Speaker 1: [00:04](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=4.6) Hello and welcome to NC state's audio abstract. I'm your host Tracey Peake. Bartonella is a bacteria most commonly associated with cat scratch disease, which until recently was thought to be a short lived or self limiting in medical lingo infection. Bartonella isn't new. Doctors have known about cat scratch disease for almost a century, but what is new is it's increasing association with a wide variety of ailments, many of them chronic and some of them life-threatening. We're speaking today with Ed Breitschwerdt, infectious disease specialist, doctor of veterinary medicine and Bartonella expert about what this bacteria can do and what researchers are trying to do about it. Welcome Ed.

Ed B.: [00:46](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=46.8) Thank you Tracey. Good to be here.

Tracey Peake: [00:48](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=48.36) What is Bartonella? What is this bacteria?

Ed B.: [00:51](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=51.03) Bartonella is a genus of bacteria that, um, was he essentially rediscovered as a result of the AIDS epidemic. And before 1990 we did not know that this group of bacteria infected animals or humans in North America at all or throughout much of the world. Essentially the Bartonellas were first discovered including Bartonella, henselea and Bartonella quintanae, essentially two of these species in AIDS patients. And the reason that discovery was made in and around 1990 was those individuals infected with a retro virus would develop very unusual skin tumors and pathologists could actually see bacteria within these tumors. But microbiologists couldn't grow the bacteria. So for a period of time we didn't know what the bacteria were. And David Relman at Stanford, a physician used a DNA approach to determine what the bacteria was.

Ed B.: [02:00](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=120.1) And Russ Regnery, who is a friend, a Rickettsiologist and a researcher at the Centers for Disease Control and prevention made the association between cat scratch disease, which as you said, we knew about for a hundred years and this very new bacteria that came out of a patient with AIDS.

Tracey Peake: [02:19](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=139.69) Okay, so the bacteria wasn't new. Just our ability to find it was what was new. What does Bartonella do?

Ed B.: [02:28](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=148.09) So to be honest, we are still trying to figure out exactly the spectrum of disease that this bacteria can cause in animals and humans. So specifically, the first associations as you indicated were with cat scratch disease and that's a fever, a big lymph node and a history of a cat scratch and that can essentially occur in a human or in a dog. We then recognized in the early 1990s that both dogs and humans developed an infection of their heart valve, which is referred to as endocarditis and that's a very life threatening infection.

Ed B.: [03:13](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=193.27) So it fell into the realm of what is referred to as culture negative endocarditis, meaning they knew there was a bacteria causing it, but no one could grow the bacteria. Subsequently, we now know that nine Bartonella species can induce endocarditis or an infection of the heart valve in dogs or humans.

Tracey Peake: [03:34](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=214.63) Let's take a little aside here and talk a little bit more about how hard it is to find Bartonella. Why can't you just like we're all familiar with, let's say you have a sore throat and you go to the doctor and they give you a strep test and they swab your throat and they swipe it on a little plate and it either grows or it doesn't. Why can't you do this with Bartonella? It's a bacteria, right?

Ed B.: [03:57](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=237.88) Absolutely. And that's an excellent question, but um, all bacteria are not created equally. And with strep, it has a dividing time of about five minutes, whereas Bartonella has a dividing time of about 22 hours. The difficulty with Bartonella in regard to culture is it has such a slow dividing time. The other difficulty is that Bartonella is in the blood, out of the blood and in the blood. Meaning that if we're doing blood cultures to confirm infection in a human, we tend to do on a research basis in my laboratory at least three cultures on alternate days, often on a Monday, Wednesday, and Friday. Because it's never that we find all three of those positive for Bartonella and most often only one of three would be positive.

Tracey Peake: [04:55](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=295.6) Why is that? What does it doing? Where is it, where does it hide?

Ed B.: [04:59](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=299.35) That is referred to by researchers as the niche. Where does Bartonella hide? And there's a group in France that thinks it hides in the bone marrow and um, a group in Germany that would argue that it primarily hides within the endothelium, which is the lining cells of our blood vessels literally throughout our body. Um, and then there's me in North Carolina that thinks it probably hides both places at a minimum.

Tracey Peake: [05:32](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=332.68) Okay. So it could actually be hiding in a lot of other places we have not even thought of yet. And so it just randomly will show up in the bloodstream when it gets to a critical mass. Like how does that work?

Ed B.: [05:44](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=344.8) So that's a great question as well. One way to facilitate the detection of Bartonella in animals in humans is to immunosuppress the patient. So when we first discovered Bartonella Henselae the cat scratch organism in dogs, it was because the veterinarians were treating specific diseases with immunosuppressive drugs and they had raised the level of the bacteria in the blood high enough that we could actually culture it or detected by a DNA approach.

Tracey Peake: [06:20](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=380.15) Okay. So that you could actually find it, when the system is down then that bacteria can thrive.

Ed B.: [06:25](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=385.28) Absolutely.

