Canine Infectious Respiratory Disease
Dr. Stephanie Janeczko
Video Transcript

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Introduction: So welcome to Canine Infectious Respiratory Disease presented by Dr. Stephanie Janeczko. After receiving her DVM from Cornell in 2004, Dr. Janeczko worked in a small animal practice, shelters and rescue groups before returning to Cornell as a shelter medicine resident. Stephanie completed her residency in 2009 and began working at Animal Care and Control in New York City shortly thereafter first as medical director and later as director of operations.

She currently works at the ACPA as senior director of community outreach shelter medicine programs working locally in New York City as well as nationally to help shelters and animal welfare groups develop and improve their medical programs.

Stephanie holds a master's in epidemiology and is board certified in canine and feline practice through the American Board of Veterinary Practitioners. She is a member of the organizing committee and vice chair of the credentials committee of Board Specialty and Shelter Medicine Practice. She is also a certified animal welfare administrator and serves as the president of the Association of Shelter Veterinarians. Dr. Janeczko. *[Applause]*

Dr. Janeczko: Thank you. So we have a pretty big topic to cover today.
We have an hour to talk about infectious respiratory disease in shelter dogs and this honestly could be a three or four-hour presentation. Usually I stretch it out into at least two hours and so what I'm going to try to do is really hit the high points recognizing that there's a lot of detail that goes into this topic when we think about all of the different etiologic agents that are involved, all the different aspects with diagnosis of an infected dog particularly depending on what agents might be at play and then thinking about treatment and management.

So certainly we can't cover absolutely everything from A to Z related to infectious respiratory disease in dogs so we'll try to hit the high points and I'm going to talk only about some of the specific etiologic agents more in the sense of the ones that are emerging or re-emerging and maybe are not quite as familiar to you as something that we see on a more regular basis like bordetella or parainfluenza or adenovirus.

So as I'm sure you're aware, we refer to this as the canine respiratory disease complex because it really is a disease complex. And while we often talk about it like it's a single entity or it's all the same and it's frequently referred to as kennel cough, which really is a misnomer, we all know that this does much more than just cause cough. And it does much more than just effect dogs who are housed in kennel environments, it is a complex. It's a complex of different organisms and a lot of different synergies that will result in a particular clinical picture in an individual dog or in a particular shelter.

But this amongst the most common causes of acute respiratory disease in dogs in general and certainly when we think about shelter populations this is something that's a particular challenge for a lot of organizations and for a lot of us veterinarians who work with these organizations. There is multiple pathogens that may be involved. This is a somewhat complete list. It grows constantly so if you come back to a similar presentation in a year or two, odds are there's going to be at least one more thing that's on there.

So we think of viruses like parainfluenza virus, adenovirus 2, certainly canine distemper virus, influenza itself, herpes virus, respiratory corona virus, even things like reovirus. Some of these we don' really understand exactly what their role is and we don't think of them as being big players as some of the other agents are, but certainly ones to consider. And then we have bacterial causes like bordetella, things like strep zoo. Certainly mycoplasma is frequently a secondary player as an opportunistic pathogen and then many, many other secondary bacterial pathogens as well.

And so knowing what an individual dog has or knowing what an individual shelter has really can become important in helping us hone our management and treatment strategies but it's going to take a fair bit of work sometimes to get there because our clinical signs are not going to be sufficient to distinguish amongst the various causes of the respiratory disease complex. None of the signs that any one of these agents are going to cause really is pathognomonic and will tell you, okay, great, I have canine influenza or I have bordetella and I can go my way without doing diagnostics. This really does become something that we require laboratory assistance with.

When we do think of the clinical signs that we see, typically they're upper airway as we would expect. We may see ocular and nasal discharge. It will depend a little bit on what pathogen is involved. So if we have something like adeno, we might expect to see a little more conjunctivitis, coughing with or without that terminal retch, and I know in my experience that actually gets presented to me in a shelter setting as a dog who's vomiting.

The dog is mistakenly identified by staff or volunteers as having had vomited in the cage or making efforts to vomit and it's really not a GI issue; it's a respiratory issue where they're having that gagging cough with that terminal retch at the end and they're producing that kind of white frothy foam that comes up. Certainly we can see a fever, but usually these dogs are otherwise, bright, alert, responsive. They seem fairly healthy.

Now, we can definitely have more severe clinical cases, and we can absolutely have pulmonary involvement certainly with some organisms more so than others or when we have co-infections or other reasons for comorbidity. Higher fevers, evidence of pulmonary involvement like dyspnea, labored breathing, lethargy, anorexia would be concerning though we may have a more serious presentation.

Now I did mention before that the clinical signs are not sufficient to distinguish between the pathogens and nor is the severity of the clinical signs helpful to really help you shorten the list. So we'll talk about distemper specifically in a little bit because it is something that we really think about as being a re-emerging pathogen, but canine distemper infection in an older dog mild infection can look absolutely like bordetella or absolutely like influenza. It can be a little bit of a snotty nose, little bit of a cough without any other signs that might be a tip off, so we can't go by severity in terms of deciding what might be likely to be at play or to make decisions about isolation.

So, clinical signs, severity and the prevalence of the actual etiologic agents can certainly vary in individual dogs. It can vary across shelters and we do see some variability at least in terms of what's been reported in the literature between pet dogs and shelter dogs and so there's relatively limited data, but in one study, bordetella and parainfluenza were the most common causes of respiratory disease, infectious respiratory disease in pet dogs and they very rarely found distemper and they never found influenza in that particular study when they investigated in pet dogs.

