Canine Infectious Respiratory Disease Complex (CIRDC, a.k.a. "Kennel Cough")

Canine infectious respiratory disease complex (CIRDC) is a syndrome of diseases that are of significant concern in any multi-dog setting. The appropriate treatment and containment practices needed to address a CIRDC incident will vary considerably based on the specific agent or agents involved. In many cases identifying the agents involved is not possible; therefore, a prevention strategy is the key to tackling CIRDC in a shelter setting.

Table of Contents:

Overview of Canine Infectious Respiratory Disease Complex (CIRDC)

It is common to use the term “kennel cough”, “infectious tracheobronchitis” and variations on “canine infectious respiratory disease complex” interchangeably. However, this is an overly simplistic view of a complicated syndrome. Disease is not limited to the trachea, nor does it always manifest as coughing. Clinical signs of canine infectious respiratory disease complex (CIRDC) may include sneezing, nasal and ocular discharge, and sometimes lower respiratory and/or systemic disease.

Multiple bacterial and viral pathogens, acting both sequentially and synergistically, are associated with CIRDC.

Viral pathogens associated with CIRDC in dogs include:

- Parainfluenza
- Adenovirus-2
- Respiratory coronavirus (this is distinct from canine enteric coronavirus)
- Herpesvirus-1
- Pneumovirus

Canine distemper and canine influenza (H3N8 and H3N2) may also be associated with upper respiratory signs, but can also cause more severe systemic disease in a proportion of infected dogs.

Bacterial pathogens implicated in CIRDC include:

- Bordetella bronchiseptica
- Mycoplasma spp.
- Streptococcus zooepidemicus (may cause severe systemic disease)

In addition, it is likely that secondary bacterial invaders of many species play a significant role in causing more severe disease in some dogs. We are still unraveling the complicated etiology of CIRDC, as evidenced by the fact that several of the pathogens listed above have only been recognized in recent years.

New findings regarding known CIRDC pathogens, as well as current research on emerging pathogens, are adding to the already complex pathogenesis of CIRDC. High-density environments, such as shelters — where exposure, susceptibility, and transmission of infectious diseases are amplified — can contribute to outbreaks of known CIRDC pathogens, as well as the emergence of novel pathogens. Continuing to define the role of these emerging pathogens is critical to CIRDC management.

Environmental factors and host immune response play an equally important role in facilitating development of CIRDC. There is a reason it has been called “kennel cough” – several of the pathogens listed above are insufficient in themselves to cause disease without the additional stress, high contact rates, and crowding often associated with kenneling. CIRDC’s multifactorial etiology requires a multifaceted approach for optimal management in the shelter setting.

Who is susceptible to CIRDC?

Although labelled **canine** infectious respiratory disease complex, some of the pathogens involved may also be transmitted to other species. *Bordetella bronchiseptica* may occasionally infect people, especially

those with respiratory disease or immune compromise, and can also infect cats. Influenza (H3N2) too has been reported to infect cats. To prevent cross-species transmission, as well as to reduce stress for all concerned, it is ideal to always house animals separately by species.

Disease Course

The incubation period for most CIRDC pathogens is typically 2-3 days but can range from 2 days (influenza H3N8 and H3N2) to up to 6 weeks (distemper). All CIRDC pathogens have a preclinical shedding period, complicating disease management. Clinical signs and shedding typically last for 5-10 days; however, some pathogens can shed for prolonged periods (Bordetella bronchiseptica, Mycoplasma, and distemper). Clinical signs are typically mild, self-limiting, and resolve with supportive care. Severe infection can sometimes be seen, more commonly in younger and immunocompromised animals.

Diagnostic options for CIRDC outbreaks

Virtually all CIRDC pathogens cause a similar overall clinical presentation of coughing and/or nasal discharge. While *Bordetella*-induced CIRDC is classically thought of as causing only relatively mild disease, more severe disease may be seen, especially in a crowded shelter or boarding facility where stress and a high load of secondary pathogens provide a synergistic effect. Therefore, **the cause of CIRDC cannot be diagnosed based on clinical signs alone in a single dog.** However, the pattern of affected animals and the severity of signs can at least provide some clue as to the likely pathogen(s).

For example, distemper is unlikely to affect vaccinated dogs over four months of age. Influenza, on the other hand, is likely to affect a high percentage of exposed dogs, regardless of age or vaccine status. Therefore, this rule-out would be unlikely in an outbreak limited to puppies or unvaccinated animals.

