CANINE FLU UPDATE
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Kennel Cough – Canine Upper Respiratory Disease Complex

A low level of upper respiratory infection is common at any shelter or kennel, for a number of reasons. First, vaccines are available for only a handful of the pathogens that cause kennel cough – *Bordetella* sp., parainfluenza, canine adenovirus 2, canine distemper virus and canine flu. No vaccine is currently available for the other causes of kennel cough – *Mycoplasma* spp., other bacteria, canine herpesvirus, canine respiratory coronavirus, canine pneumovirus, etc. As well, canine respiratory pathogen vaccines do not prevent infection; rather, they mitigate severity of disease and shedding. As a result, any shelter manager manages “kennel cough” syndrome in a few dogs at any point in time. A large outbreak or repeated outbreaks can have long term effects on a shelter and impact the entire community.

Canine Influenza Virus

Canine Flu is one of the causes of kennel cough and is caused by influenza A virus, from the orthomyxovirus family. Each influenza virus is numbered according to the Hemagluttinins (H) and Neuraminidases (N) it carries. Human flu is H3N2, swine flu is H1N1, avian flu is H5N1, and both equine and canine flu are H3N8. Human flu has been documented to infect a few dogs in Korea, and avian flu infects cats. Canine flu was first isolated from racing greyhounds that died from pneumonia at tracks in Florida in 2003-2004. It might be of interest that the dogs were fed horse meat, and some believe that this might have played a role somehow in the viruses “jump” from the horse to the dog. Testing of old serum samples showed the canine flu virus infected dogs at least back to 1999. A major outbreak in New York occurred, affecting in all dog breeds in early 2005. Outbreaks have been documented in dog tracks in 10 states, including Texas. Canine flu is considered endemic in New York, New Jersey, Florida, and Northern Colorado-Southern Wyoming. Cornell has confirmed cases in 39 states and Washington, DC. Outbreaks seem to occur most often where dogs from various locations gather: dog tracks, boarding kennels, animal shelters, veterinary hospitals, and pet stores.

Epidemiology

Because the virus appears to be a pathogen that only relatively recently has begun to infect dogs, at this time most dogs are susceptible. Few dogs in Texas have been vaccinated, and few have been exposed and infected. Horses can be infected with canine flu, but are thought to show mild symptoms. There is no evidence that cats or people can be infected with canine flu virus. Cats housed with infected dogs have been tested.

Contagiousness is defined as the likelihood that exposure will result in infection. Canine flu is highly contagious (nearly 100%), has high morbidity (80-90% of dogs infected become ill), and has low mortality (5-8% of infections result in death). It is thought that mortality might be significantly lower with prompt treatment. Most dogs infected with canine flu recover within 30 days, often within 7-10 days.

Transmission

Canine flu is transmitted by droplets, aerosols, direct contact with respiratory secretions, and fomites. Tiny droplets produced when an animal coughs or sneezes can travel up to 4 feet through the air, and human flu aerosols can travel up to 50 feet. Canine flu aerosols may cause many to get sick quickly in shelters, with most dogs being infected within 2 weeks of virus introduction. Of course, human hands are probably the predominant fomite in the animal shelter, including hands of staff, volunteers and visitors. Shelter workers have taken canine flu home to infect pets, and some recommend vaccination of dogs owned by shelter workers for canine flu.
In addition to hands, common and apparent shelter fomites include bowls, litter boxes, toys, bedding, clothing and personal protective equipment, animal hair, exam tables, scales, floors, walls, cage surfaces, etc. Fomites perhaps less obvious but likely equally important might include door knobs, keyboards, telephones, cell phones and beepers, light switches, leashes, cage cards, anything on a desk, medical records. Any surface at a shelter can potentially transmit canine flu, especially surfaces that are porous and not easily disinfected.

Virus shedding period for canine flu begins at 2 days post-infection and continues for up to 7-10 days, with peak shedding occurring 2-4 days post-infection. For canine flu, virus shedding overlaps the incubation period, so that dogs can shed virus prior to showing clinical signs, one of the characteristics of canine flu which causes it to be effectively contagious in the shelter environment.

There is apparently no carrier state of long term shedding after recovery recognized for canine flu as there can be with other canine respiratory pathogens, including Bordetella bronchiseptica, Mycoplasma spp., and canine herpesvirus. Dogs who have recovered from the respiratory phase of distemper virus can shed virus for up to 90 days. They seem clinically normal, but later develop neurologic signs which reveal their distemper infection.

