Respiratory Infections in Shelters: Beyond Kennel Cough
Video Transcript

October 2013

This transcript has been automatically generated and may not be 100% accurate. This text may not be in its final form and may be updated or revised in the future. Please be aware that the authoritative record of Maddie's Institute[SM] programming is the audio.

[Beginning of Audio]

Dr. Crawford: This session is going to deal with beyond kennel cough. What happens if it's not the normal variety kennel cough that you're used to that's sort of a baseline low rumple in the dog population in your shelter? What if it's something beyond that? What would be your concerns and would you recognize any calls for action? We're going to briefly touch on what kennel cough is defined as. You may be surprised by some of the definitions.

What pathogens are now known to cause kennel cough? The list has grown every year. Are there any concerns with certain pathogens, particularly those that are emerging as more prominent causes of kennel cough in dogs in shelters? What are the calls to action? What are the symptoms of a more severe kennel cough situation in the shelter that really

requires more action than treatment with doxycycline for seven days. If we recognize those calls to action, how do we respond?

All right. Bear with me just a second. What is your diagnosis? What is this? Is this kennel cough? No? Well, then I might as well just pack up right here, *[laughter]*, because I didn't give you all enough credit. I think many shelters would call that kennel cough simply because it's a dog and a shelter that's doing lots of coughing I'm curious as to how people in various professions define kennel cough since it's such a commonly used word in our profession and shelters and also in the media.

This is how Wikipedia defines it. You know, Wikipedia is probably one of the most resourced websites to get explanations and definitions, particularly accessed by people without medical degrees. It's defined here as an upper respiratory infection of dogs caused by a combination of the canine parainfluenza virus and the bacteria *Bordetella bronchiseptica.* It is highly contagious and named because the infection spreads quickly among dogs in a kennel or animal shelter.

How many agree with this definition? Hello? Anybody out there? Don't be shy. Okay, a few. This is actually what I was taught in veterinary school. I always thought of kennel cough like this up until recently. Here is another popular source of medical information for everyone. The

veterinarian manual, which defines kennel cough as: a canine infectious tracheobronchitis often secondary to viral infection of the respiratory system. It spreads rapidly amount susceptible dogs housed in a closed confinement. That's interesting. They say viral infection, but they totally dropped canine parainfluenza virus and *Bordetella bronchiseptica* is not included in this definition by Merck.

What about this resource? Greene's *Infectious Diseases of the Dog and Cat*, the most recent addition. This textbook is considered the bible of infectious diseases in dogs and cats. This is the most recent definition of kennel cough, as any contagious acute onset respiratory infection of dogs, typically involving the upper respiratory track. The etiology is complex and it involves several viral and bacterial pathogens acting alone or synergistically. Kennel housedogs may be particularly susceptible.

We've gone from infectious tracheobronchitis caused by canine parainfluenza virus and *Bordetella bronchiseptica*; morph that into viral infections of the upper respiratory track. Now it's truly defined as a very complex infection of the respiratory track involving several viral pathogens and bacterial pathogens, typically acting synergistically. Kennel cough, really though, is just a clinical syndrome. It just describes what we typically see in shelter dogs with respiratory infection. There is coughing. There is sneezing. There can be discharge of various colors

from the nose, from the eyes. Dogs can have any one of these symptoms or they can have all together. It's just a syndrome.

Frequently, though, when I talk to shelter staff, shelter veterinarians, and they are describing to me a kennel cough situation in their facility, I'll ask them what they mean by kennel cough, and they typically try to tell me that – well, I think it's *Bordetella*, but it must be a really virulent strain because we vaccine our dogs on admission with the intranasal *Bordetella* vaccine. I still think there is confusion out there amongst all of us about what is kennel cough. Is it a syndrome or is it naming the etiological agent of the syndrome? It's really just the syndrome.

The true name or the preferred term now, at least in the veterinarian medical profession is canine infectious respiratory disease. You'll see this term used more and more frequently. It's tagged onto names of diagnostic tests for kennel cough. Instead of kennel cough test, it is now CIRD (canine infectious respiratory disease) test, and much of the literature is coming out with use of this term instead of kennel cough. It is a multifactor pathogenic complex. Many viruses and bacteria can cause the clinical syndrome of kennel cough. I have listed seven viruses on the left-hand panel, and I've listed the top three most frequently occurring bacteria on the right panel.

Take a look at this list. Does anyone see anything new in the virus world in the left-hand panel? Canine herpes virus. People know about feline herpes virus as probably the most prominent cause of URI in sheltered cats. Well, dogs have herpes viruses too. Canine herpes virus presents primary as a mild respiratory infection unless you're a fetus or a newborn puppy, in which case it's lethal. In other ages of dogs, it is a mild respiratory presentation, and then animals infected for life.

The virus will go into a dormant stage and be reactivated by stress, just like feline herpes virus is reactivated by putting cats in shelters in little microwave ovens, so dogs reactivate with stress too, and certainly coming into a noisy, busy kennel environment where there is lots of barking and strange people is enough to set off reactivation of herpes. Then share it to all other dogs that don't have antibodies already from prior infection, they will become infected. Any other viruses besides canine herpes virus in that list? Respiratory coronavirus is newly emerging. We'll talk about that.

