



Maddie's Institute

***How Animal Shelters Can
Treat and Prevent Heartworm in Dogs***

Dr. Brian DiGangi

Webcast Transcript

August 2014

Heartworm disease is 100% preventable, yet experts estimate one million dogs in the U.S. are infected with the parasite. The challenge of prevention and treatment is particularly acute in animal shelters, which usually receive the dogs when they are already heartworm-positive and face challenges finding resources to treat them. Brian A. DiGangi, DVM, DABVP, Clinical Assistant Professor of Shelter Medicine at the University of Florida College of Veterinary Medicine, presents a review of the current recommendations for the prevention, diagnosis and treatment of heartworm infections in dogs with an emphasis on practical, safe and effective management strategies for shelter dogs

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[Beginning of Audio]

Lynne Fridley: Good evening, everyone. I'm Lynne Fridley, Program Manager for Maddie's InstituteSM. Thanks for joining us. Tonight's presentation is the last in our summer webcast series with Dr. Brian DiGangi bringing us up to date on how to treat and prevent heartworm in shelter dogs.

Dr. DiGangi is a Clinical Assistant Professor of Shelter Medicine at the University of Florida and is Board Certified in canine and feline practice. He recently completed a three-year residency in shelter animal medicine. He also serves as Vice President of the Board of Directors of the Association of Shelter Veterinarians.

Dr. DiGangi's special interests include cleaning and disinfection, high-quality, high-volume spay/neuter techniques and enhancing the welfare of animals in shelters.

Before we get started tonight, there are a few housekeeping items that we need to cover. Please take a look at the left-hand side of your screen where you'll see a Q&A window. That's where you'll ask questions during the event. Dr. DiGangi will answer as many as he can at the end of the presentation, but please submit your questions early. Questions submitted in the last few minutes will not be processed in time for a response.

If you need help during your presentation, click on the question mark at the bottom of your screen. There are other little images there called widgets. The green file widget will take you to the resources that we wanted to share with you. These resources will also be available after the presentation on our website.

Before I turn things over to Dr. DiGangi, I want to say a few words about Maddie's Fund[®]. We are the nation's leading funder of shelter medicine education, and it is our goal to help save the lives of all of our nation's healthy and treatable shelter dogs and cats. Our founders, Dave and Cheryl Duffield were going through a difficult time in their life while building their business, but each day when they came home, they were greeted by the little dog with the indomitable spirit.

Maddie's unconditional love inspired them to promise her that if they ever made it big, they would honor her by helping make this country a safe and loving place for all of her kind. With hard work, their dreams did come true, and they fulfilled their promise by creating Maddie's Fund and focusing their efforts on revolutionizing the status and wellbeing of companion animals.

We hope you'll take what you learn here tonight and continue to make the vision a reality.

Welcome, Dr. DiGangi, and thank you for being here.

Brian DiGangi:

Thanks, Lynne. Thanks everybody for joining us tonight. This is a pretty popular topic, one that we get a lot of questions about, so I'm excited to share a little bit of information with you and give you a little bit of my take on management of canine heartworm in shelters. I certainly don't have all the answers, but I may have a few, and hopefully, everybody will get a little bit of something out of this presentation that they can take back to their organization and put to good use.

So with that, a little bit of an outline for what we're going to talk about tonight. I'm going to start with a basic disease overview of heartworm disease, a little bit of epidemiology and the life cycle, and we'll talk about some of the recommended practice guidelines that are out there currently. And then I'm going to share some results of a recent survey that was done by the American Heartworm Society and the Association of Shelter Veterinarians that really looked at what are shelters doing with regards to canine heartworm disease management currently.

And then finally, we'll take a look at those results and try to make some practical points out of them, some practical take-home messages. So what can we do to prevent, diagnose and treat heartworm in animal shelters?

And how can we balance the resource challenges that we may have in some shelters with the best practices that exist?

So I'd like to start out with a little bit of a story. When I was putting this presentation together, I came across this blog post, and I'll read a portion of it for you. It says, "I'm a first-time dog owner. I recently adopted a dog and was told he was healthy. The dog was never tested for heartworm, so my poor boy has heartworm. I don't understand why they're giving out a lot of potentially-sick dogs when they could test them and let the adoption party know what kind of experience and vet bills they will have. I'm so frustrated with the rescue group."

So when I first read that I thought, "Well, great. Hey, this would be a great intro to the presentation and this really emphasizes why we need to take heartworm disease seriously and manage it in shelters." And the more I read through this, I realize the thing that was really bothersome to this individual was not that the dog had heartworm or that he had to take care of it afterwards, but he just – that he didn't know and he wasn't told about that. And I think that also speaks volumes about what our doctors might expect from us.

So there's a few messages, a few take-home messages we can get from that little story right there. And you have to wonder is that individual going to recommend adoption from a shelter to their friends? Are they going to go back to that rescue group that they were frustrated with at this point? We have to keep those things in mind as we're planning any kind of medical protocols in the shelter setting.

So specifically, some learning outcomes for the audience. I hope that, at least for the veterinarians and the veterinary technicians, that you'll recall some of the characteristics that are pertinent to clinical management of canine heartworm disease. And there are many of you where this may be new information, so it'll be a nice introduction.

And then I hope that you'll understand the current practices and the challenges to meeting those current practices and the standard guidelines in the shelter setting. And then I hope you'll be able to, like I mentioned earlier, take some of that home, disseminate some management protocols that are feasible in your shelter with a really keen eye for understanding the risks and benefits of altering from the standard guidelines.

So by way of background, the prevalence of heartworm disease has been studied in a number of different places, and so this particular study – or these two that I'm going to talk about right here looked at the prevalence of positive test results. So how many dogs tested positive of the ones that were in this study?

And the first part of this was a study that was done in private veterinary practices across the country, and you can see the different percentages there. So in the northeast part of the US, less than one percent of dogs tested positive, less than one percent in the Midwest, just slightly higher than that out west, and the southeast was a bit higher, as you might expect, at around four percent.

And when you compare those numbers to dogs in animal shelters, there was one study that looked at that and there were fifteen percent of the shelter dogs, and this particular study was done in Florida – fifteen percent of those dogs tested positive. So a much higher percentage of dogs in shelters are testing positive than is seen in private practices across the country. So that's going to be really important for us as we're working in shelters and designing these protocols.

And so that kind of brings us to the next point that heartworms are endemic in the United States. They're everywhere. All 50 states dogs have been diagnosed and they are found throughout the year any place you might go, and people don't always recognize that. They may think that if they're in a certain part of the region that's protected, maybe a part of the region that freezes over or has a long winter, and certainly the infection rates might be a little bit lower and the season of transmission might be a little bit different, but they are there. So don't – I don't want people to have that false hope that they're in a protected area.

Lynne Fridley:

Oh, and there we have our first poll question. Please answer on the screen. Not in the Q&A box. Just answer on the screen. And the question is, which of the following factors help explain the spread of heartworm disease across the United States? Transportation of heartworm positive with dogs, expanding territory of wild coyotes and foxes, environmental changes, all of the above or don't know. So which of the following factors help explain the spread of heartworm disease across the United States? Please make your selection. And we'll go on over to the results. Oh, okay, Dr. DiGangi, what do you think? I think they got it right.

Brian DiGangi:

All right. Yeah. So nobody fell for the trick there. The correct answer is all of the above, and actually, I have that on the next slide here. And so transport of positive dogs across the country. Often times it is happening from dogs being transported from the southeastern part of the US where I am up to the northeast or other regions where they may not have any puppies or certain breeds that we have a lot of in this area. And so those dogs are inevitably bringing that heartworm infections with them as they're transported across the country.

Expansion of wild dogs, the territory of wild dogs is another way that heartworms are being spread across the United States. And environmental changes. So there's no water sources being found all the time. That can be manmade water sources or natural sources. And then there's also this phenomenon called urban heat island, and that's the idea that if you get into an area concentrated around a city or a suburban area, the actual environmental temperature changes because of all the activity of the city. And so that creates a nice breeding ground for mosquitos and it's helping to expand their range and transmit and continue to spread heartworm around.