Another study, not the same one, looking at shelter dogs, found a lot of influenza, also found strep zoo and found bordetella and these were a couple of abstracts that were published through ACVIM in 2009 and 2012,

and I can always get you the reference if you're interested. So these are the prevalence rates just from that one specific study and interestingly, this was specifically comparing client-owned dogs and shelter-housed dogs.

They didn't find any influenza or strep zoo so we can see changes with time. We can see changes geographically or with different populations, but you can see mycoplasma, bordetella, adenovirus 2, distemper, herpes, parainfluenza or respiratory corona virus and the relative percentages. So the top row are sick dogs from the community, sick dogs from the shelter and then healthy dogs from the shelter and a lot of variability.

A couple of things that stand out so they never found distemper in community sick dogs, didn't find a lot in shelter sick dogs, but more frequently. So we'll see a different profile and depending on what population of dogs you're dealing with, where they were coming from before they came into the shelter, how they're coming to you, was it through rescue, was it through a larger, open-admission shelter may have some influence on what you see as well.

So thinking about all of those different possible causes, either acting alone or in concert with one or more of the other, there is a really, really highly variable incubation period that we have to consider with infectious respiratory disease. Typically most of these are going to fall within the three to ten day range, but the actual range on the short end, as little as two days to incubate influenza, as long as five weeks or even slightly past that for canine distemper virus. So huge variation there and we can kind of hedge our bets with that three to ten-day range, but recognize some will break earlier, some will break later and that can be a challenge with quarantine when you don't know specifically what etiologic agents you're dealing with.

Infectious respiratory disease in shelter dogs is going to come from one of two places; either it's community acquired and they came in with prior exposure or it could be in shelter exposure and you may have a mix of that going on in a particular facility. The specific morbidity does tend to depend on the population and on the pathogens in question.

So we know that co-infected dogs have more severe infections, other things that are going on, concurrent illness, stress, certain practices within the shelter can increase the severity of disease that we see and we'll also see significant variation in the frequency that respiratory disease is identified within shelters anywhere from very low rates to really high rates of endemic disease in shelters that have a chronic problem.

Not surprisingly as with many of the conditions that we deal with, puppies and immunologically naïve dogs are at the greatest risk certainly of

infection and definitely of severe disease. Thankfully mortality is generally low with some exceptions. Some notable exceptions -- we often think of things like strep zoo causing a higher rate of mortality at least in certain populations. Distemper in younger dogs certainly we worry about higher mortality rates.

But I want to remind everybody and I realize this is something that we all know; even when we're familiar with the slew of pathogens that may be present in the population that we're dealing with, the introduction of new agents is always possible within the community. The way that people move and the way that dogs move, it's always possible for something new to walk in the door, and so it's really important to be mindful and especially to have a good feeling of what's going on and what's typical to be able to recognize more quickly when there's something unusual and to act on it.

Most of these pathogens are pretty efficiently transmitted through direct oral nasal contact and aerosolized respiratory secretions which can be as far as a 25-foot distance. So that is important to bear in mind when we think about isolation and creating adequate population breaks to protect incoming dogs or to protect healthy dogs that are within the facility.

For shelters, fomite transmission, even though it's not the primary means of transmission -- and a lot of these are fairly wussy pathogens in terms of their persistence in the environment, fomite transmission can still be a significant concern for shelters. And for some of the other pathogens we have other routes of transmission that may be pertinent. So when we think of distemper we have to think not just about respiratory transmission, but for the most part that's what we're considering.

And then of course, unfortunately we often struggle with practices in the shelter that can enhance transmission or facilitate transmission through things like overcrowding, unplanned co-housing or comingling and that can be within the primary enclosure. That can also be haphazardly combining dogs in play groups where you end up with a high rate of cumulative exposure and you can potentially, especially if you have an incubating dog that you didn't realize, expose a lot of dogs within the facility.

Housing design can certainly be a challenge from layout or the style of the kennel enclosures. Having inadequate isolation facilities or isolation practices, so I know this isn't a dog example, but this is a bank of shoreline cages with cats in it and there is a little sticky note up here and there's actually one that's fallen on the floor whose cage I have no idea that it came from but they say I'm sick, touch me last. No idea who it came from; don't know what they're sick with, so certainly when we have

isolation practices like that we expect that we're not going to do a good job of containing disease.

Our cleaning procedures, challenges that we have with cleaning may actually exacerbate spread. This was a shelter that was housing dogs on both sides of the guillotine and so they had to remove everybody individually. They couldn't do a move one down system. They couldn't put everybody on the other side. They hadn't worked out a plan at this time to have the dogs walked while staff was cleaning and so dogs were tied out and you can imagine what type of disease transmission and barking and aerosolization we can get there. Other examples, contaminated mop buckets, our cleaning equipment serving as fomites and then certainly common areas and surfaces serving as a point of contact for disseminating an infection throughout the facility.

When we think about shelters, there's absolutely a role for shelters in recognizing and sometimes maybe being involved with the emergence or re-emergence of certain diseases and shelters are absolutely a reflection of the community in which they reside and that they serve, so I don't want that to sound at all like it's pointing a finger at shelters, but a lot of the emerging respiratory pathogens have first been recognized in shelter populations.

And we think of shelters as being a particular risk for infectious respiratory disease because of our often high density housing. Frequently we have randomly sourced animals that we know little about who often have had little or no preventative care before they've come to us. So this is just within the last decade or rather the last 11 years. These are all new pathogens that have been identified and the asterisks, which I actually didn't need to put on because they've all been associated with shelter populations.

