Ministry of Health and Long-Term Care

Management of Avian Influenza or Novel Influenza in Birds or Animals Guideline, 2018

Population and Public Health Division,
Ministry of Health and Long-Term Care

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Ontario

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1 Preamble

The Ontario Public Health Standards: Requirements for Programs, Services, and Accountability (Standards) are published by the Minister of Health and Long-Term Care under the authority of section 7 of the *Health Protection and Promotion Act* (HPPA) to specify the mandatory health programs and services provided by boards of health.[1,2] The Standards identify the minimum expectations for public health programs and services. Boards of health are accountable for implementing the Standards including the protocols and guidelines that are referenced in the Standards. Guidelines are program and topic-specific documents which provide direction on how boards of health shall approach specific requirement(s) identified within the Standards.

2 Purpose

This guideline document was created to assist staff at boards of health with the management of suspected cases of avian influenza or novel influenza in birds or animals.

3 Reference to the Standards

This section identifies the standard and requirements to which this protocol relates.

Infectious and Communicable Disease Prevention and Control

Requirement 15. The board of health shall receive and respond to all reported animal cases of avian chlamydiosis (infection of birds with the causative agent of psittacosis in humans), avian influenza, novel influenza and *Echinococcus multilocularis* infection, in accordance with the *Health Protection and Promotion Act*, the *Management of Avian Chlamydiosis in Birds Guideline, 2018* (or as current), the *Management of Avian Influenza or Novel Influenza in Birds or Animals Guideline, 2018* (or as current); and the *Management of Echinococcus Multilocularis Infections in Animals Guideline, 2018* (or as current).

Requirement 21. The board of health shall ensure 24/7 availability to receive reports of and respond to:

a) Infectious diseases of public health importance in accordance with the Health Protection and Promotion Act; the Mandatory Blood Testing Act, 2006; the Infectious Diseases Protocol, 2018 (or as current); and the Institutional/ Facility Outbreak Management Protocol, 2018 (or as current);
b) Potential rabies exposures in accordance with the *Health Protection and Promotion Act*; the *Management of Potential Rabies Exposures Guideline, 2018* (or as current); and the *Rabies Prevention and Control Protocol, 2018* (or as current); and
c) Animal cases of avian chlamydiosis, avian influenza, novel influenza, or Echinococcus multilocularis infection, in accordance with the *Health Protection and Promotion Act*, the *Management of Avian Chlamydiosis in Birds Guideline, 2018* (or as current); the *Management of Avian Influenza or Novel Influenza in Birds or*

Animals Guideline, 2018 (or as current); and the *Management of Echinococcus Multilocularis Infections in Animals Guideline, 2018* (or as current).

4 Reporting of Bird or Animal Cases to Boards of Health Heading

In accordance with Section 6.1 of the Communicable Diseases Regulation (Reg. 557), the director of a laboratory or veterinarian who knows or suspects that a bird or birds, animal or animals are infected with an avian influenza virus strain or a novel influenza virus strain, shall notify the Medical Officer of Health immediately.[3]

On an annual basis, the board of health shall provide veterinarians within its jurisdiction with information on how animal cases of avian influenza or novel influenza are to be reported to the Medical Officer of Health.

4.1 Reporting to the Ministry

The board of health shall:

- Report all cases of avian influenza or novel influenza in birds or animals to the ministry as soon as possible after receiving the report;
- Consult with the ministry with respect to managing all animal health aspects of the response, and
- Report to the ministry all actions taken in response to the case(s) of avian influenza or novel influenza.

4.2 Novel Influenza

For the purposes of veterinary reporting requirements for influenza in birds and animals under Reg. 557, a “novel influenza virus” is defined as any influenza virus not already known to be endemically circulating in its usual host animal species in Ontario, including swine or other mammal influenza viruses in birds. Finding a novel influenza virus in an unexpected host species is always a concern and requires careful investigation and appropriate action to monitor for potential re-assortment events with human influenza viruses and ensure there is no transmission to humans in close contact with the infected birds or animals.

Influenza viruses meeting the definition of “novel influenza” for the purposes of Reg. 557 may change over time. Introduction of new viruses such as canine H3N2 influenza virus may result in the spread of the novel virus through the animal population. Once a novel virus becomes established as a new endemic influenza virus in Ontario, appears stable with predictable patterns of transmission over time, and once monitoring of human exposures within Ontario indicates that the risk of transmission to humans is low, then it will no longer be required to be reported to the Medical Officer of Health.