A couple other factors that are playing a role. Some mosquito species that can transmit heartworms can actually survive over the winter months, and so that's something that people may not be aware of. They may think that when the ground freezes in the winter, we're good. But some mosquitos can survive that and the heartworms within the mosquito can survive that as well. And mosquitos can live and breed for up to five months depending on the species and the time of the year or at least the ambient temperature in the environment. And so that's probably a longer period of time than people used to think years ago or that you may have been aware of.

So again, the bottom line is the risk of transmission is always present no matter where you are in the country. And for the most part, no matter the time of year either.

So we'll step into a little bit of a review of how heartworm is transmitted. I hinted at it before when I was talking about mosquitos being affected with heartworms. And so it starts with a dog that has heartworm and what we call microfilaria, which are – you can basically think of those as baby heartworms, and sometimes they're called L1. It's the first larval stage of heartworms.

And so you have a mosquito that bites an infected dog, and within the mosquito, that mosquito takes up the heartworms or the microfilaria, which are the baby heartworms. Within the mosquito, they turn into the second larval stage, so that's called L2. And then also within the mosquito, they transform into the L3 stage and that's the stage that becomes infective. And so that mosquito will then go on and bite another dog and can transmit that infection to the second dog.

From that point, those L3 larvae turn into L4 larvae within the dog. In about two to three months, those become immature adult heartworms, and about three to four months after that you have mature adult heartworms, which you can detect on one of the common testing kits that you will find.

So here's kind of another summary of that same information with some of the dates and times in there. Again, that L1-to-L2-to-L3 phase, that's all happening in the mosquito and takes about ten to fourteen days for that transformation to occur. The L3 is transmitted into the dog or the new host for the heartworm, and they travel, excuse me, through the soft tissue where the bite – mosquito bite occurred into the blood vessels of heart and lungs, and that happens about three to four months after that original bite. And then you'll have adult heartworms in there.

In the case of a dog, those adult heartworms, if they're not treated, can live three to seven years. So it's important to keep this information in mind for a few reasons, a couple which are up here, and one being that we can only test for microfilaria, those L1, those original baby heartworms, and the mature adults. So we have a really hard time detecting whether dogs are affected with the L3, the L4 or the immature adults.

And the reason that that matters is many veterinarians are going to alter their treatment protocols and the options that you have available for treatment are going to change based on which life stage you're trying to kill.

So we'll look at what is recommended for treating heartworms and not just treatment, but we're going to start from the point of prevention, diagnoses and then treatment. And these recommendations really come from the American Heartworm Society, which is the expert Board of Veterinarians that have really done a lot of research and understand all the literature that's out there and various ways that we can manage heartworm disease in dogs.

Lynne Fridley:

And we have our next poll question. I have to apologize if my volume is not as loud as Dr. DiGangi's, but we're working on a solution. So please bear with us, and I'll try to speak a little louder. The dogs in my home or rescue receive heartworm preventative. We want to see what's going on out there. Every month throughout the year, during the summer months only, they don't receive heartworm preventative or you don't know.

So do the dogs in your home or shelter receive heartworm preventative? Please answer on the screen and make your selection. Are you treating your dogs with heartworm preventative? Let's go to the poll results. Okay, wow. Everybody's on the ball here. That's great.

Brian DiGangi:

All right. Yeah, excellent. So a smart crowd. So everybody's got their dogs on heartworm prevention throughout the year, a couple people through the summer months only, and so that may be an educated choice that you're making based on the region of the country that you're in and that may be okay if it's done under guidance of your veterinarian. But

certainly, we like to see animals on heartworm treatment every month throughout the year. That's excellent to see.

So back to what is recommended by the American Heartworm Society. Well, of course, it is monthly treatment. That's why we had that little poll question there to see what people were doing. So there are two ways that you can do monthly preventive to your dogs. There's a monthly oral tablet or chews that you can purchase or the topical preventive, a little top spot that you put on top of the dog's skin, it gets absorbed, and you do that once a month. There's also an injection that can be given every six months that can be used for heartworm prevent as well and either one of those are perfectly acceptable according to American Heartworm Society.

And then for diagnosis of heartworms, what they recommend is annual antigen testing. And so when we say antigen testing, that's testing for the adult heartworms. That should be done every year. In addition, it should also be done before you change preventives. So if you're moving from one product to another, they recommend that you test the dog at that point. If there was a lapse in preventive, you forgot to give it one month or two months and you're going to start him up again, you want to test him at that point.

And then the other thing that they recommend that might be a little bit new to people is that they recommend annual antigen testing, so looking for the adults, and they also recommend at the same time that you test for microfilaria, for those baby heartworms. And we'll talk about some of the reasons why in upcoming slides. And then some other diagnostic techniques that you might consider are taking x-rays, echocardiography, which is an ultrasound of the heart, to look for the worms. And so that indicator.

So if there are clinical signs, the dog is coughing or has fainting episodes and that sort of thing, then your veterinarian is probably going to recommend doing a little bit more of a workup and getting some more information about that particular dog's infection.

As far as treatment goes, what's recommended by the American Heartworm Society is quite a detailed protocol. And so it starts at day zero, the day that you make that diagnosis. The very first thing that has to happen is those dogs should be exercise restricted, and that's really important for the success of the treatment protocol. They also recommend that the dog be placed on a four-week course of steroids if they are showing signs like coughing or difficulty breathing.

They need to be on a monthly preventive as soon as they're diagnosed with heartworm so that they don't get additional infections and also so that it

starts to weaken the existing worms that are there. And they should be on a four-week course of doxycycline, which is an antibiotic that has some effects that I will talk about later. That's going on for two months, day zero to day fifty-nine.

On day 60 is when they recommend getting adulticidal treatment with melarsomine. So that's a product, an injectable product, the only product that we have that's licensed to treat adult heartworms. And so there's an injection given on day 60 and then 1 month after that, 2 additional injections are given on day 90 and day 91. And that three-injection course is a key recommendation from American Heartworm Society.

They also recommend starting the dog on a four-week course of steroids at that point if they haven't already been on that, and then again, they emphasize limiting activity to cage rest, leash walk, and continue the exercise restriction for six to eight weeks after you've completed that whole protocol. And again, exercise restriction is probably the number one thing that ensures you have a successful outcome to treatment.

So that's what the standard guidelines recommend, that's what the scientific literature says is probably the best thing to do. And we wanted to find out what are shelters doing? What do they think is best for their facilities? What do they have the resources to do? Can they actually meet those guidelines? And so the American Heartworm Society and the Association of Shelter Veterinarians formed a little working group earlier in this year, and we had two goals.

We wanted to identify the current practices and needs of shelter veterinarians and – as a first step. And then the second step, out of those needs, we wanted to be able to create some practical guidelines and resources for shelters and for shelter veterinarians to use in the management of heartworms in their facilities.

So back in February, we began the first part of that and we administered an online survey to the ASV membership. So these are all veterinarians, so were members of the Association of Shelter Veterinarians. And we got just over 100 responses representing 100 different shelters. And so I have the spread here of which types of shelters these veterinarians represented. And so you can see there's a wide variety, and they could have selected more than one option, so that's why you'll see some of these numbers don't necessarily add up to 100.

But most of them were from a municipal animal control facility or a private human society or a PCA with a handful working in sanctuaries, foster-based organization and other organizations that didn't fit into those categories. And the majority of respondents represented open-admission

shelters. Just over a third were limited-admission shelters, and a quarter of them describe themselves as adoption-guarantee shelters.

And so you have a map up here with the different regions of the country. This is where our respondents came from. So again, it was a wide spread. Slightly more respondents from the south and from the west. Then you can see that the average number of dogs that these shelters took in was about 4,000, but it did range anywhere from 10 to 16,000 dogs each year.

I'm hoping – by giving you this information, I'm hoping that you can kind of see where your organization fits in and try to compare yourselves to some of the results we have here so that you can maybe make some changes, if necessary, when you go back to your shelters, or maybe you'll give yourselves a pat on the back because you're doing better than most. And I think it's helpful to compare yourself to other similar organizations to gauge how things are going.

