Acarology with Dr. Neeta Pardanani Connally
Ologies Podcast
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Heeey, so just a quick note up top of an ap*ology*. Sorry this one is up a little bit later than usual; I know we're probably 12-24 hours behind on the posting. But I just had a really, really bananas couple of weeks. A loved one in the hospital, and my wallet got stolen, and I was moving and doing a couple of different shoots for Netflix and such. Just had a couple of surprises the last couple weeks so I'm a little bit behind, so sorry this is going up a bit late, but you can expect it at its normal time next week. Also, if you're hearing this before June 7th and you're in the LA area, I will be at the Natural History Museum's First Fridays doing a live *Ologies* Q&A with a curator there. So, if you're in LA, come to First Fridays, come say hello to me, that's on June 7th. Okay.

Oh hey, it's that sweatshirt who's so flattered that you've worn it three days in a row but it's starting to get concerned for you, Alie Ward, back with another episode of *Ologies*. You know, there are a few episodes that I've started off just letting you know, "hmmm…" I wasn't so sure about something. Please see dinosaurs, scorpions, and cats, because I'm just really a dog person. But I ended up loving those things and subjects because what it boils down to is, to know something is to respect it, to respect it is to appreciate it. And this episode is ticks. Will I love them? Mm, well, just listen, but first listen to me thank some people.

Namely, the folks at Patreon.com/Ologies for making this show possible by giving as little as a quarter an episode to ask questions and see behind the scenes info. Also, thank you to everyone getting *Ologies* merch and tagging your Instagram photos #OlogiesMerch so I can repost them. Thanks to everyone who just gasses me up on the weekly by subscribing, and rating the podcast, and for reviewing, which I shamelessly creep and appreciate, and this week PSAsheed said:

> *Honestly, I wanted to make a lot of environmentally friendly changes in my life, I just never got around to it. This podcast single handedly accelerated me to purchase reusable bags, reusable saran wrap and produce bags, volunteer my engineering talents to earth saving needs, spread the news about sustainable practices, and infinite other responsible practices, in like a couple months. Thank you for accelerating me towards changing our world.*

Thank you! Let's not stick straws up turtle noses. Deal? Deal.

Okay acriology? Ac-c-acarology? Acronology? Mmm, I'll figure it out. But it comes from the Greek *acari*, which means 'cheese mite' or 'tick', which comes from the word for tiny. PS, side note, I was just like, "Cheese mite??" And I just found out that there are certain mites that live on the outside of cheese. Some folks eat 'em because they impart some kind of floral, earthy flavor. So now we all know something about cheese mites. Okay, ticks.

Ticks and mites are arachnids, like schpidas [spiders], but in the subclass acari. Tick nymphs have six legs, but they have a glow up, and they molt, and then boom! Adults have not six legs, but eight. An extra pair of legs just waiting to hug and kiss you, and by that I mean cling to you and drink your life juices with its stabby, dirty mouth.

I love bugs so much, but ticks and cockroaches are two that I just have beef with. I want to love them but their existence in my personal space is just a one-way ticket to barf city. But this was a topic that we should all know more about. I saw this ologist's work via Twitter; a tick expert based in Connecticut. I gently DM'd her hoping our schedules would align and sadly, they did not for a face to face meet up. Y'all know me, I'd rather bro down in the same room than have an echoey phone

talk. But this ologist was wonderful and recorded her side of the conversation into her computer, and though the sound quality isn't the same as if we were chit-chatting in the same room in a Hampton Inn, it's totally clear and this information is timely as hell.

The weather's getting warmer in the US; hemlines are crawling upwards, lawns are flourishing. We all need to know what the hell's going on with ticks! Now, we talk about ticks in this episode; where they live, where they lurk, how to detect them, how dangerous they are, bug sprays, conspiracy theories, and what to do if you find one on you.

This ologist is a medical entomologist and Associate Professor of Biology at West Connecticut State University, where she runs the tickborne disease prevention lab, which focuses on the prevention of Lyme and other tickborne infections, which according to many reports have just risen very sharply. So, how can we stop them from spreading? How do we outsmart these buggy buggers? Ticks: what is their deal? Why do they want to kill us? Or are they just like, "Oh shoot, I was just hungry and I'm so sorry, dang it!"

Side note, when it comes to the infections themselves, there's an amazing disease ecologist in San Francisco who studies things you can catch from a tick, and y'all, DadWard's over here doing her best to interview her this week and make this a two-parter. So stay tuned and cross your fingers. But for now, the first step is understanding the life cycle, and the bitey habits, and the mind of the tick, this info is critical. Tuck your pants in your socks and get ready, it's about time for some *tick talk* with Dr. Neeta Pardanani Connally.

Alie Ward: Thank you so much for talking to me, I'm so excited to talk about ticks, you have no idea. Thrilled.

Dr. Neeta Pardanani Connally: I'm excited too.

Alie: Do you tell people straight off the bat that you work with ticks? Are you excited at cocktail parties to be like, "Guess what I work on!"?

Neeta: Actually yeah, I used to do that. Now I try not to. But you know, any chance I get I will talk about it, but I try not to lead with that. I think I learned that a long time ago, sometimes it's not always what people want to talk about.

Alie: Really?!

Neeta: Yeah.

Alie: I would think people would be dying to just milk you for information.

Neeta: Well, I mean, it may have come from a childhood experience I had, with talking about headlice at the dinner table at a friend's house. [*"Oh boy."*] Learning it was not cool.

Alie: Did you have them?

Neeta: Oh yes. So, I was about eight years old. My brother and I got sent home from school with headlice and my mom, she's a pathologist, and she was like, "Oh, cool!" So, she had a microscope in her bedroom, which didn't seem weird to me at the time, and she found an adult headlouse in my brother's hair, and she took it out, and put it under the scope, and we got to look at it. And I was like, "This is amazing!"

Not that long afterwards, I went to my best friend's house for dinner, I start telling them about this close up view of my headlouse. And how these little claws were holding onto the hair, and it had these little hairs hanging off of it, and it was the coolest, and I was shut

down. I learned very quickly that it was uncool and it was not dinnertime conversation. That stuck with me for quite some time. [*laughs*]

Alie: Did you get invited back?