Clinical Signs

Distinguishing canine flu from other causes of upper and lower respiratory infection in dogs can be difficult. The typical shelter history is sudden increase in the prevalence of kennel cough in dogs of all ages, occurring within a 2 week period. As herd immunity develops in endemic areas, the onset might not seem as sudden or as dramatic with successive outbreaks. There typically is prolonged to complete lack of response to antibiotic therapy, with cough lasting longer than the typical kennel cough, for up to 3-4 weeks.

Incubation period for canine flu is very short, typically only 2-4. This is much shorter than other causes of kennel cough which can incubate for up to 14 days prior to causing symptoms in the dog. Included in the web resources for this presentation found at [http://wendyblount.com](http://wendyblount.com) is a Respiratory Pathogen Chart which summarizes for respiratory pathogens in dogs and cats mode of transmission, incubation, duration of shedding, carrier state, survival in the environment, treatment, and zoonotic potential.

Ten to 20% of dogs infected with canine flu shed virus, but never become ill. In comparison to other canine respiratory pathogens, canine herpesvirus is shed for weeks with asymptomatic carriers, distemper virus for up to 90 days, parainfluenza for 6-8 days, Bordetella bronchiseptica for 90 days or more with asymptomatic carriers, canine adenovirus 2 for 10 days, and Mycoplasma spp. for 90 days or more with asymptomatic carriers.

Symptomatic dogs fall into 3 categories: asymptomatic infection, 10-20%; mild infection, 60-85%; and severe infection, 5-20%. Most dogs infected with canine flu resemble the garden variety kennel cough that lasts a little longer than usual, and a few get severely ill. A distinguishing characteristic may be that dogs with the mild form of canine flu tend to be mildly ill dogs that cough, as compared to dogs with other causes of kennel cough that tend to be well dogs that cough (eating well, active, etc.).

Symptoms of mild infection include productive cough for several weeks, with gag or swallow at the end. Inexperienced caretakers may think the dog has something caught in their throat. Sometimes foamy fluid or mucus is expectorated. Mild fever and lethargy are typical, with no response to antibiotics. Purulent to hemorrhagic nasal discharge may be present, due to secondary bacterial infection and vasculitis.

Symptoms of severe infection include high fever (105°-106°F), tachypnea (>40 breaths per minute while resting), pneumonia, hemoptysis and prolonged recovery. Fatality rate for the severe form of canine flu is 5-8%, with death often caused by peracute hemorrhagic pneumonia.

Differential Diagnosis

Canine Respiratory Disease Complex in shelters often involves multiple pathogens in each patient, which can cause upper and/or lower respiratory disease. This can make diagnosis, treatment, and managing outbreaks complicated.

Other causes of upper respiratory disease to be considered were discussed in the first paragraph of this paper. Other causes of lower respiratory disease to be considered include chronic obstructive
pulmonary disease, various bacteria, distemper virus, protozoans such as Toxoplasma and Neospora spp., fungal organisms such as Histoplasma sp., Blastomyces sp. and Cryptococcus sp., and parasites such as lung flukes, migrating intestinal parasites and heartworms.

**Diagnosis**

Canine flu cannot be distinguished from other respiratory pathogens based on clinical signs. Diagnostic tests used to work up canine upper respiratory disease complex might include: CBC, serology, and urinalysis; thoracic radiographs; trans-tracheal wash or bronchoalveolar lavage for cytology, culture and sensitivity; virus isolation of nasal and pharyngeal swabs; serum titers; PCR/ELISA of conjunctival, nasal, or pharyngeal swabs; and necropsy. Swabs must be taken in the first week after exposure to yield positive results. This may be the single most challenging factor to using swabs to diagnose canine flu – the outbreak must be diagnosed before shelter staff realizes it is actually occurring. Sampling patients as soon as symptoms begin is best, as peak shedding occurs during the first 2-4 days after exposure. Regardless of the diagnostic method used, it is advisable to contact the laboratory for specific sample collection instructions.