If some animals show distinctive clinical signs, such as neurological signs characteristic of distemper, it is possible that other dogs showing milder disease are also infected with the same pathogen. Conversely, a distemper outbreak is unlikely if many dogs are affected and none show characteristic neurological signs.

If there is any suspicion that an atypical or more virulent pathogen is at play (influenza, distemper, *Strep. zoo*), the most critical management goal is to recognize and diagnose the pathogen(s) as quickly as possible. Diagnostic testing is therefore indicated if an outbreak has occurred

(sudden rise in incidence of disease), if affected dogs are not responding to supportive care, if affected dogs are showing systemic signs of disease, or if there is the slightest suspicion of zoonotic infection. A diagnosis can help guide effective treatment plans and control measures.

Acutely affected dogs should be sampled, ideally prior to treatment, in sufficient numbers to provide data representative of the larger population (at least 10% of the population). Collection of samples from multiple dogs (at least 5-10) may increase the chance of positive test results. The ideal sample depends on the localization of clinical signs: if signs are predominantly upper respiratory, nasal swabs should be obtained. If lower respiratory disease is suspected, tracheal wash is the preferred specimen.

Several diagnostic tests are available but sensitivity and specificity will vary depending on the pathogens involved, the location of sample collection, and the timing of collection. For example, influenza (H3N8) shedding peaks early in the course of disease and may be missed by the time clinical signs are noticed, resulting in false negative results.

Current diagnostic options include:

- Culture and sensitivity - useful for bacterial pathogens that demonstrate antimicrobial resistance (e.g. recent isolates of *Strep. zoo* can carry doxycycline resistance genes)
- Serology - use is limited due to vaccine interference; however, it is useful for influenza diagnosis in non-endemic communities
- Virus isolation - uncommonly used now due to its relatively slow turnaround time.
- Polymerase chain reaction (PCR) - the most practical option for viral detection (respiratory PCR panels are available from most commercial laboratories). To minimize the chance of false negative results, contact the laboratory regarding optimal sample collection, transport, and to ensure that the pathogens of interest are included in their panels (e.g. respiratory coronavirus as opposed to enteric coronavirus). Keep in mind that false positives can result from recent vaccination with a modified live virus (e.g. false positive from MLV distemper vaccination as long as 3 weeks post-vaccination). Some laboratories now offer quantitative real-time PCR results that can help differentiate vaccination from field strain infection.
- Histopathology

Merely documenting the presence of a pathogen does not necessarily indicate causation, of course. Most of the pathogens associated with CIRDC can be isolated with some frequency even from clinically normal dogs, especially in a densely-housed canine population. If the same

pathogen is found in several dogs, this raises the index of suspicion that a causative relationship exists, but still does not rule out other contributing, or even primary, agents.

For definitive diagnosis, necropsy is the most powerful tool available, and should be utilized if possible whenever dogs die or are euthanized with suspected severe infectious respiratory disease. Necropsy can help clarify both the presence and the role of the involved pathogens. If you are uncertain whether a single death represents an isolated incident or the beginning of an outbreak, it is prudent (and virtually free) to obtain lung specimens and oropharyngeal swabs and hold for future analysis if indicated. Formalin fixed, frozen and refrigerated specimens should be obtained, for histopathology, viral isolation, and bacterial culture, respectively. If you suspect you are dealing with an unusual outbreak of canine respiratory disease, please contact us.

How can CIRDC be prevented in a shelter?

As with other infectious conditions in shelter animals, strategies for prevention of CIRDC rely on supporting the animal's ability to ward off disease and reducing the level of environmental contamination. Important strategies to accomplish the first goal include vaccination, stress reduction, and prevention of airway irritation (e.g. by minimizing barking and by cleaning in such a way that airborne irritants are reduced). The latter goal is accomplished through reduction of crowding, effective sanitation, and maintenance of good air quality.

Although we cannot control what specific pathogens affect a shelter or the age of the animals within a shelter, we can control our ability to provide optimal care to shelter animals, thereby reducing the likelihood of CIRDC infection.

Reduction of crowding and stress

Crowding, with its associated stress, is undoubtedly the single greatest risk factor for severe respiratory (and other) disease outbreaks in shelter populations. Increased population density leads to a greater risk of disease introduction, higher contact rates, increased stress, reduced air quality, and often, compromises in housing and husbandry.