Neeta: I did. I learned a lot at that friend's house. My parents are from India and I didn't learn how to, you know, eat spaghetti with a fork properly. I didn't know what mayonnaise was until I was in my teens. So yeah, thank goodness for that friend. I learned a lot about how to behave.

Alie: I think a lot of us don't really know what mayonnaise is, to be honest. Your memoir needs to be, *Headlice and Mayonnaise*. So now, a headlouse, is that a mite?

Neeta: No, it's a louse.

Alie: Is it a type of mite?

Neeta: No it's not. It's a different organism than a mite. Mites and ticks are related, lice are totally different.

Alie: Oh, I didn't know that. Okay. When did you decide to start studying bugs?

Neeta: I think the way that best describes how this sort of evolved was when I was a biology major. And everyone in my family, basically, is a medical doctor. And I think there was this expectation that I would head in that direction. And I'm interested in human health, but I took this parasite biology class in college and it was very cool. So human parasites, worms and things that live inside, but also things that live outside, ectoparasites. I thought it was really amazing and so interesting, and then I went on to pursue a graduate degree in parasite biology.

It turns out a lot of the parasites that are found inside people, are transmitted by insects and arthropods like ticks, so it just sort of evolved in that way. So, I found myself living in a place where blacklegged ticks were ubiquitous, so it really just felt very natural to start studying these organisms.

Alie: And were you raised in Connecticut or did you go there for school?

Neeta: I did not. I was raised in upstate New York outside of Albany, so that is where I started my tick journey.

Aside: A little background: Neeta got her Bachelor's in Animal Biology from Louisiana Tech, a Master's in Public Health studying human parasitology from Tulane University in New Orleans, and then went on to earn a PhD in Environmental Science, focusing on medical entomology from the University of Rhode Island. She's also been an associate research scientist at the Connecticut Emerging Infections Program at Yale School of Public Health. Woman. Knows. Ticks.

Neeta: Really, the work that I've been doing related to ticks since 1998 has been in the northeastern United States.

Alie: Which is the place for them.

Neeta: Yeah. Well, yes, the blacklegged tick for sure, the deer tick.

Alie: And now, have you heard of the word acronologist? Does anyone ever call you that?

Neeta: Acarologist. Yes.

Alie: Acarologist? [*laughs*]

Neeta: Yes.

Aside: I have, like, one job here and that is to furnish the ologies. But sometimes, despite having them on my radar for years, I just, "Boomp! Oops," can't remember what they are. So I just did the equivalent of when your dad doesn't know a band name but tries to act like he does. So just quietly mortified, but we're going to move on.

Neeta: I don't normally call myself an acarologist, but I guess technically I would be. I tend to call myself a medical entomologist. Entomology being the study of insects and arthropods, and the medical piece being the part about why these organisms are important for causing disease in humans.

Alie: And now getting to, "What is a tick?" Obviously, it's an arthropod. Can you be more specific about what makes a tick a tick? [*voice of The Tick from Netflix TV series: "I am The Tick"*] And how did they get that way?

Neeta: Oh, how did they get that way? Okay, so what makes a tick a tick? A tick is an organism that's sort of a cousin of spiders. It's also related to mites. And it is distinguished from insects, meaning it is not an insect, by some key features. Whereas, an insect would have three body segments and six legs, ticks do not have three body segments.

They really have one major body segment and then they have this sort of head area, at least in the ticks that I study; it's called a 'basis capitulum'. And ticks, in most life stages, have eight legs similar to their spider and mite cousins.

Aside: Quick aside. Isn't it weird that every tick has grandparents and cousins? Like, every bug you see has uncles. Anyway...

Neeta: They are parasitic so they require a bloodmeal in order to carry out their life cycle.

Alie: Euggh. Just the words [*slowed down, low pitch*: *bloodmeal*], it's so dramatic. It feels definitely like they're a tiny, tiny villain in a story. Do we just know them as villains or are ticks good for anything?

Neeta: Well, in the general ecosystem, the ticks will serve as food sources for other organisms. Birds will eat them, for example. But if you're asking me, would our world be okay if we eradicated all the ticks? You know, I don't know the answer to that. I personally really admire ticks very much. Of course, I don't want people to become sick, but I think if you learn a little bit about them, you can kind of admire how they've evolved to be pretty sneaky. And although they are the villain, they do a really good job at it.

Alie: What are some of the things that you admire about ticks and how they go about doing their business?

Neeta: Okay, well, the tick that I primarily study is the blacklegged tick. Many people call that the deer tick, and it is a very hardy animal. So, it can survive in temperate regions of the United States in the northeast and in the upper Midwest. And it can sustain very cold temperatures. It can live in Minnesota and Wisconsin, where it's very cold. It can live for a long time under the snow. It lives for a long time; this particular tick has a two-year life cycle.

Aside: Two years! Granted, I have refrigerator mustard older than that, but still. That's 24 of your periods, that's two Hanukahs, that's a longer lifespan than some pairs of shoes, or the span of getting a master's degree. So just think, you could meet someone, fall in love,

move in together, fall out of love, break up, and maybe be over it, and there's still a tick out there that was on the planet for all of it. That was sadder than I intended, but whatever.

Neeta: It's kind of hard to kill this tick. And on top of that, when we think of it as a parasite, as something that requires a host in order to carry out its lifecycle, it really has evolved to have these features that make it go undetected. This tick in particular and many tick species will feed for several days on a host. If you think about a mosquito, it lands, it takes a quick bloodmeal and by the time you realize it's there, you've swatted it away.

When a tick has to feed on a host for several days, it doesn't want to be detected, right? So, it has this saliva that is full of all sorts of components that can fight the host immune system. Typically when you're being a host for a tick, you may not feel it. You won't feel itchy, you don't feel pain, because it has in its saliva vasodilators and anticoagulation factors. It's got these substances that really can protect it. And also, it keeps your blood from clotting so they can just start pulling in that blood very effectively.

