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

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What is Canine Infectious Respiratory Disease Complex, and what causes it?

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 syndromes of Canine Infectious Respiratory Disease Complex (CIRDC) may include sneezing, nasal and ocular discharge, and sometimes lower respiratory and/or systemic disease.

Viral pathogens associated with upper respiratory disease in dogs include

- Parainfluenza
- Adenovirus
- Canine respiratory coronavirus (this is distinct from canine enteric coronavirus)
- Canine herpesvirus

Canine distemper and canine influenza may also be associated with upper respiratory signs, as well as potentially causing 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)

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.

Environmental factors and host immune response play an equally important role in facilitating development of CIRDC. There's a reason it's called "kennel cough" - several of the pathogens listed above are insufficient in themselves to cause disease without the additional stress, high contact rate, and other factors associated with kenneling.

Who is susceptible to CIRDC?

Although labeled **canine** infectious respiratory disease complex, some of the pathogens involved may also be transmitted to other species. Most notably, *Bordetella bronchiseptica* may occasionally infect people, especially those with respiratory disease or immune compromise. To prevent cross-species transmission as well as reduce stress for all concerned, it is always ideal to house ill animals separately by species.

For more information on some of the specific pathogens, see our [infectious disease "cheat sheets"](#).

Diagnostic options for CIRDC outbreaks

Virtually all pathogens listed above cause a similar overall clinical presentation of coughing and/or nasal discharge. While Bordetella-induced kennel cough 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 can not be diagnosed based on clinical signs in a single dog**. However, the pattern of affected animals can at least provide some clue as to the likely pathogens. For example, [canine distemper](#) is unlikely to affect vaccinated dogs over four months of age. [Canine 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.

Additional diagnostics are warranted if CIRDC is occurring in a population with unusual frequency or severity, or if there is the slightest suspicion of zoonotic infection. Acutely affected animals should be sampled. The ideal sample depends on the localization of clinical signs: if signs are predominantly upper respiratory, deep nasal swabs should be obtained. If lower respiratory disease is suspected, tracheal wash is the preferred specimen. Samples should be submitted for bacterial culture and sensitivity for Bordetella, Mycoplasma, Streptococcus and others such as E.coli, Klebsiella, Pasteurella, enterobacter etc. PCR is the most practical option for viral detection; panels are available which include most common viral pathogens. Keep in mind that false negatives may be caused by problems with sample handling or timing. For instance, canine influenza is shed only very early in the course of disease, and may be missed by the time clinical signs are recognized. False positives can occur following vaccination; this has been documented as long as three weeks after vaccination for canine distemper, for example. See [information sheets](#) on specific diseases for additional diagnostic options for canine flu and distemper.

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. 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 canine infectious respiratory disease 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 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.

Reduction of crowding and stress

Crowding and the attendant 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 rate, reduced air quality, and often, compromises in housing and husbandry. Housing dogs in each side of a double-sided cage intended for a single dog; housing multiple unrelated dogs per cage (particularly if not done in "all in/all out" fashion?); failure to isolate symptomatic animals; and delays in moving animals through the facility are frequent precursors of serious outbreaks in over-crowded shelters. Unfortunately, crowding in shelters is not uncommon, either due to insufficient facilities to provide even minimal care for the stray population, or (as is increasingly common) a well-intended attempt to decrease euthanasia by housing more animals. Tragically, such efforts may not only fail to improve the number of animals adopted, they may actually lead to increased disease and death[1].

An underappreciated strategy for CIRDC prevention is to simply reduce the amount of time dogs spend 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 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 assessment 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 length of stay are contra-indicated, just that the risk/benefit of every such policy should be carefully evaluated.

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 deficits, vaccination definitely plays a role in controlling CIRDC. In some cases disease can be virtually entirely prevented (e.g. canine distemper), while in others frequency and severity can be mitigated. In one study, vaccination for Bordetella and parainfluenza (with or without adenovirus) of even a fraction of dogs on intake to a shelter resulted in a significant reduction in the risk of coughing [2]. For general information on vaccination of shelter pets, see our [vaccination information sheet](#).