So the respiratory corona virus, canine influenza virus, strep zoo and pneumovirus and you know, we think about flu originally with race track greyhounds, but then we think about how it's really become a challenge for shelters. So as the list of pathogens goes up, our risk of having to deal with this in shelters increases. And so remember there's a lot of synergy that can go on.

I'm sure some of you have seen this slide before. This is actually a slide that was originally done by Dr. Kate Hurley, but we have our bacteria and our viruses where we can have co-infections and then certainly we have other husbandry considerations that can exacerbate or add to disease whether that's crowding or stress, inadequate sanitation, all of those things that we talked about.

So I'm going to hit a couple of the newer, the emerging pathogens. I'm not going to spend a lot of time on them, but I just wanted to say a couple of words about them to at least have them in your head. If they're not ones that you routinely think of -- probably not ones that you routinely see, but just to have on your radar.

So canine respiratory corona virus is a group 2 corona virus. This is distinct from the GI tract corona virus that we typically think of in dogs. So this is a distinct virus and it was first reported in 2003 in the UK in shelter dogs. And then not surprisingly, as often happens when new pathogens are identified, when people go back and look at archived samples, there's evidence that it's been circulating since at least 1996, so not super new, but not something that we necessarily think a whole lot about right now.

Most commonly it's been associated with mild upper respiratory symptoms and some have actually questioned its ability to cause disease as a primary pathogen. Whether it just is involved as a bad co-actor that sets dogs up for infections with another pathogen or exacerbates those is a question mark still, although there have been less frequent reports of severe disease seemingly caused just by respiratory corona virus.

In the US it certainly seems like it's here. More than half the dogs that were tested in a serum prevalence study had evidence of prior exposure. And we see high rates of seroconversion over a pretty short period of time. So really within three weeks you can see seroconversion suggesting that it's easily transmitted which would be a concern for us in a shelter environment.

By and large it's thought to be a respiratory pathogen. There's a little bit of evidence and some question mark as to whether or not it's just limited to infection of respiratory tissues. There have been some case reports where it's been isolated from other organisms, other organs rather, GI tract in particular. In those cases, those dogs often had other co-infections. One of those reports the dog was also coinfected with parvo and so maybe it just happened to be there not because of an actual tropism for the tissue, but just by nature of the damage from parvo, but I mention it because it raises at least the theoretical possibility of fecal-oral transmission. And so if you are dealing with respiratory corona virus that may be a piece to think of not just with the respiratory transmission.

Another new one that you may be familiar with is pneumovirus infection in dogs and this is another recently identified pathogen associated with the respiratory disease complex. It's in the paramyxoviridae family so same family that has parainfluenza and has distemper in it, but it's most closely related to a murine pneumovirus and respiratory syncytial viruses. So

canine distemper on the phylo-genetic tree – canine distemper is out here. Canine pneumovirus is over here, and again, much more closely related to the murine pneumovirus.

So, this one was isolated from shelter dogs that had acute upper-respiratory symptoms. These were nasopharyngeal swab samples and of a little over 200 samples there were 13 that ended up having this isolated. And how it was first found, how it was first identified was there were virus isolations being carried out on these nasopharyngeal swabs and they were seeing cytopathic effects in the cell culture that were different from those you would expect to see with other causes of infectious respiratory disease. Doing additional testing from other locations they found other positives. So it's not just this population. It's not just this group of dogs. This was work that was done at Cornell.

What's been tested and where it's been reported right now is pretty limited so northeast US, South Carolina, Nevada. That's not to say that it's not elsewhere. There hasn't been a whole lot of work looking for this, though. We're unclear really what its role as a primary pathogen is. Most of the dogs that had pneumovirus found in them were also coinfected usually with influenza, sometimes with parainfluenza. But there is at least a potential for virulence.

We know that the main pneumovirus can cause clinical or subclinical disease. So again it's a lot of question marks with regard to this, but something that you'll probably hear more about. And there is ongoing research looking at the prevalence and the genetic diversity of those new virus isolates, and where it fits into in terms of its real significance as a player in the respiratory disease complex. So that's actually being done here. That original paper came out of Cornell and Dr. Ed Dubovi in the virology section of the animal health diagnostic center, and that work is continuing here and specific testing is actually done through Cornell.

Canine influenza – I always hesitate as to whether or not to put this in. I'm on the fence about whether or not I think it still legitimately falls into the emerging disease category, and I think that answer probably really depends where you practice. If you're in the New York City area, if you're in Florida, if you're in Colorado where we've seen a fair bit of flu for a fairly long time at this point maybe it doesn't feel like an emerging disease anymore. But even upstate or other areas of the country where we see it a lot less frequently it's still a fairly new player in the respiratory disease complex.

So 2004, originally found in Greyhounds in Florida racing tracks. Not surprisingly with most of these when people go back and look it's been circulating for several years before that at least back to '99. It's an H3N8,

so different from the avian influenza strains that are circulating out there. This was intra-species transmission from horses. Nobody really knows how that happened, but it did, and it subsequently been reported, since those original reports in 2004 in most states in the US and that for the most part now is not associated with race tracks.

It's something that we think about as being problematic for any dogs that are in high-density housing. So certainly shelters, boarding facilities, any type of environment where you have that potential risk of transmission and ease of transmission. It is something that we often do think about very specifically as being connected to shelters and that we do have some literature that reports on specific evidence of in-shelter exposure as opposed to community exposure.