Which one? The canine pneumovirus, new kid on the block, and just discovered in 2010. We'll talk about canine pneumovirus. I think that's going to become a much more frequent player in unusual kennel cough situations in shelters over the next few years. How about on the bacterial side? Which one? *Mycoplasma*. Those of you have actually done some

diagnostic testing for causes of a more severe kennel cough may have seen a lot of your tests come back with *Mycoplasma*. I will talk on *Mycoplasma* a little bit because I always receive lots of questions about its role in CIRD. Anything else? Okay.

All of these seven viruses and three bacteria have common pathogenic properties. They are all high contagious and easily transmitted in the kennel setting or shelter setting. They don't just colonize the upper respiratory tract. They have the propensity to not only colonize the upper respiratory track, including the trachea, but also the lungs. It's a complete respiratory tract colonization process, which leads to the different clinical signs dependent upon the extent of infection in dogs.

As I've said before, you usually just don't have one of these in a dog, there is usually a mixture and it can be different viruses all together, a couple of bacteria, or viruses and bacteria. It can make the situation more difficult to deal with. They all cause not only sick dogs with the kennel cough syndrome, but they also cause some clinical infections. You have a little stealthy "Typhoid Marys" in the population that are truly infected with the virus or bacteria, or both, and yet for some reason, that infection is not causing the kennel cough syndrome in that dog. It's a silent infection, and yet they are contagious to other dogs.

These sub clinical infections actually create the situation and fuel the situation of more spread of the infectious disease between dogs because you don't know to isolate these dogs from the general population. In addition to the typical signs of kennel cough, all of these can cause pneumonia. I'm sure all of you all seen some pneumonia in your kennel cough cases. They are all spread by direct contact with the droplets coming out of the nose, the eyes, and the oral cavity. Their major mode of spread of the respiratory pathogens, at least in a kennel setting room is aerosolizatoin.

These aerosols are generated by coughing and sneezing, and they can travel more than 20 feet in a room depending on the air currents. Here is a typical shelter kennel setting, and this walkway is about eight feet wide. You've got dogs, and you can see their little heads in there on both sides of the aisle way. So what if this dog right there was infected, coughing; do you think that aerosols generated by this dog are going to go across the aisle way here? Absolutely. Absolutely. It will also go all the way back to the end of this hallway.

This is why kennel cough, in many cases, can be an explosive number of infected dogs in a very short period of time if coughing dogs are left in place without any separation or protection of the other dogs. Then of course: staff. Staff is a major culprit in the spreading of pathogens

between dogs, and, also, if there is no bio securities measures in place. What if it's beyond kennel cough? Are there different concerns for these different causes? The seven know viruses and the three more frequent bacterial culprits.

I want to touch on some of the concerns with the traditional kennel cough pathogens, and then also taught more on the concerns for the newer kennel cough pathogens of respiratory coronavirus, influenza virus, pneumovirus, strep zoo and *Mycoplasma*. *Bordetella* is still a significant pathogen for sheltered dogs even in the face of vaccination, there still can be infection because the vaccines do not protect against infection, and they just reduce clinical signs and amount of bacteria shed from the vaccinated dogs.

You can still have *Bordetella* infections in both unvaccinated and vaccinated dogs. It causes that sort of transient self-limiting disease. It's over with in adult dogs in about five to seven days. The coughing is gone. It is deadly in puppies. Deadly. It is a very common cause of severe life threatening pneumonia in puppies because the bacteria are replicating and damaging the lungs in addition to the upper respiratory tract. This is a common cause of severe pneumonia of puppies in pet stores coming from the Missouri and Oklahoma puppy mills. I frequently get called about *Bordetella* pneumonia with puppies purchased from pet stores.

Did you know you can actually establish a chronic infection in dogs that aren't treated with antibiotics? Sometimes dogs with kennel cough aren't treated with anything. The infection is just allowed to run its course. If it's truly due to pathogenic *Bordetella*, and there is no antibiotic therapy to eliminate the bacteria, the bacteria can establish a chronic infection in both the upper and lower respiratory tract. A dog can have intermittent relapses of clinical signs, at which time; they also are contagious to other dogs. This can go on for months.

It is true that *Bordetella* is very susceptible to doxycycline, the most commonly used antibiotic in the shelter world. Thank goodness these bacteria are still susceptible, we think, to doxycycline. That's in shortage, and has been for a year or so now. People have to get minocycline as a substitute. It works equally well. Clavamox does not work as well as the doxycycline or minocycline choices. It's effective at least in the more current studies in killing only about 90 percent of the strains.

Please remember that *Bordetella* is resistant to your trimethoprim-sulfa drugs like Tribrissen and also cephalosporins, so cephalexin, Convenia injections, any of the cephalosporins. So these will not work against the organism. If these antibiotics are used, then there will be an establishment of chronic infection. What about parainfluenza virus and adenovirus type

II? Yes, these still occur. One of the older known respiratory pathogens, they frequently occur as a co pathogen situation with other more evolving respiratory viruses and bacteria. Many dogs don't ever show clinical signs.