Aside: Just a little aside as to *why* they are tiny creepy vampires. Many tick species need a bloodmeal to get to its next life stage, kind of like a video game, levelling up, only they are detecting your breath, your odors, and your movement. And sometimes crawling on vegetation and outstretching their top two legs waiting to hug you. This very thirsty behavior is known as 'questing' and I hereby think it should be applied to humans who go out looking for a sugar momma or a money daddy or a non-binary bucks-fuck. That last one could use some workshopping.

Anyhoozle, they find some skin, they cut you like a bitch and then they stick their straw face in you, sometimes using cement-like saliva to tack it down like hot glue on a bad craft project. Their saliva might contain a few thousand proteins that do everything from anesthetize you, to administer, like, an anti-inflammatory so your skin doesn't freak out and tattle that you are being used as a blood buffet.

Did I mention that they can get engorged with your blood 200-300 times their original weight? Can you imagine what a boss you'd be if you could hose a Souplantation like that for the price of one meal? Like, pay $15.99 and walk out of there weighing 4,000 pounds and just set for the winter. Ticks do that and they don't even pay for the price of admission! They sneak in the back, while you blinked. I mean, respect.

Neeta: And so, it's pretty good. It's not to say all people don't have a reaction to tick bites because some people have quite a reaction, particularly after they've been bitten several times. But the fact that it can go on undetected, particularly the adult stage ticks that are pretty large, is pretty amazing.

Alie: Yeah. It's kind of like the stealth bomber of tiny parasites.

Neeta: Totally.

Alie: Under the radar. And now you mentioned adults versus little guys, and I understand that the nymphs are the size of a poppyseed.

Aside: Okay, so quick background on this. I mentioned this in the Epidemiology episode with the Doctors Erin of *This Podcast Will Kill You*. Hey ladies! So, the CDC, to really viscerally, appallingly, delightfully, illustrate how tiny ticks are, put three little baby tick nymphs on a big, softball-sized, Costco poppyseed muffin. And it wasn't until the third confused zoom in, that you could even see their little leggies.

We Americans, not always fans of truth and consequences, shamed the CDC into taking it down. But I like to burn the image into your brain. Not to ruin muffins, but to make you just stop and think, "If I had a poppyseed somewhere on my body right now, would I even know?" And as a person who got ranch dressing on her face, hours ago, I'm gonna wager a no here, buddies.

Alie: So, they're very tiny. In terms of their life cycle, are a lot of the little guys out in the spring? Is there a higher risk of tick bites in this time of year?

Neeta: Yeah, so the way that it works is there's three main life stages. There's the larval stage, which usually feeds on small mammals and birds. And then there's the nymph stage, which you said is the size of about a poppyseed. And actually, we put them under the microscope here in the lab because we were like, "Are they really the size of a poppyseed?" And they actually are approximately the size of a poppyseed, but truly the poppyseed is easier to see. [*"I see."*] You know, it's a little bit darker than a nymph-stage blacklegged tick. And you know, the coloration is more uniform, so it really is maybe easier to see a poppyseed than to see the nymph stage tick.

But the tick, in its nymph stage, in this region, in the northeastern states and in the upper Midwest where it's most common, are typically most active, in the spring and early summer months. So, we really see them start coming out in May, and then really picking up after Memorial Day with their activity peaking in the early few weeks of June, and then slowly subsiding as we get into the end of July. And it's not to say that you couldn't find a nymph during other months of the year. You certainly can. We collected some nymphs in October last year, but they're most active during the spring and early summer months.

Alie: And is that when most people who get a tickborne illness will contract it? Or does that happen pretty much all through the temperate months?

Neeta: Yeah. So, most cases of Lyme disease and some of the other diseases that are associated with blacklegged tick bites occur during the time, or shortly after the time, when the blacklegged tick nymph stage is active. So, spring and summer, we see cases into August and September.

But with that said, the adult stage of tick, which is active in the fall, and in the spring, and even in the winter when the weather is above freezing, that tick also can transmit infectious agents to humans, and actually is twice as likely to be infected than the nymphs. But the thing about nymphs is that they're out during the time of year that more people tend to be recreating outside. Also, they're very tiny and the adults are a little bit easier to spot. It's bad luck for us, but good luck for the tick in terms of their timing of activity.

Aside: Okay, so adult ticks: bigger and more Lyme and disease ridden. Nymphs: less Lyme, but it's more likely that you'll find one in a crevice in spring, because no one is out in November picnicking at an outdoor concert series, or making out with a Tinder date in a park, or heading to the woods to cook over a fire, or making an appearance in a speedo, trying to get that D, that sweet, sweet vitamin D. So, what about flimflammery? Is there any that Neeta would just like to take to the mat and debunk?

Neeta: Yes! Thank you for this opportunity! Ticks do not fly. They don't jump. They don't hop. You hear a lot of people saying that the ticks are falling out of the trees on to their heads, and that is unlikely to happen. They're on the vegetation. When they're in the smaller stages, looking for mice and birds, they're kind of low to the ground. And then the adult stages are

looking for deer and they tend to crawl up a little higher on the vegetation to find a deer. Then they'll crawl upward on people until they find a good spot.

So, if you find a tick on your head, it probably found you somewhere lower on your body and crawled upward, and it didn't fall out of a tree. So that is something that I think is often misunderstood. [*"Did it fall from the sky?" "No."*]

And I think that's the big one, that and leaving the head in. We don't really leave the whole head in, just the feeding tube when you remove a tick. Removing it is the most important thing, so even if you leave a little piece of the mouthpart, it's better than leaving the tick attached.

Alie: Right. Do you ever look at Dr. Pimple Popper?

Neeta: Oh my gosh, that's funny you mentioned that because I actually don't really watch TV. And recently, we had a friend over, and it was late in the night, and they decided to show us this and it was really something. [*"Wow that's disgusting."*]

Alie: There was this one little video she posted where she's like, "I was treating a patient, a dermatology patient, and his girlfriend was like, 'Hey, can you check out this growth I've got? I've had it for a couple of days'," and she looked, and it was like, a fully engorged dog tick.

Neeta: Oh wow.