This was Northeast Mid-Atlantic Shelter. This was published in JAVMA a couple of years ago and they looked at seroprevalence for dogs whether or not they were seropositive and what really was the distinguishing factor was whether or not they had been in the shelter for at least a week. So when they'd been in a shelter less than a week it was only about 15 percent that were seropositive. If they'd been there eight days or longer you can see it jumped all the way up to 71 percent. And the number of days that a particular dog spent in the shelter was the only factor that was significantly associated with having a positive flu titer.

So it wasn't things like their origin or previous vaccination history or anything like that. It was solely reflective. The only risk factor that they could find was length of stay in the shelter. And the odds of having a positive test went up for every three days that they spent.

A little bit different than what's been reported in pet dogs. This is out of Colorado. So CIV is considered endemic in Colorado. It's one of our sort of hot spot areas and Colorado State has some unpublished data that you can sort of dig around and find this paper that 11 of 16 shelters that had reported to the laboratory that they were experiencing an outbreak of infectious respiratory disease had at least one dog in their population test positive for influenza. So it's something that at least we have some evidence to support probably comes up with some frequency amongst infected dogs in shelters in Colorado.

When they looked at pet dogs, less than three percent for the pet dogs that were seen through the community practice service at the teaching hospital were seropositive. A little higher for dogs seen by other services, and the association that they found was with daycare visits. So again, some type of higher density housing, contact with dogs maybe from multiple locations that seems to be a risk and when you think about the types of situations that we encounter in shelters and the types of dogs that we often

have in our shelters, that makes sense that it's potentially a bigger challenge for us.

So New York, Florida and Colorado are the hot spots, but the shaded out states, so the sort of brownish states are all of those that have reported influenza in the dog population. These ones we just – they don't have any positive test results. It doesn't mean it's not there. It just hasn't at least been submitted for a positive test result.

Whether or not it causes high morbidity in non-endemic populations I think is a little bit of a question mark certainly in terms of the high morbidity. Influenza certainly we have seen spread since it was first identified in 2004, but we still see it predominantly in specific geographic locations and it hasn't sort of been this complete wildfire spread to every dog in every community where a flu positive dog has potentially gone. The clinical signs are still indistinguishable from all of the other causes of infectious respiratory disease.

The cough, which can persist for quite a while, nasal discharge – I see that frequently in dogs with influenza that I've seen -- mostly mild disease though with severe disease in lower respiratory involvement possible. The hemorrhagic pneumonia that was originally reported that was sort of that really scary initial though that wow, this is what happens to a certain percentage of all dogs that are infected with flu; we don't often see that.

It does seem to be something that's not limited to Greyhounds but maybe more frequently seen in Greyhounds either because of they themselves or maybe because of the physiology of these being dogs that are high performance in exercise. I have seen hemorrhagic pneumonia in dogs who have tested positive for flu and no other pathogens so I do believe that it can occur. It's not something that I think of as happening particularly frequently though.

The nice thing about flu is that while it has a short incubation period of two to five days it also has a pretty short shedding period. So shedding peaks just a couple of days after infection, but it's over within a week to ten days. So at least this isn't something that they stay contagious forever with. This is just average clinical score and this is days post-influenza challenged. So you can see you get the big spike right here at about four to five days post-challenge. And then this is the viral shedding. What's unfortunate about this is you get viral shedding that goes up very early just within a couple of days of challenge before you may see clinical signs.

And so when you line them up because I have a hard time looking at stuff that isn't line, the red line right here was when the dogs were challenged. The blue line is the onset of viral shedding and you can see it's not quite

peak, but it goes up quite dramatically and then here is where clinical signs come in.

So a couple of days later and then peak shedding is over pretty quickly. But this is challenging because the clinically ill dogs shed the highest level of virus very early in infection, probably before you're necessarily going to identify them and that creates a real management and control issue on top of the fact that a proportion of the dogs exposed to influenza who become infected, probably about 20 percent of them, don't actually go on to develop clinical signs, but they can be contagious to other members of the population.

Strep zoo is the last emerging pathogen that I'm going to talk about. I'll touch briefly on distemper and then we'll get into treatment and management. *[Inaudible] Streptococcus equi*, the sub species *zooepidemicus*, which probably, if you don't do a lot of large animal work may ring a faint bell in your head as having to do with horses, back in the days when you were in vet school.

This is a beta-hemolytic strep. It falls within Lancefield group C and I point that out because strep canis, which is a normal commensal, is group G, and that we'll talk about when we get to diagnostics. That can be helpful in getting an early diagnosis if you think you have a strep zoo case and you're waiting for a culture, they can do that Lancefield grouping very early. They can gram stamp for you, take a look and then do the grouping and you can get, certainly some level of comfort or discomfort that you may have strep zoo going on there.

So this is the one that we think of as causing strangles in horses. It's rarely been isolated from healthy dogs. Really, the association is with typically severe respiratory disease now when we do think of this in dogs. And this one's pretty recent too. The first reports of severe respiratory disease in populations of dogs came out just in 2007 and then subsequently there were outbreaks reported in Korea, in the United Kingdom and in the US. With mortality rates that were often high prior to and immediately following the diagnosis. So whether or not that's because there were other pathogens there and this somehow became involved or it took a little while to detect this and that was that high mortality rate isn't always clear.

Anecdotally, the outbreaks and certainly all the outbreaks have not been published so not all of this you can pull out of the published literature, but speaking with people who do consults and some of the cases that I've seen we tend to associate, not always, but frequently strep zoo with large, urban often open admission facilities that often are in flue endemic areas or they have flu as a coinfection as well.