For protection against canine distemper, all dogs should receive a modified live (MLV) or recombinant subcutaneous vaccine immediately upon intake to a shelter (if not sooner). Puppies should be vaccinated starting at 4 ? 8 weeks of age, and revaccinated every 2-4 weeks until 16-18 weeks of age. The younger end of the age range and shorter revaccination interval should be used in high risk environments, including any distemper (or parvo) endemic shelter. Adenovirus and parainfluenza virus vaccines can be given in combination with MLV distemper/parvo vaccination or in combination with **Bordetella** via intranasal vaccination (see below).

Both intranasal MLV and subcutaneous antigen extract vaccines are available for vaccination against **Bordetella**. In general, intranasal vaccination is recommended due to the demonstrated rapid onset of immunity (3-5 days) and the potential benefits of local IgA derived protection. Additionally, this vaccine can be used in puppies as young as 2-3 weeks of age, and may provide local immunity even in the face of maternal antibody. Vaccines should be given within one year and at least one week prior to admission to a boarding facility, and immediately upon intake to a shelter.

Previous studies suggested that a killed whole bacterin SC vaccine provided superior IgG levels, and vaccination with both the IN and this 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[3]. However, if staff are unable to administer the intranasal vaccine, there may be some benefit in giving the subcutaneous antigen extract vaccine; keep in mind this vaccine must be boosted for full effect, and therefore a series should be completed at least 2 weeks prior to admission to a boarding facility.

A subcutaneous killed vaccines are available for canine influenza. These vaccines are labeled to reduce the severity of clinical signs and decrease the duration of viral shedding, though like many respiratory vaccines they may not completely prevent infection. The vaccines are labeled for use in puppies 6 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 canine influenza. 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).

Environmental decontamination/removal of infected animals

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 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. Virox®, 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 doubled sided runs separated by a guillotine door, such that the dog can be held on one side while the other side is cleaned. For facilities with a good dog walking program such that runs 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 kept the run tidy. If dogs must be removed from their run for cleaning, they should not be left in a common holding kennel nor tied in aiseways while contaminated water and disinfectant is 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 [disinfection information sheet](#).

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 canine distemper or influenza which could be fatal for another animal. Prompt removal of all symptomatic 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 observing dogs for clinical signs before walking, cleaning or otherwise interacting. Because airborne transmission of CIRDC is a possibility, ideally isolation areas should have separate air flow. However, if this can not be achieved, don't despair. Facilities have managed to maintain effective isolation by providing at least 20 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

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 an individual dog that fails to respond to empirical therapy. Orally administered prednisone had been recommended to reduce the severity of symptoms; while this may be beneficial if constant coughing is a problem for dog or owner, it has not been found to shorten the course of illness[6]. For dogs unresponsive to oral or parenteral antibiotics, nebulization with aerosol/non-absorbable antibiotics (e.g. gentamycin, polymyxin) may be beneficial. Other supportive care should include minimizing barking and walking on harness or gentle leader to avoid pressure on the trachea.

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[7]. Narcotic antitussives are specifically **not** recommended because they can decrease respiratory function. 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; therefore treatments with questionable benefit should be avoided in a population setting.

Kennel Cough/CIRDC Information for Foster Homes

Keys to preventing the spread of infection

- Always remember that vaccines do not completely protect a dog that is exposed to kennel cough. For maximum protection of your own dogs, they should receive the canine kennel cough vaccine at least 1 week and not more than 1 year before bringing in foster dogs into your home.
- 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 dogs with kennel cough after other dogs in the home have been handled.
- 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 symptoms of illness. Remember some dogs infected with serious illness such as canine distemper may be infectious to others while showing only mild signs themselves.
- Dogs can continue shedding some of the infectious agents associated with kennel cough for some time after recovery. The risk is greatly reduced once all signs have resolved. However, adopters should be asked to keep their new pet away from areas where animals congregate, such as dog parks or obedience classes, for two weeks after recovery.