As far as the prevalence of heartworms in these shelters that responded to the survey, so they indicated, on average, about ten percent of the dogs that came into those shelters, and nine percent here, tested positive for heartworms, but it did range, again, anywhere from one percent of the dogs up – all the way up to seventy percent of dogs in some shelters tested positive for heartworm.

So we asked some specific questions about prevention and, "How are you administering heartworm preventive to your dogs? Or if you are administering it." And so 66 percent of shelters were actually providing monthly heartworm preventives to all the dogs in their facility. And 65 percent of those shelters were using oral Ivermectin products according to label. So these are products that were designed for heartworm preventive and that's what their labeled use is. A majority of shelters were actually doing that.

And so you can see the spread of different options along the bottom. Oral Ivermectin was the most popular choice on label. But there's also a lot of oral Ivermectin that was given off label. That's that second bar there, the extra label bar. So about twenty percent of shelters were doing that. And then we have a mixture of other things. Some oral products, some topical products and maybe one or two shelters that were doing the injectable product. That's what that *[inaudible]* bar means there.

And I wanted to look at the other category in a little bit more detail, and so the ones that I selected, they were doing something different. What they were using for heartworm preventive was the injectable Ivermectin. They were giving that as preventive. So that would be categorized as an off-label use. And then many shelters were just doing whatever is donated.

Their actual preventive might change over time based on what they had available.

So next we wanted to know a little bit about the diagnostic practices that were going on in these shelters. And so we asked, "Are dogs tested for heartworm infection?" And here's what we got. So about just over 42 percent of the respondents said, "Yes, we test all our dogs for heartworm infection." Just under ten percent said, "No, we don't test dogs for heartworm infection." And about half of the shelters said, "We test some dogs for heartworm infection."

And actually, we wanted to know, "Well, which dogs are you testing?" And the answer was that, "We're testing dogs that are adoption candidates." So it's sort of part of the screening criteria to get to adoption. Some shelters were only testing dogs that they felt were coming from an endemic area, so an area where there was a really high risk of dogs coming in with heartworm disease.

And then some shelters were just testing dogs that had specific concerns. So maybe they were coughing or they had a heart murmur or they had some kind of clinical sign that they were attributing to – possibly to heartworm disease and they wanted to test them and see if that was the case.

So we asked, "When does testing occur?" And you can see the spread here as well. So the top bar is prior to admission. So these dogs before they're being admitted to the shelter, just over ten percent of the respondents' shelters were testing dogs then. But the vast majority of shelters, over 50 percent were testing dogs during their intake examination. So admission is prior to entering the shelter. Intake is they may have been there, just maybe the day of their intake or a day or two later when they're getting examined by the veterinarian or the veterinary staff is when they're drawing blood and doing that heartworm test.

Other options, they were being tested prior to transfer to a partner organization or just prior to adoption. And then shelters had various protocols. About fifteen percent of them had other protocols that were a mixture of those things.

And then we wanted to know, "Well, okay, you're testing. Now what type of test are you using?" And so the top two, the ELISA and the lateral flow, are both tests that test for antigen, so the adult heartworm. And you'll see that that's the majority of what is being used. Over 80 percent of shelters are using the ELISA, that's your common snap test, or the lateral flow, which is very similar to that.

And then the bottom three options are ways of testing for microfilaria, so those baby heartworms. Or excuse me. The next few. Direct microscopy and centrifugation microscopy are ways of testing for the microfilaria, and we'll talk about the pros and cons of that coming up. And then a couple shelters were testing by looking for antibodies to the heartworms in a blood sample.

So that the initial test that I was just talking about. So we call that the screening test. About 48 percent of shelters said that they actually do additional testing after they get a positive screening test, and the type of additional testing they did was most commonly a repeat reading test. So they got one positive, they wanted to check it again to make sure it was right, so they ran another screening test, the same thing they did before.

Some shelters were doing bloodwork, chest x-rays, urinalysis, echocardiogram. In those cases, those tests were indicated by clinical signs in the dog. So the dog had some other signs that they wanted to make sure their heart and lungs were okay; they wanted to check the urine; they wanted to do an ultrasound of the heart because there was some other reason to do that based on the presenting signs of the dog.

And then we asked about treatment. And so we found out that 85 percent of the shelters that responded to the survey did treat at least some dogs that came up positive with canine heartworms. Among the dogs that were not treated, most commonly those dogs were euthanized or they were placed for adoption without treatment or they were transferred to another organization where they would be treated.

So probably what everybody is most interested in seeing, or at least the shelter veterinarians I'm sure are, is, "What is the adulticide treatment protocol that was used? So among those shelters that did actually treat in their facility, these are the treatment protocols that they used. So about a 50-50 split between those that do the three-dose melarsomine protocol, which is, you'll recall, what was recommended by the American Heartworm Society. That's sort of the standard protocol that's recommended. It takes at least two months to get those two injections in – those three injections. Excuse me.

And then about another 50 percent was doing the two-dose melarsomine protocol. So they were just doing one injection, waiting twenty-four hours, doing that second injection. They were skipping that very first injection that occurs a month earlier. And then some shelters were just giving monthly Ivermectin, so they were just keeping them on the preventive and waiting for the heartworms to die. We sometimes will call that "slow kill." I'll talk about that a little bit more in a minute. And then

a handful of shelters were just coming up with their own protocols that didn't neatly fall into one of those three categories.

Many times veterinarians will choose to add in additional treatments with the adulticide treatment protocol. And so we call those adjunctive treatments. And you can see what's used there. So most commonly shelters are using doxycycline, which is an antibiotic. Many shelters are using prednisone as part of that protocol. Macro cyclic lactone is the third option there and those are the heartworm preventives, so the Ivermectin-based products, usually Ivermectin-based products. Some groups are using nonsteroidal drugs during the treatment protocol. And then a mixture of other things down at the end.

Bear with me a minute. I think I may have clicked something. Okay, so we'll take a look and see how those survey results compare to some other data that we already have. So there was a study done in 2011 where they looked at over 500 shelters in the southeast part of the United States only, so just the southeastern region. And they asked a lot of the same questions that we asked, and so what they found was that 70 percent of those shelters provided monthly heartworm preventive. And you're recall that in our survey, our nationwide survey, there was only 66 percent, so very similar.

Sixty-six – excuse me. Sixty percent of those shelters used on-label Ivermectin as preventive compared to 65 in the nationwide survey. So again, a very similar result. Diagnosis was a little bit different. So 72 percent of dogs in this survey of southeastern shelters tested all their dogs for infection versus only 52 percent of dogs in our nationwide survey. So in the south, there seemed to be a sort of heightened awareness of this and it was more important for people to prioritize resources toward testing.

And then for the treatment, 88 percent treated at least some infections, which is similar to the 85 percent that we got in our survey. And the most common treatment protocol in this article that I have up here was the two-dose melarsomine protocol, so just two injections given twenty-four hours apart, versus the most common response in our survey was people were using three-dose protocol. Fifty-five percent of the people were using that. So again, which is the Heartworm Society's recommended protocol.

Lynne Fridley:

Then we have another poll question. In your shelter, how is canine heartworm disease treated? With Orville – excuse me – with oral Ivermectin products, melarsomine injections, we do not treat heartworm disease or you don't know. So please answer on the screen. In your shelter, how is canine heartworm disease treated? And we'll give you just a second more here to make your selection. And we'll go to the results. So many of the people are listening to the American Heartworm Society.

Brian DiGangi:

Yeah, so that's interesting. We have a little bit of a spread there. About a quarter of you are using oral Ivermectin products to treat heartworm disease, and just under 60 percent are doing the injection. And then about ten percent are not able to treat heartworm disease right now. So that doesn't seem to mirror what the two studies I showed you found, so that's good that we have a nicely-representative audience here.

So some of the things that kind of stood out to us when we looked at those results and kind of where they deviated from standard guidelines were not necessarily surprising, but it was nice to get some sort of confirmation about these things. And so related to prevention, as I mentioned, Ivermectin is frequently used extra label for prevention. So that means people are using products not labeled for heartworm prevention in dogs to treat – or excuse me, to prevent heartworm infection in dogs. So usually that's an injectable product designed for cattle. I'll talk about that in a minute.