Alie: And it was just floopy-floppin' off of her abdomen and Dr. Pimple Popper was like, "Yeah, that's a tick." But I guess she just thought it was a new mole.

Neeta: Wow.

Alie: I know.

Neeta: Well, that surprises me a little bit just because adult ticks, particularly dog ticks, are quite big, and particularly when they're engorged. I mean, think of like a Raisinet. That's really what they look like to me. Sorry if I ruined Raisinets for you forever, but they do. If you put an engorged female deer tick next to a Raisinet, they're hard to tell apart. That's how big it is. If you had one of those hanging off your abdomen, I think that would be, at least for me, it would be alarming.

[*clip from Dr. Pimple Popper: "See the head right there? And this is the body here, with the feet, so need to try to pick it up. Sorry, am I hurting you? God, that thing was on tight!"*]

But with nymphs, even when they're engorged with blood, they're still very small and so I think that not being able to detect one or just think it's like a flick of dirt is very common.

Alie: I do love the CDC poppyseed muffin comparison. That was great. I was so bummed when they had to take it down. People were grossed out.

Neeta: Oh, see, I love that. I also think that was great and very effective. And I know it may have ruined poppyseed muffins for some people, but I thought it really just drives home the point and the visual of like, "This is what you're looking for." So, maybe *we* can bring back the poppyseed muffin.

Alie: It's better to be grossed out for like 30 seconds on Twitter by a poppyseed muffin than to be, you know, putting yourself at risk.

What's the best way to not get bitten by one? Is it repellent, is it just wearing a wet suit all the time?

Neeta: A suit of armor? Yeah. So, unfortunately, in the 40 years since Lyme disease was first described, right here in the state of Connecticut, we haven't really done a super job at getting people to prevent disease. In fact, the number of cases in the nation has been growing rather than subsiding. But what we do know from many research studies is that there are some things that may be protective against Lyme disease specifically.

So for example, we know that, in a couple of studies, performing bodily tick checks frequently can be protective against Lyme disease. That is inspecting your body, that includes your entire body. [*"Ohhh"*] So, particularly the cracks and the crevices, and arm pits, because a tick will crawl up. It'll find its host; it'll be waiting on the vegetation for a host to walk by. And so you may encounter it at your leg, but if there's no skin showing there, it will keep walking up until it finds some skin. That might mean it will crawl under your shirt and into your arm pit or up into your hair, behind ears.

We find a lot of them at places that are constricted by, say, a bra strap, or underwear, waistbands, those kinds of things. And so, performing a tick check is a good idea and actually performing one daily is a great idea, because the Lyme-causing tick, the blacklegged tick, is unlikely to transmit the bacteria that causes Lyme if it's been attached less than 24 hours.

Alie: Oh!

Aside: Okay, so this is amazing news. There is a magical window, an almost biological grace period, in which you are less likely to have one of these tiny bastards drool a disease into your blood. So, take a moment to just feel yourself, all around, get comfy with a hand mirror. Also, you can do this one thing that people on the bus might appreciate as well.

Neeta: Yeah, so the other thing you can do, and there's a couple of studies that support this, is to take a bath or shower shortly after coming inside from being outside. That could work in a couple of ways. You could be washing off ticks that haven't yet attached. If the tick is attached you, it's not going to wash off unfortunately, it will stay there. The water will not do anything to deter it. But, if it hasn't attached, you could maybe wash it off.

You're also removing the clothes that you were wearing that may have ticks crawling upon them. And another thing you can do – and this is all this, sort of, personal protective measures you can take – you can take your clothing after you've been outside and put it right in the dryer. There was a study that showed that if you put the clothes directly into the dryer and dry them on high heat for 10 minutes, that should kill the ticks that are crawling upon them.

Alie: What do you do when you're out in field season and your job is literally to get yourself close to a tick bomb and just drag layers of cloth through tick infested weeds? Like, what do researchers do? Do you just cover yourselves in DEET? What happens?

Neeta: Yeah. Well, in my case, my goal is to get as many ticks as possible, so I don't cover myself in DEET at all. And in fact, when I'm sampling for adult ticks, I find that I'm more effective using my body as a method to collect ticks than to use a flannel tick drag or a flag, which is what we use typically to collect nymph-stage ticks.

Our field staff, I of course want to keep everyone very safe. They wear long sleeves, white coveralls that zip up to the neck, they tuck their pants in long white socks. And, depending on the study that we're doing, oftentimes, we have coveralls. They are treated with a product that contains permethrin, which acts as a pesticide and also as a repellent, which we know is very effective at repelling and killing ticks or knocking them down.

You actually can buy this stuff to put on your own clothing. And it's great because it lasts through many washings. So, it's called permethrin and you can either buy a retail clothing item that is already factory impregnated with permethrin or you can buy the spray. Usually, you can find it at camping and hiking sort of retailers.

Aside: Side note: I know all about this chemical because I was covered in a constellation of red itchy bumps in Hawaii last November. And I spent most of my time in paradise convinced I had scabies and rubbing this formula on me just in case. Turns out, it wasn't scabies, just mosquitos, but now I have half a tube of this in my medicine cabinet. I just hope no one discovers it and googles it. I feel like we're closer now that I've shared that.

Anyway, it is a synthetic form of compounds found in chrysanthemums and it acts by disrupting nerve cell membranes, causing paralysis and death of some ticks, and mites, and other bugs. You can also just mist it on your cargo shorts and not on your actual body. But rubbing some fresh mums down your pants likely will not do the trick, it also won't hurt if you wanted to.

Neeta: And you can spray your gardening clothes or clothes you do yard work in; you can spray that and those could be the clothes you wear outside. But typically we don't, because we want the ticks, so we just have eagle eyes. We check one another after being at each field site and we do it that way.

But for my children, I have two kids, and everybody knows that tick checking is part of our daily routine. Sometimes multiple tick checks a day. And taking a bath or shower, particularly this time of year, everybody bathes daily. And I highly recommend that. There's all sorts of landscaping things that you can do in your backyard. But taking a bath or shower is really, it doesn't cost a lot. We like it when people bathe. It's not controversial, it's easy to do.

