Mosquito Day – 20th August 2026
Popular Article

Influenza A Virus in Animals: A Veterinary and One Health Perspective

Kuldeep Kumar* and Swarali Prashant Pawar**
**Assistant Professor, Department of Veterinary Pathology, Shekhawati Veterinary College, Kochhor, Sikar, Raj. (332406)*
*** B.V.Sc. & A. H Student, Shekhawati Veterinary College, Kochhor, Sikar, Raj. (332406), India*
***Corresponding Author:** vetkuldeepkumar@gmail.com
DOI: https://doi.org/10.5281/zenodo.22063290

Received: August 18, 2026
Published: August 23, 2026

Abstract:

Influenza A virus is an important infectious pathogen affecting a wide range of animal species and has considerable significance in veterinary medicine and animal health. The virus is maintained in nature primarily among wild aquatic birds, but it can also infect domestic poultry, pigs, horses, dogs, cats, marine mammals, and other wildlife. Its segmented RNA genome and remarkable ability to undergo genetic changes enable the virus to adapt to new hosts and, occasionally, cross species barriers. While many interspecies infections remain limited and self-contained, some can cause severe disease or facilitate the establishment and spread of influenza virus in new animal populations.

The occurrence and spread of animal influenza are influenced by several interacting factors, including host susceptibility, viral characteristics, animal density, farming practices, wildlife migration, animal movement, environmental contamination, and close contact between different animal species. Among these, highly pathogenic avian influenza (HPAI), particularly H5N1, has emerged as a major concern because of its wide host range, severe disease potential, and ability to infect both domestic and wild animals. Understanding the ecology, transmission, and interspecies spread of Influenza A virus is therefore essential for effective disease surveillance, prevention, and control within the framework of One Health.

Keywords: Influenza A virus; Animal influenza; Highly pathogenic avian influenza (HPAI); H5N1; Wild aquatic birds; Interspecies transmission; Host susceptibility; Viral adaptation; Cross-species transmission; Wildlife–livestock interface; Animal health; Viral ecology; Disease surveillance; One Health.

Introduction:

Influenza A virus is one of the most important viral pathogens of veterinary significance. Its importance extends beyond the disease caused in individual animals because of its ability to circulate

among different animal populations and, occasionally, cross species barriers. Influenza A viruses have been detected in birds, domestic livestock, horses, companion animals, wildlife, and humans. This broad host range makes influenza A continuing challenge for animal health, disease prevention, and control [1].

Wild aquatic birds, particularly waterfowl, are considered the natural reservoirs of many influenza A viruses. These birds can carry a wide variety of influenza virus subtypes, often without showing severe clinical signs. However, when influenza viruses infect other animal species, the outcome can be very different. Depending on the virus and the host, infection may result in mild respiratory disease, severe systemic illness, or even death [1,2].

Another important feature of influenza A virus is its ability to cross species barriers. Transmission can occur between wild birds and domestic poultry, among different livestock species, between wildlife and domestic animals, and between animals and humans. Most interspecies transmission events do not lead to sustained transmission in the new host. However, influenza viruses can undergo genetic changes that may enhance their ability to infect, adapt to, and spread within a new species [1,3].

The veterinary importance of influenza is particularly evident in poultry production. Highly pathogenic avian influenza (HPAI) can cause severe disease and high mortality in poultry, resulting in the loss or culling of infected flocks and substantial economic consequences. The disease can also affect wild bird populations and, increasingly, has been recognized in a range of mammalian species [1,3].

In modern animal production systems, the risk of influenza transmission is influenced by several factors, including high animal density, movement of animals, international trade, farming practices, environmental contamination, and contact between domestic animals and wildlife. These factors make effective biosecurity, disease surveillance, early detection, and rapid control essential components of veterinary practice [1,3].

Influenza A is therefore not restricted to a single animal species or a single field of science. Its ecology and transmission involve the interconnected health of domestic animals, wildlife, humans, and the environment. Effective prevention and control consequently require collaboration among veterinary medicine, human medicine, wildlife science, and environmental health. This integrated approach is known as **One Health** and is particularly relevant to understanding and managing diseases such as influenza A [1].

General Characteristics of Influenza A Virus:

Influenza A viruses belong to the family **Orthomyxoviridae** and possess an enveloped, segmented, single-stranded RNA genome. The genome consists of eight RNA segments that encode viral proteins required for viral replication and infection.