It establishes a clinical infection. If there are clinical signs, it goes away very quickly, five to seven days. There is a situation where you can have dogs that have kennel cough to parainfluenza virus or adenovirus. It is not recognized as the cause. The shelter staff treats the dogs with doxycycline for *Bordetella*. Seven days later, the dog is cured. It's always attributed to the fact that doxycycline killed the *Bordetella*. When, in fact, it was viral and the virus just ran its course, which happened to be five to seven days for these older traditional pathogens.

Distemper, my favorite, the thing that I spend most of my time on, and I have a love/hate relationship with this virus. I think it's fascinating, but it's also – I think probably the most deadly situation that can occur in a shelter, other than a rabid bat. *[Laughter]*. Certainly this is the respiratory pathogen. It is part of the multi-pathogen complex causing kennel cough. It is the one that most often results in total depopulation of dogs in shelters once it gets in. We did a study with some Florida shelters that was published in 2010. Basically what we did was collected blood samples of dogs on admission into shelters in various geographical regions of this state. It was probably close to 1,000-serum sample total.

We tested these samples for the presence of protective levels of antibodies to distemper virus. And it didn't matter which geographical region the samples came from, which shelters, age of dog, breed mix of dog, stray or owner surrender. More than 50 percent of the dogs entering these shelters did not have protective levels of antibodies to the distemper virus. That means that on any given day and any given shelter in the state, we can suspect that at least half of the dogs on site aren't protected against distemper virus.

If one dog brings it in – poof, it will spread to all the susceptible dogs. Most recently, the Williamson County Animal Control and Adoption Center in Tennessee had diagnosed distemper cases in dogs in their shelter with kennel cough, and had to take some actions to stop the spread, including adoption and basically just shutting down this animal control shelter. They did not depopulate those. This was just March of this year.

The thing that separates distemper as being so deadly from all the other traditional and emerging respiratory pathogens for dogs is that it isn't confined to the respiratory tract. It affects all organ systems of the body. It presents primarily as a respiratory syndrome though, as kennel cough, than eventually over time gets worse and worse and worse, more severe; pneumonia, death, and many more dogs become severely ill.

This is a dog that had advanced distemper infection, lots of discharge from the upper respiratory tract. It did have pneumonia and terrible respiratory distress. And this is what a lung lobe looks like in distemper-infected dogs. It's totally filled with little puss balls. There is no room to exchange air in these lungs, so they are suffocating. But this virus also infects the gastrointestinal tract causing hemorrhagic gastroenteritis; vomiting, bloody diarrhea; the eyeballs squinty eyes, photophobia, dry eye, urinary tract. It affects the skin. Some dogs, it does affect the central nervous system to cause seizures or twitching muscles, the typical chewing gum seizure fits.

Since this virus, which we think of primarily as a respiratory pathogen, actually affects multiple systems; this really confounds its recognition as something that is beyond kennel cough. It causes the multiple organ involvement that frequently results in this diagnosis. Here is a puppy that has a large pile of hemorrhagic diarrhea. What if I told you it tested negative twice for canine parvovirus using the snap test. Would you think, well, maybe it's hookworms. It could be. Let's deworm. Maybe it's *Giardia*, *Salmonella*, *Cryptosporidium*, *[inaudible]* toxin, and all the other GI pathogens that could cause hemorrhagic diarrhea.

What is probably the last thing that people think about in puppies with vomiting and diarrhea that test negative for parvovirus? Yes, distemper. Yes, this puppy did have concurrent respiratory signs. Since it infects all the organs, this virus is not only shed in droplets from the respiratory tract, and through aerosol generated from sneezing and coughing that go all over the building, but it's also in urine. Remember it affects the kidneys. It's also in feces and vomit since it affected the GI tract. This is a bad boy.

Let's touch a little bit on the newer causes of kennel cough that are actually becoming the more frequent players. Canine respiratory coronavirus; has anyone heard of this? Have you dealt with it? Did you know you had it? Okay. Good. So there is some recognition out there that this is actually a very, very common cause of kennel cough in shelter dogs. Many shelters are endemic for canine respiratory coronavirus. It's always there. As long as no dogs keep coming in, this high density, high turnover population style in kennels and shelters, there is always going to be a low level of canine respiratory coronavirus infections. You'll always have sick dogs.

It frequently is a co pathogen with other viruses, as opposed to just initiating kennel cough itself. It does occur – or does cause a milder transient disease, somewhat like adenovirus and parainfluenza virus are certainly not devastating like distemper, or a mild or transient disease that

we see in adult dogs infected with *Bordetella*. There are large, large numbers of dogs that are infected, but yet don't cough or sneeze or have dischargers. They are shedding the virus, maybe not as much as those that are actively generating all sorts of secretions to share with their colleagues, but they are still infectious to other dogs.