The board of health shall consult with the ministry in order to determine when and what level of response to reports of novel influenza infections in birds or animals is warranted.

See Appendix A for background information on influenza viruses in birds and animals, and Appendix B for an overview of influenza A virus testing in birds and animals.

5 Response to Avian Influenza in Birds

The identification of a confirmed or suspect case of avian influenza in a bird or birds shall trigger an investigation by the board of health in order to evaluate potential disease transmission to human exposures of the infected bird(s).

Infection of birds with non-avian strains of influenza (e.g. swine influenza strains) may also occur. Response activities by the board of health to reports of these cases may differ, depending on the numbers of birds affected and other specific circumstances. The appropriate level of response to specific situations shall be determined in consultation with the ministry.

See Appendix C for background information on avian influenza, including high pathogenicity avian influenza (HPAI) vs. low pathogenicity avian influenza (LPAI) viruses, transmission and clinical signs in birds.

5.1 Inter-agency response – Animal Health

In responding to avian influenza outbreaks in Ontario, boards of health shall work closely with the ministry, as well as the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), the Canadian Food Inspection Agency (CFIA), and the poultry industry to coordinate an inter-agency response to an avian influenza outbreak. Interagency response activities between the board of health, OMAFRA, CFIA and any other agencies will be coordinated and facilitated by the ministry.

Depending on the strain of avian influenza involved, animal health response activities by the CFIA and/or OMAFRA may differ from outbreak to outbreak.

5.1.1 Management of Infected Birds – CFIA Response

In poultry, HPAI and LPAI H5 and H7 are federally reportable pathogens in Canada under the federal *Health of Animals Act*, and must be reported to the CFIA by veterinarians and veterinary laboratories.[4] In terms of animal health response to reports of domestic flocks infected with H5 or H7 LPAI or HPAI, the CFIA is the lead agency for animal health response.

According to its Notifiable Avian Influenza Hazard Specific Plan, the CFIA responds to H5 and H7 avian influenza outbreaks by establishing quarantines, ordering the humane destruction of all infected and exposed poultry, conducting trace-out activities, overseeing the cleaning and disinfection of premises, and verifying that affected farms remain free of avian influenza according to international standards.[5]

5.1.2 Management of Infected Birds – OMAFRA Response

OMAFRA is responsible for providing support to the CFIA's lead in response to federally reportable influenza outbreaks in poultry. In animal influenza outbreaks not led by the CFIA, OMAFRA is the provincial lead on animal aspects, under the authority of the provincial *Animal Health Act*.

Under Ontario's *Animal Health Act*, all influenza A viruses in birds or animals are designated as an Immediately Notifiable Hazard, requiring the reporting of positive laboratory results by veterinarians and veterinary laboratories to OMAFRA.[6]

Depending on the circumstances of the outbreak, OMAFRA may arrange for the collection and submission of appropriate samples, notify industry associations, provide available resources such as personnel, technical resources or laboratory capacity, etc.

5.1.3 Management of Infected Birds – Board of Health Response

If neither the CFIA nor OMAFRA undertake any active animal health response activities, the board of health shall consult with the ministry to determine whether management of infected birds may require animal health response activities to reduce or prevent the risk to human health (*e.g.* cleaning and disinfection of premises).

5.2 Management of Human Exposures

In infected poultry flocks with large numbers of birds, influenza virus is being shed into the environment at high rates through both respiratory secretions of infected birds, and fecal contamination. As a result, the level of potential human exposure to avian influenza virus in this setting is much higher than it would be in cases of exposure to an individual infected animal, and management of human exposures needs to be more intensive.

The board of health shall obtain a list of all human exposures and individuals entering an infected commercial poultry premises in the 21 day period prior to the onset of clinical signs in the birds.

The board of health shall provide information to individuals who live/work on the farm to reinforce the potential for transmission of disease from birds to humans, emphasizing the need for appropriate infection prevention and control measures.

During an outbreak of avian influenza in poultry, the risk to the general public is low. Human infections with LPAI and HPAI have both been reported, but are rare and have occurred in people who had close, unprotected contact with infected poultry or the infected poultry's contaminated bedding, feed, or water troughs. Avian influenza generally does not spread easily between people; however, limited clusters of person-to-person transmission, generally between family members, have been observed, notably for avian influenza H5N1 and H7N9.