The two major surface glycoproteins of influenza A virus are **haemagglutinin (HA)** and **neuraminidase (NA)**. Haemagglutinin plays an important role in attachment of the virus to receptors on susceptible host

cells, whereas neuraminidase assists in the release of newly produced virus particles from infected cells. The combination of HA and NA determines the subtype of influenza A virus. Examples include **H1N1, H3N2, H5N1 and H9N2**. [1]

Influenza A viruses have a high capacity for genetic variation through **mutation and reassortment**. Mutations may occur during viral replication, whereas reassortment can occur when two different influenza viruses infect the same cell. Because the genome is segmented, genetic material from different viruses can be combined in newly formed virus particles. This may produce viruses with new biological properties and contribute to viral evolution and adaptation to new hosts. [1]

Animal Reservoirs and Host Range:

Wild aquatic birds are considered the primary natural reservoir for a large diversity of influenza A viruses. Ducks, geese, swans, gulls and other water-associated birds can carry several influenza virus subtypes and play an important role in maintaining and spreading influenza A viruses in nature. Many viruses circulating in their natural hosts cause little or no obvious disease.

Infected birds may shed virus through faeces and respiratory secretions. Contaminated water and environmental surfaces may subsequently become sources of infection for other susceptible animals. [1,2] Influenza A virus is not restricted to birds. A wide range of animal species can become infected, including **domestic poultry, pigs, horses, dogs, cats, marine mammals, wild carnivores and other wildlife species**. The outcome of infection varies between host species. Some animals may develop mild disease, whereas others may experience severe respiratory or systemic illness. The presence of influenza viruses in multiple animal species creates opportunities for cross-species transmission and viral evolution. [1,2]

Epidemiology:

The epidemiology of animal influenza is influenced by the interaction between the **virus, host and environment**. Several factors determine the occurrence, maintenance and spread of influenza A virus among animal populations.

- **Host Factors:** Age, species, immune status and susceptibility can influence the outcome of infection.
- **Viral Factors:** Different influenza virus subtypes possess different abilities to infect and spread among animal species.
- **Population Density:** A large number of susceptible animals housed together can increase opportunities for transmission.
- **Animal Movement:** Transport of infected animals may introduce influenza viruses into new areas.
- **Wildlife Migration:** Migratory birds can carry influenza viruses over long distances.
- **Environmental Contamination:** Water, soil, equipment and surfaces may become contaminated with virus and contribute to indirect transmission.
- **Management Practices:** Housing systems, biosecurity, animal mixing and contact with wildlife can

influence disease transmission.

The epidemiology of influenza A is therefore dynamic, and the same virus may behave differently in different animal populations depending on environmental and management conditions. [2]

Influenza A In Different Animals:

- **Poultry:** Poultry are among the most important domestic hosts of influenza A virus. Chickens, turkeys, ducks and other birds may become infected with avian influenza viruses. Some infections cause mild respiratory signs, reduced production or no obvious disease, whereas highly pathogenic strains can cause severe systemic disease and high mortality.

  Poultry farms can be particularly vulnerable because large numbers of susceptible birds are often housed together. Once infection enters a flock, rapid transmission may occur. Important consequences include mortality, reduced egg production, reduced growth, increased control costs, culling of affected birds and trade restrictions. [1,2]
- **Pigs:** Pigs are important in influenza epidemiology because they may be susceptible to influenza viruses originating from different host species. When a pig is infected with more than one influenza virus, genetic reassortment may potentially occur. Therefore, pigs are important animals for influenza surveillance. [1,2]
- **Horses:** Equine influenza primarily affects the respiratory tract of horses. Clinical signs may include fever, coughing, nasal discharge and reduced performance. The movement of horses for racing, competitions and other activities may contribute to the spread of infection between different locations. [1,2]
- **Dogs:** Dogs can occasionally become infected with influenza A viruses following exposure to infected animals or contaminated environments. Although dogs are not considered primary reservoirs of influenza A viruses, their close association with humans makes infection in dogs relevant from veterinary and public health perspectives. [1]
- **Cats:** Cats may become infected following exposure to infected birds or contaminated materials. Infection in cats is particularly important during outbreaks of highly pathogenic avian influenza because cats may hunt or consume infected birds and can consequently be exposed to high amounts of virus. [3]
- **Wildlife and Marine Mammals:** Influenza A viruses have been detected in several wild mammalian species, including marine mammals. Infection of wildlife is important because it may contribute to the continued circulation and evolution of influenza viruses outside domestic animal production systems. [1,3]

Interspecies Transmission:

Interspecies transmission occurs when an influenza virus infects a species different from its usual

host. A possible transmission pathway may be represented as:

Wild birds → Domestic poultry → Mammals → Humans

However, influenza transmission does not necessarily follow this exact sequence. Viruses may move in different directions depending on the species involved and the ecological conditions.