In terms of clinical signs we can see coughing, nasal discharge, a fever, which is often very high but one of the really scary things about strep zoo is it can cause peracute death, and I have had inquiries and I've done consults where essentially the presenting complaint was we're finding dogs dead in a pool of blood in their cage and we're really didn't appreciate that anything was wrong with them before. In full disclosure this is a dog sleeping on a red, velvet pillow. It is not a dog dead in its cage in a pool of blood. I just feel compelled to say that.

So these dogs, this peracute death or this very early death with strep zoo infections may or may not be preceded by antemortem signs that are noticed by staff. Affects all ages. Most of the cases seem to occur within seven to 14 days of exposure, but as soon as 48 hours. And the epidemiology really remains unknown. We don't know how this gets into shelters. We don't know exactly all the ways it's transmitted. We don't know a whole lot about incubation period, carrier states, how long they stay infective after you implement treatment, so this to me is a management nightmare because we don't have all of those pieces of information that we often base our recommendations on.

Postmortem is often the way this is initially diagnosed so not surprisingly if a shelter is finding dogs deceased with large volumes of blood, necropsy is a very good step to take. And it's really dramatic if you open up the thoracic cavity red, rubbery, consolidated lungs, a lot of free blood in the thorax. The lungs will ooze if you cut into them. You may see some hemorrhagic fluid in the nasal cavity and then if you open the abdomen, if you open the pericardial sac, you don't have blood. It's not a rodenticide case and certainly you can test for rodenticide or another coagulopathy and make sure that's not what's going on, but this is just limited to the thoracic cavity.

What's helpful, what I found very helpful, is if you do the necropsy, often the bacteria is there in such great numbers that you can do impression smears or you can make a smear out of some of the fluid sample and at least get some information looking for numerous chains or clusters of gram positive cocci. These are pictures out of a vet path article on strep zoo. So epidemiology is largely unknown. It's hard to say a whole lot about it. We don't understand risk factors, certainly not completely or shedding or carrier states, and this also means this poses an unknown risk to other pets in homes or sending these animals out to rescue or to other foster placement out in the community.

There has been one case of transmission that's been documented to an exposed pet. That happened at a kennel. No documented transmission of a dog going from a shelter to a home. That's not to say that it couldn't

potentially occur. It's certainly worrisome. Really scary, one clinical case of reportive transmission from a dog to his attendant, so it raises the question mark of there is at least a potential for this to be zoonotic under certain exposure conditions or maybe for certain individuals and it's also been reported in cats now as well, causing rhinitis and meningitis and also there's been an outbreak reported in cats.

Canine distemper I did include as a re-emerging virus. And I'm just going to touch on it briefly. We could spend a whole hour talking about distemper, which we won't, but this is an enveloped RNA virus with genetically diverse isolates. So those isolates vary in their pathogenicity although their serologically homologous. And so that, the genetic makeup of this specific isolate that infects the dog will influence severity and the type of extent of disease that we see. So what picture of clinical signs along with other things like that animal's immune system, whether or not they've been vaccinated previously and their age or if they have natural immunity.

It can infect a wide range of hosts so certainly we think about it infecting dogs. Don't forget this can also infect things like raccoons and the picture of the animal control truck. Some of you may remember several years ago there was an article on animal sheltering about an ongoing distemper outbreak in a shelter that they eventually managed to trace back.

They couldn't figure out where the ongoing exposure was coming from and it was actually related to animal control transporting sick raccoons that actually were infected with distemper at the same time as dogs and so we were having exposure before they even walked in the shelter. So certainly if your organization deals with wildlife this is a consideration as well. And so for some populations this is very much a re-emerging disease.

This also has one of those really frustrating incubation periods that I just want to point out. So typically what we get is a fever that spikes three to six days following infection, often goes unnoticed and then the clinical signs that might raise the flag for distemper occur somewhere one to four or maybe a little bit more weeks following exposure. And what clinical signs you're going to see depend on the strain virulent, on the environmental conditions, on the virus load that the dog is infected with and certainly host immune status.

Shedding can start as soon as seven days following infections so these dogs can be contagious before they're clinical and they can shed for a really long period of time. So typically we think of about two weeks following resolution of clinical signs, but it can be up to a few months and so that's something to consider if you are handling distemper dogs. If

you're receiving distemper dogs and thinking about when they can be released back to the general population or when are they safe to adopt or send to a foster home and that may be a place for doing some diagnostics doing some RTPCR to see if they're still shedding can be helpful in making that decision.

Clinical signs are really variable in dogs all the way from severe, fatal disease and remember, adult dogs who are infected may have very mild clinical signs that looks indistinguishable from other causes of infectious respiratory disease and so they can serve as a reservoir to keep this circulating in a population. Up to 50 percent of those cases with that mild clinical presentation is the estimate and so that's probably what keeps us going within the dog population. So just general listlessness, diminished appetite, fever are typical respiratory signs and it may or may not progress to other signs, ocular discharge, coughing, dyspnea.

Certainly we know distemper can cause systemic signs. We don't always get so "lucky" to have the dog who has respiratory signs and GI signs and then maybe we have somebody who does develop neurologic signs and it becomes a bit more obvious that we're dealing with distemper. Those cases, those outbreaks are a bit easier to recognize because we have a couple more telltale signs.

The more mild cases, unless you have a high index of suspicion and you're specifically testing may go unnoticed, but it's all still the same distemper and a mildly infected dog can still shed a virus isolate that can result in severe or fatal disease in a puppy for example. So you don't want to go making management decisions on the basis or isolation decisions on the basis of the severity of the symptoms.