For farms that have confirmed cases of avian influenza, the board of health shall conduct active daily monitoring of asymptomatic close contacts of infected birds for the development of fever, cough, sore throat, wheezing, gastroenteritis, malaise, conjunctivitis and other

acute respiratory illness symptoms for seven days after their last exposure to infected poultry or contaminated environmental surfaces. After the initial period of active monitoring, the board of health shall require close contacts of infected birds to self-monitor for a further seven days.

The board of health shall instruct individuals who develop symptoms during the monitoring period to notify the health unit, and seek medical care. In advance of arriving at a health care provider's office or a health care facility, the symptomatic individual should notify the office or facility of their potential exposure to avian influenza.

Symptomatic individuals under investigation for novel influenza infection in humans due to exposure to confirmed influenza in domestic poultry flocks are candidates for laboratory testing by the Public Health Ontario Laboratory (PHOL). The health unit should contact PHOL's Customer Service Centre at 416-235-6556/1-877-604-4567 to arrange appropriate testing. Testing information is available at http://www.publichealthontario.ca/en/ServicesAndTools/LaboratoryServices/Pages/Index.aspx?letter=I.

5.2.1 Immunization

If human influenza viruses are circulating in the community at the time of an avian influenza outbreak and the seasonal influenza vaccine is available, the board of health shall determine the seasonal influenza immunization status of all close contacts of infected birds.

Poultry industry workers should be encouraged to receive the seasonal influenza vaccine annually in order to reduce the likelihood of co-infection with human and avian influenza viruses.

5.2.2 Infection prevention and control for Caretakers of Infected Birds

The board of health shall advise all workers who may come into close contact with infected birds of the appropriate training and equipment required to prevent and control transmission of avian influenza to humans.

This includes the use of personal protective equipment such as fit-tested N95 respirators, goggles, disposable gloves, protective clothing, disposable boots or boots that can be cleaned and disinfected.

5.2.3 Anti-viral Prophylaxis

The board of health shall recommend that individuals who have been exposed to large numbers of infected poultry or contaminated environmental surfaces in an outbreak situation without using full, appropriate personal protective equipment receive 75 mg of oseltamivir twice daily for seven days after their last direct contact with the birds or the contaminated environment. Note that the recommended dose for prophylaxis of avian influenza exposures is twice daily medication, instead of the once daily approach used for seasonal influenza.

6 Response to Novel Influenza in Mammals

The identification of a confirmed or suspect case of novel influenza in a mammal shall trigger an investigation by the PHU in order to evaluate potential disease transmission to human exposures of the infected animal(s).

See Appendix D for background information on influenza in mammal species, including swine influenza, equine influenza, influenza in companion animals and variant viruses in humans.

6.1 Interagency response – Animal Health

In response to a report of a suspect or confirmed novel influenza infection of an animal, boards of health shall work closely with the ministry, as well OMAFRA, and any attending veterinarian(s) involved in caring for the animal to coordinate an inter-agency response to the identification of a novel influenza virus in Ontario. Interagency response with OMAFRA and any other agencies shall be coordinated and facilitated by the ministry.

6.1.1 Management of Infected Mammals – OMAFRA Response

Under Ontario's *Animal Health Act*, all Influenza A viruses in animals are designated as an Immediately Notifiable Hazard, requiring the reporting of positive laboratory results by veterinarians and veterinary laboratories to OMAFRA.[6]

Depending on the circumstances, OMAFRA may elect to arrange for the collection and submission of additional appropriate samples, notify veterinarians, provide available resources such as personnel, technical resources or laboratory capacity, etc. Animal health response activities by OMAFRA may differ from case to case, based on the strain of influenza and animal species involved.

6.1.2 Management of Infected Mammals – Board of Health Response

The board of health shall interview the owner and/or caretaker(s) of the infected animal(s) as soon as possible and collect the following information:

- Number, species and individual descriptions (colour, age, sex, as well as tattoos or microchip numbers where applicable, etc.) of all infected animals;
- Current location of all infected animals;
- Date of onset and nature of clinical signs in all infected animals;
- Current health status of infected animals;
- Any veterinary treatment protocols already in place;
- Any influenza A or other respiratory pathogen testing results for the animals, if available or pending;
- Length of time the owner has had the animal(s) in their possession;
- Source the animal(s) were obtained from;

- Whether any new animals entered the household, or facility in the 21 day period prior to the onset of clinical signs, which may have been a source of infection for the infected animal(s);
- Number, species and individual descriptions of other animals housed with the infected animal(s) within the 21 day period prior to the onset of clinical signs; and
- Health status of all potentially exposed animals

In cases where OMAFRA does not undertake any animal health response activities, the board of health shall consult with the ministry to determine whether active management of the infected mammal(s) is required to reduce or prevent risks to human health, including further spread of the novel virus or genetic re-assortment.