Client Information Handout: Kennel Cough

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

- Kennel cough is common, contagious, and very rarely fatal. The disease is caused by bacteria and/or viruses that spread among dogs and cats in shelters.
- Kennel cough is spread by air and hands, therefore is as common in animal shelter as the common cold is in a day care center.
- Kennel cough could spread to your other dogs. Vaccinated, healthy dogs in a home usually develop mild if any signs of kennel cough after exposure to a new dog, however in some cases serious illness may be transmitted. Talk to your veterinarian if you have concerns.
- RARELY, an immunocompromised person (with AIDS or undergoing cancer chemotherapy) could be infected with ***Bordetella bronchiseptica***, one of the bacteria involved in kennel cough. If someone in the family is severely immunocompromised, please discuss kennel cough with your physician.
- Kennel cough is manageable in a home. The BEST thing to do for a dog with kennel cough is provide them with a warm, stress-free home. In this environment most dogs will recover within a few weeks.
- There are vaccines that either prevent kennel cough or reduce the severity, but giving these vaccines to an animal who is already infected will not help the animal recover any quicker.
- Sometimes antibiotics are used in treating kennel cough, and may help the dog deal with the disease. These medications can be obtained through your regular veterinarian.
- Severe, untreated cases of kennel cough can develop into pneumonia, so it is important to discuss kennel cough with your veterinarian.

When should you seek treatment for your dog?

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

Antibiotic Susceptibility Patterns

Antibiotic susceptibility patterns for positive *bordetella* cultures submitted to the Veterinary Medical Teaching Hospital (VMTH) at Davis

Antibiotic	Shelter samples		*VMTH Samples (including all shelter samples)	VACCINES
	Dogs	Cats	Dogs and Cats	
Amoxicillin/clavamox	81.2%(16)	29.1%(55)	59%(78)	100%(3)

Ampicillin	28.6%(14)	3.6%(56)	7.6%(79)	0%(3)
Timentin	85.7%(14)	66.7%(57)	71.1%(76)	100%(3)
Amikacin	100%(7)	82.5%(57)	85%(80)	100%(3)
Gentamicin	100%(17)	87.7%(57.7)	90%(80)	100%(3)
Chloramphenicol	68.8%(16)	80.4%(51)	75.3%(73)	100%(3)
Enrofloxacin	87.5%(16)	93%(57)	90.5%(74)	100%(3)
Tetracycline	100%(16)	98.3%(58)	98.8%(80)	100%(3)
Trimethoprim Sulfa	70.1%(17)	94.7%(57)	87.5%(80)	100%(3)

*Only a small number of positive **Bordetella** cultures are listed here. We are currently working on a comprehensive listing of all **Bordetella** positive cultures tested for sensitivity in the VMTH

Infectious disease cheat sheet for kennel cough

Disease name:	Kennel Cough (canine URI)
Agent:	Bordetella bronchiseptica, canine parainfluenza virus (CpiV, enveloped RNA paramyxovirus), canine adenovirus 2 (CAV-2, unenveloped DNA Virus), others
Susceptible domestic species	Dogs, Cats- Less common for cats to suffer clinical disease, but they may be carriers. In some cases Bordetella infection may contribute to URI or pneumonia in young kittens.
Zoonotic?	Yes ? rare ? most common in immunocompromised people or those with preexisting respiratory disease
Diagnostic tests:	Culture or PCR of ocular, nasal or oropharyngeal swab for Bordetella. PCR for adenovirus, parainfluenza virus available from some labs.
Test sensitivity	Good ? improved by careful sample handling
Test specificity	Good ? however, Bordetella may be isolated from healthy dogs. Specificity of culture is improved by culturing transtracheal or endotracheal wash fluid rather than oral or nasal swabs.
Test comments	Diagnosis almost always made based on clinical signs, r/o of canine distemper in severe cases.
Vaccine available?	Yes ? for Bordetella, CpiV, and CAV-2

Vaccine efficacy	Moderate: does not completely prevent infection but reduces severity of signs. MLV IN vaccine may cause mild signs including green nasal discharge that can trigger distemper worries.	
Excreted in :	Primarily ocular, nasal and oral secretions	
Mode of transmission:	Highly contagious. Transmitted by aerosolized microdroplets, fomites over moderate time/distance, direct contact.	
Disinfection	Routine disinfection adequate for all but CAV-2, which requires bleach 1:32 or potassium peroxymonosulfate to fully inactivate	CAV-2 probably a minor player in most cases of kennel cough
Incubation	3 -10 days.	
Post-recovery shedding	Bordetella may be shed up to 3 months. Viral agents shed < 2 weeks	Infectious risk is greatly reduced when dogs no longer have discharge or coughing.
Carrier state?	Yes, for Bordetella. Cats may have subclinical infections and transmit disease to dogs.	

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