For a virus to establish infection in a new host, several steps are required: exposure, entry into the host, attachment to suitable cells, successful viral replication, avoidance of host immune responses and transmission to another susceptible individual. Failure at any of these stages may prevent the virus from becoming established.

Consequently, many cross-species infections are **dead-end events**. However, if the virus becomes sufficiently adapted to the new host, continued transmission may occur.

The risk of interspecies transmission increases when different animal species come into close contact. Important situations include mixed-species farming, live animal markets, poultry farms near wetlands, wildlife entering livestock areas, animal transportation and human handling of infected animals. [1,2]

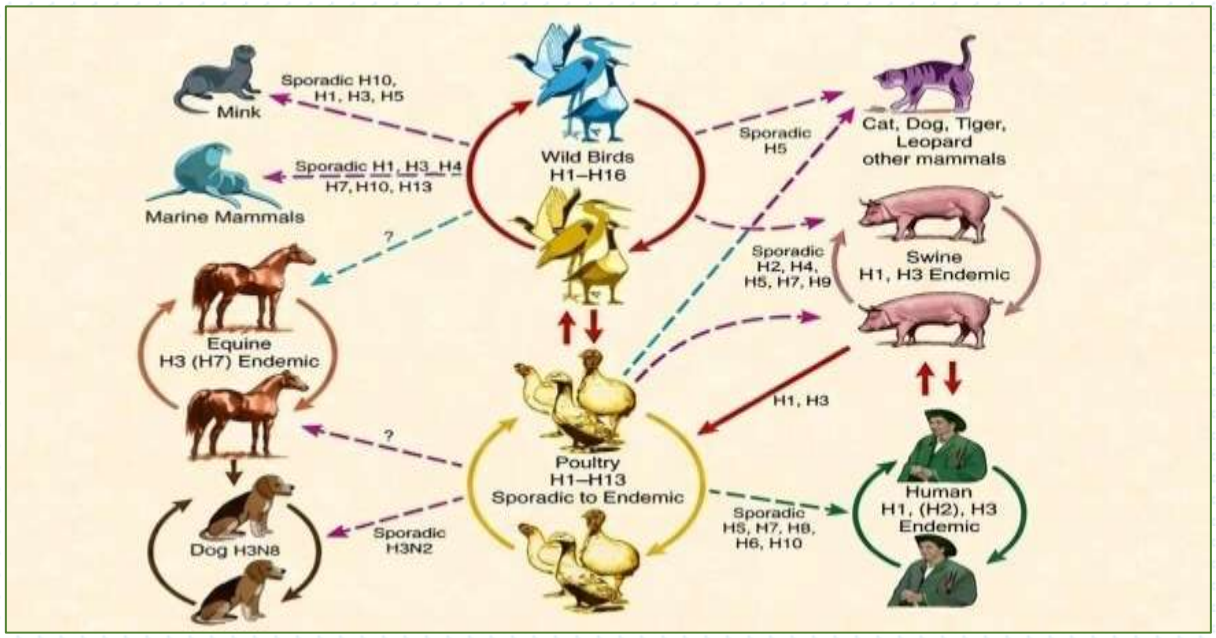

Fig. 1 Diagrammatic representation of the origin and transmission of influenza A virus and its genetic components among avian and mammalian hosts in different ecological and epidemiological settings. From Swayne, D.E. (Ed.), Avian Influenza, p. 62.

Mechanisms of Host Adaptation:

When an influenza virus enters a new animal species, it must overcome several biological barriers before it can establish infection. Genetic changes may contribute to adaptation to the new host.

- **Mutation:** Mutations can alter the structure or function of viral proteins. Some changes may improve the ability of the virus to replicate in a new host and may influence cell attachment, replication, transmission or immune evasion.
- **Genetic Reassortment:** When two influenza viruses infect the same cell, their genome segments may

be exchanged during the formation of new virus particles. The resulting virus may therefore contain a new combination of genetic material.