Now, this coronavirus is not the same as canine and enteric coronavirus. I find that that's a frequent misunderstanding. Because when shelters learn through diagnostic testing that they actually have canine respiratory coronavirus and not *Bordetell*a or some of the more traditional pathogens causing a spike in their kennel cough cases, they go to their vaccine distributors and start ordering the DAPP with killed canine enteric coronavirus in it, thinking they'll add that to their armamentarium of preventive vaccines to give it at admissions. There is no cross protection between enteric coronavirus and respiratory coronavirus.

There isn't a vaccine. If it's in your shelter, it's going to just be there. You almost have to accept it, unless you can shut down totally and let it work its way through all the dogs and finally burn out, and then open your doors again. Canine flu, most dogs in this country are still susceptible despite the fact that millions of dogs have been infected in, I think, 40 stays. This is a little bit more of an unusual kennel cough presentation. It's like human influenza virus getting into kindergarten class, where in a

matter of two days, you have this explosive number of kids that are very sick with influenza-like illness.

We don't call it kennel cough in kids. We could just call it influenza-like influenza in dogs – a very short period of time. This virus causes epidemics of respiratory infections way beyond the typical level of kennel cough, a massive sweep through the shelter population. It also can cause very high fevers, 105-108, severe pneumonia that can be lethal if the dog does not receive hospital care because the pneumonia is just so severe that they need oxygen support and advanced care in a hospital setting.

Dogs in shelters are the highest risk group for being infected with canine influenza virus. We determined this using a study sample of nearly 1,500 dogs infected with canine flu across the United States in various housing situations. Dogs in shelters came out as the highest risk group. It is endemic right now, just like canine respiratory coronavirus is endemic in many shelters, canine influenza virus is now endemic in shelters in the Northeast section – in many states in the Northwest quadrant of the country, as well as Colorado.

It's been endemic in these states now since 2007, and it's not in Florida anymore. It's gone. It left Florida. It will be back eventually. Flues pop here and there. They are here today and gone tomorrow. They are always

recycled back. I imagine it will come back to Florida shelters in the future, it's just I can't find it in shelters right now. This virus has cause depopulation because of the epidemic status, the mass number of dogs involved, some of which die from pneumonia; it has caused depopulation in shelters in several states just like distemper has.

This is a newspaper article from a shelter in Cheyenne, Wyoming that elected to euthanize all 42 sick dogs in their shelter, but they also euthanized those that weren't sick. That's further down in the article. So there was a lot of public community outcry about that. Canine pneumovirus, has anybody had this yet in their shelter? Yeah? If not, it's coming to you soon. *[Laughter]*. I hope that if anything else, that you remember this new pathogen and what it looks like basically. It looks like flu.

Most dogs are susceptible to infection by this virus because they have no preexisting immunity. Just like influenza virus, there is just explosive numbers of dogs that are sick all of a sudden within a weeks period of time, just gone through the whole kennel. Epidemic status, just like flu – just like flu, high fevers, severe pneumonia, dogs found dead from the pneumonia in their run. Is this what you would corroborate Dr. Jackie? Yes.

This has been identified in shelters in this state, as well as it was actually discovered in 2010 and shelter dogs in the New York City animal care and control shelters, where it still circulates. Also maybe she is here – this virus – I guess I should go back to the previous. Canine pneumovirus got into a temporary dog shelter set up for displaced victims of Hurricane Sandy in New York City. This was a shelter that was housing people's pets that could not take dogs with them to wherever they were evacuated. It housed some dogs from New York City Animal Care and Control. It housed some stray dogs.

Somebody brought canine pneumovirus in, and it circulated through all the dogs from these various sources within this temporary shelter, and actually contributing to probably the length of stay there because it all had to be shut down and quarantined until the virus had run through. Strep, some of you have come – or any of you that have come to previous Maddie's Shelter Medicine conferences have heard me speak about *Streptococcus zooepidemicus.* Anybody heard of this or experienced it? Anybody experienced strep zoo? *[Laughter]*.

Not recently, yes. This is beta hemolytic strep bacteria that's in Lancefield group C. Byteria is a special name for strep zoo. It causes on two clinical syndromes. One that is very frightening and induces panic in the shelter is finding dogs dead in the kennel. These were dogs that were

normal that at 6:00 p.m. the night before, and when the staff comes in at 7:00 a.m. the next day, they find the dog dead in the kennel with its head laying in a pool of blood. I'll show you a picture in just a section. There is blood emanating from the respiratory tract.

There is a second syndrome if you catch this before dogs die suddenly, they actually present with kennel cough, but it's beyond kennel cough. It is much more severe. It is much more life threatening. It will kill the dog unless there is some intervention. Within hours of coughing and having nasal discharge, which staff may or may not recognize, the dog will rapidly progress to having very difficult time breathing. I'll show you a video of one in a minute. Respiratory distress is what we call it. They start to bleed from their nose and from their mouth. It is a very frightening presentation.

Here is a picture of a dog that was found dead in the kennel. Notice we cleaned up the background a little bit, but left this on the nose. These are actually the lungs from the chest of dogs found in this situation. The lungs are like a huge heavy, heavy blood-soaked sponge. You could squeeze them and lots of blood comes out. Not only that, but there is lots of blood in the chest. So they die of a very fulminate hemorrhagic pneumonia, but they also have hemothorax, free blood in the chest cavity.