Housing dogs in each side of a double-sided kennel intended for a single dog; housing multiple unrelated dogs per kennel (particularly if not done in "all in/all out" fashion); failure to isolate clinical animals; and delays in moving animals through the facility are frequent precursors of serious outbreaks in crowded shelters. Unfortunately, crowding in shelters is not

uncommon.

An underappreciated strategy for CIRDC prevention is to simply reduce the amount of time each dog spends in the shelter environment. One study showed that each day in a shelter increased the risk of CIRDC by 3%. Increased time for each dog in the shelter also contributes to increased crowding with all the associated risks. Management practices that increase length of stay (LOS) for shelter dogs should be carefully assessed to ensure the benefit of these practices outweighs the risk of disease they may create. Common points for possible delay in some shelters may include:

- Posting to lost/found sites, correct identification, owner contact
- Routine quarantine of apparently healthy animals
- Delays while dogs await behavior evaluation or surgery
- Holding dogs away from public-viewing areas of the shelter even after they are available for adoption, due to lack of staff to move animals or lack of space in public viewing areas

This is not to say that all policies that result in increased LOS are contraindicated, just that the risk/benefit of every such policy should be carefully evaluated. Reducing the average LOS for sheltered animals starts with thoughtful, proactive population management which includes implementation of daily medical/population rounds, as well as the provision of a low stress environment, to ensure animals remain healthy and are moved efficiently through the sheltering system. To learn more about rounds please see the ASPCA Professional page on Population Wellness Rounds and Dr. Kathy Makolinski's presentation at the 2014 HSUS Animal Care Expo. To learn more about enrichment please see Dr. Karsten's lecture on Managing Stress and Providing Enrichment for Confined Cats and Dogs.

Vaccination

Canine infectious respiratory disease complex, almost by definition, is not a vaccine-preventable condition. There are no vaccines available for some contributory or primary pathogens, some vaccines only provide partial protection at best, and it is not always possible to vaccinate animals prior to exposure in a shelter environment. In spite of these limitations, vaccination definitely plays a role in controlling CIRDC.

In some cases, disease can be almost entirely prevented (e.g. distemper), while in others, frequency and severity can be mitigated. In one study, vaccination for Bordetella and parainfluenza (with or without adenovirus-2) of even a fraction of dogs on intake to a shelter resulted in a significant

reduction in the risk of coughing [1]. For general information on vaccination of shelter pets, see our vaccination information sheet.

For a shelter setting, the recommended vaccination protocol is for all dogs over 4 weeks of age to receive a modified live virus (MLV) subcutaneous (SC) vaccine against distemper, adenovirus-2, and parvovirus immediately upon admission or, ideally, 3-5 days before admission. Puppies should be revaccinated every 2 weeks until 18-20 weeks of age due to possible interference by maternal antibody.

A recombinant parenteral vaccine is also available against distemper. While the recombinant vaccine may provide better protection in the face of maternal antibody and does provide rapid immunity, the MLV vaccine likely provides even more rapid immunity and is the better choice for high-risk shelters with puppies for whom maternal antibody is not likely to be present. Many dogs and puppies entering shelters have no evidence of either prior exposure, vaccination or maternal antibody to canine distemper, suggesting that, for puppies in most shelters, the MLV vaccine could be the better choice.

In addition, all dogs over 2 weeks of age should receive a bivalent or trivalent, mucosal MLV vaccine against *Bordetella* and parainfluenza immediately upon admission, or, ideally, at least 3 days before admission. Mucosal vaccines are available for either oral or intranasal administration. The only available oral vaccine is a monovalent *Bordetella* product, while the intranasal vaccine is available in bivalent or trivalent formulations containing parainfluenza and/or adenovirus-2, providing potentially broader protection.

Puppies less than 6 weeks old should be revaccinated with the mucosal vaccine once after the age of 6 weeks. Mucosal *Bordetella* vaccines are designed to stimulate both local mucosal immunity and systemic immunity, thereby providing rapid onset of protection within 3 days after a single dose. In comparison, the subcutaneous antigen extract *Bordetella* vaccine does not produce protection until 2 to 3 weeks after a booster vaccination. The rapid protection offered by mucosal vaccination is important in a shelter setting where there is continuous introduction of susceptible animals. Not only is protection provided quickly, but a single dose mucosal *Bordetella* vaccine can provide immunity for at least 12 to 13 months. In addition, mucosal vaccines are not affected by maternal antibody and are therefore preferred for use in puppies.

