

Low pathogenic avian influenza viruses (all subtypes)(Infection with)

Aetiology Epidemiology Diagnosis Prevention and Control
Potential Impacts of Disease Agent Beyond Clinical Illness References

AETIOLOGY

Classification of the causative agent

Avian influenza (AI) is caused by members of the genus *Influenzavirus A* (Orthomyxoviridae family) and is further divided into two categories: low-pathogenicity and high-pathogenicity avian influenza (LPAI and HPAI, respectively). These viruses are enveloped with a segmented, negative-sense single-stranded RNA genome. Having a segmented genome - in conjunction with error-prone replication strategies - allows this virus to undergo rapid genetic change by recombining with other influenza viruses to form different viral subtypes. For this reason, avian influenza is used to describe a collection of *Influenzavirus A* viruses that primarily infect birds.

Influenza viruses present two main surface-protein antigens: haemagglutinin (H), of which there are 15 types, and neuraminidase (N), of which there are 9 types. Viruses are named and classified by the particular H and N combination they express.

H5 and H7 LPAI and HPAI detected in **domestic birds** must be reported to the OIE as indicated in the *Terrestrial Animal Health Code*. Moreover, HPAI must be reported in **non-poultry including wild birds**. However, LPAI (all serotypes) in **wild birds** is only reportable on a voluntary basis.

Resistance to physical and chemical action

Temperature:	Cooler temperatures contribute to virus persistence in the environment, however, there is evidence to suggest tropical climates are unfavourable. The virus can be inactivated by heat (56-60°C) for 60 minutes.
pH:	Influenza is sensitive to pH extremes (1-3 and 10-14).
Chemicals/Disinfectants:	Inactivate utilising bleach, ethanol, quaternary ammonium compounds, aldehydes, phenols, acids, povidone iodine, and ionising radiation.
Survival:	Environmental stability is highly variable based on conditions such as sunlight, organic material presence, pH, temperature, relative humidity, and salinity. Different viral strains may also have variable persistence.

EPIDEMIOLOGY

Hosts

- The following orders are known to be susceptible to and/or carriers of avian influenza:
 - Anseriformes (waterfowl)
 - Charadriiformes, Strigiformes, and Pelecaniformes (shorebirds)
 - Passeriformes (passerine birds)
 - Accipitriformes (raptors, birds of prey)
 - Galliformes (poultry)
 - Columbiformes (doves, pigeons)
 - Psittaciformes (parrots)
- A variety of mammalian species are susceptible to infection:
 - Suidae (swine)
 - Mink (*Mustela* and *Neovison* spp.)
 - Domestic horses and donkeys (*Equus* spp.)

- Domestic cats (*Felis catus domesticus*)
- Domestic dogs (*Canis lupus familiaris*)

Transmission

- Virus is shed in faeces (faecal-oral transmission) and respiratory secretions of birds.
 - Certain birds will shed more virus via one route in comparison to the other, e.g., waterfowl have a predilection for faecal shedding, whereas poultry shed more virus in respiratory secretions.
- Contaminated surfaces and environments
- Flies can act as mechanical vectors.
- There is some evidence of vertical transmission, but infected eggs are unlikely to hatch.
- Documented methods of transmission to mammals include faecal-oral transmission, contact with mucous membranes (conjunctiva), and consumption of raw poultry/blood from infected birds.

Sources

- Other infected birds and their faeces
- Contaminated fomites
- Broken infectious eggs

Occurrence

LPAI is found worldwide, predominantly in wild free-ranging waterfowl near wetlands and other aquatic environments. These birds are typically asymptomatic and carry the virus year-round, but population prevalence does wax and wane somewhat with seasonal behaviours such as migration. Therefore, waterfowl are recognised as a reservoir.

Other avian species may be infected at any point throughout the year, but population incidence instead follows a strict seasonal pattern dependant upon their migration and nesting habits. For example, shorebirds follow a spring/fall pattern, marine birds a spring/summer pattern, and more terrestrial species a summer/fall pattern.

Migration routes are believed to play a significant role in viral epidemiology. Viral subtypes tend to be unique between flyways unless populations of birds intermix at stopover sites, nesting sites, etc. during migration. This intermixing allows birds to communicate different strains of avian influenza; this creates the potential for viral recombination (antigenic shift). However, some influenza subtypes have limited host ranges and are unlikely to spill over. It should be noted that viral subtypes observed in flyways also change on an annual basis.

It is unlikely for wild birds to develop HPAI from LPAI, but transmission of an LPAI strain (particularly an H5 or H7 subtype) to poultry may incite evolution into HPAI.

Swine serve as an excellent medium for viral recombination when infected with multiple subtypes of AI. This allows for antigenic shift and the creation of new viral subtypes with variable virulence; oftentimes, the product of this recombination is transmissible and pathogenic to other mammalian species.

DIAGNOSIS

For practical purposes, a 21-day incubation period for AI is often utilised for disease control efforts. However, incubation may vary from hours to weeks pending host, population, and environmental factors. Incubation periods in wild birds are much less understood than they are in domestic poultry.