Under the diagnosis category, many shelters are not testing dogs for infection, and many shelters are just using a single screening test for diagnosis. And under the treatment category, the two-dose treatment protocol is frequently used, and the adjunctive treatments, so that was the antibiotics, the nonsteroidals, all the other drugs that might be selected. The use is really inconsistent and we got a lot of responses across the board. And so people weren't necessarily following all those guidelines by the American Heartworm Society that I mentioned in the beginning. So we're going to explore those in a little bit more detail.

And so this is going to be a little bit of an advanced portion of the presentation, so please ask your questions if I say anything that confuses you or contact me afterwards. I'll have my email address up there in the end. So we'll try to look at those in a little bit more detail and figure out what's going on in shelters? And how can we make the best of our situation?

So take a little bit of a step back and – if we're going to talk about preventives and ask, "Well, why do we need to administer preventives in the first place?" And there's two reasons that are particularly important in shelters, and the first being that if you have infected dogs in your population, which we already talked about how heartworm disease is everywhere throughout the United States, so you probably do, these dogs can serve as reservoirs for infection of other dogs in the shelter and other dogs in the community.

So if they're sitting there in your shelter with the microfilaria, they're at risk for getting bit by a mosquito who's going to go and transmit that

infection throughout the community. And we certainly don't want to be known as the place where disease outbreaks start. So we can administer preventives to prevent that from happening.

The other thing is that the majority of these products that we use to prevent heartworm disease actually assist with a lot of other parasites. So some of the intestinal parasites that we spend a lot of time and money deworming our animals for, it can be included in these heartworm preventives. And so that's a best practice for sure. And many of these parasites are actually zoonotic parasites, which can be transmitted to humans. So there's sort of a public health implication for treating those intestinal parasites as well.

So we can get more bang for our buck here if we can treat heartworm and we can prevent intestinal parasites at the same time.

So as I mentioned, so what's the problem with that for shelters? Well, as I mentioned, Ivermectin is frequently used extra label. And so a lot of practitioners have trouble with this concept, and so let's look at the pros and cons and figure out how we can sort of mitigate the risk if there is risk associated with that practice.

And so the main pro of using extra label Ivermectin is that it's a lot cheaper, and so many of you are probably using the Ivomec product that I have a picture of up here, which is an injectable de-wormer designed for cattle. And so you can buy that, a large bottle of it, and it's a heck of a lot cheaper than buying the products that are labeled specifically for dogs. But the big concern with that is toxicity and the risk of toxicity because you have to be very careful about the dosing that you use because, again, it's high concentrations and are for use in animals much larger than our dog.

So what exactly are the risks with that and what are the specific concerns? Well, some dogs have a gene mutation that results in their inability to move avermectins out of the brain. So avermectin is that class of drug that we used to prevent heartworm. That includes Ivermectin, milbemycin, moxidectin, selamectin, and all those different products that are labeled for heartworm prevention. The thing to keep in mind is that the toxic dose of Ivermectin is four times higher than the dose that we use for heartworm preventive. So it's actually very safe to use in all breeds of dogs, even those that may have that gene mutation that prevents them from processing that drug appropriately.

And then just to keep in the back of your mind that of course there is a small risk of toxicity with any drug that's given at the wrong dose. In this case – generally, this is a treatable problem if an overdose is given, so you

prevent further absorption. If it was a drug that was administered topically, you can bathe the animal or get the drug off of them. Or if it was something administered orally, there might be an indication to make them vomit the drug up or give them other medications that can prevent them from absorbing the drug.

You provide supportive care and in a few days to a few weeks, in most cases, these dogs can overcome this problem. So this can be something that is manageable if it occurs. Of course, you want to prevent it from occurring, so with that information in mind, we want to take some steps to mitigate the risk of toxicity. If you can't use the products that are labeled for dog, if you have to choose to use off label Ivermectin products, then let's take some steps to make it a little bit safer.

So you're going to be sure to get an accurate body weight measurements on the dog, you're going to think about diluting it out so that it – you can more accurately dose it out for a dog. Again, it's a cattle product, so it's very highly concentrated and meant for a large animal. So we can dilute it out. Create a dosing chart to minimize human error. Very simple steps. And then you can just kind of selectively avoid its use in certain breeds if you're concerned.

So we know that that gene mutation I was talking about is most common in Collies, Australian Shepherds, long-haired Whippets and Shetland sheepdog. And so something that they teach you in vet school is if it has white feet, don't treat *[Laughs]*. So a lot of times you can use that to decide if this dog is at risk for having this problem with processing Ivermectin products, maybe we'll use the on-label products for that particular dog and we won't take the risk.

That was kind of a simple example for prevention. It's going to get progressively more complicated as we go through. So the next thing that we're going to look at is the questions about diagnostic practices. So why do you obtain a diagnosis for heartworm disease or why should we prioritize doing that? As I mentioned before, infected dogs serve as reservoirs. We need to know who those infected dogs are so we can do something about it so that they're not spreading that disease around.

Secondly, those infected dogs have specific medical needs. So we have to know that they're infected so that we can address those needs. And one of those being they need to be exercise restricted and cage rested and leash walked. The other being that they should be on antibiotics, which I'll talk more about when we get to the treatment section.

And then heartworm is a preventable disease and a treatable disease. So if we diagnose it in them, we can identify the infections before the damage has occurred and we can prevent it from getting worse.

So specific concerns with diagnostics related to shelters. Like we showed in the survey results, many shelters don't test dogs for infection, and basically, the thought is, "I'm not going to treat them. Why should I test them?" And so hopefully I just explained an answer to that. And then the second concern with diagnostic practice is that a single screening test is often all that's used in shelters.

So what are the pros and cons of not performing screening tests at all? So on the – this is a little bit – maybe a little bit confusing, but bear with me. I think it'll make sense as I go through the examples. So many shelters do not perform a screening test at all. So the pro of not performing a screening test is that it saves you money. It's expensive to perform a screening test. It also saves you time because you have to go through the steps and actually wait for the test result to come up. It takes a little bit of technical skills to draw blood samples or run the test. So that may be considered as a pro of not doing a test.

A con of not doing the test and not knowing if your dogs are positive or negative is that you're really placing the burden on the adopter. And so you're kind of washing your hands of the situation and now it's up to that adopter to find out what's going on with that dog and that adopter's new veterinarian. And if you recall back to the example in the beginning, that wasn't received very well by that one adopter that wrote that blog post.

I think it also sets a poor example. So we want to be sure that we're setting the example for what veterinary care and what standard of animal welfare we expect in our community. And so it's a pretty standard recommendation to test dogs regularly for heartworm. And so if you're not doing it in the shelter, why should the adopter bother to do it too? They see you as the experts in animal care in the community.

And finally, it also promotes the stigma of shelter adoption. So we all know that there's nothing wrong with shelter animals, but there's that perception out there in the field. And so if we're putting dogs out there that are potentially infected and we're not bothering to test, we're not telling anybody about it, we're going to promote that stigma.

So what is the actual evidence on this topic? And so we talk a lot about heartworm disease epidemic. It's everywhere throughout the US, so you can't rely on, "Well, it's not here, so I don't need to test for it." It's there. Mild illness can become life threatening. We know that. We know the

course of heartworm disease and how it progresses if it's not treated and if it's not diagnosed.

And then this is an interesting study that was done where they found that mosquito-infection rates in kennels with positive dogs were ten times higher than in the community. So they tested mosquitos – they had a kennel full of dogs that were heartworm positive, they tested mosquitos in those kennels, and they had a much higher rate of infection than mosquitos taken from random parts of the community.

So if you just ignore that disease status, you're going to facilitate spread in the kennel and throughout the community. And as you think about it, you want to know who those dogs are because the treatment, in fact, is going to be greatest where the prevalence is low. So if you've only got one dog that's positive, you're going to be able to make a huge impact on preventing the spread through the community. You've only got one dog to treat to prevent further spread.

If you're in an area where there's lots of heartworm, you got to treat everybody. So that is a little bit bigger of a burden, but that point is targeted to the people who may be in an area where heartworm disease is not quite so prevalent or they're thinking, "Well, it's not here, we don't have to test, we don't have to treat." You have the greatest opportunity to make the greatest impact in those settings.