Previous studies suggested that a killed whole bacterin subcutaneous vaccine provided superior IgG levels, and vaccination with both the intranasal and the killed bacterin vaccine in succession provided superior protection against clinical signs. However, this vaccine is no longer

available. Little information is available about the efficacy of the antigen extract vaccine; one recent study found no difference in clinical signs between dogs receiving this vaccine and a placebo[2]. However, if staff are unable to administer either the oral or intranasal vaccine, there may be some benefit in giving the subcutaneous antigen extract vaccine; keep in mind this vaccine must be boostered for full effect, and therefore a series should be completed at least 2 weeks prior to admission to a boarding facility.

Two subcutaneous killed vaccines are available for canine influenza (H3N8). These vaccines are labeled to reduce the severity of clinical signs and decrease the duration of viral shedding, though, like many respiratory vaccines, they do not completely prevent infection. The vaccines are labeled for use in puppies 6-8 weeks of age and older, and should be given as two injections, 2-4 weeks apart. The requirement for a booster limits the usefulness of this vaccine in some shelters, but it should be considered for pet dogs that stay in boarding kennels, attend doggy day care centers, frequent dog parks, or otherwise congregate with other dogs, especially in areas known to be endemic for influenza (H3N8). The series of two vaccines should be completed at least two weeks before boarding to allow for optimal immune response. This vaccine may also be useful for shelters in endemic areas if dogs frequently stay for a prolonged period, or for shelters transferring dogs from non-endemic to endemic areas (to be administered *prior to transfer* into an endemic area). As of now, neither of these H3N8 vaccines has been shown to provide cross-protection against H3N2.

Environmental decontamination/removal of infected animals

Shortened LOS, along with reduced crowding, will facilitate implementation of appropriate biosecurity measures, including adequate sanitation practices and prompt recognition and isolation of affected animals, which are critical in managing CIRDC.

Most CIRDC pathogens survive in the environment no more than a few hours (canine distemper) to a few weeks (*Bordetella*) and are inactivated by virtually all routinely used disinfectants. Adenovirus-2 is an exception; like other un-enveloped viruses, it is reliably inactivated by a limited number of disinfectants, including household bleach (5% sodium hypochlorite) diluted at 1:32 (1/2 cup per gallon), calcium hypochlorite (e.g. Wysiwash®) and sodium dichloroisocyanurate (e.g. Bruclean®), potassium peroxymonosulfate (e.g. Trifectant®) and accelerated hydrogen peroxide (e.g. Rescue™, formerly branded as Accel®).

Survival of primary and secondary pathogens may be greatly enhanced by persistent moisture in the environment; therefore, surfaces should be in good repair to prevent pooling of water, and cleaning should be followed by thorough drying on a daily basis.

The cleaning process itself may serve to spread, rather than prevent, disease if not carefully thought out. Ideally, dogs should be held in double-sided kennels separated by a guillotine transfer door, such that the dog can be held on one side while the other side is cleaned. For facilities with a robust dog walking program such that kennels are not soiled with urine or feces, complete cleaning and disinfection need only occur at the conclusion of a dogs' stay, with daily spot cleaning sufficient to keep the run tidy.

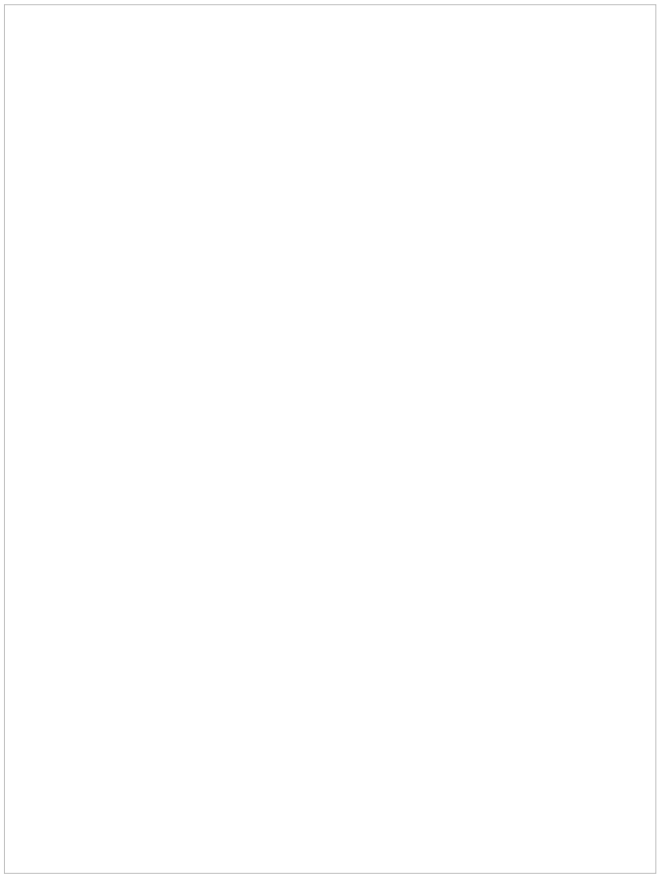
If dogs must be removed from their kennel for cleaning, they should not be left in a common holding kennel, nor tied in aisle ways while contaminated water and disinfectant are sprayed nearby. Disinfectant should be applied via a sprayer or other application system rather than a mop and bucket, which will quickly become contaminated. For more information on cleaning and disinfection methods, see our information sheet on sanitation.