Aside: Well it depends if you're depressed, but yes that *should* be easy. Yes, okay.

Alie: Have you ever gotten bitten by a tick?

Neeta: Oh, sure, absolutely. I've been bitten many times by ticks over the years. I think it's a hazard of the occupation.

Alie: And now, obviously you study Lyme disease, which is such a huge issue right now. Have you ever worried that you have contracted Lyme disease or what are your personal feelings about it?

Neeta: Certainly, Lyme disease is a very important human disease, and everyone who lives in an area where these ticks are prevalent should be aware and really try to prevent it. Now for myself, I don't know if you call this lucky or unlucky, I've always been extremely sensitive to the bites of many different kinds of arthropods. I have a severe allergy to many types of stinging bees, fire ants, mosquitoes; I have very poor reaction. And so even with ticks as soon as they attach and start to salivate, which they do to anchor themselves into the skin, before they even start to take blood, I will get quite a large reaction to these organisms and I'll be able to detect it and remove it.

Aside: Quick run-down of what is in the tick's toolkit and by that, I mean their alive face. So, they have two palps which are parts of their mouth, like little tough moustaches, and they have chelicerae, which cut through their host's skin, and then of course they have that one barbed needle like hypostome. Kind of like a cross between a boba straw and Satan's tiny pitchfork. But Neeta isn't a frequent victim, thankfully.

Neeta: So, I've never had a tick feed particularly long on me actually. I'm not sure a tick has ever taken a bloodmeal. At least not a blacklegged tick. I did once find a dog tick in my hair that might have been there for a day. And the dog tick can transmit Rocky Mountain Spotted Fever but not Lyme disease, and Rocky Mountain Spotted Fever is much more rare, and it was okay.

It's something we take very seriously because this tick that we study can carry, not just one, but actually five recognized tickborne illnesses. It's full of all sorts of different kinds of microorganisms that may turn out to have some sort of human disease-causing capability. So, all of our seasonal staff and anyone who's working in tick research is very careful about being safe and protecting ourselves.

Aside: We're all crossing our fingers I can make this a last-minute opportunistic two-parter with a disease ecologist. But, just to wet your infectious barbed whistle, here are some other things ticks can spit into you: Anaplasmosis, Babesiosis, Borrelia, Bourbon Virus, Colorado Tick Fever, Ehrlichiosis, Heartland virus, Lyme disease, Powassan Disease, Rickettsiosis, Rocky Mountain Spotted Fever, Southern Tick-Associated Rash Illness, Tick-borne Relapsing Fever, Tularemia, and some robot sounding thing called 364D-Rickettsia.

Ticks, I know it's not your fault, you just got caught up in a bad disease racket, but dang, you are not welcome in my butt crack. So, let's lightly touch on a few though. [Transcriber Note: She means diseases, not butt cracks.]

Alie: Let's talk a little bit about the diseases in particular. You mentioned that you study five, but is the one that's at the forefront Lyme disease just because of its prevalence right now?

Neeta: Oh, absolutely. So, Lyme disease is the number one reported vector-borne disease in the country. So, cases are reported by doctors and laboratories to state health departments, who then report them to the CDC, and the CDC counts them. And so, each year there's about 30,000 cases but a couple of studies have estimated that that's very underreported. There was a study in 2014, I think, it's estimated that the true number of cases is probably about 10 times that, maybe 300,000 cases per year. In its early stages, if caught early, most people will be treated and be okay.

But in its late stages or in some percentage of the population, even after treatment, they will have persistent symptoms or symptoms that go away and come back. And those late stage complications of Lyme disease can be very serious. They can involve severe arthritis, neurological involvement, cardiac complication, facial paralysis, many types of things.

Alie: With Lyme disease, can you tell me a little bit about what are some of the symptoms of it? And is there a difference between late stage and chronic Lyme? What are we looking for?

Neeta: Yeah. So, I'm not a medical doctor, but I can tell you that in its earliest stages, Lyme disease can present itself in a very vague way, kind of flu-like symptoms, and fever, and malaise, and feeling generally terrible. [*"I feel awful."*] Unfortunately, sometimes it goes undiagnosed. The tell-tale early symptom of Lyme disease is what many people call a 'bullseye rash', or an EM, which stands for Erythema Migrans rash. This is a red rash that will appear usually at the bite site. But sometimes, some area away from the bite site, and there may be multiples of them.

They're typically painless so they can go undetected, and they expand. It expands over a period of days or weeks, and then it will disappear. And so, you can imagine if you were bitten behind the knee, you may not see any rash that appears.

Aside: If you need a visual, this rash looks like if the Target logo got a little sloppy drunk, and manifested itself on your skin, as if by a ghostly possession. Not to be dramatic.

Neeta: And so, while it's believed, most people who do get infected with Lyme do get a rash, not everybody does. Or it may go undetected because it's not painful or itchy. But that sign occurs between three and 30 days after infection. If you can catch that symptom, which is a very classic clinical symptom of Lyme disease, that's one of the earliest symptoms, you can treat it well. In its later stage, we're talking about things like I mentioned before, severe arthritis, there are cases of Lyme carditis, which is a heart infection, other neurological issues and, and it really can run the gamut.

Alie: And when it comes to having Lyme disease that might be resolved with an antibiotic versus late-stage Lyme or maybe what some people call chronic Lyme, how do you differentiate and how do you also feel about some people saying one doesn't exist? I guess it's funny that Lyme has such controversy around it.

Aside: By funny I mean weird and scary.

Neeta: Yeah, yeah absolutely. The way that we approach this, from the science that we do is… Well, first of all, I'm not a medical doctor. I'm a tick doctor, I guess you could say. It's definitely true that there are a lot of people who are very ill. And whether it's Lyme alone, or it's Lyme plus some other co-infection, or it's some other tickborne illness, or it's some other illness, I can't say. But I know that there are a lot of people who are very, very ill from tickborne illnesses and in particular Lyme disease.

