

# Heartland Virus Transmission, New York

*[Announcer] This program is presented by the Centers for Disease Control and Prevention.*

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Alan Dupuis, a research scientist at the New York State Department of Health in Albany. We'll be discussing the transmission of Heartland virus in New York State.

Welcome, Alan.

[Alan Dupuis] Thank you for having me, Sarah. It's a pleasure to be able to discuss our work.

[Sarah Gregory] So let's start off with you explaining what seroconversion is to us.

[Alan Dupuis] Yeah. So seroconversion is when a person has been exposed to an infectious agent (like a bacteria or a virus) and begins to produce antibodies. So we measure those antibodies to confirm infection. So we need to see a rise in the antibody titers (or levels of antibodies) between the earliest timepoint in infection and the later timepoints. So basically, it's just the change from being antibody negative to becoming antibody positive.

[Sarah Gregory] Okay. And what is Heartland virus?

[Alan Dupuis] Well, Heartland virus is an emerging virus that was only recently isolated in 2009. It's closely related to other viruses that are transmitted by mosquitoes and ticks. Its closest relative is probably Severe Fever and Thrombocytopenia Syndrome virus—which is a real mouthful, so I'll just say SFTSV. Coincidentally, that virus was also isolated in 2009, but it was isolated in China. And there and in other parts of Asia it has caused thousands of infections.

[Sarah Gregory] And how is it different from the endless, it seems, other tickborne diseases?

[Alan Dupuis] Yeah, sure. It seems like there's a new one every few years. Many of the tickborne diseases that we're most familiar with—like Lyme, anaplasmosis, babesiosis—are caused by bacteria or parasites, whereas Heartland is a viral infection and it's transmitted by a different tick species. But most, if not all of the tickborne diseases share similar symptoms, especially during the early stages of infection.

[Sarah Gregory] What are the symptoms in a person?

[Alan Dupuis] Very few cases have actually been described in the literature, but of those that have been described, symptoms include fever, fatigue, headache, achy muscles and achy joints, thrombocytopenia (which are low platelet counts), leukopenia (which are low white blood cell counts). And it's the latter two symptoms (the thrombocytopenia and leukopenia) that seem to be hallmark symptoms of Heartland disease. But these symptoms are similar to another tickborne disease, ehrlichiosis, which is a bacterial infection and that's actually treated with antibiotics. Some of the more severe cases of Heartland disease occur in individuals that are immunocompromised. But because Heartland disease is newly recognized and testing is relatively limited to a few state health labs and the Centers for Disease Control, it's possible that only the most serious cases are actually reported. We suspect that there could be many other cases that are mild that self-resolved or are completely asymptomatic.

[Sarah Gregory] I see. Okay.

So you mentioned that it was discovered, or identified anyway, in 2009. Where was it first discovered?

[Alan Dupuis] It was first discovered in Northwestern Missouri. Two farmers presented at a hospital with some of these symptoms that I just mentioned, but the actual case study wasn't reported until 2012.

[Sarah Gregory] And now what's the known geographic location?

[Alan Dupuis] Human cases of Heartland have occurred primarily in the Midwest and southeastern states, mainly Missouri, Tennessee. But antibodies to the virus have actually been detected in deer and moose and raccoons in the northeastern US as well—particularly in Maine, New Hampshire, Vermont, and Pennsylvania—but virus has not been isolated in those areas specifically in the northeast.

[Sarah Gregory] Yet.

[Alan Dupuis] Yet, or as of yet.

[Sarah Gregory] As of yet, yes.

And when was it identified in New York?

[Alan Dupuis] At New York State Department of Health, we've been screening ticks for Heartland virus since 2016, but it was during the fall of 2018 that epidemiologists at our Bureau of Communicable Disease Control at New York DOH, they were notified by researchers from the University of Massachusetts regarding the positive Heartland results from a tick submitted by a Long Island resident (it was submitted to them for testing). So upon hearing this, our epidemiologists reached out to our partners at Suffolk County DOH to contact the individual for an interview and request blood samples to see if the individual was possibly infected with the virus. In addition to that, we also collected ticks from the areas where the individual could have been exposed.

[Sarah Gregory] Okay. So they've got this tick. How was it identified? You said it was identified there then, but how?

[Alan Dupuis] Viral RNA (or the genetic material) from the original tick was detected at a place called TickReport, which is a tick ID and testing service formerly located at the University of Massachusetts but now is wholly independent. They detected this viral RNA by a process called reverse transcription-polymerase chain reaction, and that's just a sensitive test designed to make many copies of a small portion of the virus. So they detected the RNA and then we, subsequently to their positive results, we found evidence of Heartland virus in five other ticks located at different sites on Long Island. We also found specific antibodies in the individual that removed the tick, which indicated that the individual was infected with Heartland virus. And since we've been doing serosurveys or looking for antibodies in hunter-harvested deer on Long Island, we found that almost 10% of those hunter-harvested deer in Suffolk County contained antibodies to Heartland virus.

[Sarah Gregory] So the Suffolk County Health Department, they didn't actually have the tick. They just had this readout of the genetic material. Is that right? Or did you actually have the tick?