- **Receptor Binding:** The virus must attach to suitable receptors on host cells. Receptor distribution varies among species. Therefore, a virus adapted to birds may require genetic changes before it can efficiently infect mammalian cells.
- **Replication Efficiency:** The virus must also replicate effectively inside the cells of the new host. Changes in viral proteins involved in replication may contribute to host adaptation. Host adaptation is therefore a complex process rather than the result of a single genetic change. [1]

Highly Pathogenic Avian Influenza A Virus (H5n1):

Highly pathogenic avian influenza A(H5N1) is one of the most important influenza viruses from a veterinary perspective. It has caused serious outbreaks among poultry and wild birds and has also been detected in different mammalian species.

In birds, infection may be associated with sudden death, severe depression, respiratory distress, neurological signs, reduced feed intake and high mortality.

The severity of infection depends on the virus strain, host species and other epidemiological factors. A systematic review and meta-analysis of H5N1 infections in animals analysed 33 studies involving nearly 97,000 animals. The pooled prevalence was approximately 5% in birds and about 1% in pigs, while available data for cats and dogs showed very low pooled estimates. Considerable variation existed between studies, indicating that infection levels differed according to animal populations and study conditions.

The importance of H5N1 is not determined only by its prevalence. Even limited infection in a new host species may be important if the virus causes severe disease or acquires characteristics that improve its ability to spread. The detection of H5N1 in mammals highlights the importance of surveillance at the wildlife–domestic animal interface. [3]

Risk Factors for Interspecies Transmission:

Several factors can increase the likelihood of influenza A virus transmission between animal species.

- **Close Contact Between Species:** Direct contact provides opportunities for transfer of respiratory secretions, faeces and other infectious materials.
- **High Animal Density:** Dense animal populations allow infected and susceptible animals to remain in close proximity.
- **Wildlife–Livestock Interaction:** Wild birds may introduce influenza viruses into poultry farms through direct contact or environmental contamination.
- **Animal Movement:** Transportation of infected animals can spread influenza viruses over long distances.

- **Poor Biosecurity:** Contaminated equipment, footwear, clothing and vehicles can carry virus between farms.
- **Environmental Contamination:** Water and contaminated surfaces may act as indirect sources of infection.
- **Human Activities:** Farm workers, veterinarians, traders and animal handlers may have repeated exposure to infected animals.

The risk of transmission is therefore determined by a combination of **biological, environmental and management factors**. [1]

Veterinary And Economic Importance:

Influenza A virus can have serious consequences for animal health, animal welfare, livestock production and the economy.

In poultry and livestock, infection may result in reduced growth, reduced egg production, reduced reproductive performance and reduced milk or meat production. Farmers may also experience losses due to animal deaths, culling, treatment and diagnostic expenses, disinfection and restocking.

Additional indirect losses may occur because of movement restrictions, trade bans, market disruption and reduced consumer confidence. Outbreaks among wild birds and mammals may also threaten vulnerable wildlife populations.

Therefore, influenza is not only an infectious disease problem but also an important **veterinary, economic and wildlife conservation concern**. [1]

Zoonotic Importance:

Certain influenza A viruses can infect humans following transmission from animals. Individuals with increased exposure may include poultry workers, farmers, veterinarians, slaughterhouse workers, animal traders, wildlife handlers and people involved in caring for infected animals.

Animal-to-human transmission does not necessarily result in efficient human-to-human transmission. However, zoonotic infections may sometimes cause serious disease. For this reason, veterinary surveillance is an important component of public health protection.

The detection of unusual influenza infections in animals should be considered an important warning signal because influenza viruses may undergo changes while circulating in different hosts. [1,2]

One Health Significance:

Influenza A virus is a classic example of a disease requiring a **One Health approach**. The virus may circulate in wildlife, infect domestic animals, spread through livestock systems and occasionally affect humans.

A successful One Health strategy should include veterinary surveillance, human health surveillance, environmental surveillance, laboratory collaboration and joint outbreak investigation.