The place that I come from and the work that we do in our lab is really focused on prevention and understanding tick behavior and also human behavior so that we can prevent Lyme disease, whether it's early stage, or late stage, or post-treatment Lyme disease, or chronic Lyme disease. You know, if we can do better at prevention science and being able to convince people to do prevention well before they have an experience with illness, then really, hopefully, we can stop having conversations or have fewer conversations about how sick everybody is and really start having conversations about how well we're doing at keeping people from getting sick.

Alie: Are there any documentaries that you like or would recommend on the topic? Are there any that you're like, "As a tick doctor…"?

Neeta: I don't, I don't. And that's probably only because I haven't had a lot of time to spend watching them. So, I don't know. I did see one documentary, and I think it was called *Under Our Skin*. It was very emotionally provoking. I think that it really was moving, really pointed to the problem of people who are sick with Lyme disease.

Aside: The trailer of this is pretty chilling. [*clip from Under Our Skin: "We have, I think, a horrible epidemic."*] And again, Neeta studies how to prevent the tickborne diseases and not how to treat them.

Neeta: But I also think that… There's been a lot of scientists who have been studying this topic for a long time. And so sometimes, those scientists have become enemies of the public. I just want everyone to get along. I try not to watch that stuff. I know that me personally, this is my life, and my career, and I really feel strongly about wanting to do a good job and researching my field of study.

Aside: Obviously, Lyme disease is a very charged topic. So charged, in fact, that:

Neeta: But we made some videos recently, so maybe I can tell you about those. So there's a lot of, I wouldn't say controversy, I'd say questions and confusion, about how people can use pesticides in their backyards to reduce the tick populations in their backyards. We get a lot of questions about that.

Recently, the Environmental Protection Agency awarded us a grant to try and tackle the science communication issue regarding safe, but also judicious and effective, pesticide use for controlling ticks because unfortunately there's a lot of stuff out there on the market. There's all sorts of rules and regulations about how things can or don't have to be labeled, and what you can say about how effective they are. And so it leads to a lot of confusion, and we think people either overapply stuff, or they apply stuff that doesn't work but they feel like they're safe. So we made these story-based videos.

Aside: Neeta says that she's trying to communicate the science in a way that is conversational, kind of like two neighbors just yakking about precautions and sharing good advice about the blacklegged tick which is a super hardy mother sucker. Anyway, go to SpraySafePlaySafe.org and you will find Neeta's videos and a wealth of information on how to deal with these little backyard pests.

There's also different types of control methods discussed, everything from essential oils, to fungus-based ones, to synthetic chrysanthemum juice, which is not the scientific term for it. But pyrethroids is hard to say and I already botched acoral-akaral-akar… acarology, yes. Spray Safe Play Safe has you so covered in safe and effective pesticides.

Neeta: And so, we just want to make sure that people… The decision to use a pesticide is totally a personal one and whether you want to use it or not is up to you. But if you're going to use it, we want you to be armed with all the information to make informed choices.

Alie: So, it's not just like, "throw a grenade in the backyard."

Neeta: [*laughs*] No, but I've been places where people have said they're going to pave over the whole backyard, which is really sad to me. Or they say, "My rule to the children is 'don't touch anything green outside'."

Alie: [*sad*] Aww.

Neeta: Right!? I know. And I'm like, "Is that what it's coming to?" We really want people to be aware, but not afraid, because I think just arming yourself with knowledge is really important in terms of being able to keep yourself safe.

Alie: What about these tick populations seeming to go up or Lyme disease spreading? I've looked at maps from the CDC that have shown where Lyme disease, essentially, was first identified, which, you know, Old Lyme, Connecticut, and then seeing it kind of bleed out.

Aside: So, to see these maps go to the CDC website and you can type in historical data. I'll also link this into the show notes and on my website. Clicking year by year, it's kind of like seeing blue dots hemorrhaging like ink. And in 2017, the only states which did not have reported cases on Lyme disease, were Oklahoma and Hawaii. And I asked Neeta about where these blacklegged ticks are hanging out. Are they moving out of the northeast? Are they like aging hipsters going to the suburbs?

Alie: I understand that a lot of folks think it's maybe just in the northeast, but it's been identified in ticks in all the continental US, right?

Neeta: Yeah. The blacklegged tick species is fairly spread in many places of the US besides the northeast and upper Midwest. We have the same species down all the way in Florida and Texas as well, and in the states in between. The ecology of the tick is a little bit different, and so even though we do see the tick, we see less disease. And I think up here in the northeast in this part of the country we have this perfect storm of transmission.

It has to do with how the ticks behave and how the hosts behave. We have this issue of climate change as well, which really, I think is going to make the tick situation a lot trickier. And really it is changing, even more than you've seen in those maps, because the tick range has been spreading northward and westward. And so, we commonly now see blacklegged ticks up in Canada and some cases of Lyme disease are more frequently reported in Canada now.

Aside: One thing I don't recommend looking at, unless you like to be very grossed out, appalled, and sad for a moose, is a photo of moose covered in ticks to the point where they look like they were just doused in pebbled concrete, or like the underside of a boat that's been barnacled. I want to help the moose so badly, even though, given that I'm untrained in helping moose with ticks, it would probably like to kick me in the face.

Neeta says that we have other tick species that are also encroaching, take for example the lone star tick, which sounds like the town asshole walking through saloon doors to suck your blood and leave you with an infectious souvenir. Their range is in the east, southeast and Midwest United States, and Neeta says in recent years they've been detecting them more and more, which means, they are coming for us, [*Old Western shootout tune*] pointy mouth-suckers drawn.

Neeta: And this tick is really important because it also can carry different disease-causing agents, different than Lyme disease. It's also been implicated in causing a severe red meat allergy, and we're talking like anaphylactic red meat allergy. And the thing about that lone star tick is, it is a seriously aggressive human biter. And so, it's different than these deer ticks who just kinda hang out and wait for you to walk by and they'll grab hold. The lone star tick [*suspenseful scary music in background*] will detect you from far away and will come after you. Yeah. And so you think mosquitoes are a nuisance; I think nothing would ruin a picnic like a bunch of lone star ticks coming along wanting to grab hold.