Domestic gallinaceous birds can develop overt disease due to LPAI but may also remain asymptomatic. Wild birds rarely develop clinical disease due to LPAI, and HPAI rarely occurs in these species. Research has shown clinical signs and lesions that do occur due to LPAI are very difficult to reproduce experimentally.

Clinical diagnosis

Clinical signs in wild birds are highly variable and are dependent upon viral subtype, host species, and other host factors such as age and sex. There have not been documented descriptions of clinical disease in wild birds as they are typically asymptomatic, but major categories of disease in poultry include enteric disease, respiratory disease, and reproductive abnormalities. Infected domestic birds often show vague clinical signs such as ruffled feathers, tremors, coughing/sneezing, swollen sinuses, nasal and ocular discharge, diarrhoea, lethargy, anorexia, decreased weight, and decreased egg production.

Spill-over into mammalian hosts typically induces respiratory disease of variable pathogenicity and virulence.

Lesions

- Gross lesions rarely develop in wild birds and are therefore not utilised to diagnose LPAI in these species.

Differential diagnoses

- Infectious bronchitis
- Infectious laryngotracheitis
- Avian paramyxovirus serotype 1 (lentogenic Newcastle disease)
- Mycoplasmosis
- Fowl cholera (respiratory form)
- Aspergillosis
- Heat exhaustion
- Water deprivation

Laboratory diagnosis

Laboratory assays should be validated for the host species; tests utilised for poultry may not be efficacious for waterfowl or other wild bird species.

Samples

For isolation of agent

- Oropharyngeal, tracheal, and/or cloacal swabs from live birds
 - Recovery of virus from swabs is variable and depends on host species and virus subtype.
 - Faeces may be substituted for cloacal swabs.
- Immature feathers are currently being evaluated for their use as a diagnostic sample.
- Postmortem: trachea, lungs, air sacs, intestine, spleen, kidney, brain, liver, and heart
 - Organ samples are particularly useful for animals suspected of having HPAI.

Serological tests

- Whole blood or serum

Procedures

Identification of the agent

- Virus isolation from embryonated eggs
- Agar gel immunodiffusion (AGID)

- Antigen-capture enzyme-linked immunosorbent assay (ELISA)
- Reverse-transcriptase polymerase chain reaction (RT-PCR)
- Genome sequence analysis of H and N genes
 - Often utilised near cleavage sites to differentiate LPAI from HPAI

Serological tests

- Not useful for differentiating LPAI from HPAI
- Cross-reactivity is a concern
- AGID
- Haemagglutination inhibition assays (HI)
 - Assays are subtype-specific and may yield false negatives.
- Antibody-capture ELISA

For more detailed information regarding sampling and laboratory diagnostic methodologies, please refer to **Chapter 3.3.4** of the latest edition of the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals.

PREVENTION AND CONTROL

Sanitary prophylaxis

- Avoid contact with birds of unknown health status; precautions should be taken in the field and all tools, instruments, and vehicles should be properly disinfected before moving locations. Consider the use of personal protective equipment or changing shoes and clothes before leaving a site.
 - Limit the amount of foot traffic in areas where AI is a concern.
- Bird-proofing and pest control of domestic bird and swine housing in endemic areas; efforts should be made to reduce interactions with wild birds.
 - Employ biosecurity and disinfection protocols for domestic animals and employees to reduce the risk of introducing virus from a wild bird to a captive facility.
 - Proper carcass disposal
 - Keep susceptible animals indoors.
- People should avoid contact with swine and poultry if suffering from symptoms of the flu.

Medical prophylaxis

- There are many types of vaccines available for domestic poultry (inactivated whole virus, recombinant vectored). Efficacy has not been determined in wild bird species, and clinical protection is variable even in domestic birds.

POTENTIAL IMPACTS OF DISEASE AGENT BEYOND CLINICAL ILLNESS

Risks to public health

- LPAI does not infect humans directly. However, the virus can infect other mammals such as swine and recombine with other influenza types within the host; in this way, it is possible for a new viral subtype to form that is infectious to humans.
 - An exception to direct infection is the N7H9 and H9N2 viruses. Adaptation to humans is possible but extremely rare.

Risks to agriculture

- LPAI has the potential to evolve into a highly-pathogenic form upon transmission to domestic poultry. HPAI is devastating to the poultry industry when an outbreak occurs. Therefore, precautions should be taken to prevent interactions between domestic and wild free-ranging birds.

Facilities should take care as to develop biosecurity protocols to prevent accidental introduction of the virus.

REFERENCES AND OTHER INFORMATION

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The OIE will periodically update the OIE Technical Disease Cards. Please send relevant new references and proposed modifications to the OIE Scientific and Technical Department (scientific.dept@oie.int). Last updated 2019. Written by Marie Bucko and Samantha Gieger with assistance from the USGS National Wildlife Health Center.