So I've said it a couple of times but just a friendly reminder that all of those causative agents cause clinically indistinguishable signs and so we really do need to rely on laboratory confirmation for a definitive diagnosis. Severity of symptoms does not determine the pathogen and we can see often a range with a specific pathogen. When we think about diagnostic testing and who we're going to test and when we're going to test and how we're going to test, this can be a significant challenge. And depending on how testing is being performed it's also important to realize that getting a positive test result back for one or more organisms doesn't prove causation of clinical signs.

Many of these pathogens have been reported in healthy animals and so sometimes it can be a little bit difficult to tell in an individual animal. So if you're doing something like a PCR panel that becomes a little bit more of a concern. Having necropsy results is more helpful because it helps you

put not only that organism's presence into certainty but also its role in the pathogenesis of what you're seeing.

Testing multiple animals when we're dealing with a population really helps to clarify what the mix of pathogens that we're seeing in that population is and so as a rule of thumb we typically say test approximately 10 to 30 percent of the affected dogs or at least three to five animals. So where that number is going to fall depends on how big your population is, but the idea is that you want to have a fairly representative sample and enough animals so that you can get some meaningful information that you can make some decisions about the entire population.

So typically we're going to test acutely affected pre-treatment dogs, but sometimes recently exposed dogs may be appropriate as testing candidates as well. And I realize that diagnostic testing on every dog who develops respiratory disease is rarely possible in the worlds that most of us occupy and so having a plan for when diagnostic testing really becomes a priority especially thinking about that population level aspect.

Certainly if you're seeing increasing morbidity or mortality from what you typically associate with if you do have respiratory disease in your population that can be a warning sign and a good point to initiate some testing. If you're seeing poor response to treatment, unusual clinical signs, if you're seeing zoonotic or multispecies involvement absolutely I think it's important to understand what's going on there, and if you're seeing transmission from the shelter out into the community I also think that's another point that's really important to do testing.

In terms of what samples to collect it's going to depend a little bit in large part on what symptoms you're seeing. So when it's predominately upper respiratory symptoms we probably want to go with deep nasal or pharyngeal swabs and those can be submitted for PCR. You can also do bacterial culture and sensitivity or virus isolation which, you know, I don't find virus isolation super helpful when I really need an answer because it takes so long, but when everything else comes up negative, looking for some of those new pathogens and certainly in terms of having those samples available to research labs to identify some of those emerging pathogens is important.

With lower respiratory signs then we're thinking more about doing a tracheal wash, and again submitting for PCR, bacterial culture and sensitivity, virus isolation and cytology. So again, what you're going to submit and from how many animals will depend a little bit on whether or not you're trying to identify pathogens within the population of guide individual animal treatment or do both. So it's not always going to be the same testing profile for every case.

Necropsy is really, really helpful. It's often the most efficient way for us to get a diagnosis. Whether you do it in house and then you send the samples out for histopath or if you send the entire body out for necropsy if you do it in house, obviously you want to make sure that you clearly document your initial findings. And then those non-fixed samples that we're going to collect for bacterial and virus isolation are going to be collected first, in the fridge for bacteria, in the freezer for viruses and you want to get both upper respiratory tract and lung.

You also want to make sure to collect the samples for histopath and put them in formalin. And just please remember I don't even know why Antech and IDEXX and those little tiny cups because you can't put anything of a meaningful size in there. It's a nine to one ratio of formalin to tissue. The formalin can only penetrate so far and so when it doesn't you end up getting rot essentially in your samples so you want to make sure that you have an adequate container with sufficient formalin so not the little dinky ones, typically.

In terms of treatment, definitive diagnosis really is needed to determine more specific treatment and management strategies although we'll often make empirical decisions. I know this is something that we all think about and something that everybody is aware of, but when we're considering treatment we really have to make some careful considerations about our ability to provide humane care and that includes everything from the supplies and the space and the housing to the staffing and our ability to also get everything done that's still needs to happen to retain a focus on wellness and prevention for all the other animals in our care.

Whether or not sufficient isolation is possible that we can protect the rest of the population and again making sure that we don't become so focused on treatment that we lose sight of prevention. So remembering that we need to make a decision both for the individual animal, keeping in mind the influence that that's going to have on the population is really critical. Prompt identification of clinical dogs is key so that we can get them out of the general population to reduce spread and because timely treatment may improve outcome.

One of the nice things about strep zoo is it is remarkably responsive to treatment once it's identified and you catch those dogs early. After a certain point though, not surprisingly, or if you think about a really severe pneumonia case, at some point, our likelihood of success is going to go way down when treatment is implemented too late. And having written SOP's if you don't already is really, really helpful.

To have that case definition written out and what the treatment plan is, who can initiate it, what's your first line of treatment, who's responsible for administering that, how you're going to contain and management and what are your next steps. But our treatment remains largely supportive. Stress reduction, controlling coughing to break that cycle, fluid support for some dogs, nutritional support to make sure they continue eating. Antibiotics may be indicated and certain other treatments.

Sometimes we need to use things like antiemetics for distemper dogs if they have concurrent GI signs and for more severely affected cases when we do have pulmonary involvement much more aggressive treatment like nebulization and coupage or even oxygen support which for many of us is going to be outside of the shelter facility although some organizations do have the possibility. So antibiotics either in the face of primary or secondary bacterial pathogens or for secondary mycoplasma infections.