I talked a little bit about time and costs money. I'm not going to go through this in great detail, but the point is there's different methods of testing. They all have different costs. The most expensive are going to be the antigen tests. Those are the two that you see at the bottom. Those are the ones that are most commonly used and they're also the ones that are most reliable, as you see the sort of accuracy ratings over on the right, 100 percent. They're very accurate tests compared to the other testing methods that we may use, even though the other methods are a little bit cheaper.

And then we talked about technical skills to run heartworm tests. I think this most comes into play for those of you that might be using the DiroCHEK test kit because it takes a little bit of knowledge about how this test kit and how to – some laboratory skills to do that. But this is something that's also easily overcome. The manufacturer has videos online of how to do this. You can find videos on almost anything online these days. And so they can easily sit a staff member down and walk them through this and learn how to do that pretty easily. That shouldn't be a reason to not test.

So with that background information, how can we mitigate the risk? So if we can't test everybody, which we know is ideal, what can we do to get

the best outcome? So you might choose to selectively test dogs that are high risk. And so that might be dogs that are coming in as a stray or dogs that are transported from an area where you know is high risk. Maybe you are on the receiving end of some of those transported dogs from the southeastern part of the United States. So maybe you're going to selectively test those dogs if you can't afford to test everybody.

Maybe you're also going to test dogs that are selected for adoption or transfer. So if you have to decide who – if you're on the other end, you have to decide who you're going to put up for adoption or who you're going to transfer to another organization. Maybe you're going to test those dogs again as part of that selection criteria before they get to that point.

Onto the what I call “inadequate diagnostic protocols.” And so we talked about antigen testing and microfilarial testing. And so here's sort of the pros and cons of antigen testing. So again, that's testing for adults. High sensitivity. So it's a very accurate test. There is a bulk-testing option, which is the slide I showed you back before with that DiroCHEK test, and that's why people use it because you can save some money testing in bulk. But in comparison, it is costly compared to the other testing methods that you may use, so the microfilarial testing. And even though it's highly accurate, you can still get false test results, and false-negatives are a particularly – of particular concern.

For microfilarial testing, those are the baby heartworm, pros are really inexpensive. It costs about a few pennies to test a dog for microfilaria. A reason that you might do it is that it may actually impact your treatment plan. So you might make different choices as far as the drugs you give the dog and the protocol that you use if you know about their microfilarial status.

If you look for microfilaria, you can also validate the other test results you got. So if you got a positive test result on some bloodwork and you looked for microfilaria, then you can confirm that that result was real.

An area of kind of growing concern is the potential for resistance. So there's some concern that there are some strains of heartworms that are becoming resistant to the preventives that we use. And so this is a way of figuring out if those strains might be in your area. So if you have dogs that are on microfilaria preventive and you're still finding that they test positive for microfilaria that might be an indication that there's some resistance going on.

And the final pro for microfilaria testing is that there is something called antigen antibody complex interference, and so basically, what that means is that you can get a false result when you do one of the antigen tests that

we talked about before because of this phenomenon called antigen antibody complex interference. In this case, we're not testing for antigen, so there's no risk of that making the results inaccurate.

On the negative side, if you think back to the chart that I showed you, they are much – have much lower sensitivity. So they're definitely not as accurate as the antigen test and they just take a little bit of technical skill and some equipment. Got to have a microscope and some slides to be able to do microfilarial testing. Maybe even a centrifuge, depending on what method you're going to use.

So I talked a little bit about false-negatives on both sides. So what does that mean? If you're testing for adults, so the antigen, and you get false-negative test results, you could have that happen in the male-only infection because some of you may know that these antigen tests that we use only detect the female – adult female heartworm. So if you just had males present, you're going to get a negative result. If you only have one or two worms, the test may not pick it up as well.

The most common reason for a false-negative result is probably poor technique. So if you didn't follow the manufacturer's instructions on actually using the test kit. And then this thing that I mentioned a moment ago, antigen antibody complex interference. There was one study that showed – took a whole bunch of samples that tested negative for heartworm disease and then they heat treated those samples to get rid of that antigen antibody complex interference, and 70 percent of those negative samples turned positive after they did this heat treatment to them. And so that's something that we're starting to learn more about and that may be something to keep an eye on for the future when we're trying to increase the accuracy of these tests even further.

When we're talking about testing for microfilaria, and this one, again, the baby heartworms, we're going to get false-negative results if there's male-only or female-only infections. There's not going to be any babies. If there's immature life stages present, they're not yet reproductively active, so you're not going to have microfilaria. And I mentioned before if the dog is on preventive, hopefully there's no microfilaria there as well. So you might get a negative result, even though there could be adult.

You might recall in the beginning I mentioned the American Heartworm Society recommended doing both antigen and microfilarial testing. And so I'll kind of talk through it a little bit here, and hopefully you understand that these two types of tests provide different information. That's why they recommend doing both tests. And the results may actually impact what you do with those particular dogs.

So, some examples of that are when a dog has circulating microfilaria in their bloodstream, they're much more likely to have an adverse reaction to a treatment. And so there are specific indications that have been documented dogs that are treated with milbemycin are more likely to have an adverse reaction if they've got those circulating microfilaria. A small dog known to have a really high microfilarial count in their blood are more likely to have an adverse reaction. So those might be some reasons that you'd want to know that ahead of time so you can plan which drug you're going to use, which protocol you're going to use.

So taking all that information, how can we mitigate the risk and put it to some sort of practical use? So you might consider testing for microfilaria before antigen testing because remember, the microfilarial testing is cheaper, but not as accurate. So we might do that first. If you're in an area where you know most of the dogs have heartworm, there's a good chance you're going to find those baby heartworms on a blood smear. And so you might do that first because it's going to save you some money.

Or if you're in a practice or – your shelter veterinarian is going to alter the treatment plan based on the microfilarial count and obviously needs to know what that is. And so you'd want to look for microfilaria in that case. You might choose to test for adult, so the antigen testing before you test for microfilaria. If you know the dog's been on a heartworm prevention product, probably not going to have microfilaria circulating throughout the bloodstream, so it's going to be a waste of your time and you might as well just go ahead and go do the antigen test first. And you can kind of make that gamble.

If it's a vaccinated dog, if it's a surrendered dog, a neutered dog, it's probably had some kind of care given to it before it got to you, probably without heartworm preventive. So maybe in that case, jump to the antigen testing first as well. And again, I mentioned something to consider that may be coming in the future is there could be recommendations for treating – pre-treating the sample before we run them to increase the accuracy of our results.

Okay, so onto treatment protocols. So again, we'll take a step back. Why do we need to offer treatment? Like I said, this is a deadly disease, but it's curable and we have a drug that can cure it. There's always a welfare concern in shelter medicine, so we have to pay attention to that as well. So severely-affected dogs may have compromised welfare, and that's certainly a good enough reason to treat. And most of the doctors do not want a project; they want a pet. And I know that there are studies that show that there are certain levels of cares that doctors are more than happy to provide, but this is an intense one, it can be an intense one, it can be an expensive one.

Again, think back to that blog post that I shared in the beginning. If people were not expecting that, they're not going to be too happy. And so we want to make sure that if we have the ability to offer treatment, let's try to do that.

So the concerns with offering treatment in the shelter studies that we looked at, a lot of people are using the two-dose melarsomine treatment, which is not what's recommended by the Heartworm Society. And a lot of people are using a mixture of other alternative treatment plans. And we'll look at the pros and cons of those.

So I call these suboptimal treatment protocols. So this is basically anything, other than the three-injection protocol as recommended by the American Heartworm Society. So obviously, if you're using only two injections or you're doing something other than the melarsomine injection, it's going to be a lot cheaper than giving three injections. And it's also going to decrease the length of stay. So remember, that three-injection protocol took two or three months to complete, and so length of stay is a huge concern in shelter settings, and so that may be a big pro.

On the negative side, there are concerns that if we do anything, other than what's written in those guidelines, it might actually be less effective or there might be an increased risk of complication, and certainly we don't want either of those things as well.