There is nothing more suffocating than to have your lungs be a blood-filled sponge. There is certainly no way to exchange air in those situations. Thankfully it's bacterial, and if recognized soon enough, it will respond to antibiotics. Strep zoo is sensitive to any of the penicillin's, injectable or oral, injectable pen-G or ammoxicillin, Clavamox, cephalexin, unlike *Bordetella*, and Convenia, unlike *Bordetella*. Convenia is great for a situation that a shelter has with lots of strep zoo infected dogs because you can just give them an injection of this cephalosporins antibiotic, and it lasts for 7-14 days, and strep zoo is sensitive to it.

It sure beats having to give penicillin injections every day for seven to ten days, or cefalexin or Clavamox twice daily by mouth. Some strains of strep zoo are resistant to doxycycline and the fluoroquinolone family of antibiotics, which would include your Orbax, your pradofloxacin and your Baytril or your enrofloxacin. I would not use that for strep zoo at all. Actually, there is some evidence that use of fluoroquinolone can worsen the pathogenesis of strep zoo.

Then *Mycoplasma*. This is a very misunderstood bacterial pathogen that with all of our new fancy diagnostic testing, it pops up in all dogs with kennel cough so it's a frequency co pathogen. Lung damage by prior infection or primary infection, with either of the viruses strep zoo or *Bordetella*, damages the lungs. And it sets up house for *Mycoplasma* to

come in and start to replicate and contribute more to the damage situation, worsen the disease in many cases. We don't know if it can cause infection in and of its self. We see it mostly in dogs that have respiratory infections associated with other pathogens. This role as a primary/secondary pathogen is still being elucidated.

This is also sensitive to doxycycline, minocycline, azithromycin or Z-paks, as well as betro orbifloxacin, Orbax, other fluoroquinolone. This causes walking pneumonia, or at least the human variety of *Mycoplasma* causes walking pneumonia in people that have survived a bout of the flu. The flu viruses have come and gone. It's damaged the tissues, and now they can't get rid of the cough. It's two or three weeks later, so they finally go to the doctor does is put them on a Z-pak, suspecting that they have the secondary *Mycoplasma* infection that is promoting clinical disease.

Azithromycin is used a lot in dogs now. Is this sort of like what you think is the common response to kennel cough? I mean this is what I see in the majority of shelters I work with. They either don't get treated, or they are treated with doxycycline daily for seven days. Depending on the shelter design and resources, they may or may not be isolated from other dogs. You've seen all the situations possibilities out there. Most of the time this works. I'm not flooded or inundated with phone calls and emails every

day because the doxycycline for seven-day treatment approach is failing. It works in most situations.

Why is that? Is it because the dogs truly did have *Bordetella* in the face of vaccination, or it is because they were infected with paraflu or adenovirus or some of the quick hit, short-acting viruses that actually resolves in seven days too, and are not amendable to treatment with antibiotics. That's probably the real situation. What if this approach is failing? That happens too. That's when I get the phone calls and emails are because something is wrong. It's not quite right. It's beyond our normal kennel call situation.

What would be the reason to call me or call others for help? What prompts the call for action? Usually it's more dogs are sick than normal. Many shelters it's usually only one in every ten or twenty dogs that has kennel cough, and after seven days on doxycycline it goes away. All of a sudden, we have one in every five dogs are sick. Larger numbers of affected dogs – oh, but they are sicker. They are not recovering in seven days, some of them are really sick. They won't eat. They are having a hard time breathing. Oh, we found one dead yesterday in the kennel.

The other way shelters get this sort of feedback or know there is a call to action is actually from the community when the phone starts ringing off

the hook at the front desk with complaints from adopters of dogs, as well as the community veterinarians that are seeing the dogs that the new adopters brought to them. They are pretty sick, and they are seeing lots of them, so complaint-driven. This is an email that I received last week actually from a shelter veterinarian. "We have a kennel cough outbreak that is different from our normal situation." It's beyond kennel cough.

"Our problem is that these dogs, young and old, seem to be getting very sick, and some have died. The dogs may or may not show any upper respiratory signs before we see them for lung involvement." What she is saying is while they didn't catch them coughing or having nasal discharge, all of sudden they were just having trouble breathing. The shelter has little in the way of isolation abilities, which describes most shelters, and the only drug we have been able to get to have a good response with is Baytril, the big gun that we reserve for very severe bacterial infections.

"This is starting to scare me. I really don't want to create a supernova of respiratory infection that is immune to our medications." Good for her. She recognized the call for action. What about this one on June 8th of this year: "We are getting four to five new cases of URI among a shelter population a day, and now the directors closed the shelter, probably complaint-driven closure. Do you think is canine flu; we have more than one hundred dogs in this shelter. Any suggestions on what to do?" Good

for this shelter veterinarian, reaching out for help. They recognize a situation that's beyond kennel cough.

Then last year: "Hello. We recently have had complaint from rescue groups about dogs from the shelter getting very sick. We've been getting increased URI incidents and recently I euthanized 23 dogs in URI isolation." What to do? Certainly a very big call to action when you have so many dogs that are filling up your isolation unit, and you have many more than need to come in, and there is no space, or some of the dogs are getting really sick. It's driving increased euthanasia.