[Alan Dupuis] Unfortunately, we were never able to get the tick, because we would have performed a few more tests to actually try to isolate the infectious virus. But the rest of the tick was not available to continue testing. So the tick went to TickReport and not to the health department.

[Sarah Gregory] I see. So what kind of tick does this virus infect?

[Alan Dupuis] The tick that has been implicated in the transmission of Heartland virus is *Amblyomma americanum*, which is commonly referred to as the lone star tick. It's named the lone star tick for the white dot on the scutum or back of the adult female. Colloquially it's also referred to as the turkey tick, as turkeys are a common host for the immature stages. In the United States, these ticks are found from central Nebraska south through central Texas, eastward all the way throughout the southeast United States, north through the Midwest just south of the Great Lakes, and then east again all the way to the Atlantic coast, following the coast up to the southern portions of Maine. So they're distributed primarily throughout east of the Mississippi.

[Sarah Gregory] So tell us about the life stages of this tick. Is it infectious at all the stages?

[Alan Dupuis] Well, for Heart ticks there are 4 life stages. They start out as eggs, they hatch into larvae, and then they molt into nymphs and adults. Lone star ticks are three-host ticks, meaning that once the egg is hatched, each of the active stages requires blood from a different animal to grow and develop to the next stage. Now the immature stages (the larvae and the nymphs), they typically feed on small mammals and birds whereas the adults will feed on medium sized and larger mammals like raccoons, but especially deer. Now most ticks, like the blacklegged tick or the deer tick, they typically quest or kind of climb up on vegetation and wait for a host to pass. But lone stars are a bit different or can be a bit different—they utilize that method, but they also are known to actively pursue their host. So it gets a little scary. Each of these engorged adult females, they can lay as many as 5000 eggs, so they're pretty prolific. And then during the field studies that have been performed and published, both the nymphs and adults have been found infected with Heartland virus. But in the laboratory studies that have been performed, it seems that each of the life stages could become infected and subsequently transmit the virus. In the same laboratory studies, vertical transmission was also noted, and that's simply virus passing from the infected female to the newly hatched larvae. So it's possible that a host is not necessarily needed to continue to maintain the virus in nature.

[Sarah Gregory] I have to ask you what you mean by "the tick pursues its host". What does that mean?

[Alan Dupuis] Yes. So I have not experienced this, but others that have collected this species of tick have noted that when they're out in the environment, the ground actually looks like it's moving because so many ticks are pursuing the host. So they're out hunting, so to speak.

[Sarah Gregory] I am duly horrified.

[Alan Dupuis] Yeah, me too. I am fortunate that I do not live in an area with high populations of this tick.

[Sarah Gregory] So it's a virus, so is there an antiviral for it? Is there any kind of treatment?

[Alan Dupuis] Unfortunately, no. Unlike Lyme disease and most of the other tickborne diseases that are caused by a bacteria, antibiotics aren't effective for the viral infections. So there are no vaccines or specific medications to prevent the disease. If somebody does get infected and shows symptoms, the treatment consists of supportive care or medications to help alleviate the symptoms. So the only tried and true mechanism is tick bite prevention. That's paramount for avoiding infection with the virus, and it works for all the other tickborne diseases as well. So these prevention tips are widely available, they can be found on the New York State Department of Health website as well as the CDC website.

[Sarah Gregory] And they are basically the same preventatives as you would use for mosquito-borne illnesses, right?

[Alan Dupuis] Yes. Yeah, for the most part.

[Sarah Gregory] You did a drag and flag in 2016. Can you explain that procedure to us?

[Alan Dupuis] Dragging and flagging is a simple low-tech way of collecting ticks. And it's simply...you drag a 1 meter by 1-meter square white cloth on the ground or flag it across low vegetation, and the cloth picks up the tick. After a certain distance, we visually inspect the cloth and then any questing ticks that are swept up onto the cloth, we collect those using tweezers, we place them in alcohol so that we can easily transport them back to the lab for further testing.

[Sarah Gregory] Okay. So when you did that in 2016, none of the ticks had Heartland virus. Do you know what happened between 2016 and 2018?

[Alan Dupuis] Well, the easiest answer is that we either weren't looking in the right spot or we didn't collect enough ticks at the time to detect the virus. Fortunately, our results indicated that the tick infection rates are very low (approximately 1%) and they vary across all the sites. So it's likely that it's just because the numbers were so low that we didn't detect the virus.

[Sarah Gregory] Okay. Not that it just spontaneously appeared in those two years.

[Alan Dupuis] Exactly. We don't think it spontaneously appeared; we just didn't have enough data at the time.

[Sarah Gregory] Okay.

You mentioned raccoons and deer. Do we know what the main host for this tick amplification is?

[Alan Dupuis] We know which hosts the ticks feed on, but we don't know which species of host animals are responsible for virus amplification. There have been a couple of studies published; one assessed mice and chickens, hamsters, goats, I think rabbits, and raccoons. But they did not detect any circulating virus in the blood of those animals. And in a separate study, actually experimentally infected white-tailed deer, but once again none of the animals became symptomatic and no live virus was detected. But I mentioned earlier that these other laboratory studies that infected female ticks, they track the virus, and it could pass the virus to the next generation. So again, it's possible that the vertebrate host isn't needed to maintain the virus.