Based on this consultation, the Medical Officer of Health may consider implementing additional animal management requirements, which may include, but are not limited to: ordering a quarantine of an infected and/or exposed animal(s), requiring influenza testing of animal(s) to determine the virus involved or the shedding period for a novel virus.

6.2 Management of Human Exposures

Unlike birds, which shed influenza virus in both respiratory secretions and feces, mammals shed the virus primarily in respiratory secretions. As a result, the level of potential human exposure to a novel influenza virus strain as a result of close contact with an infected individual animal is lower than it would be in cases of exposure to an infected poultry flock. Management of human exposures in this scenario is thus less intensive, unless an outbreak occurs in a commercial swine operation or an animal shelter setting, where large numbers of infected animals are being housed together in an enclosed environment.

The board of health shall interview the owner and/or caretaker(s) of the infected animal(s) as soon as possible and collect the following information:

- Names and contact information for any close human contacts of the animal(s) during the 21-day period prior to the onset of clinical signs in the infected animal(s); or
- For commercial swine operations and animal shelter settings, a list of all human exposures and individuals entering the infected premises in the 21 day period prior to the onset of clinical signs in the animals.

The board of health shall follow up with all human exposures to infected animals occurring in the 21 day period prior to onset of clinical signs in the animals.

The board of health shall provide information to individuals who live/work with the animals to reinforce the potential for transmission of disease from animals to humans, emphasizing the need for appropriate infection prevention and control measures.

The board of health shall require close contacts (including all household contacts) of infected animals to self-monitor for the development of fever, cough, sore throat, wheezing, gastroenteritis, malaise, conjunctivitis and other acute respiratory illness symptoms for 14 days after their last exposure to the infected animal(s) or contaminated environmental surfaces.

The board of health shall instruct individuals who develop symptoms during the monitoring period to notify the health unit, and seek medical care. In advance of arriving at a health care provider's office or a health care facility, the symptomatic individual should notify the office or facility of their potential exposure to a novel influenza virus.

Symptomatic individuals under investigation for novel influenza infection due to exposure to a confirmed novel influenza virus in an animal are candidates for laboratory testing by the Public Health Ontario Laboratory (PHOL). The health unit should contact PHOL's Customer Service Centre at 416-235-6556/1-877-604-4567 to arrange appropriate testing. Testing information is available at http://www.publichealthontario.ca/en/ServicesAndTools/LaboratoryServices/Pages/Index.aspx?letter=I.

6.2.1 Immunization

If human influenza viruses are circulating in the community at the time of the outbreak and the seasonal influenza vaccine is available, the board of health shall determine the seasonal influenza immunization status of all close contacts of infected animals, particularly in animal shelter settings.

Swine industry workers and individuals who work in animal shelter settings should be encouraged to receive the seasonal influenza vaccine annually in order to reduce the likelihood of co-infection with human and canine influenza viruses.

6.2.2 Infection prevention and control for Caretakers of Infected Animals

The board of health shall advise all household contacts of the infected animal(s) to avoid close contact with animals that are symptomatic, and implement common sense hygiene measures such as frequent hand washing and avoiding unnecessary hand contact with the eyes, nose or mouth following contact with infected animals to reduce the risk of disease transmission.

In the case of outbreaks of a novel influenza virus in animal shelter settings, where large numbers of infected animals may be housed in a common enclosed space, the board of health shall advise all shelter workers entering areas where infected animals are housed to use appropriate personal protective equipment such as fit-tested N95 respirators, goggles, disposable gloves, protective clothing, disposable boots or boots that can be easily cleaned and disinfected.

6.2.3 Cleaning and Disinfection in Animal Shelter Settings

In animal shelter or kennel settings with a novel influenza outbreak where there may be ongoing concerns about risks to human health as a result of environmental contamination of surfaces, the Medical Officer of Health may consider ordering the cleaning and disinfection of the facility.

Influenza A viruses are susceptible to a wide variety of disinfectants, including sodium hypochlorite, 60% to 95% ethanol, quaternary ammonium compounds, povidone-iodine and other agents.