Tracey Peake: [06:26](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=386.12) It's obviously not a direct cause and effect, but in some people bartonella symptoms mimic other immune system diseases. When did this start to become a concern?

Ed B.: [06:37](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=397.43) It has been a very slow and very gradual progression in our understanding since Bartonella was discovered in North America in 1990 a substantial amount of that work has actually been done here at North Carolina State University in my research laboratory. And to be honest, it became very controversial where a veterinary research laboratory was documenting longstanding infection. Oftentimes in veterinary workers who have a lot of contact with animals or fleas and ticks that are on those animals when they're being examined. It became pretty obvious early on that this organism could localize to heart valves and induce an infection within the heart valve itself. Probably after that, um, we started looking for this bacteria in dogs and humans that had cardiovascular disease, rheumatologic disease or neurologic disease.

Ed B.: [07:50](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=470.18) And particularly when we tested veterinarians and veterinary technicians, those three systems where the three systems that were most frequently involved, the system that worries me, um, the most is the neurological system. And the reason that's a concern is the spectrum of neurologic disease that we and others around the world literally have described in individual cases or case series, um, spans a very, very large spectrum from having involvement in making you paralyzed to seizures, to Migraines, um, to vascular events in the brain where there's rupture or, um, the formation of tumor-like lesions. So again, not having Bartonella on a differential for those type diseases would be very unfortunate because the therapy would be directed at autoimmune encephalitis or some other entity where we wouldn't consider a bacteria to be causative.

Tracey Peake: [09:03](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=543.121) We'd be treating the wrong calls for the disease. The person would not get better. And in fact, that has been the case with some people who've been diagnosed with Bartonella in the past. So it's definitely a concern. So what kinds of ailments, um, have been misdiagnosed as one thing, but actually were bartonella caused or Bartonella associated?

Ed B.: [09:27](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=567.03) Perhaps the place to start with answering that question is that our current understanding of this genus bacteria, we'd suggest that there's good news and that's that in most instances the goal of Bartonella is not to kill the host, it's to maintain a very chronic persistent low grade infection until a vector comes along, picks the bacteria up and transmits it to a new host. So we could say the good news is that Bartonella in most instances does not kill you quickly. The bad news is that based on what we have published, people can be ill for three years, five years, 10 years with this bacteria. And during that period of time they can have diagnoses such as multiple sclerosis, rheumatoid arthritis, systemic Lupus arathematosis. So diseases that are extremely well established in the veterinary or human literature for which causation is less than clear. And I want to be accurate in stating that Bartonella is not the cause of all of these diseases or some of these diseases, but Bartonella can cause symptoms that mimic these diseases.

Tracey Peake: [10:54](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=654.24) And that's the difference.

Ed B.: [10:55](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=655.38) That's the difference. If our research stands the test of time, which I'm pretty confident that it will, I am of the opinion that Bartonella will be the next bacterial paradigm changer in our understanding of a persistent infection and very complex chronic disease expression.

Tracey Peake: [11:19](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=679.38) So all of that aside, let's be hopeful. There are ways to treat this if you can actually identify it. Right. Is there a treatment that is effective against Bartonella?

Ed B.: [11:29](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=689.97) Um, yes. And in most instances the treatment, whether it's a cat, dog or human, um, is relatively straightforward. It is antibiotics and there is some variation in response. Um, depending on the Bartonella which species of these bacteria we're dealing with in the vast majority of instances, we immunologically eliminate that infection. So most veterinarians that get scratched by a cat and Bartonella is transmitted, probably never get anything other than a little pimple on their skin. And the immune system takes care of it. But for those where that doesn't occur, they end up with classical cat scratch disease and then a subset of those veterinary workers would end up with what we've described. And that's very chronic, very insidious rheumatologic disease like arthritis, joint pain myalgia, or neurologic disease or ultimately some cardiovascular disease.

Tracey Peake: [12:43](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=763.57) Okay, well the good news is we can actually treat it if we can find it. This is true. It's good. So let's talk a little bit about how exactly this could be transmitted to a person. Is it fleas? Are Fleas the way that it goes from animal to animal? Would a flea bite potentially transmit this to a person or is it usually contact with an infected animal?

Ed B.: [13:07](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=787.24) Transmission of Bartonella. As we look across all the different species and all the animals that are reservoirs, um, has become much more complicated as well. It is very clear that fleas obtain a blood meal from an infected cat, that once that occurs, the flea actually grows the Bartonella within its intestinal tract that flea feces within 24 hours of obtaining a blood meal from an infected cat contain Bartonella that are infectious to a cat or a human and that they remain infectious in the environment for at least nine days. And we've only tested, we researchers around the world have only tested out nine days and that's very disconcerting because what, what we believe in regard to with for cat scratch disease is the cat has to have fleas and the cat has to contaminate its saliva or its nails with the flea feces that contain the Bartonella and then it's like a hypodermic needle that contains that combination of Bartonella and flea feces that's injected into the person that induces cat scratch disease.