[Sarah Gregory] That's actually probably worse than if a host is needed, right?

[Alan Dupuis] Well, it certainly can be worse. There are certain implications for either scenario, but yeah, it appears that these ticks can not only amplify the virus within themselves but actually maintain it for several generations.

[Sarah Gregory] And how big a problem is it in New York? How concerned do people need to be there?

[Alan Dupuis] Well, fortunately Heartland virus prevalence is quite low, especially compared to the other tickborne pathogens. But people definitely need to be aware of its presence. One should just automatically assume that wherever lone star ticks are established, the chance of Heartland virus could be there.

[Sarah Gregory] Were there any surprises in this investigation?

[Alan Dupuis] So when you've been doing this for long enough nothing really surprises you, especially when it comes to tickborne diseases. But the one notable finding that we had was that of all the positive ticks that we detected—and again, there were only five—but they were all nymphs. And this is somewhat notable because nymphal ticks have only fed once in their lifetime as larvae, whereas adult ticks have had two opportunities to potentially acquire the virus from the animal host, if that indeed is the mechanism to become infected. So you would think that adult ticks would be, you know, twice as likely to be infected rather than the nymphs. But, you know, there are many possible explanations for this and something that we hope to further explore.

[Sarah Gregory] What do you think are the public health implications of this study?

[Alan Dupuis] One implication is that Heartland virus is likely distributed wherever the lone star tick exists and not just relegated to the Midwest or Southeast United States where most of the studies have been published. Also given the apparent mild infection of the Suffolk County case, it's possible that the number of actual Heartland cases is under-reported or that they're going undiagnosed or possibly misdiagnosed. Because as I mentioned earlier, ehrlichiosis has the same symptomology as Heartland virus (typically the thrombocytopenia and leukopenia). So if that infection resolves on its own, clinicians could think that it was the result of antibiotics kicking in rather than a mild case of Heartland disease.

[Sarah Gregory] Do you have any suggestions for actions or programs that you think should be implemented?

[Alan Dupuis] Wherever a tick surveillance program exists currently, we would suggest the inclusion of protocols that are there for the detection of Heartland virus—we would certainly recommend that. Our study also demonstrated the utility of testing the hunter-harvested white-tailed deer. Deer are a really sensitive sentinel model because they're very abundant; they have small home ranges so if you do find an infected deer, you'll know that it's relatively local; and they're fed upon by hundreds if not thousands or ten thousands of ticks during their lifetime. So even if a pathogen or a virus (in this case) is rare, that deer will have a greater chance of encountering that. So if they produce antibodies, it will be detected. But this process is obviously not practical for most local and state health departments.

[Sarah Gregory] Should clinicians be paying attention to this infection? And if so, how would they go about it?

[Alan Dupuis] Absolutely. I believe most clinicians in the Midwest and Southeast have been alerted to Heartland virus. Otherwise, healthcare providers should be aware of the overlapping symptomologies (that seems to be a theme of this interview). Those symptomologies include fever, fatigue, loss of appetite. They are shared with all the other tickborne diseases so they should consider requesting Heartland virus tests, especially in patients that don't get better with antibiotics or those with thrombocytopenia and leukopenia and have a history of tick bite.

[Sarah Gregory] Alan, tell us about your background, your job with the New York State Department of Health, and what you like best about it.

[Alan Dupuis] I'm a pretty avid outdoorsman. I go hiking and camping, and I'm a bit of a bird nerd. So I'm out there all the time in the environment. You know, unfortunately I have to deal with the problem with ticks, but my job at the State Health Department is one where I get to work with an awesome group of colleagues. I'm fortunate enough to get to perform a wide array

of activities in my job. I perform clinical testing for all the mosquitoborne and tickborne, especially, viral diseases. Whenever there's a field study, I get to go out and sample birds, collecting blood or ticks from those birds. If there's a particular study that involves the use of wild birds (or any birds for that matter), I get to be involved with that. So it's just the variety that keeps me interested and stimulated and enthusiastic about what I do.

[Sarah Gregory] Okay. I have to ask you this. Several years ago, I did a podcast with a tick expert who has a tick tattoo on his arm. Do you?

[Alan Dupuis] I do not have a tick tattoo, but I do have a couple bird tattoos though.

[Sarah Gregory] Okay. The host, not the tick itself.

[Alan Dupuis] That's right. Maybe I'll consider getting a tick tattoo if I get to discover a disease of my own.

[Sarah Gregory] Okay. Well, thank you for taking the time to talk with me today, Alan.

[Alan Dupuis] Thank you so much. It was a real pleasure.

[Sarah Gregory] And thanks for joining me out there. You can read the December 2021 article, Heartland Virus Transmission, Suffolk County, New York, USA, online at [cdc.gov/eid](https://www.cdc.gov/eid).

I'm Sarah Gregory for *Emerging Infectious Diseases*.

*[Announcer]* For the most accurate health information, visit [cdc.gov](https://www.cdc.gov) or call 1-800-CDC-INFO.