Aside: Do not on any circumstances imagine a wave of lone star ticks cresting and crashing into your wine and cheese basket, aimed at your warm crevices. Don't imagine it! Don't imagine it. *Don't do it*. [*chipmunk voice*] Eeeuurrgghh!

Neeta: And in addition, you may have heard that there was a new tick in town, an invasive tick species. I don't know if you've heard this. A couple of years ago, a sheep farmer in New Jersey was covered in these tiny little ticks, and she went to the health department and they were like, "Take off your pants, because they're everywhere!" and they put her pants in the freezer. And it turns out this tick is a tick that had previously not been established in the United States and it's known as the Asian longhorned tick.

Aside: So, according to the CDC, as of May 28th, 2019, which was like one second ago, longhorned ticks have been found in Arkansas, Connecticut, Kentucky, Maryland, North Carolina, New Jersey, New York, Pennsylvania, Tennessee, Virginia, and West Virginia. Researchers are looking to see where else it has gone. So, google image search them and be aware. They're kind of like a reddish-brown color, with what appears like long legs, and they can be up to a size of a pea, fully engorged. Why are we freaking out about them?

Neeta: And so, this tick in Asia is a serious vector of human disease. They carry a virus. It can also cause a Rocky Mountain, sort of, Spotted Fever type illness, and then it's a serious pest of livestock. So it's now established itself here in New Jersey, and Staten Island, and parts of Westchester County in New York. And this tick is really scary because it can reproduce by parthenogenesis. That means the female, she doesn't need a male mate to reproduce. [*Beyoncé: "All the single ladies. All the single ladies."*]

So one female can create a thousand or more babies, just essentially cloning herself. And so, we really are watching this tick and what it's going to do. And we are right in sort of the center of where it has now become established. We're really in a place of, I think, this region around New York City and heading northward, this sort of tick apocalypse where a lot going on. And so, I think we have a lot to learn and we're going to be seeing a lot of changes in terms of what the ticks are doing in the next decade.

Aside: This is terrifying. Also one question, why? Why? Why? Why? [*anguished voice: "Whhhyyy!?"*]

Alie: Is it that there are more ticks, or that there are more deer, or that there are more white-footed mice, or that there's more development so there's less land so they're more concentrated? Why is it such a boom town for ticks?

Neeta: Yeah. Well, part of it is, if you think about what the landscape looks like. The ticks have been around a long time, but if you think about what this part of the country looked like in the year 1900, it was primarily an agricultural place. There was a lot of farmland and pastureland, and there were deforestations to make these grazing areas. And so, the white-tailed deer were not so abundant. As we've sort of reforested this part of the country, we've really led to an abundance of white-tailed deer. So, we know that there's a link between the abundance of ticks and the abundance of deer, because deer are their primary reproductive host for the tick. So, the more deer, there's more opportunity for the adult ticks to reproduce.

The other thing that has happened is, we have started to move into these forested landscapes, and in doing so we fragmented those landscapes. We've sort of made all these little cuts into the forest. So, we're living sort of right in the habitat where the ticks live and the deer live. And on top of that, by fragmenting the forest, we create a lot of edge habitat, and edge habitats are really, really great for deer. They love them, mice love them. We find a lot of ticks right on the edge. And so, the riskiest place really for encountering a tick in this part of the country is really in one's own backyard, particularly in that region, the ecotone we call it. Right where the lawn is meeting woods is really your riskiest spot. But yeah, it's kind of all of the above. There's a lot of deer, there's a lot of ticks and there's a lot of people living really close to them.

Alie: Oof. How do you feel about the conspiracy theories about Lyme disease having started in Plum Island as biowarfare and then spreading from there?

Neeta: Uh…

Alie: No comment?

Neeta: I don't think it's likely. It's so complicated. Like, if I were going to make a… I don't want to, but if I were to think about what would make a good bioterrorist agent or a biowarfare agent, I don't think I would want to choose a tick that needs all these things. It has a two-year life cycle, it only feeds three times in its life, and it needs all these different hosts. It just seems too unlikely to me, personally.

Alie: That was the dumbest question ever, but I just wanted to see if you were like, "Oh no! we figured out that that's completely legit."

Neeta: Oh no. Yeah, no. And as far as I know it's not legit. It just seems unlikely. I mean, you think about some of the biowarfare agents, like tularemia is one. Tularemia can be transmitted by a tick, but it also can be transmitted in other ways. And so, I think, having only one way to transmit it or something that doesn't persist in the environment very long without a lot of other factors, and something that people are always going to encounter. It just doesn't seem like a good way. Especially because, with all different diseases out there, you'd want a biowarfare agent that would cause a lot of death. I would think, right? So, I think Lyme can be very serious and even fatal in some cases, but it's not causing a high degree of mortality.

Alie: That's funny to think that someone would come up with a biowarfare scheme and their boss would be like, "Sorry, just not fatal enough. Keep working on it."

Neeta: Well really, I mean, yeah. I think to be a good bioweapon, you really have to think about those things. I don't want to think about those things, but when I think about Lyme disease being a bioterrorist agent, I think it just seems not terribly plausible to me, personally.

Alie: That makes me feel a little better. I was like, "Aaah, we are all under attack!"

Neeta: Yeah. But you know what, that thing about under reporting, I mean for me, we know there's a lot of cases of Lyme disease, and we know there's a lot of ticks out there. I just sort of have this attitude that is, if you live in a place where there are ticks and you go outside, or you have a pet that goes outside, you're probably at risk and you should take preventative action and precaution and be aware, no matter what. Whether they're counting the case or not, you can still get sick and your doctor can still treat you.

And so, I think counting cases and things may be important for some people in terms of trying to show the scope of the problem, but in terms of keeping yourself safe from being sick, we know people get sick, and we know there's a lot of ticks, and ticks are bad.

Alie: What do you do if you have a pet that's out romping?

Neeta: I have two Australian shepherds. They're awesome and they are my best field assistants; they come out with me. We do know… there are some studies that really kind of point to pets that go outdoors as potentially being an additional risk factor for getting a bite by a tick. And so, treating your pet with a tick preventive product is a good idea. And treating them all year long, not just during spring and summer months, because we'll find ticks in December if the temperatures are above 40 degrees.

