DIAGNOSIS & MANAGEMENT OF CANINE INFLUENZA & PNEUMOVIRUS OUTBREAKS

Cynda Crawford, DVM, PhD

Contagious respiratory infections are the most common cause of illness in dogs in shelters. The risk for acquiring respiratory infections increases with every day of residence in the shelter. Longer stays in the shelter result in saturating the housing capacity of the facility, crowding of numerous dogs into each kennel, and increased stress for the animals and staff. Crowding decreases ventilation and air quality which contributes to irritated airways, predisposing to colonization by pathogens. Holding dogs for treatment and recovery adds to the number of animal care days until adoption, which in turn impacts the housing capacity for the shelter and contributes to potential for crowding. Overall, respiratory infections represent a significant and frequent drain on shelter resources, including treatment costs, staff time, and staff morale.

Canine pneumovirus (CnPnV) and H3N2 canine influenza virus (H3N2 CIV) have emerged as frequent and significant causes of respiratory disease outbreaks in shelters. This presentation provides experience-based insights on diagnostic tests and outbreak management using an unconventional strategy based on viral properties and epidemiology.

Canine respiratory viruses are highly contagious in a high density/high turnover shelter setting. Factors that promote transmission include the immune status of the dogs, length of the incubation period, preclinical shedding, subclinical shedding, duration of shedding, and aerosol and fomite transmission. These same factors also affect diagnosis and management of outbreaks.

The CnPnV and H3N2 CIV incubation periods are <7 days, typically 2 to 4 days. The short incubation period contributes to a rapid increase in number of dogs in a short time frame. Preclinical shedding makes infected dogs contagious before appearance of clinical signs. CnPnV is shed in respiratory secretions for 10-12 days, while H3N2 CIV is shed for 14-21 days. These contagious periods are a bit longer than for most other respiratory viruses, contributing to greater risk for exposure. A smaller proportion of dogs have subclinical infections and shed smaller amounts of virus for shorter periods of time. However, the inability to identify dogs with subclinical infections ensures more dogs are exposed. Like other respiratory viruses, CnPnV and H3N2 CIV are spread by contact with infectious oronasal secretions, contact with contaminated environments and staff, and contact with large droplets and aerosols generated by coughing and sneezing. Droplets and aerosols are responsible for rapid transmission throughout the shelter.

Similar to other respiratory viruses, CnPnV and H3N2 CIV infections are characterized by acute onset of cough, sneezing, and nasal discharge with progression to pneumonia in some cases. These viruses cannot be diagnosed by clinical signs alone. The unique epidemiological characteristic for CnPnV and H3N2 CIV is the explosive increase in number of coughing dogs in a short period of time. Since nearly all dogs are susceptible due to lack of immunity, these viruses cause epidemic-scale outbreaks in shelters. The explosive increase in coughing dogs over a 2-week time period is a tip-off for CnPnV or H3N2 CIV. Diagnostic testing is necessary for confirmation.

Diagnosis

Not every coughing dog with nasal discharge needs diagnostic testing to determine the cause. However, there are certain triggers signaling the need for diagnostic testing to provide proper

management of individual dogs as well as the population. Shelters should invest in diagnostic testing when:

- The numbers of affected dogs increase above a typical baseline for the shelter
- There is explosive spread throughout the population in a short time
- Dogs progress to pneumonia or die
- The duration of illness is prolonged beyond expected time frames
- There is an increased frequency of complaints from adopters, rescue groups, and community veterinarians about sick dogs coming from the shelter.
- Testing during outbreaks has shown that 75 to 100% of exposed dogs will be infected

The best diagnostic test is PCR for the pathogen nucleic acid on nasal and pharyngeal swabs. PCR is the most sensitive, specific, and accurate test, and rapid turnaround time for results provides for timely patient and population management. There is no vaccine interference for CnPnV and H3N2 CIV PCR tests because there is no vaccine for CnPnV and the H3N2 CIV vaccine is inactivated and non-replicating. Not all diagnostic labs include CnPnV and H3N2 CIV in their PCR panels, so careful selection is required.

Diagnostic testing should be conducted on both sick animals and asymptomatic exposed animals. Timing of swab collection is critical for diagnostic accuracy – peak viral shedding generally occurs during the asymptomatic incubation period and the acute phase of illness (sick for <4 days). At least 8 to 10 cases of the combined sick and exposed population should be tested in order to identify a pattern and improve reliability of the results. Testing just 1 or 2 dogs most often leads to misdiagnosis or no diagnosis.

Outbreak Management

One of the key steps for traditional management of respiratory disease outbreaks in shelters is isolation of sick dogs in a physically enclosed space for the maximum duration of the infectious period. This is 2 weeks for CnPnV and 3 weeks for H3N2 CIV. Another key step is quarantine of exposed asymptomatic dogs in a different physically enclosed space for the maximum incubation period, which is 1 week for CnPnV and H3N2 CIV. However, the quarantine clock must be started over after every new clinical case, extending the total quarantine time to many weeks.