For some of you who attended Dr. Newberry's talk yesterday about management of ringworm outbreaks in shelters, do you remember her talking about the rules and the tools, yes, are the plans that need to be put in place on dealing with situations that are beyond kennel cough. Here are the basic tools, and there are some rules that go with some of these tools and how to use them. For intervening in situations that are not your typical kennel cough for your shelter: diagnostic testing, isolation of sick animals. There are some rules for that. There are some rules for diagnostic testing. There are some rules for quarantining of exposed animals that don't have clinical signs.

Do you remember her talking yesterday about creating the clean break, that is I agree with her, the most important tool, and the rule is prevent exposure of other dogs to those that are sick and those that have been housed with sick dogs. They are not yet sick, but what if they are infected and shedding. Then there are the struck bio security protocols, environmental decontamination appropriate for the pathogen and so forth. Why should we perform diagnostic testing? Why can't we – when we recognize that something bad is going on, just treat all the dogs with Baytril?

We need to know what's causing this more different presentation. It provides – if you know what is infecting the dogs, then you know how to manage them. You know what their prognosis is for recovery with appropriate treatment. You know what the average time to recovery will be, therefore you can calculate or estimate how much it's going to cost and what you need treatment-wise to support them, and how long you're going to have to treat them before they are no longer going to be a contagious risk to other dogs, and their disease has resolved.

It's also essential for successful intervention strategy planning. As Dr. Newberry said yesterday for ringworm outbreaks: planning, planning, planning must be done upfront before there is action, action, action. Successful intervention strategies will address – based on diagnosis and the cause of disease will help you plan to address for spread to other dogs,

to keep from adding more fuel to the fire. It will let you know how long sick dogs have to be isolated from other dogs. It will let you know how long to keep exposed dogs that aren't sick in a quarantine situation before you can release them to their outcomes.

There is no doubt about it when it's beyond kennel cough, no or late diagnosis, that is no or late recognition. There needs to be something different done, the call to action, and no or late diagnosis increase the number of infected dogs guaranteed and can lead to depopulation at that point. What do we test or how do we test or what test do we even use? Well, remember kennel cough is a clinical syndrome. You cannot diagnose based on clinical science. You don't know this. *Bordetella*, paraflu, adeno, canine flue, pneumovirus, and coronavirus – you don't know.

The best diagnostic approach to date is collection of swabs from the upper respiratory tract, and submitting them to commercial laboratories for diagnostic testing using the PCR methodology. PCR methodology detects the actual pathogen's DNA or nucleic acid. It looks for the pathogen itself. This is the best tool we have. It is very sensitive and very specific. Although I'll add a caveat to that, the sensitivity and specificity is certainly lab dependent. So beware. Some commercial laboratories

offering PCR for canine infectious respiratory disease pathogens have not validated their testing.

You cannot reliably depend upon the accuracy of their results. The three major ones: IDEXX, Antech, and Cornell's Animal Heath Diagnostic Center have very well validated PCR tests. This provides a rapid turnaround time for an answer – two to three days after submission of the swabs. Because you get rapid results, it provides for timely patient and population management. It is costly, a moderate cost. That is the same as chemistry panels, CBC, different tool tests at a veterinarian clinic or radiographs of the chest.

It can range from $82.00-$115.00 per dog, per sample, which is costly for a shelter. There is a one – and I'm not being paid by this particular lab to advertise them, but I like them because they give shelters discounts, substantial discounts. Your $82.00 test for a canine respiratory pathogen, PCR test, can be reduced to forty-something dollars. You have to ask for it. That company is IDEXX. They are a very shelter friendly company. They want to support diagnosis of infectious diseases, of many kinds, in shelter dogs and cats. They do work with shelters.

Here are the two major CIRD respiratory pathogens PCR panels. This is the IDEXX lineup, the Antech lineup. Look at all the pathogens they test

for on a set of swabs from one dog for $82.00, or shelter discount: forty-something dollars. That is very comprehensive. I highlighted this because now IDEXX has a test that actually quantifies the amount of distemper virus on swabs, which I'll get to in a second. Here are some other panels out there. Cornell's Animal Heath Diagnostic Center, right now, is the only one offering a test for pneumovirus. Only one. IDEXX is adding it to their panel by the end of the year.

Then Zologic doesn't have a comprehensive panel, and neither does Abaxis, but they are out there as other choices. How to test? The supplies you need are swabs. They can be individually wrapped *[inaudible]* swabs, which is most recommended, and what I use of course, but I work at a university. What else can you use in a shelter setting if you don't have the fancy swabs, you can use the culture rat portion of bacterial culture rats and throw this piece away. Don't swab a dog and then plunge it into the auger because that will totally negate testing by PCR.

You can even use the old wooden handle Q-tip type swab that you can get a CVS, Walgreen's, Wal-Mart, anywhere like that. Not having swabs should be not be a barrier to doing this test because you can – I'm sure you could probably use the old plastic Q-tips that they sell for cleaning ears if you needed to. Then you need some sterile plain red top tubes because that's going to be what you put your swap in after swabbing the dog.