So what does the actual scientific evidence say? There are a number of studies that have been done. The ones in this particular slide are straight out of the product insert for the melarsomine injection product. And so they talk about laboratory studies that were done. And when they gave dogs one dose of the product, it killed about half of the heartworms that were there. When they gave them two doses, it killed about 90 percent of the heartworms. When they gave them the full three-dose protocol, it killed between 98 and 99 percent of the adults that were there. So that's why they recommend doing that three-dose protocol. It's going to be much more effective.

So that was in a laboratory setting, very controlled. So in the field setting, there were dogs that had mild infection that got the two-dose protocol. And between 90 and 98 percent of those dogs tested negative for a month after the two-dose treatment. Another study showed that the two-dose protocol was between 97 and 99 percent effective, resulting in a negative test result three months after treatment.

And then there's one study that looked at those dogs that had a really severe infection that got the three-dose protocol. Between 89 and 100

percent of those dogs tested negative 4 months after treatment. So those were really interesting studies I found that was basically what's called a meta-analysis. And what that is, is a study that evaluates all the other studies that are out there and they look at the evidence that's out there and decide, "Can we make one final conclusion based on all this knowledge?"

And so they wanted to see – look at all the different treatment protocols that are out there. So they looked at both two- and three-dose, the melarsomine injection treatment protocol, and they had to be confirmed to be efficacious by a negative antigen test afterwards or actual microscopy to find that there were no heartworms left. So they did a fancy calculation. They called it the weighted average efficacy. What they found was that with the two-dose protocol, it was 88 percent effective. With the three-dose protocol, it was 89 percent effective.

So their grand conclusion was that ten percent of dogs diagnosed and treated for heartworms will have more than or equal to one heartworm remaining after treatment with either of those protocols. They were basically equivalent in this particular study.

So that's the information about the injectable protocols. But then I mentioned earlier about slow kill, and so I'm defining slow kill as the use of a preventive alone to kill adults. And usually that's talking about a monthly oral Ivermectin product. And so this might be attractive to a lot of shelters because it seems to be a relatively cheap way to go about it. You're just giving them that monthly preventive rather than having to do the expensive injection.

But the thing to realize is that while this may actually be effective, it takes a really long time to be effective. And the other thing is that how effective it is actually depends on how old those heartworms are when you start giving them that oral Ivermectin. And that is something that we usually don't know. There's really no way of figuring that out.

So you can see on the table here for the heartworms that were four months old at the time that the slow kill was started, after fourteen treatments, so that's over a year, it was ninety-seven percent effective. And you can see that as the number – or excuse me, as the age of the heartworms increases, the efficacy goes down. Kind of one exception there in the middle is that five-and-a-half-month-old heartworms – or excuse me. After that, the seven-month-old heartworms took twenty-nine treatments to get ninety-four percent effective.

So if you're just kind of scanning that, it looks like 94 percent in that was really good, but it took actually 29 treatments, almost 3 years of being on monthly preventive before they got that high level. So it takes a long time.

It depends on the age of the heartworms, and we'll talk about why that's important coming up.

Lots of alternative protocols have been tried, so people have used intermittent doxycycline, weekly Ivermectin, Ivermectin and doxycycline, which that seems to work better when you combine them together. So if you look at 9 percent effectiveness, 36 weeks with doxycycline alone, 20 percent effectiveness with weekly Ivermectin alone, when you combine them, they jump together and have this sort of synergistic reaction, so 78 percent effective. If you combine it with the injection, even more, so 93 percent effective. In this particular study, the three-dose melarsomine was 100 percent effective.

Some more alternative protocols and some evidence that we have surrounding them. So this is a protocol that used doxycycline for one month and Ivermectin for six months at being negative, both dogs tested negative for microfilaria. There was no microfilaria circulating in the bloodstream and they were no longer a risk to other dogs. And by day 300, they had a big improvement in their clinical signs. Most of them were antigen negative, but again, that's day 300, so almost a year after doing this protocol.

One thing that is interesting is that the damage that was occurring to the lungs resolved a lot sooner than using the three-dose melarsomine-injection protocol. But using a three-dose-injectable protocol resulted in faster killing of the adults. So again, kind of a tradeoff there.

So, well, I'll just talk about doxycycline. What does that do? So it's an antibiotic. It's effective against this bacteria that you see a picture here. It's called Wolbachia organism. And it really – it's something that they call endosymbiont of the heartworm parasite. And so with this bacteria present, it's responsible for parasite embryogenesis. So it helps create – helps the parasites – heartworm, excuse me, reproduce and be born. It's responsible for larval development of the young heartworm. It's responsible for microfilarial production, the long-term survival of the adult worm, and it also depresses a dog's own immune system, so prevents it from fighting off the heartworm.

So if we can get rid of the Wolbachia, we can rid of all these negative things and make it a lot easier to kill the adult heartworm, which is why doxycycline has such an important role to play.

Some of the studies with doxycycline, if you use it in conjunction with the heartworm preventive, it reduces the microfilarial count pretty quickly, within three months. If you use it intermittently with weekly Ivermectin, one study found that there was a faster decrease in the microfilarial count

and higher adulticide efficacy at 36 weeks as compared to just using one or the other by their self.

And then another studies looked at dogs that just had doxycycline for 30 days and that eliminated some of those larval stages of heartworms and the juvenile worms and it delayed production of the microfilaria. And then finally, this is an interesting study that showed that mosquitos that fed on the blood from dogs that were treated with doxycycline – so the dogs are given doxycycline. The mosquitos that bit those dogs they still produced the L3 larvae, so those larvae that they can transmit to other dogs, but those larvae were not infective. They weren't able to infect another dog with them. So just giving that doxycycline prevents the life cycle from happening and preventing transmission from occurring.

Lynne Fridley:

And we have our next poll question. Which of the following are concerns when using treatments, other than – I'm sorry – melarsomine injection for treating canine heartworm disease? Select your option. They take longer to be effective, overall efficacy is generally reduced, and worms continue to damage heart and lungs, all of the above or don't know. So which of the following are concerns when using treatments, other than melarsomine injection for treating canine heartworm disease? Please make your selection. And we'll go to the poll results. Oh, what do you think of that, Dr. DiGangi?

Brian DiGangi:

All right. Great. So everybody was paying attention. All of the above. That's true. So it takes longer, efficacy is generally reduced. The worms continue – we didn't talk much about this, but it coming up next, so it's sort of the lead-in, is that the worms do continue to damage the heart and lungs while you're waiting for all those other treatments to work. So even though they might work over time, there's still damage that's happening. And so that's exactly what this slide is about.

So the longer the worms are there, the more damage they're doing to the lungs and the heart. And the other thing to consider is that exercise restriction must be maintained for this whole period of time. So if you're choosing to treat the animals with something other than the injectable protocol, it's going to take a lot longer and the exercise restriction is going to have to be withheld for a lot longer period of time.

So you may make that decision for – let's say for the dog on the left who's in the natural environment, who is having a great time in shelter stay. Maybe it's okay for him to be exercise restricted or to undergo this longer period of treatment because he's handling shelter life okay. Compared to the dog on the right who's looking a little bit depressed, who's in a traditional run, there's not much enrichment going on there. The little cropped image that I showed you. So that may be a dog that it's really

going to be important to get him out a little bit sooner. So you definitely need to consider the welfare aspect of the treatment protocol that you're choosing for the individual dog.

So how do we digest all that information and sort of mitigate the risks? If we cannot treat everybody with the three-injection protocol and follow the guidelines by the American Heartworm Society, what can we do instead? So maybe you're going to prescribe treatment based on the severity of disease. And so you might decide that if you have a dog that has no clinical signs of heartworm disease, not coughing, not exercise intolerant, maybe you're going to use a two-dose protocol on that dog and save a little bit of time and a little bit of money there. If you have a dog that has clinical signs and it's showing some of the effects of heartworm disease, maybe it's going to be a safer option to actually go do the full three-dose protocol on that dog.

For the adjunctive treatment. So we talked about all the benefits of doxycycline. There's really no reason not to use that. It used to be very cheap. Its cost is going up, and I'll talk about some alternatives in a moment. There's always a good indication for that. Prednisone. Maybe you're going to limit that to dogs with circulating microfilaria or dogs with clinical signs because you want to reduce the risk of complications occurring. That's how I treat the dogs that come in to see me is I wait for those dogs that are clinical signs before I put them on prednisone.