The One Health approach allows disease threats to be studied across the entire transmission system rather than focusing on only one host species. [1]

Prevention And Control:

- **Biosecurity:** Biosecurity is one of the most important tools for preventing influenza introduction into animal populations. Important measures include preventing contact between poultry and wild birds, restricting unnecessary farm visitors, cleaning and disinfecting equipment, maintaining hygienic footwear and clothing, controlling movement between farms and appropriately managing newly introduced animals.
- **Surveillance:** Clinical observation and laboratory testing help identify infection at an early stage. Surveillance should include domestic poultry, livestock, wild birds, mammals and, where indicated, companion animals. Diagnostic testing and surveillance are essential for detecting influenza infection and monitoring changes in virus circulation. [5]
- **Quarantine and Movement Control:** Infected and exposed animals may need to be isolated. Movement restrictions can help prevent spread to other farms and regions.
- **Safe Disposal:** Dead and infected animals should be disposed of safely to reduce environmental contamination.
- **Vaccination:** Vaccination may be used in certain control programmes. However, vaccination should be combined with surveillance because influenza viruses continue to evolve.
- **Personal Protection:** People handling infected or suspected animals should use appropriate protective measures.
- **Public Awareness:** Farmers and animal handlers should be educated about clinical signs, reporting procedures, biosecurity and safe animal handling. [1]

Challenges In Veterinary Surveillance:

Influenza surveillance faces several challenges, including continuous virus evolution, limited surveillance in wildlife, subclinical infections, unequal diagnostic capacity, animal movement and fragmented information between different sectors.

Some infected animals may show few clinical signs, while sick or dead wildlife may not always be detected or tested. In addition, movement across farms and geographical borders can facilitate rapid spread of viruses.

These challenges demonstrate the need for improved surveillance systems and stronger collaboration between veterinary, public health and environmental sectors. [1]

Future Perspectives:

Future influenza research should focus on understanding how viruses move between species and acquire new biological characteristics. Important areas include genetic monitoring of circulating viruses,

surveillance of wild birds, monitoring influenza in livestock, investigation of infections in mammals, development of rapid diagnostic tests, improvement of vaccines, study of environmental transmission and strengthening of One Health networks.

Genomic sequencing can help identify relationships between viruses and track their movement between populations. Combining genetic, epidemiological and ecological information may improve the early detection of emerging influenza threats. [1,3]

Conclusion:

Influenza A virus is a major veterinary concern because of its broad host range, genetic variability and ability to cross species barriers. Wild aquatic birds serve as important reservoirs of influenza virus diversity, while domestic animals, livestock and wildlife may become infected under suitable conditions. The movement of influenza viruses between species is influenced by host susceptibility, viral characteristics, animal density, wildlife migration, farming practices, animal movement and environmental contamination. Although many cross-species infections do not result in sustained transmission, genetic changes may occasionally allow a virus to adapt to a new host. [1]

Highly pathogenic avian influenza A(H5N1) highlights the importance of animal surveillance. Its effects on poultry and wild birds, together with its detection in mammals, demonstrate the need for continuous monitoring at the wildlife–domestic animal interface. [3]

From a veterinary perspective, influenza A virus is important because it affects **animal health, welfare, livestock production, wildlife conservation, the economy and zoonotic disease prevention**. Effective control requires biosecurity, early diagnosis, surveillance, quarantine, movement control and appropriate outbreak management.

Since influenza viruses circulate at the interface between animals, humans and the environment, the **One Health approach** is essential. Collaboration between veterinarians, physicians, environmental scientists, researchers, farmers and public health authorities will be necessary to reduce the impact of influenza A virus and identify emerging threats at an early stage. [1]

References:

Bonilla-Aldana, D. K., Calle-Hernández, D. M., Ulloque-Badaracco, J. R., Alarcón-Braga, E. A., Hernández-Bustamante, E. A., Cabrera-Guzmán, J. C., and Rodriguez-Morales, A. J. (2024). Highly pathogenic avian influenza A (H5N1) in animals: A systematic review and meta-analysis. *New Microbes and New Infections*, *60*, 101439. https://doi.org/10.1016/j.nmni.2024.101439

Ducatez, M. F., Webster, R. G., and Webby, R. J. (2008). Animal influenza epidemiology. *Vaccine*, *26*, D67-D69. https://doi.org/10.1016/j.vaccine.2008.07.064

Short, K. R., Richard, M., Verhagen, J. H., van Riel, D., Schrauwen, E. J., van den Brand, J. M., and Herfst,

ISSN: 3048-8397

S. (2015). One health, multiple challenges: The inter-species transmission of influenza A virus. *One health*, *1*, 1-13. http://dx.doi.org/10.1016/j.onehlt.2015.03.001

Swayne, D. E. (Ed.). (2009). *Avian influenza*. John Wiley & Sons.

Swayne, D. E. and Sims, L. D. (2021). Avian influenza. *Veterinary vaccines: Principles and applications*, 229-251. https://doi.org/10.1002/9781119506287.ch18