You must wear exam gloves because PCR is so sensitive, it's subject to false positives by detecting stray DNA on people's hands that have touched contaminated surfaces in the environment, or have rubbed the face of a sick dog during the swab collection, and then the person goes and handles the next dog down the line they once swabbed, and they are just transferring whatever goes on dogs upstream. You must wear exam gloves. They don't have to be sterile, and you must change between dogs. You need to collect at least two swabs for each dog from different sites, *[inaudible]*, nasal, deep pharyngeal doesn't matter which combination, just get two swabs because that will maximize the opportunity of pathogen detection. Here is an illustration of how to do a conjunctival swab. I love this. Love this because dogs don't mind it. They stand perfectly still for this. It's apparently not bothersome to them so you are just taking the Q-tip part and rubbing off some of the epithelia cells in that conjunctival sac. Dogs hate this. *[Laughter]*.

It's very difficult to get a nasal swab other than just – you don't want to just swab right here at the nasal opening. You need to get in there. They will give you one shot, and then that's it. You'll never get it again so you better practice a little bit, and then – you won't get it again. The other option besides conjunctival swabs will be open wide and swab back there

at the tonsils, like what physicians do to us when they want to test for strep throat.

Stay off the tongue, don't bring up a big spitball because that sample is heavily contaminated with and are not very good for PCR testing. Then you stick the swabs down into the red top tube, snap the handle, whether it's plastic or wooden, and to release the tip, itself, down into the tube. Then get rid of the handle. Here is a sample of a tip in there. What's missing? I said collect two swabs per dog. This one only has one. Actually when you get the second swab, you just stick it right in that same tube. With the first one, snap the handle, close the top, and off it goes to the lab.

Do we need to worry about when to collect the samples, the timing of swabbing? Yes, we do because the timing of sample collection is very much affected by each respiratory pathogen's incubation period and shedding period. You obviously want to swab dogs when the pathogen is there because PCR is a test that looks for the pathogen, itself. So we have to be sure we're choosing the correct dogs to get a shedding sample for all of the pathogens.

Notice that the incubation period for all of these major viral players is less than one week. Which means that the dogs are not going to be shedding –

are not going to be – let me put it this way. Most viral pathogens are shed in highest amount during the incubation period. The incubation period is defined from the time of actual infection to the time of onset of clinical science. That can be two days. That can be four days. It can be seven days.

In the case of distemper, one of the things that make it so bad, on average, it's two weeks between the time of infection and the dog starts showing clinical signs, and the whole time it's infectious. It's in that "Typhoid Mary" stage. You need to get dogs that are more acutely affected. They have only been sick for two to three days, not dogs that have been sick for seven or fourteen days. The pathogen is probably gone except for distemper. They shed for a very short period of time, except for the bad boy, where dogs will shed distemper virus and all discretions from the body from weeks to months.

It's hard if you're testing for this, it doesn't really matter which dogs you select because if they are infected with distemper and they are still ill, you are likely going to find the virus. All the other dogs, it's highly dependent upon the shedding period. So you want to get cases that are acute onset. You don't want to stop there. Don't just look at the sick dogs. Get all the dogs housed in the same run, all the littermates, dogs across the aisle way, dogs that have been exposed to the sickness dogs. Test them too.

The reason is because if they are infected and they are in that clinically silent incubation period, they are going to be shedding tons of virus. It also lets you know how far this has spread beyond the nucleus of the sick dogs. You want to test at least ten, at least ten. I have asked this question all the time. Well, can we do one or two dogs? No. No. You have to do at least ten in a population, you know, five six dogs that have been sick for more than three days.

Five dogs housed nearby that aren't sick. And by testing this number, it will increase drastically the accuracy of your test result, and whether there is a pathogen or pathogens that are actually responsible for the infection of most of the dogs. It looks for a pattern. You're not going to have your diagnosis based on testing of one or two dogs, and thinking that's actually what's going on with everybody. There needs to be a good sampling. Yes, it does take some resource investments upfront. What's that think that Dr. Newberry said yesterday? Pay now or pay later.

This is why you want to test acute and exposed. Here is virus amount of the first seven days of infection. This is typical for all of our visits except for distemper. Incubation periods are less than seven days from infection to onset of clinical science so here is the amount or degree of illness the dogs are showing up until – they could have kennel cough for two weeks.

But you want to get dogs here, where they are shedding the most amount of virus for this test to pick up. I love PCR. It is our best tool for diagnosing what's causing the atypical kennel cough, but there is a diagnostic dilemma with it just like for most tests.

PCR doesn't know the difference between a vaccine strain in the dog and a true wild type pathogenic strain. It can't tell the difference. It's just the virus, whether is the safe vaccine strain or the disease-causing wild type strain. Yes, the guidelines for vaccination of dogs in shelters, as put out by AHA, states that all dogs should receive the modified live distemper adeno/parvo combination sub-q, and preferably the intranasal vaccine containing live *Bordetella*, modified live paraflu, and modified live canine adenovirus.