Remember that mildly infected dogs can play a substantial role in maintaining CIRDC in a given population, especially for the less environmentally durable pathogens such as canine distemper. A common (and dangerous) misunderstanding is that a mildly infected dog is shedding only a mild pathogen. In fact, the severity of clinical signs is dictated as much by the dog's immune system as by the inherent virulence of the pathogen. A perky dog with a mildly snotty nose may very well be shedding a pathogen such as distemper or influenza, which could be fatal for another animal.

Prompt removal of all clinical animals, no matter how mild the signs, has been critical in resolving many outbreaks. Staff and volunteers should be trained to carefully scan for sneeze marks on kennel walls, as well as to observe dogs for clinical signs before walking, cleaning, or otherwise interacting. Because airborne transmission of CIRDC is a possibility, isolation areas should, ideally, have separate air flow.

However, if this cannot be achieved, do not despair. Facilities have managed to maintain effective isolation by providing at least 25 feet of physical distance between sick and healthy dogs and paying careful attention to fomite control. In a shelter this could even be accomplished by maintaining 2-3 empty runs between an "isolation area" and a "general healthy population" area, with crime scene tape or some other physical barrier separating the two sections of kennel runs. Nothing fancy is

required, as shown in this makeshift arrangement at one shelter:



Treatment

Treatment is typically symptomatic and supportive. There is no single “drug of choice” for treatment of CIRDC. For dogs in a pet home with mild illness, antibiotic treatment may be unnecessary. For dogs in the more challenging environment of a shelter, however, antibiotic treatment is often indicated.

Doxycycline and potentiated sulfas are relatively good empirical choices when *Bordetella* infection is suspected, although resistance is possible even to these. *Bordetella* is always resistant to Cephalexin. See information below for antibiotic susceptibility patterns for *Bordetella* at the UC Davis Veterinary Medical Teaching Hospital. Remember that *Bordetella* is not the only bacterial pathogen that may be involved with CIRDC, as either a primary or secondary pathogen.

For secondary infections subsequent to canine influenza or other viral infections, cephalexin, fluoroquinolones, Clavamox or other broad-spectrum antibiotics are more likely to be effective than doxycycline. Culture and sensitivity is indicated in an outbreak or if an individual dog

fails to respond to empirical therapy. For dogs unresponsive to oral or parenteral antibiotics, nebulization with aerosol/non-absorbable antibiotics (e.g. gentamicin) may be beneficial.

Additional supportive care includes maintaining appropriate nutrition and hydration, minimizing excitement by modifying the environment (e.g. reducing barking triggers), and preventing tracheal irritation by walking with a harness or gentle leader. Keep in mind also that consistent monitoring of clinical signs is a key factor in treatment – it ensures dogs are moved in and out of isolation promptly and that optimal welfare is maintained.

The long-acting antibiotic, cefovecin (Convenia), should **not** be used for typical CIRDC cases since it is not effective against *Bordetella* or Mycoplasma (one exception is if *Strep. zoo* is present). Although orally administered prednisone may reduce the severity of coughing, it has not been found to shorten the course of illness and should not be used alongside a bacteriostatic drug such as doxycycline [3]. There is no evidence that antitussive or expectorants are beneficial to reduce symptoms of CIRDC in dogs; there is minimal evidence that dextromethorphan-based cough suppressants are helpful even in humans [4].