And then you might want to consider alternative protocols. And by alternative protocols, I mean doxycycline and Ivermectin, not just one or the other alone, but the two combined in the following circumstances. So again, you might have a dog with no clinical signs. Maybe that's when you're going to elect to do an alternative protocol if you can't do the full injectable protocol that's recommended. In a dog that maybe length of stay is not important. Maybe you're in a sanctuary setting, you're not doing a lot of adoptions; maybe you have a really great foster home that dog is doing great. The length of stay is not a critical issue for you in that – for that particular dog, and so maybe you'll choose an alternative protocol in that setting.

Some of the veterinarians may remember a year or maybe two years ago now there was a shortage of melarsomine. So again, that's the one and only drug we have to treat adult heartworm. So if that's not available, there's got to be something else. And so actually, at that time, the American Heartworm Society did recommend using doxycycline and Ivermectin together until dogs could be treated with the injectable protocol.

And then another time when you might select to use an alternative protocol could be if there's a really good opportunity for informed adoption. You have a really special adopter who is understanding of what they're getting into and willing to follow the rules and take care of the dog who may not be a good candidate for adoption at massive adoption center where there's maybe not a lot of counseling going on and there may not be a lot of follow-up happening. So you want to make sure that the adopter knows what they're getting into and you have a chance to sit down and talk with them and make sure they understand all this. And so that may be a case when you choose an alternative protocol.

So just some final summarizing points. Heartworm disease is an issue of increasing importance. Veterinarians, animal shelters and adopters, and don't forget about the impact that it has on the end result in those adopted families and those private practice veterinarians who are going to receive those cases afterwards. We talked about a lot of the challenges that shelters are faced with to following the standard guidelines and how you might, with a little background knowledge, take some steps to mitigate the risk of doing something other than what the standard recommendations are. There's a wide variety of protocols that you can use, and it may be okay to do that in select circumstances as long as you understand the risks and benefits of what you're doing.

So I just want to – I'll go through these FAQs now. I believe we have a little bit more time left. Is that okay, Lynne?

Lynne Fridley:

Yes, yes. Go ahead, Dr. DiGangi.

Brian DiGangi:

So one question that we get a lot is, "Do I spay or neuter before or after heartworm treatment?" So our program, the Veterinary Community Outreach Program at UF, we treat about 100 dogs for heartworm disease each year. We require that the dog be spayed or neutered before they get their heartworm treatment. And so the idea is that these are dogs – most of these dogs have no clinical signs. They just have a positive test result like many of the dogs, I'm sure, that you're all seeing. They're perfectly stable. Their heart and lungs are working fine, even though they're infected. And so that's the time to anesthetize them. Not after you've treated them and you have worms dying off and they're at risk for all these complications.

And so we've been doing this for a few years now. We haven't had any complications that were a result of the heartworm status in those dogs. And so we require them to be spayed or neutered at least a week before we do the heartworm treatment. In the select case where that is not possible for whatever reason, we're going to wait at least four to six weeks after they get that second – that final heartworm injection.

There was also some data presented at the 2013 Heartworm Symposium that showed that there was no increase in perioperative complications in dogs that had no or just mild clinical signs of disease that underwent spay or neuter surgery before treatment. So there was some published data to support that recommendation as well.

I mentioned about doxycycline. For some people it's been challenging to get lately. So if you can't get doxycycline, these are some of the other antibiotics that may be effective. We don't have all the studies that we do for doxycycline, but they kind of work the same way, in the same class of antibiotics, and so they should be effective. And so one is minocycline, one is azithromycin. A lot of shelters that I work with are custom compounding doxycycline and that's actually been cheaper for them. They've been able to get a pharmacy to do that.

Some people are using a drug called Rifampin that has been shown to be effective about that Wolbachia organism in other worms. Not heartworms, but in other similar worms, so we would presume that it would be effective for canine heartworm. And then I've also heard of some people that are able to get doxycycline inexpensively still by buying some formulations that are made for birds or for fish. And so we can't comment on really how effective all these things are because nobody's really studied them, but this is what people are doing and how they're getting around some of the challenges to getting doxycycline.

All right. And I'll show you a little video clip here of our heartworm injection technique. And the reason that I want to show this to everybody is that – to make the point that you have to follow the manufacturer's direction very precisely. So they give you a specific-size needle to use, a very specific location to do the injection, a very specific injection technique, and you have to follow that. And so we do these. Ninety-nine percent of the dogs that we do are not sedated. And as you saw, the secret to making that work is a little bit of Cheese Whiz or a little bit of peanut butter to distract them while the injection is happening.

The other thing you might have noticed is that we twist the needle about a quarter of a turn before we pull it out, and then the technician places her finger over the injection site when the injection was complete. We just do that as a way of trying to prevent any of that immiticide from coming out and causing a problem as it comes out through the skin. So that's been successful for us.

Then to kind of bookend the story that I told you in the beginning, when I was preparing for this presentation, I was contacted by this young lady, Annie Blumenfeld, who adopted a dog from a shelter that was heartworm

positive, and she kind of turned it around and really researched a lot about heartworm disease, founded this organization called Wags 4 Hope. And like I said, she contacted me and wanted to tell me about her organization and see if she could assist me with any of this work in heartworm disease.

And so what she has done is started this organization. She creates artwork, and there's a painting of hers that you see up there. And she donates the proceeds of that artwork to shelters, primarily in the northeast. Her email is up there. She did say I could share that, and you could contact her. And she has raised \$15,000.00 since 2012. I believe she's 16 years old. And really turned that experience into something positive. So I thought that would be a nice note to end on.

As I said before, there's my contact information, my email address. If we don't get to your question or if you think of something later on, please feel free to email me, contact me, and I will do my best to find an answer if I don't have it. Thanks very much for listening. And I think we might have a couple questions coming through now.

Lynne Fridley:

Yeah, we do have a few questions, and let me push this first one to the slide area so the audience can see it too. "I have never understood why there is the recommendation to test dogs prior to a switch in heartworm prevention. Can you explain?"

Brian DiGangi:

Yeah, so my understanding for this recommendation is that it's really to document that the dog is negative, hopefully, at the time that you finished that one heartworm preventive. And should the dog come up positive later on, you can – you'll be able to figure out, based on the timing of test results, when the infection occurred, and if you were going to blame it on one of the preventives, you could figure out which one it was.

A lot of these companies that make preventives, if you use it according to the directions, will essentially guarantee that the dog won't get heartworm. So they may assist with some of the treatment if you documented that the dog has received heartworm then – or excuse me, heartworm prevention and still got infected. So they may be able to offer some advice or even – in some cases, even some financial assistance with treatment if that's the case. So it's really for accuracy and medical documentation and so you can figure out when there's a problem with one of the preventives itself. Is there some issue going on or was it somebody didn't administer it properly? Or what was the issue there? So that's my understanding of why that recommendation is there.

Lynne Fridley:

All right. Here is the next question. "There has been a lot of discussions about inefficacy of heartworm prevention due to resistance. What do you think about it?"

Brian DiGangi:

Yes, that's a good question. I just sort of brushed over that topic earlier. And so there has been some documented cases of select strains of heartworms that are resistant to preventives that really, it's the microfilaria that are resistant to the preventive. It's very select regions of the country, it's mostly certain areas of southeast, Georgia and Mississippi region, but it has been documented so that it is out there. It's not widespread. They're not – there isn't this huge level of resistance across the board.

The preventives that we use, for the large part, except in these specific circumstances, do work. Even in most cases they generally work over time the more doses that are given, but they're just not as effective right now. So people are getting alarmed because we have basically one class of drugs in order to prevent heartworm infection. So if they stop working, then we'll be in trouble.

But if there is some resistance out there. And the way to – the best way to combat that is to be sure that you're giving a preventive according to the directions. So every month. And that's another reason that I didn't put up earlier why you want to give that preventive year round because there's some thought that if you kind of start and stop it, you may actually help promote some of this resistance from developing and from expanding. So there is a little bit of resistance out there. Probably not anything you need to be too concerned about at this point, as long as you're following your veterinarian's recommendations for administering preventive and you're doing it on a consistent basis.