7 Reporting of Human Cases

Influenza infection in humans is designated as both a disease of public health significance and a communicable disease under Regulation 135/18 (Designation of Diseases).[7] Any identified human cases meeting the provincial case definition provided in the Appendices to the Infectious Disease Protocol shall be reported to the ministry by the board of health.

8 Other Agencies and Response Considerations

Depending on the setting in which cases of avian or novel influenza are identified, a number of other government agencies may be involved in the response from an animal health and welfare perspective, or may be able to provide additional support to the board of health.

In settings such as breeding operations, kennels, or commercial pet stores, as well as rescue organizations being run out of private residences, where there may be additional concerns about overcrowding of animals or other animal welfare concerns, the Ontario Society for the Prevention of Cruelty to Animals (OSPCA) and/or municipal Animal Services agencies, where available, may be able to provide assistance or support, depending on availability.

In cases where novel influenza outbreaks may occur in animal shelter settings, the OSPCA may provide expertise on infection prevention and control, supplies such as personal protective equipment to shelters, kennels or rescues, and/or transport animals if required.

In all cases where large numbers of birds or animals are being kept in private residences, and particularly where this is being done for commercial purposes, municipal authorities should be advised of the situation, as this may be violating zoning by-laws and posing a risk to the community.

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Appendix A: Background Information on Influenza Viruses in Birds and Mammals

1. Background Information on Influenza Viruses in Birds and Mammals

Influenza viruses are highly variable RNA viruses that can affect birds and mammals including humans. There are currently three species of these viruses, designated influenza A, B and C. Influenza B and C viruses primarily affect humans, and seem to be less likely to cross species barriers. However, infections have occasionally been reported in animals. A new influenza C-related virus recently detected in livestock has been proposed as “influenza D.”

Influenza A viruses are the most widely distributed influenza viruses in birds and mammals. Worldwide, there are numerous strains of influenza A virus circulating. They are identified by H and N sub-types, which can change over time. Subsequently, the host species that they may infect, their ease of transmission, and pathogenicity can also change.

Influenza A viruses are widespread and diverse in wild aquatic birds, and these birds are thought to be the natural reservoir hosts for all influenza A viruses. Each influenza A virus is adapted to circulate in a particular host species; however, viruses can occasionally infect other species. In most cases, the virus cannot be transmitted efficiently in the novel host, and soon disappears. On rare occasions, however, a virus will change enough to successfully continue circulating in the new host species.

Poultry are readily infected by viruses from wild birds, and a limited number of influenza A viruses have adapted to circulate in humans, pigs, horses and dogs. In the mammals to which they are adapted, influenza A viruses usually cause respiratory illnesses with high morbidity but low mortality rates.

The names of influenza A viruses reflect the hosts to which they are adapted (e.g. avian influenza, swine influenza, equine influenza, canine influenza).

The impact of an influenza virus strain varies depending on the animal species or human populations affected. Influenza viruses in animals may play a significant role in the emergence of novel human influenza virus strains by contributing viral genes to human strains through genetic re-assortment.

The influenza A genome consists of 8 individual gene segments, and when two different influenza viruses infect the same cell, gene segments from both viruses may be packaged into a single, novel virion. This can occur whenever two influenza viruses replicate in the same cell, whether the viruses are adapted to the same host species (e.g., two different human influenza viruses) or originally came from different hosts, such as an avian influenza virus and a swine influenza virus. Re-assortment can occur either in the new host or in an intermediate host, which then transmits the virus further. For example, an avian influenza virus could re-assort with a human influenza virus in a pig or a dog, and then be transferred

to humans. Acquisition of new influenza viruses is more likely when different species live or are kept in close proximity.

Abrupt changes due to genetic re-assortment, called ‘antigenic shifts,’ may be sufficient for the novel virus to completely evade the existing immunity in its host species. When influenza viruses are able to evade the immune response of the host, they can cause influenza epidemics or pandemics.

Antigenic shifts can also occur if one species acquires an influenza virus in its entirety from another species, or if a virus disappears for a time and is maintained in another host species, then re-emerges in the original host.

2. Incubation Period

The incubation period for influenza is short in all species.

In poultry, it can be a few hours to a few days in individual birds, and up to 2 weeks in the overall flock. A 21-day incubation period, which takes into account the transmission dynamics of the virus, is used for bird populations in the context of disease control.

The incubation period for influenza viruses in mammals is often 1-3 days, although some cases may take longer to appear. In particular, incubation periods up to a week have been reported in some dogs and cats infected with H3N2 canine influenza viruses.