And I'm not going to talk about specific drugs, but remember when you're thinking about antibiotic therapy looking at antibiotics and picking one that works for what's likely to be the pathogen of concern, remembering to consider whether or not it's a time dependent or a concentration dependent drug, which will have some impact on how frequently you have to give it, the drugs ability to penetrate respiratory tissues, do we think it's going to work against the pathogens that we think are likely to be there and then how the animals are responding to treatment, and also the implications for use in a large population.

I'm very hesitant to just sort of give fluoroquinolones out to everybody on a large scale on any sort of ongoing basis because of real concern for antibiotic resistance and of course we know that they won't help with primary viral infection. I did just want to point something out about strep zoo. So early recognition and treatment with antibiotics can be very, very effective.

A common protocol – it does seem to be quite susceptible to penicillins so common protocol is injectable Pen-G for everybody followed by oral meds, but Convenia has been shown to be effective in at least one outbreak. There was an outbreak in Florida and they actually treated all the dogs with Convenia, which if you've ever dealt with a strep zoo outbreak, being able to give everyone an injection of Convenia instead of dosing everybody every single day is amazing. Whether or not that will hold true for all isolates we don't really know, but it's a possibility. And then fluoroquinolones may be an option as well. Certainly for the more severe cases or the later stage cases even with treatment, even with very aggressive treatment it can still be fatal.

In terms of antivirals influenza is the one not surprisingly that this comes up most commonly for in terms of Tamiflu, but it's really still not recommended for the treatment of influenza affected dogs for a number of reasons. Most will recover without needing antivirals. We don't have the pharmacokinetic studies that we really need to know what's an appropriate dose. In people it has to be administered very early in the course of infection and we're often not identifying dogs that quickly. And then there is a lot of public health concerns and there's frequently talk about will there be legal restrictions from veterinarians accessing Tamiflu because of the concern that it needs to be preserved for human influenza cases.

Other considerations, other antivirals that have been thought of, things like nitazoxanide or tizoxanide have shown to inhibit viral replication of influenza in vitro. They haven't been studied in vivo though so there may be more work coming out about that down the line, but right now we really don't have a good antiviral treatment. So we have to retain an ability to provide humane care and also have ideally in your SOP written out what's going to require revision of the plan, whether that's options for further treatment and changing medication, your ability to provide more aggressive supportive care. Can you do diagnostics if they weren't done or is transfer a possibility? And identifying what stopping points are for your particular organization is all really important.

In terms of adoption considerations, remembering that clinically recovered animals may still be contagious even though they are often not as efficient at spreading when they're not showing clinical signs, so there is at least that theoretical risk for spread into the community either as incubating or convalescent carriers when we're placing dogs. So when we have recovered dogs ideally we want to avoid moving them back to the general population if possible or consider doing testing following recovery so doing something like the PCR on your distemper recovered dog to make sure that they are not still shedding and certainly adopter education and full disclosure is really key.

I know I'm just about out of time. I'm going to just quickly cover two slides on prevention and then I'm going to stop there and take questions. So for me when I think about prevention and management I lumped them into sort of my plan A and my plan B, and we want to be doing both simultaneously, but to me plan A is prevent them from getting exposed. Just don't let them get infected to begin with. And realistically we're not often going to be able to make exposure zero so we try to limit the dose to as little as possible by avoiding overcrowding, having excellent sanitation procedures, having really good fomite control.

If you're treating, adequate isolation and maybe depending on the population that you care for adequate quarantine. If you for example are not in a flu endemic area and you're bringing in dogs from an area that you know has a high rate of influenza, you may want to have a quarantine for that specific population. Addressing ventilation and reducing barking to minimize aerosolization and airborne transmission and then reducing length of stay all fall under that category.

And then our other option, if that fails, if they do get exposed is we want to strengthen host defenses so that hopefully they won't become infected or they'll have a much more mild case of disease and that includes through good husbandry and nutrition, treating any concurrent infections that they have, vaccination for what we have it available for.

Certainly vaccination against distemper is a core vaccine, vaccination against bordetella is a core vaccine as well as para-influenza for all dogs coming into the shelter and then depending on the population that you serve and the community where you are, influenza vaccination may be appropriate. It's considered non-core according to the current guidelines, but for certain populations it may be appropriate and then certainly reducing stress.

I'm going to stop there because I think we're just about out of time. We do have a couple of minutes for questions and then I'm certainly happy to stay after and I apologize I didn't quite get through all the material that I had, but hopefully if I didn't cover a high point I can answer it for you now. And I'm going to step forward so I can see you. Sorry. Yes.

Question: I don't remember how long ago it was, but there was a change in protocol for vaccines for dogs against canine distemper virus when a dog – they go through the puppy series and then they have their annual vaccine the first year and then after that they started saying well every three years was adequate. Do you think it's possible with the *[inaudible]* to coming back *[inaudible]* the fact that *[inaudible]* the vaccination?

Dr. Janeczko: Sure. That's a good question and I'll repeat it just for anybody who didn't hear. So several years ago we really transitioned from annual vaccinations as a general recommendation for owned pets, from annual to every three years after they've had that initial puppy series. So the current recommendation is go through the puppy series, booster it a year and then go out to three years. And the question was does that have any role in the re-emergence of distemper in certain populations and this is my opinion. I don't know that anybody knows an absolute answer to it. I certainly don't know an absolute answer to it.

I suspect that is not why we're seeing a re-emergence of distemper. I suspect that why we're seeing a re-emergence of distemper in certain populations is because people have stopped vaccinating not because we've extended out the interval and we have animals who no longer have adequate immunity to prevent infection but because people have wholesale stopped vaccinating because they don't believe distemper is a risk any more or less so with parvo I think.