Antigen detection (immunoassay) kits commercially available to detect human flu also detect canine flu. If staff is properly trained, they are easy to run in the shelter for instant results. Sensitivity for these assays is high, so a positive result is most likely correct. Specificity is low largely due to the short shedding period, so a negative result is less helpful. After the peak shedding period, PCR tends to be more sensitive than immunoassay, but specificity is still relatively low. As with all PCRs, there are problems with positives, often due to poor sample handling technique. Examples of commercially available cage side flu immunoassay kits include Directigen Flu-A (BD – Becton-Dickinson), and QuickVue Influenza Test (Quidel). Test most often are sold in boxes of 20, and come at a cost of $10-25 per test.

Though instructions from the in house test manufacturer or the reference lab should always be consulted and carefully followed, helpful hints include the following. Exam gloves should be worn when taking swabs to prevent contamination of the sample with stray own DNA, and new gloves should be donned for each dog sampled. The swab tip should be touched only to the area sampled, as quickly as possible to prevent contamination by aerosols or droplets in room air.

Virus isolation is considered by many to be the diagnostic gold standard, but is seldom done. Virus isolation takes a week or more, and when sample shipping and result reporting time are also considered, the outbreak is often largely played out by the time results are available. However, virus isolation can help identify the cause of a severe canine flu outbreak, and might indicate the need for future vaccination of dogs on intake at that shelter, or an advisory to local veterinarians that canine flu present in the area. Samples for virus isolation should be collected and shipped according to instructions provided by the lab in question. Polyester rather than cotton tipped swabs are used, placed into sterile dry tubes or tubes with transport medium, and shipped on ice to arrive the within 2 days. As with immunoassays and PCR, there are many false negatives with virus isolation due to the brief viral shedding time of canine flu.

Serum titers are the most reliable test for identifying canine flu infection in a particular dog, though prolonged result time makes titers of little use to managing shelter outbreaks as well. Antibodies to canine flu are detected as soon as 7-10 days after infection. Two blood samples should be taken, the first 7-10 days after first signs, and the second 2 weeks after the first sample. Samples should be spun as soon as clotted, serum harvest and stored in the freezer, and paired sera sent to the lab in a single submission. Four-fold increase in titer is diagnostic for active canine flu infection.

Diagnostic Laboratories accepting samples for canine flu diagnostics include: New York State Animal Health Diagnostic Center, Cornell University (PCR, titers, virus isolation); CSU Veterinary Diagnostic Laboratory, Colorado State University (PCR, ELISA); Lucy Whittier Molecular & Core Diagnostic Center, UC-Davis (PCR); U of Florida VMC Clinical Diagnostic Laboratory (titers).

Low white count might indicate overwhelming infection or concurrent parvovirus. Results of serum profile and urinalysis provide information as to co-morbidity and severity of disease. Thoracic radiographs can evaluate for present of bronchopneumonia or alveolar pneumonia. Necropsy is of course indicated for dogs that die from or are euthanized due to respiratory disease. Be sure to ask the necropsy lab to look for specifically for canine flu keeping in mind that after 1-2 weeks post exposure, canine flu virus can be difficult find in the body.
In order to contain the highly contagious canine flu, the entire shelter must be quarantined and isolated as appropriate, unless there are shelter areas which are truly separate and will not be cross-contaminated. To review, quarantine separates exposed from unexposed animals to see if the former become sick, and isolation separates infected animals from others, to limit infection of the latter. Ideally, quarantine and isolated groups should be housed separately, with no cross-contamination. Because canine flu spreads so quickly, most dogs have already been exposed before quarantine is possible, so practically speaking, isolation is the mainstay of outbreak control for canine flu. Fourteen days after the last dog begins to show symptoms is sufficient for quarantine/isolation if there are no breaches.

As with management of all infectious disease outbreaks in shelters, deep cleaning and disinfection are paramount. Canine flu is killed by most disinfectants, including quaternary ammonium compounds, peroxygens, accelerated peroxides and halogens. Canine flu virus can live for 24-48 hours on nonporous surfaces, for 8-12 hours on porous surfaces, and only minutes on hands. Cleaning and disinfection protocols should be reviewed to ensure they are being followed.

Adequate contact time of disinfectant is perhaps the most significant challenge to proper sanitation in shelters. An advantage of used accelerated peroxides is their short contact time of approximately one minute, as compared to 10 minutes required by most other disinfectants used in shelters. Some shelter managers conclude that decreased contact time and greater likelihood of adequate disinfection offsets increased cost of accelerated peroxides, especially during outbreak management. If disinfectants requiring longer contact time are used and staff has difficulty finishing proper cleaning if contact times are stringently observed, keep in mind that adequate contact time of every surface at least once or twice a week for each surface is preferable to daily unacceptably short contact times on all cleaned surfaces. A rotating schedule can be established to ensure periodic adequate contact time for all surfaces.