Most zoonotic infections in humans caused by swine, avian or other mammalian influenza viruses also seem to become apparent soon after exposure (e.g. within 5 days for most North American H3N2 swine viruses and Asian lineage H5N1 HPAI viruses), although the incubation period for some H5N1 cases might be as long as 8-17 days.

Appendix B: Overview of Influenza A Virus Testing in Animals

1. Diagnostic testing for influenza in birds

Avian influenza viruses, their antigens and nucleic acids can be detected in respiratory and/or intestinal samples (e.g. cloacal swabs) from birds. Samples from various internal organs are also tested in dead birds suspected of having highly pathogenic avian influenza.

The CFIA conducts active surveillance for H5 and H7 avian influenza through the Canadian Notifiable Avian Influenza Surveillance System (CanNAISS).

2. Diagnostic testing for influenza in animals

Respiratory samples are usually taken from mammals (e.g. nasal or nasopharyngeal swabs from living animals, or lung tissue samples collected at necropsy). Viral shedding is usually relatively brief in mammals, and respiratory samples should be collected very soon after the onset of clinical signs, although dogs have been shown to shed virus for well over two weeks.

3. Diagnostic testing modalities in birds and animals

RT-PCR assays are often used to detect influenza viruses in clinical samples. In Ontario, both commercial diagnostic laboratories and the Animal Health Laboratory at the University of Guelph offer PCR assays for influenza A virus.

Following an influenza A matrix PCR positive test result, the Animal Health Laboratory will often follow up with H gene sequencing to determine the influenza sub-type involved. Further confirmatory testing and whole genome sequencing is performed at the National Centre for Foreign Animal Disease laboratory in Winnipeg.

Viral antigens can also be identified in clinical samples with ELISAs in various species, and immunohistochemistry techniques. The sensitivity and uses of these tests can differ among species.

Serological tests for antibodies may be used for diagnostic and surveillance purposes.

Please see the table below for an overview of Influenza A virus testing for animals available from the Animal Health Laboratory at the University of Guelph.

4. Animal Health Laboratory at the University of Guelph

The Animal Health Laboratory at the University of Guelph offers the following tests for Influenza A screening and diagnosis in animals.

With the assistance of the ministry, health units may submit animal samples to the AHL.

STEP 1	**VIRUS DETECTION TESTING**		**ANTIBODY DETECTION TESTING**	
Test	**Real-time PCR - matrix gene**		**ELISA, Multi-Screen**	**Agar gel immunodiffusion**
Sample	Swabs in VTM (swine-nasal, birds-cloacal/tracheal), oral fluids, tissues		Serum	
Use/advantage	Primary screening test targeting a conserved influenza virus gene. Detects all common Influenza A virus subtypes in multiple animal species, very sensitive, fast.		Primary screening test, detects antibody from all common Influenza A virus subtypes in multiple animal species.	Screening test used for avian samples.
Disadvantage	Cannot determine the subtype of the virus.		Cannot determine the subtype of the virus to which animals were exposed. Cannot be used on paired samples to determine a 4-fold titer change/seroconversion.	
	⬇		⬇	
STEP 2	**VIRUS SUBTYPING**		**ANTIBODY SUBTYPING**	
Sample	PCR positive sample		Serum	
Test	**PCR typing for specific subtypes**	**Hemagglutinin gene sequencing**	**Hemagglutination inhibition test** (E.g., H1N1, H3N2, H3N8 – other subtypes may be available upon request)	
Use/advantage	Swine: H1N1& H3N2 Turkeys: H5& H7, also H1N1& H3N2 All other avian species: H5 & H7 Simpler, faster than sequencing.	Covers all common Influenza A virus subtypes. Allows strain identification and comparison of various viruses.	Use on paired samples to determine a 4-fold titer change/seroconversion.	
Disadvantage	Detects only H1N1, H3N2, H5 & H7 subtypes Weak positives may not have enough virus for typing.	Weak positives may not have enough virus for typing.	Subtype/strain specific-depending on antigen used.	
OTHER TESTS:				
Test	**Immunohistochemistry**			
Sample	Formalin-fixed tissues			
Use/advantage	Used on fixed tissues when fresh tissues are not available, or as a part of postmortem procedures. Detects all common Influenza A virus subtypes.			
Disadvantage	Cannot determine the virus subtype.			