But I frequently have conversations with veterinarians who are in private practice who say no, no, we don't have distemper anymore. It can't be distemper in the shelter because it just doesn't exist anymore and I've also had that same conversation about panleukopenia, and I can assure you both are alive and well unfortunately and we sadly see that very frequently both because we have an environment that can facilitate transmission and we have that population coming in who is at such great risk.

And so I think at where we see distemper even geographically in certain communities we tend to see those in areas where to some extent – and I don't want this to sound negative or derogatory – where you might expect to see it, areas that are underserved by the veterinarian community, where maybe there isn't the highest level of pet care, you have high rates of intake to the shelter. You see a lot of disease coming from those communities. I think that probably has more to do with the re-emergence of distemper. But good question. Yes.

Question: You commented that many of these viruses are wimpy in the environment so what does that *[inaudible]* balancing enrichment devices, feeding devices, *[inaudible]* that are cleaned in between versus their potential to transmit?

Dr. Janeczko: Sure. So the question was that I had said at one point that these were fairly wimpy viruses for the most part and what does that mean in terms of balancing behavioral aspects of care, enrichment, toys, getting dogs out, getting them some interaction maybe with other dogs with the need for disease control. And I think that balance is something that we all struggle with even outside of respiratory disease.

In general I tend to worry about it a bit less with respiratory disease than I do for pathogens that we know are very durable in the environment like parvo virus because for the most part these are unenveloped viruses or they're bacteria that are not particularly resilient in the environment and so we don't have to worry necessarily to the extent about which disinfectant we're using. Is it something that has efficacy against nonenveloped viruses?

Certainly adeno 2 is an unenveloped virus. That one's a bit heartier than something like influenza, but a lot of those other viruses, influenza, parainfluenza, they're less of a concern for persistence. And so I think it is a balance and what that balance is going to be I think it going to depend on a lot of factors and I don't know that I feel like I could give a recommendation for all shelters because it's going to depend a little bit on the population of dogs that you're talking about and it's going to depend a bit on what pathogens and what rate of infectious respiratory disease you have in your facility.

Certainly dogs who have clinical signs I would want to treat with more care and more focus on limiting their contamination of their environment and their exposure to other dogs to try to limit transmission, but I think we have a lot of good options without sort of going nuts to sort of bridge that barrier between providing enrichment and providing toys and sort of throwing sanitation considerations out the window.

And so we have lots of products that can be disinfected in between dogs or getting cheap disposable version, having one that stays with one dog or creating enrichment devices through recycled materials or donated materials that you can just toss after one of them. So I definitely don't think that we should ignore behavior either in the interest of trying to preserve health or while we're treating animals. We have to figure out a way to balance both. Yes.

Question: This is a question about the therapeutic for the strep zoo slide. You didn't *[inaudible]*.

Dr. Janeczko: I didn't, you know, and we don't know a whole lot about strep zoo in general so it's a handful of really clinical reports looking at what would have been outbreaks and the most common reported treatment out there is a penicillin-based treatment. And I think honestly a lot of us have continued to reach for that because it's cheap, it's been effective in just about any case and these are really scary to deal with.

And so I think there is sometimes a hesitance to consider other options. I've never used Azithromycin to treat dogs from a strep zoo outbreak. It's probably not the first thing that I would reach for in part because of expense and for the really sick dogs I'd want something that had an option as an injectable for at least initially.
And I'm happy to answer other questions too afterwards if they're follow-up questions. Anybody else? Yes. Sorry. It's still – it's much better with the lights down, but I still have spots.

Question: Can you comment on the role of the influenza vaccine?

Dr. Janeczko: Sure. So the question was on the role of the influenza vaccine. So it's great that there's finally a vaccine. It's been out for a few years on the market. It's something that a lot of us wanted to see for a while. The challenge with the influenza vaccine – a couple of challenges – it's a killed product and so, you know, to me what we really need and what is unlikely to happen any time soon if ever, if the USDA or the FDA would approve it would be a modified, live intranasal vaccine that we could give and we could expect would provide some meaningful immunity within a couple of days if you really have a high risk of exposure.

If you have less of a risk of exposure I think that there is an opportunity to use that as a control strategy if you're in an environment where you either see or you suspect that you may see influenza. So if you're in certain areas of the country or if you've had cases documented in your community it's not to say that if you weren't you couldn't have it brought in, but sort of trying to titrate your risk because it's not a cheap vaccine. It's much more expensive, but it's a killed vaccine so it's one, another dose two weeks later and then we could expect seroconversion.

The manufacturers do have some data that suggest that a certain proportion of the dogs will seroconvert after a single vaccination and what it has been shown to really help with – it's not a vaccine that's going to prevent infection. So it's going to limit severity and it's going to limit intensity and duration of shedding which may be enough that makes a huge difference to help get it under control in a population or keep it from taking hold in a population. But that's going to depend on the specific dynamics in your shelter.

There is some data that the manufacturers have and I've never seen it. I've asked to see it and I've never seen it. I'm not saying it doesn't exist but I can't sort of verify it. They have some indication that a certain percentage of dogs will seroconvert and presumably be largely protected and have most of the benefits of vaccination after a single vaccine. That's not well enough studied I think that I would want to rely on that. You know, I think if you had a real concern about exposure I'd be trying to keep those dogs protected until you've gotten both of them in. But I think for certain shelters it can be helpful.

Question: Thank you.

Dr. Janeczko: You're welcome. Okay. Well, I'll hang around up here for a couple of minutes too if anybody has any other questions. *[Applause]*

[End of Audio]