Ed B.: [14:30](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=870.94) Bite transmission has been suggested from dogs. Needle stick transmission has occurred in veterinarians where they are working with animals and they took a specimen sample from an animal and inadvertently stuck it into their hands and transmitted the organism experimentally in the laboratory. We can document blood transfusion transmission amongst cats or dogs. Um, so you know, in veterinary medicine it is become standard of care to routinely screen blood donors for Bartonella. In human medicine that's not done. And we've done a collaborative study with physicians in Burra Brazil where nearly 3% of healthy Brazilian blood donors had Bartonella Hensel a in their blood.

Tracey Peake: [15:25](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=925.46) Wow. Fleas are the worst. I just fleas are the worst.

Ed B.: [15:29](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=929.36) One more potential vector for Bartonella that we haven't talked about is ticks and there's considerable research around the world demonstrating that ticks actually contain Bartonella Henselae DNA within them. There is now one laboratory study that has been completed in France with the help of a tick researcher from our centers for Disease Control and prevention in Atlanta that documented in a laboratory setting that Bartonella could be transmitted by ticks. We have also reported instances where dogs did not have fleas but had recent tick exposure and then we documented that they were infected with Bartonella. So I guess we could say the jury is still out as to if, when and how often Bartonella is being transmitted by ticks to people in the United States, but there's increasing evidence that that's another source of infection that would become very important and very disconcerting.

Tracey Peake: [16:39](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=999.05) Ticks are also the worst. Now that we've covered the factors of transmission or the ways that you could come into contact with the bacteria, the kinds of illnesses that could cause and the treatment for the illnesses and how tricky it is to diagnose it to begin with - what are your next steps?

Ed B.: [16:55](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1015.85) So the, the major focus in my research lab currently is to enhance the detection of these bacteria and with currently available molecular diagnostic test techniques, we have pushed that envelope as far as we believe it's possible. There's a new generation of molecular diagnostic techniques to start pursuing how good that will be at helping us increase our ability to detect these bacteria. The other thing that our laboratory published and NC state holds the patent on is the use of an insect biochemical composition, growth media rather than mammalian growth medias to enhance the growth of these bacteria. And that becomes, became very important because that propelled our research in identifying these bacteria initially in veterinary technicians, veterinarians and then subsequently in people working in agriculture or other areas that would have a lot of arthropod and animal contact. Um, and then in the general public, so clearly, you know, as I say to my internal medicine residents, the kindest form of therapy is accurate diagnosis and the primary focus for us is to improve diagnostics by molecular detection and then trying to grow these bacteria better in a culture system.

Ed B.: [18:37](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1117.8) Um, we are currently working with UNC medical school on neurological patients with Bartonella and we are working with Duke Oncology, Duke Cancer Institute on determining the extent which Bartonella may contribute to vascular cancers and other cancers in animals and people.

Tracey Peake: [19:04](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1144.98) And that's important important work going forward and making it easier to detect is going to make it easier to treat. There is hope, there is hope. Just get rid of the fleas and ticks. Is there anything else that you wanted to add?

Ed B.: [19:17](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1157.19) One of the most recent things that we have documented initially in cats and then in dogs and to a much lesser extent at this point in time in humans is infection of the heart muscle, not the valves, but actually the muscle itself, which is referred to as Myocarditus. And that is really important because infection of your valve generally leads to what most people are familiar with as congestive heart failure, infection of the muscle leads to sudden death and dropping dead.

Tracey Peake: [19:53](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1193.46) Wow.

Ed B.: [19:54](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1194.33) And so that is a whole new area of research where I think in veterinary medicine we are actually a little hit of human medicine in regard to what we have already published and described. And it's an area of research that deserves some attention as to can Bartonella induce infection within the myocardium and contribute to abnormal cardiac rhythms or that rhythm being so abnormal that you die suddenly. One of the things I've learned through my two decades of experience with the genus Bartonella is that it takes many years and many research publications, which I think my lab's generated about 150 now with Bartonella and the title to start to get people to think differently about a genus of bacteria. So all of our research and collaborations now, are currently being supported by donations to the Bartonella vector borne disease foundation fun here at North Carolina State University. There is precedent for sudden death in association with Bartonella is well established in the literature, including Phd theses is that were based on trying to figure that out.

Tracey Peake: [21:17](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1277.32) Wow. That's amazing.

Ed B.: [21:18](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1278.88) It is. It's an amazing story. The Bartonella story is an amazing story.

Tracey Peake: [21:24](https://www.temi.com/editor/t/8yTPhnA3UqOz0pK3AI-If3TrcX69oun9-q3AiquZPWtE8oXqpCaa4E3j8nQvl1yTQV9-j3d2PHVzSmIXX3nRrIu_T2g?loadFrom=SharedLink&ts=1284.83) We've been speaking with Ed Breitschwerdt, infectious disease specialist, doctor of veterinary medicine and Bartonella expert at NC State University. I'm Tracey Peake. Thanks for listening to audio abstract.