Appendix C: Avian Influenza

1. Avian Influenza

1.1 Highly-Pathogenic Avian Influenza vs Low Pathogenic Avian Influenza

Avian influenza viruses can be classified into two categories, based on their ability to cause disease and the degree of disease severity in birds, The viruses maintained in birds are classified as either low pathogenic (also called low pathogenicity) avian influenza viruses (LPAI) or highly pathogenic (high pathogenicity) avian influenza viruses (HPAI). LPAI typically causes few or no clinical signs in birds; but HPAI can cause severe clinical signs and/or high mortality in birds.

Wild aquatic and shoreline birds are natural hosts for LPAI. When LPAI viruses from wild birds infect domestic poultry flocks, the viruses may either circulate inefficiently and die out; become adapted to the new host and continue to circulate as LPAI viruses; or if they contain H5 or H7, they may evolve into HPAI viruses.

With rare exceptions, the HPAI viruses have always been of H5 or H7 sub-type.

1.2 Transmission of Avian Influenza Viruses

Direct contact with excretions, especially the feces and respiratory secretions of infected poultry and other birds, is the principal method of transmission within infected flocks. Once the virus is introduced into a flock of birds, it is transmitted, either from bird to bird or from flock to flock. Some AI viruses spread rapidly through a flock, while others spread slowly. Similarly, the same AI virus may differ in transmissibility in various species of birds. The rate of transmission of an AI virus through a poultry flock is not necessarily dependent on the pathogenicity of the virus. The disease may also be spread by waterfowl and other wild birds, and through contamination of feed, equipment, humans, and other mechanical means.

Most avian influenza viruses do not cause disease in humans; however, some are zoonotic. Two particularly virulent viruses affecting people are the Asian lineage of H5N1 HPAI viruses and an H7N9 LPAI virus that has caused serious outbreaks in China. Avian influenza viruses have also caused or contributed to at least three past pandemics in humans.

1.3 Clinical Signs of Avian Influenza in Birds

HPAI viruses usually cause severe illness in chickens and turkeys, and few birds in infected flocks survive. Decreased feed and water intake, with other nonspecific systemic, respiratory and/or neurological signs are common, but no signs are pathognomonic and sudden death can also be seen. Infections with HPAI viruses may be asymptomatic, mild or severe in other domesticated and wild bird species. Domesticated waterfowl such as ducks and geese tend to have minimal or mild signs, but respiratory signs, diarrhea, corneal opacity, occasional neurological signs and somewhat increased mortality may be seen.

LPAI viruses usually cause subclinical infections or mild illness in poultry and other birds. In chickens and turkeys, there may be decreased egg production and egg quality, respiratory signs, lethargy, decreased feed and water consumption, or somewhat increased flock mortality rates.

Appendix D: Influenza in Mammals

1. Influenza in Mammals

Influenza A viruses in mammals are currently maintained in pigs (swine influenza viruses), horses (equine influenza viruses), and dogs (canine influenza viruses).

Many influenza A virus infections in novel mammalian hosts have been mild, but some viruses can cause life-threatening illnesses.

Influenza is now known to be an uncommon cause of respiratory illness in species not previously considered susceptible, such as cats, ranched mink and various captive wild mammals, which have been infected by viruses from humans, pigs, birds and other species.

1.1 Swine Influenza

Swine influenza is a highly contagious infection of pigs most commonly caused by the Influenza A viruses H1N1, H1N2, and H3N2. Swine influenza spreads quickly within a swine population, but not all infected pigs demonstrate clinical signs. The infections are usually followed by rapid recovery of the infected animals.

Ontario has a number of swine influenza viruses circulating endemically in pig populations. As of the beginning of 2018, the three endemic swine influenza viruses known to be circulating in the province are H1N1, H1N2 and H3N2. The majority of submissions for swine influenza testing in Ontario come from Perth, Huron and Oxford counties, correlating to the large number of swine farms present in these counties.

Swine influenza typically causes mild disease in pigs and is uncommon in humans; however, some countries have reported cases of human infection with swine influenza viruses. Most of these human infections have been mild and the viruses have not spread to other people. The H1N1 virus that caused the influenza pandemic in 2009-2010, thought to have originated in swine, is an example of a variant influenza virus that was able to spread easily among people and cause human disease. It did not cause significant disease in swine.

As with humans, pigs can become infected with influenza viruses from a variety of different hosts (such as birds and humans) and can act as a "mixing vessel," facilitating the reassortment of influenza genes from different viruses and creating a "new" influenza virus. The concern is that such "new" reassortant viruses may be more easily spread from person to person, or may cause more severe disease in humans than the original viruses.