Lynne Fridley:

Okay. Thank you. Here's another question. "I heard that inhalant anesthetics can kill worms, cause them to detach and embolize. Is this a concern for these dogs going under anesthesia? Is it less of a risk if it's an infection without clinical signs?"

Brian DiGangi:

That's a good question. Yep. So I've not heard specifically about that point of inhalants causing the worms to die and detach, so I don't know if that's true or not. My experience is that it's probably not true just because of what I said before is that we require all – we see a lot of heartworm-positive dogs and we see a lot of dogs that we probably don't know are heartworm positive and we spay and neuter them. But we're primarily a surgical service, so we do a lot of spay/neuter.

And it's not been an issue for us. And so yes, I would agree that it's less of a risk if there's dogs without clinical signs, but if I have a dog that is showing clinical signs of heartworm disease, its coughing persistently, it has a little bit of trouble breathing, I hear abnormal heart and lung sounds when I listen to the dog's heart and lungs with my stethoscope, and that dog I may actually take one of those additional diagnostic steps. I might

get a chest x-ray and see if there's any signs of damage occurring. I may look for something else before I did surgery.

But in a dog that – a very mild infection, maybe a mild cough, but nothing persistent or no clinical signs, which, again, is the most common finding, I have no concerns about putting them under anesthesia. We don't use any different protocol than I use for any other healthy dog. And we haven't had any trouble with that because, again, the dog is walking around, functioning normally, his heart and lungs are working fine. It just has a positive test result in that situation.

So I don't want to do anything to mess up its physiology that will make it a risk for anesthesia, which when you treat the heartworm, you will – they will die off. You know they're detaching, they're embolizing and they're causing problems. And so – and I don't want to do surgery when that's going on. I want to wait long after that's done or do it before that happens.

Lynne Fridley: Great. Here is the next question. "Do the high – the low-high antigen tests give you any indication of how heavy the worm burden is in the dog?"

Brian DiGangi: That's a good question. I was actually reading a little bit about that this afternoon, and the short answer is no. It's really a positive or negative test. Whether it's low or high doesn't really make any difference. And there are various reasons why you might get a test that shows you a low or high burden. That doesn't necessarily mean it has a low or high burden. So one example is a dog that just got treated for heartworms often will test like it has a really high burden because all the worms are dying off and there's more antigen circulating throughout the body, and so that test picks all that up. So you can't rely on that. It's either positive or negative.

The best way to gauge how to severe the worm burden is and actually – so there's really no way of knowing how severe the worm burden is, the number of worms that are there, but how severe the damage is, is to do an x-ray of the heart and lungs or to do an echocardiogram, that ultrasound of the heart. Those things will give you more information about how serious the infection is in that dog than will, like, a strong positive or weak positive on a test.

Lynne Fridley: Okay. "When do you recommend retesting for heartworm after treatment? Four months or six months?"

Brian DiGangi: Great. Yeah, another good question. And so this one is actually in the American Heartworm Society's guideline, which if people aren't aware, it's available online. You can download them at heartwormsociety.org. I think we have that link in one of the resource widgets for you. Along with

all the reference list that you may have seen flash across there. Those are all in the resource widget if you want to look up some of the actual studies that I talked about.

But what they recommend is testing six months after treatment. And the reason for that is it takes a few months for those heartworms to die after you've given them that last injection. So if you test them right away, you might get a positive result, even though the worms are dead. And if you get a positive result, say – even though they're probably all dead by four months, if you test them at four months and you got a positive result, you might not be sure about it and you're going to want to wait until their sixth month. But there's still a chance that there's some that are taking a longer time to die and are causing that sort of – almost a false-positive test result.

So you're not going to believe any positive test result until six months afterwards. If you get a negative result, then you're good to go. So you can test them earlier and get a negative result and believe it, but if you get a positive result, you wind up retesting them. And so you might – we recommend waiting until six months, but if you need to know – if you need a negative test result before you can move the animal on, maybe you're going to test him sooner and hope for that negative result and just understand if you get a positive, maybe it's just not enough time.

Lynne Fridley: Great. The next question. "Are there better products to dilute the Ivermectin injectable product with? And are there stability storage concerns once diluted?"

Brian DiGangi: That's a good question. What I have heard people dilute products with, usually they're using propylene glycol. But that said, I'm not a pharmacist and I'm sure there are stability storage concerns once a product is diluted. And so that would be something to consider. I don't have sort of a guideline that I could give you on that. You – I would probably talk with a friendly pharmacist who will give you an answer that probably would be – who's shy to actually make a statement like that because they can't guarantee that it's going to be effective if you alter it in any way.

Lynne Fridley: Next question is coming up. "To what do you attribute perceived increase in adverse reactions to melarsomine" – I'm sorry, I'm having trouble saying that word – "in recent years?"

Brian DiGangi: Yeah, so it – that's not something that I've heard a lot about. I'm curious where – if you may be in a particular region of the country that's hearing that. There was a survey that was done not long ago by the American Heartworm Society. I think it was maybe last year. They surveyed a lot of veterinarians out in private practice to see what their perceptions were of heartworm disease. Is it increasing? Are there more reactions to

treatment? Are people using a preventive more or less than they were a few years ago? And the results were kind of all across the board. There wasn't any clear trend. Some veterinarians felt there was more heartworm, some thought that there was less. It depending on a lot of different things.

So I haven't seen that. Certainly in our area I haven't seen anybody having the perception of an increased risk of adverse reaction. If it's real, it could be attributed to inappropriate use of the drug. Like I said before, there's a specific injection dosing protocol that has to be followed. It could be dogs that are having these reactions just have a higher worm burden and, therefore, they're having more reactions that way too. So I haven't – it's not something I've seen specifically.

Lynne Fridley: Okay. Another question. "Is it safe for shelters to give Heartgard without testing first?"

Brian DiGangi: Yeah. So it is safe, but that may impact your results down the line, so hopefully you're going to be testing at some point. If you're testing for microfilaria, that may interrupt those tests. Heartgard in particular, if you're asking about Heartgard in particular, is an Ivermectin-based product. I talked about the dose before. It's very safe. It's a very low dose. It's safe to give it to dogs of all breeds. And it is – and you'll recall it is part of the treatment protocol for killing the adults as well. And so it's safe to give it to dogs that are positive. It's actually part of the recommended protocol. And so you're not going to cause any harm. You just may complicate sort of the diagnostic and testing situation later down the line.

Lynne Fridley: And we're going to take one more question. Actually, this is a statement, and you may want to comment on it. "Shelters should tell adopters that tests showed heartworm below detectable levels and should be retested by their vets in four to six months. It avoids mad doctors if the dog comes up after the shelter says it's negative."

Brian DiGangi: Yeah, that's a great point, and actually in the AHS guidelines, they have a specific language that they recommend. They recommend very similar things. That you should never say that a dog tests negative if the test – the results should say no antigen detected because, as we talked about, there's a lot of reasons why you might get a false-negative result. So with any test, you can never be 100 percent positive.

And so it's all about setting those adopters up for success and setting their expectations in the right way. Again, think back to that original blog post. Like, it wasn't the fact that the dog was positive for heartworm and he had to undergo treatment and that the guy had to pay for it. It was that he

wasn't informed about that and just didn't know about it ahead of time. So that's an excellent point. I certainly would agree with that.

Lynne Fridley:

Well, thank you, Dr. DiGangi. This has been a very informative webcast tonight, and we appreciate your time. That's the end of our event. We want to thank Dr. DiGangi and all of you for your time. Please click on the link to take our survey. It might have been blocked by your pop-up blocker or it may be on a different screen, but don't worry if you can't see it. We'll be sending the link to you, and we would really appreciate it if you would take a few minutes to respond.

Make your plans to join Maddie's Institute on September 18th for a webcast with Dr. Elizabeth Berliner. "Treating the Treatables: Saving Lives Through Medical Protocols, Foster Care and Proactive Thinking".

The archive version of tonight's webcast will be available soon. For more learning opportunities, please visit our website at www.maddiesinstitute.org. Thanks again for sharing your evening with us. Goodnight.

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