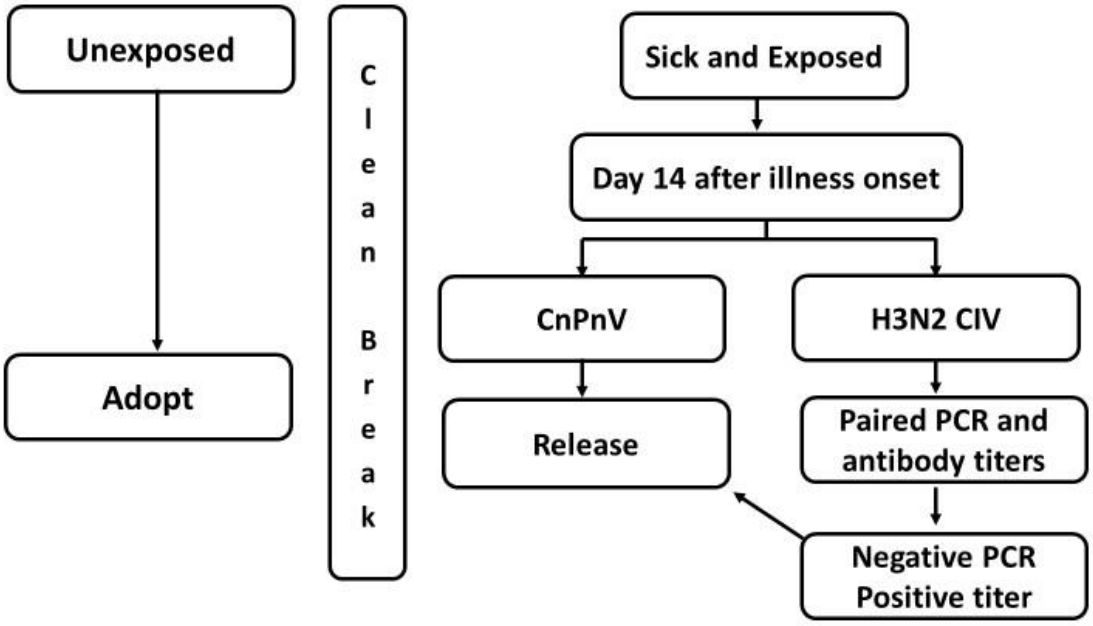
These 2 traditional steps are not very successful for managing CnPnV and H3N2 CIV outbreaks. Many shelters do not have enclosed isolation areas to house dogs with contagious respiratory infections. The explosive numbers of sick dogs during a CnPnV or H3N2 CIV outbreak quickly overwhelm the isolation housing capacity in other shelters. The very short incubation period for CnPnV and H3N2 CIV, preclinical shedding, subclinical shedding, and aerosol transmission guarantee exposure of nearly every dog in the shelter. Since most exposed dogs are susceptible to infection, there will be a continual rolling wave of new clinical cases over several weeks to months. Diagnostic testing during CnPnV or H3N2 CIV outbreaks has shown that 70-100% of the dogs eventually become infected.

Since CnPnV and H3N2 CIV outbreaks are challenging to manage with traditional isolation and quarantine, another strategy is needed, one that achieves a quicker resolution. We use a strategy that intentionally exposes all dogs, similar to that employed for human chicken pox before a vaccine was available. The objective is to synchronize the infection by forcing the viruses to spread quickly in the population. Sick and exposed dogs are left in place instead of attempting

segregation into isolation and quarantine spaces. Virus die-off occurs when there are no more susceptible hosts to sustain transmission. This approach has reduced outbreak resolution time from 8-12 weeks or longer to 4-6 weeks.

A critical requirement for the chicken pox strategy is stopping all movement of dogs into and out of the shelter until resolution. Admission of new dogs provides more susceptible hosts for infection, resulting in perpetual transmission and establishment of endemic disease. Dogs that need housing and care should be diverted to another facility, temporary homes, or rescue groups. If intake diversion is not possible, the "must admit" dogs (injured/ill strays and legal custody cases) should be housed in a physically enclosed room and cared for by dedicated staff following strict biosecurity practices. This can be an Achilles heel as staff mistakes lead to virus exposure. Clinical and asymptomatic dogs in the "dirty" population should remain in the shelter until they are deemed noncontagious. Alternatively, these dogs can be released to medical foster homes that don't have other dogs as long as the caregiver maintains strict in-home confinement to avoid virus spillover into the community.