Since the first serologic evidence of a swine influenza virus (SIV) infecting humans in 1958, sporadic cases have continued to occur. Human infections with swine strains of influenza, such as H3N2v, are generally mild, and often may not be diagnosed; however, these infections can be quite serious in patients with underlying medical conditions. Most commonly, human infections occur in people with exposure to infected pigs (e.g. children near pigs at a fair, or workers in the swine industry). There have been documented cases of

multiple persons becoming sick after exposure to one or more sick pigs and also cases of limited spread of variant influenza viruses from person-to-person. The vast majority of human infections with influenza viruses transmitted from pigs do not result in person-to-person spread. However, each case of human infection with a swine influenza virus should be fully investigated to be sure that such viruses are not spreading in an efficient and ongoing way in humans and to limit further exposure of humans to infected animals if infected animals are identified.

1.2 Equine Influenza

Equine influenza (EI) is a highly contagious, although rarely fatal, respiratory disease of horses, donkeys, mules and other equidae. EI is caused by two subtypes of the Influenza A viruses: H7N7 and H3N8, with H7N7 not being isolated for almost 30 years and possibly extinct. They are related to, but distinct from, the viruses that cause human and avian influenza. Equine influenza is endemic in North America and most of the world.

To date, there has been no evidence of transmission of equine influenza virus from horses to people. H3N8, however, was transmitted to dogs in the United States in the early 2000's resulting in outbreaks at greyhound racetracks and shelters. The virus adapted to the canine population and is now transmissible canine-to-canine.

The possibility of transmission of influenza from horses to people may emerge if the virus changes.

1.3 Influenza in Companion Animals

Dogs have been sporadically affected by viruses from other species, but were not known to maintain any influenza viruses until the last 20 years, when two viruses, one from horses and another from birds, began to circulate in some canine populations.

The first canine influenza virus to be recognized was an H3N8 virus acquired from horses in North America in the late 1990s or early 2000s. This virus has diverged genetically from equine influenza viruses, and adapted to circulate in dogs. It may now be evolving into two lineages.

An H3N2 canine influenza virus, with gene segments entirely of avian origin, became established in some Asian countries in the mid-2000s, and was first identified in dogs in the United States in 2015. These viruses have diversified and may be evolving separately in different countries.

Canine influenza viruses have also re-assorted with other viruses. An H3N1 virus, which appears to be a re-assortant between a canine H3N2 virus and the human pandemic H1N1 virus, was isolated from one dog with respiratory signs in Korea. There is also evidence of occasional re-assortment with avian influenza viruses from poultry (e.g., H9N2, H5N1).

The first cases of canine influenza to be diagnosed in Ontario were identified in January of 2018 in two dogs that had been imported from South Korea by a rescue group. Infection prevention and control measures were implemented to try to ensure that the virus did not spread beyond an initial group of exposed dogs in Ontario.

In December of 2016, over 120 cats in shelters in New York City were infected in an outbreak of LPAI H7N2, with extensive cat-to-cat transmission of the virus. One human infection, resulting in relatively mild illness, was associated with the outbreak, in an individual who had close, prolonged and unprotected exposure to the respiratory secretions of infected cats.

1.4 Transmission to Humans: Variant Viruses

Swine, equine and canine flu viruses do not normally infect humans. However, sporadic human infections with influenza viruses that normally circulate in animals and not people have occurred. When this happens, these viruses are called “variant viruses”. They are denoted by adding the letter “v” to the end of the virus subtype designation. Human infections with swine origin H1N1v, H3N2v and H1N2v viruses have been detected in the United States, and sporadic cases have also occurred in Ontario.

Some of the new North American swine viruses have affected hundreds of people in the United States, who were exposed to pigs at fairs.

Occasionally, a variant virus will become well adapted to a human host, and result in ongoing human-to-human transmission. For example, the 2009-2010 pandemic influenza virus resulted from the likely acquisition of a virus from pigs.

Most commonly, human infections with variant viruses occur in people with exposure to infected animals (e.g., children near pigs at a fair, animal shelter workers, etc.). This is thought to happen mainly when an infected animal coughs or sneezes and droplets with influenza virus in them spread through the air. If these droplets land in the nose or mouth of a human, or are inhaled, the infection can be transmitted to the human. There is also some evidence that variant viruses can also be transmitted to humans when individuals touch something that has virus on it and then touch their mouth or nose. A third way to possibly get infected is to inhale particles containing influenza virus.

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