Air exchanges should be increased where possible, to exhaust droplets and aerosols from the shelter. The routine 10-12 exchanges per hour that is acceptable in shelter HVAC systems should be increased to 15 during an outbreak. Air vents should be closed where possible to stop air-sharing between clean and contaminated areas of the shelter.

Stringent attention to wearing and properly decontaminating Personal Protective Equipment (PPE) should take place during an outbreak. Disposable are affordable at less than $2 each, in addition to gloves and appropriate boots or shoe covers. Ideally, staff should be assigned to either quarantine/isolation or naïve population for the day, with no cross-over. Best practice is for staff to change out of street clothes when they clock in, and into you street clothes when they clock out (scrubs work well). Though foot baths are controversial, recent publications have confirmed that peroxygen foot baths and mats are effective at minimizing contamination by foot traffic.

The public should be informed of the outbreak periodically during a 30 day period. Public service announcements in newspapers, radio, and local TV can be invaluable tools to getting the word out quickly. Adoptive families should receive information orally and in writing on canine flu, including what to look for, what to do in case symptoms occur, and risk to other dogs in the adoptive home. As with management of all infectious disease outbreaks, the public can be gently reminded that pathogens are not generated at the shelter. Rather, shelter outbreaks are a symptom of a community problem, as they result from pathogens that are carried into the shelter from the community, and the shelter makes every effort to eradicate the pathogens that come in the door every day to the greatest extent possible. An additional appropriate reminder is that there are many respiratory pathogens not prevented by kennel cough vaccines.

As a considerate member of the animal welfare community, any shelter suffering a canine flu outbreak should issue a canine flu advisory to neighboring animal shelters, rescue groups, foster homes, veterinary clinics, boarding kennels, dog parks, pet stores, groomers, trainers, local and state VMAs, Association of Shelter Veterinarians, and the state health department. Put your vaccine sales reps to work – they will likely be only too happy to help with this.

Releasing adopted dogs only after the 14 day quarantine is an additional consideration, if outbreak control at the shelter is excellent. If outbreak control is suboptimal, removing asymptomatic animals from the shelter with medical release as soon as possible is best for each individual animal.
Symptomatic animals can also be released 14 days after symptoms begin, as by this time they are no longer shedding flu virus. Adopting dogs to single homes is ideal during a flu outbreak. Alternatively, dogs in the adoptive home can be vaccinated twice, at least 2 weeks apart, prior to introduction of the new dog into the home. As always, complete medical record for transfer to the new veterinarian should be provided to each adoptive owner.

Depopulation is seldom required to manage a canine flu outbreak, as its short incubation and shedding periods make canine flu more manageable than other shelter pathogens. As well, canine flu is associated with low mortality, shows little resistance to routine disinfection, survives a relatively short time in the environment and has no zoonotic potential. On the other hand, the high contagiousness and morbidity of, and universal susceptibility to the virus makes outbreak control more challenging. Depopulation in the face of a canine flu outbreak is a consideration when the challenges outweigh the factors that can be managed well in a particular shelter situation. When new shelter intakes cannot be effectively separated from general population (including separate air system), reduction of population density for 30 days can be considered as an alternative to complete depopulation.

**Intake Procedure**

Though seldom done for practical reasons, intake quarantine of at least 2 weeks is required to keep respiratory outbreaks down to a dull roar. If your intake quarantine is shorter as it is at most shelters, you will have frequent problems with kennel cough. If 2 week intake quarantine, consider “cohort admissions,” where dogs are added to one room or area until it is full, no more are added until the room is empty, and then the room is sanitized from top to bottom before the new cohort begins to arrive. Multiple small rooms at the shelter are required for cohort admissions.

**Treatment**

Antibiotic therapy for secondary bacterial infection in canine flu cases are indicated by productive cough, purulent nasal discharge or pneumonia. Orally administered tetracyclines or azithromycin are often used for mild canine flu (doxycycline 5-10 mg/kg PO SID-BID x 10-21 days). Intravenous antibiotics (often cephalosporins) are recommended for severe canine flu. A recent unpublished study has demonstrated that Convenia (cefovecin) is equally effective to daily administration of antibiotics in puppies treated for parvovirus, but yet exists on comparison of Convenia to intravenous cephalosporins for severe canine flu.