How many shelters or how many people in this room follow the guidelines by giving these two vaccines to all dogs on admission? Or at least most of them? Okay. Great. Great. Most of us do. Unfortunately, the *Bordetella* adeno and paraflu vaccine strains in the intranasal form of vaccination stay in the nose for weeks – six weeks according to this study. They are not protective against infection. They just ameliorate the disease signs, which we like that. We like less – it does have to be infected, at least it's nice that they are less sick and sick for a shorter amount of time.

What if we are sticking a swab in that dog's nose after a recent intranasal vaccine, and our results come back *Bordetella*, paraflu, and adenovirus? Are we going to be able to know is that infection in the face of vaccination, or is the PCR really just telling us, yeah, your vaccine strain is doing its job? It's still in the nose. We can't tell. I think there is a real dilemma now in diagnosing true *Bordetella* paraflu and adeno virus infections in shelter dogs with kennel cough using PCR.

There is not a method that I know of that could differentiate the vaccine strain from the pathogenic strain for these three pathogens in the face of vaccination. It doesn't matter, I guess. Paraflu and adenovirus are going to go away quickly, probably not the calls of beyond kennel cough. *Bordetella*, if the dogs are getting put on doxycycline anyway, we are taking care of that if it's truly there. It is a dilemma but not our worst dilemmas.

It also – this test cannot differentiate between live strains of distemper and our usual DAPP combo given sub-q. Believe it or not, the distemper virus make its way to the mucosal surfaces of the respiratory tract, where it replicates and doesn't cause disease because it's attenuated, but it induces a good immune response. It's here in the same sites that we swab if we are looking for what's causing this dog to be sick in the face of vaccination.

We, in conjunction with Dr. Luginator at IDEXX conducted a study on a rather large population of healthy dogs in a local shelter that we swabbed every dog on site every other day for two weeks, as long as they were in the shelter. We knew the vaccine dates for each of those dogs. We submitted these swabs to IDEXX for testing using their respiratory pathogen panel, and we found that less than 20 percent of these healthy dogs that had been vaccinated within a two-week period of swabbing came back positive for distemper or adeno or paraflu.

This is something that I deal with every day with shelter veterinarian trying to interpret their PCR results, and I'll show you that dilemma is just a second. It is a conversation that I can just count on having every time. In PCR, frequently, the text, the replicating vaccine strain of distemper is the other two pathogens. Infrequently. I like to use Merial recombinant canarypox vaccine. It has a recumbent DNA of distemper virus in it during distemper outbreaks.

I recommend that shelters switch from their modified live vaccine and to the recumbent canary poxvirus in the face of a distemper outbreak that we're trying to work through. And it is because PCR will not detect distemper in dogs that received that vaccine. To get around this diagnostic dilemma, IDEXX created a quantitative CDV PCR test that tries to

differentiate between vaccine and wild type strains based on virus quantity on the swab. This has been the bane of my existence. I love the attempt, but it has caused much confusion.

They sort of set this threshold of virus amount below, which the result on PCRs probably is due to detection of the vaccine strain, and above which – well, it's probably a truly infected dog. They did several studies basically using the swabs that we submitted from that large group of healthy dogs that had been recently vaccinated, and a matching cohort of dogs with true distemper infection. We looked at the virus counts by PCR technology in both cohorts, and established this cutoff point for vaccine interference.

Here at their three ranges. And those of you who run IDEXX PCR panels now, they all have the quantitative distemper analysis on it. So you have seen the three ranges put on the printout for the results. If the virus count is less than 105,000, it's probably a vaccine strain as long as the dog is recently vaccinated. If the virus count is in this range, 105,000 to one million per swab, we don't know. It could be vaccine strain, it could be real infection.

If it's above one million virus particles on the swab, it's likely a true infection. This is how the report comes back. This is a dog two weeks in shelter stay. It did get its intake vaccines that are recommended.

Something is going on the shelter. It's really bad. This is one of the dogs that were swabbed. It comes back positive for distemper virus. This is the quantity; this is the interpretation.

Is this dog infected? Not according to their cutoff threshold for vaccine interference. This is 2,000 virus particles in this sample. Their cutoff is below 105,000, and dogs that were recently vaccinated could be detecting the vaccine strain and not a real infection. If the dog has not been vaccinated recently or received the recumbent vaccine and positive result, even this low 2,000, is consistent with true infection, early phase, recovery phase, don't know. Retest in one to two weeks to differentiate between the possibilities. Is that helpful to you? Retest in one to two weeks? Hold the dog for another one to two weeks. It's sick. It's probably getting worse. Where am I going to put it? I don't know if it's infected or not. No. It's not that helpful.

We did a study on truly infected dogs. These are the Bushnell puppies from 2010 that you may or may not have heard about. The Puerto Rican puppies that came infected with distemper and parvo. We swabbed these puppies at numerous time points while they were in our quarantine, and even when they were placed in the homes. These are the survivors. Each line represents a single dog swabbed at different time points after recognition of illness. The virus was quantified by the PCR test at

IDEXX. Here is the cutoff for vaccine strain. Here is that indeterminate we don't know range, and anything *[audio ends]*.

[End of audio]