Another critical requirement for the chicken pox strategy is tracking the status of every dog. A spreadsheet can be set up for recording the unique ID number, intake date, housing location, age, date of onset of illness, and the date for 14 days after onset of illness. All clinical cases are assumed to be due to CnPnV or H3N2 CIV infection instead of spending money on testing every dog. For CnPnV outbreaks, all clinical cases are considered noninfectious by 14 days after onset of illness based on the known shedding period and can be safely released from the shelter. Prior testing of hundreds of dogs has not identified virus by this 14-day mark. For H3N2 CIV outbreaks, the 14-day mark is when paired PCR and antibody titer testing is performed (Cornell Animal Health Diagnostic Lab). The majority of dogs will have a negative PCR and positive antibody titers at this time and can be safely released. PCR-positive dogs should be retested on day 21.



A dilemma for the chicken pox strategy is what to do with the small number of dogs that remain asymptomatic despite continuous virus exposure for weeks. Possible explanations include subclinical infection, pre-existing immunity to infection, or lack of exposure to enough virus for infection. For CnPnV outbreaks, these dogs are released on the same day as the last clinical case. For H3N2 CIV outbreaks, paired PCR and antibody titer testing after at least 4 weeks of exposure can determine the dog's status. Dogs with a negative PCR and positive antibody titer either have recovered from a subclinical infection or had pre-existing immunity and are safe to release. Dogs with a negative PCR and no antibody titer are still susceptible to infection and should be held and re-tested at the time the last clinical case is tested.

A frequent question is the value of vaccination for quicker resolution of outbreaks. There is no vaccine for CnPnV. The H3N2 CIV vaccine contains inactivated virus and requires 2 doses over at least a 2-week interval. An effective immune response appears about 3 weeks after the first dose. This vaccine does not induce protection from infection, but does reduce disease severity and duration, shortens the shedding period, and protects against pneumonia. While this is very valuable to the individual, the immune response time is too long for stopping virus transmission in the population. Perhaps a better use for the vaccine is administration to unexposed dogs that must stay in the shelter.

One valid concern for the chicken pox strategy is the possibility of intentional exposure and infection causing pneumonia and death. While this is certainly an important concern, only a few cases have occurred in hundreds of dogs managed by this strategy and all recovered.

Key Takeaways

- CnPnV and H3N2 CIV cause explosive increases in sick dogs in a short time period. Since nearly all dogs are susceptible due to lack of immunity, these viruses cause epidemic-scale outbreaks in shelters. The explosive increase in coughing dogs is a tip-off for CnPnV or H3N2 CIV, but diagnostic testing is necessary for confirmation.
- The best diagnostic test is PCR testing on nasal and oropharyngeal swabs collected from acute cases (ill for <4 days) and exposed asymptomatic dogs. At least 8 to 10 cases of the combined sick and exposed population should be tested in order to identify a pattern and improve reliability of the results. Testing just 1 or 2 dogs most often leads to misdiagnosis or no diagnosis.
- The CnPnV and H3N2 CIV incubation periods are <7 days, typically 2 to 4 days. The short incubation period, preclinical shedding, and subclinical shedding contribute to the rapid increase in number of dogs in a short time frame.
- CnPnV is shed in respiratory secretions for 10-12 days, while H3N2 CIV is shed for 14-21 days. These contagious periods are a bit longer than for most other respiratory viruses, contributing to greater risk for exposure.
- CnPnV and H3N2 CIV are spread by contact with infectious oronasal secretions, contaminated environments and staff, and large droplets and aerosols generated by coughing and sneezing. Droplets and aerosols are responsible for rapid transmission throughout the shelter.
- Traditional disease outbreak management by isolation of sick dogs and quarantine of asymptomatic exposed dogs does not work well for CnPnV and H3N2 CIV outbreaks due to the 70-100% infection rate.

- A more successful strategy for quicker resolution is intentional exposure of all dogs to synchronize the infection by forcing the viruses to spread quickly in the population. Sick and exposed dogs are left in place instead of attempting segregation into isolation and quarantine spaces. Virus die-off occurs when there are no more susceptible hosts to sustain transmission. This “chicken pox” strategy reduces outbreak resolution time from 8-12 weeks or longer to 4-6 weeks.
- A critical requirement for the chicken pox strategy is stopping all movement of dogs into and out of the shelter until resolution. Admission of new dogs provides more susceptible hosts for infection, resulting in perpetual transmission and establishment of endemic disease.
- Another critical requirement is tracking the status of every dog. After initial confirmation of the diagnosis, all clinical cases are assumed to be due to CnPnV or H3N2 CIV infection. For CnPnV outbreaks, all clinical cases are considered noninfectious by day 14 after onset of illness and can be safely released from the shelter. For H3N2 CIV outbreaks, paired PCR and antibody titer testing is performed on day 14 after illness onset. Dogs with a negative PCR and positive antibody titers can be safely released.
- A dilemma is what to do with the small number of dogs that remain asymptomatic despite continuous virus exposure for weeks. Possible explanations include subclinical infection, pre-existing immunity to infection, or lack of exposure to enough virus for infection. Strategies are presented for determining when and how to safely release these dogs.