Intranasal vaccination for kennel cough has been recommended for management of all respiratory outbreaks in shelters. There is evidence that intranasal vaccination decreases severity of secondary bacterial infection with *Bordetella spp.* and may mitigate clinical signs of respiratory disease.

Symptomatic therapy for individuals displaying clinical signs might include Antitussives, fluid therapy, coupage and other respiratory therapy such as nebulization and vapor therapy or oxygen supplementation.

For best results in people, Tamiflu (oseltamivir) must be given with 48 hours of being infected with flu. There is no existing scientific evidence as to whether Tamiflu it helps dogs with flu or not, but it does make more sense to use Tamiflu for canine flu than for canine parvovirus. Neuraminidase is an enzyme that breaks down mucus on the surface of the respiratory and GI tracts so the virus can attach t cells and replicate. Flu viruses have neuraminidase, but parvovirus does not. Further, there are no existing studies providing information on dose, frequency or toxicity of Tamiflu in dogs. Some shelter medicine experts discourage its use for fear of causing resistant flu in people.

Some shelters may need to euthanize dogs with severe canine flu if they do not possess adequate resources to care for those patients well. But remember that euthanasia will not change the outcome of the outbreak by mitigating contagion, unless all euthanasia is carried out within 2-4 days of exposure.

**Immunity**

Antibodies to canine flu persist for at least 5-6 years after infection, but it remains unknown whether these antibodies protect from disease. Flu viruses affecting people mutate often, so that new flu vaccines must be produced each year to keep up with the changes in the virus. Two manufacturers produce killed canine flu vaccines (Pfizer, Merck). Both recommend administering canine flu vaccine at 2 doses given 2 weeks apart, then boosters administered annually. If the second booster is not given on time and it has been more than 6 weeks since the first dose was administered,
then the vaccine series must be started again from the beginning. Merck has suggested that insisting on payment up front for both doses might increase the likelihood that owners will see that the second dose is given on time. Killed vaccine can be given as young as 6 weeks of age.

As with most respiratory disease vaccines, vaccination does not prevent infection, but lessens severity of symptoms and decreases but does not prevent shedding. Pfizer claims that their vaccine is more effective at reducing shedding than the Merck vaccine, though I have not personally seen the supporting data. Vaccine induced immunity is best 1-2 weeks after the second dose (a month after the first vaccine). There is no evidence that vaccination of any dogs after the outbreak begins can mitigate either the outbreak or disease in the patient. Because of the rapidity with which the virus spreads and ceases to be shed, in most cases the outbreak is contained by the time the vaccine takes effect in any individual. It is likely that vaccination for canine flu at shelters would lessen severity of inevitable outbreaks in endemic areas, and might help minimize community impact of an outbreak in shelters with short turnover time. Those adopted out infected with canine flu will be less likely to have clinical signs if infected, and if are symptomatic, their symptoms will be less severe.

The State of Canine Flu in Texas

Two years ago, a veterinarian in San Antonio received a series of PCR positives and reported an outbreak, but no cases were reported at any other veterinary clinics. One case (mild) was reported to be confirmed by Pfizer in Katy, TX, earlier this year. New positives test results in TX have been reported by Cornell since 2010.

Some boarding kennels in the Houston areas are requiring the vaccine for boarding, possibly as a result of vaccine manufacturers marketing directly to boarding kennels and shelters. I recommend the canine flu vaccine for dogs who attend competitions or shows which might be attended by dogs from endemic areas. I have spoken with numerous shelter vets around Texas who have aggressively tested for canine flu virus in their shelters during repeated respiratory outbreaks, and I have received to date no reports of a documented canine flu outbreak in a Texas animal shelter. It seems that at this time, while cases are sporadically reported in Texas, canine flu is not yet endemic here.

It is the recommendation of the author at this time that expense of routine vaccination for canine flu on intake at shelters in Texas outweighs any benefit that would likely result. However, due to the highly contagious nature of canine flu and increasing prevalence of international travel of pet dogs, canine flu could become endemic in Texas at any time in the future. Should that happen, this position should then be re-evaluated by all Texas Shelter Veterinarians.

References

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