Narcotic antitussives are specifically **not recommended** in the shelter setting, because they can reduce expectoration and bacterial clearance, thereby facilitating the colonization of secondary invaders. These drugs are not without side effects, and administration to numerous dogs in an outbreak can be time-consuming and facilitate fomite spread of disease. Accordingly, treatments with questionable benefit should be avoided in a population setting. Judicious use of these medications in a more controlled setting, such as an adoptive or foster home, can be considered.

For an example treatment protocol refer to our Sample CIRDC Treatment Protocol.

Kennel Cough/CIRDC Information for Foster Homes

Keys to preventing the spread of infection

1. Always remember that vaccines do not completely protect a dog that is exposed to CIRDC. For maximum protection of your own dogs, they should receive a mucosal *Bordetella* and parainfluenza vaccine at least 3 days and not more than 1 year before you bring foster dogs into your home.

2. Keep dogs isolated. Some CIRDC pathogens can spread even to otherwise healthy, vaccinated pet dogs (e.g. canine influenza). Medication and other treatments should be given to affected dogs only after the healthy dogs in the home have been handled.
3. Refrain from bringing your foster dog to pet stores, dog parks, obedience training, or other places young puppies may visit as long as the dog is showing any signs of illness. Remember some dogs infected with serious illness, such as canine distemper, may be infectious to others while showing only mild signs themselves.
4. Dogs can continue shedding some of the infectious agents associated with CIRDC for some time after recovery. The risk is greatly reduced once all clinical signs have resolved; however, fosters (and adopters) should be asked to keep their new pet away from areas where animals congregate, such as dog parks or obedience classes, for at least two weeks after recovery.

Client Information Handout: Canine Infectious Respiratory Disease Complex (CIRDC), aka Kennel Cough

Congratulations on your new dog! The shelter staff has worked very hard to ensure the health of your dog, but CIRDC is a very common disease in dogs adopted from shelters. Here is some information about this condition and how you can help your newly adopted dog to recover from this condition and lead a happy, healthy life!

1. CIRDC is common, contagious, and very rarely fatal. The disease is caused by bacteria and/or viruses that spread among dogs and cats in shelters.
2. CIRDC is spread by air and hands, therefore it is as common in an animal shelter as the common cold is in a day care center.
3. CIRDC could spread to your other dogs. Vaccinated, healthy dogs in a home usually develop mild, if any, signs of CIRDC after exposure to a new dog; however, in some cases serious illness may be transmitted. Talk to your veterinarian if you have concerns.
4. RARELY, an immunocompromised person (e.g. an HIV patient or someone undergoing chemotherapy) can be infected with *Bordetella bronchiseptica*, one of the bacteria involved in CIRDC. If someone in the family is severely immunocompromised, please discuss CIRDC with your physician.
5. CIRDC is manageable in a home. The BEST thing to do for a dog with CIRDC is to provide them with a warm, stress-free home. In this environment most dogs will recover within a few weeks.
6. There are vaccines that can reduce the severity of CIRDC, but

giving these vaccines to an animal who is already infected will not help the animal recover any quicker.
7. Sometimes antibiotics are used in treating CIRDC, and may help your dog deal with the disease. These medications can be obtained from your veterinarian.
8. Severe, untreated cases of CIRDC can develop into pneumonia, so it is important to discuss CIRDC with your veterinarian.

When should you seek treatment for your dog?

1. We recommend that all newly adopted dogs be seen by a veterinarian within a few days of adoption, for a routine health check.
2. If your dog(s) develop a hacking cough, discharge from eyes and nose, lethargy or loss of appetite, you should make an appointment with a veterinarian.

References

1. Edinboro, C.H., M.P. Ward, and L.T. Glickman, A placebo-controlled trial of two intranasal vaccines to prevent tracheobronchitis (kennel cough) in dogs entering a humane shelter. Preventive Veterinary Medicine, 2004. 62(2): p. 89-99.

2. Davis, R., et al., Comparison of the mucosal immune response in dogs vaccinated with either an intranasal avirulent live culture or a subcutaneous antigen extract vaccine of Bordetella Bronchiseptica. Veterinary Therapeutics, 2007. 8(1).

3. Ford, R.B., Canine infectious tracheobronchitis, in Infectious diseases of the dog and cat, C. Greene, Editor. 2005, W. B. Saunders Company: Philadelphia. p. 54-63.

4. Paul, I.M., et al., Effect of dextromethorphan, diphenhydramine, and placebo on nocturnal cough and sleep quality for coughing children and their parents. Pediatrics, 2004. 114(1): p. e85-90.