I use a collar on my dogs, they're good for eight months. It kills and repels, and there's oral preventatives, where the dog gets a pill, or the cat gets a pill, every month. And then if a tick starts to bite, it will die before it can feed to completion, and so they can work that way. There are these topical spot treatments that can work in different ways, either repelling, or killing on contact, or also treating such that the tick attaches and then dies while it's feeding. Which is better? I can't say, but I think it's very important to treat your animals with a tick product all year long.

Alie: Better than not having an animal, I guess. Or you could just get a goldfish.

Neeta: Yeah, I guess so. Yeah. When I think about the behavior of dogs and cats and things, depending on if, you know, how you behave with your dog, if you take it on a leash you may be able to avoid some of that ticky habitat. But if you have cats that go outside, which I've

just learned is apparently not cool to do. I thought everyone's cats just went outside. But that's a thing now, and I feel really dumb because I didn't know, but I'm learning now.

Aside: Okay, for more on this, listen to the Felinology episode with Dr. Mikel Delgado, so much I did not know about cats! So much none of us knew about cats! Anyway…

Neeta: But people do still have cats that go outside, and so those cats will go all over, right? They'll go in the woods and they'll be in the leafy areas where the ticks are hunkered down when they're not looking for hosts. And so, they can be exposed in that way. So even if you don't go outside, if your cat does and then comes back inside and you're petting it, you know, there is a risk for sure.

Alie: Yeah. We don't know what cats are doing out there. They're out honky-tonkin', they're like, "Later days, man."

Neeta: Oh man.

Alie: Ornithologists are like, "Excuse me? Put your cats back indoors please!" So, I guess, if for no other reason than you don't have to check your butt crack for ticks more often, keep your cats inside.

Neeta: Yeah, totally. And I guess there's a lot of reasons for keeping your cats inside. And I felt really dumb because I didn't know. Maybe it's because I'm a dog person and I'm not a cat person. But you know, shout out, I love cat people. ["*Why, thank you."*] I'm just learning. I do know, for sure these cats can pose a risk to birds, and there's an issue with feral cats and potential rabies transmission in certain parts of the country. So yes, PSA, keep your cats indoors.

Alie: I talked to a felinologist who's like, "Put it on a leash and take it to the park for an hour! That's just fine." But I have questions from listeners who are super excited that you're on. Can I ask you some rapid-fire questions?

Neeta: Okay, sure.

Aside: Okay and before we get to the lightning round with your questions, a few words about sponsors I like very much, who also make this podcast possible. But before we get to them, the sponsors also make it possible for us to donate to a charity of the ologists choosing each week. Neeta enthusiastically supports TickEncounter.org, saying it's a wonderful science-based resource for all things tick related. It's housed at the University of Rhode Island where she worked on her PhD. They do great stuff, they have so many pictures of ticks, tips. That's TickEncounter.org. A donation was made to them in her name.

Some things I like this week:

[*Ad Break*]

Back to your questions.

Alie: Okay. Allison Tuuri wants to know: What is the proper method to remove ticks if you get any on you?

Neeta: Great. So, the proper method would be to get the pointiest pair of tweezers that you can find. Grab the tick as close to the skin as you can and pull it perpendicular to the skin, pull up and deliberately. And so, we really don't recommend, slathering it with Vaseline or setting it on fire, [*"Get some hairspray. Make some flamethrowers."*] or some people put a lit match on it, which isn't a great idea.

We want the tick to come out as soon as possible. The longer it's attached, the more likely it is to transmit things that it's carrying, and we don't really know what happens if you soak a cotton ball in peppermint oil and put it on the tick. Does it make the tick really pissed off, and then does the tick start salivating more, and then more likely to transmit something? We don't know. And so, we recommend that you just use a pointy pair of tweezers and pull it straight out.

And the thing is, with the pointy tweezers, the closer you can get the better. You'll hear people say, "Oh, I left the head in," which is actually impossible. But what you can leave is the feeding tube, it's called a hypostome. It's like a straw, but it's barbed like a fishhook, and so it's hard to get out and sometimes that breaks off and that's not the end of the world. Think of it as like a splinter. Eventually it'll work its way out.

Aside: [*deep voice alteration*] Whoo! Also, when a tick is hungry versus engorged, it looks so much different, and I did not know that until this episode. Full ticks can take on a greyish color. They look like a whole different species. So, if you go to TickEncounter.org you can see different pictures of different stages of feeding. Kind of looks like a big grey brain that's about to burst. Pretty gnarly.

Alie: Ruby Oestreich wants to know: How close are we to a human vaccine?

Neeta: I know that there is a lot of work in the vaccine research field and I don't know the answer to that. I would like to think that within this decade, there will be something. And as you may know, there was a vaccine on the market for a short period. It was removed from the market, so we'll see. I think that the vaccine for Lyme has a lot of potential. With that said, if the same tick that carries Lyme can transmit other pathogens to humans, prevention measures beyond being vaccinated are still really important, like checking your body or wearing repellent.

Alie: RJ Doidge wants to know: What is it about the area of Connecticut that leant itself to the onset of Lyme disease? Is it the altitude, or climate, or soil composition?

Neeta: Yeah, well, we have a lot of forested habitat with deciduous forest in particular. And so, the ticks really thrive under the leaf litter, those dead leaves at the base of the forest. And in these forested areas we have lots of white-tailed deer, which are the most important host for the adult stage of deer ticks. So, we have great habitat, and of course those forests are full of white-footed mice and other small mammals that can be great hosts for our ticks. And I think the other piece of it is, that we live among these hosts and this forest.

And then the third thing, particularly here in Connecticut, is that we have in some places an abundance of an invasive shrub plant that's known as Japanese barberry. And unfortunately, a Japanese barberry is often sold as an ornamental plant by nurseries and garden centers. And so, you can buy it and plant it, and unfortunately it can become very widespread and it's really damaging to the forest ecology.

The thing about Japanese barberry is now we know that places that have more barberry actually tend to have more ticks, so it sort of adds to this already problematic environment. Now we have to worry about Barberry being something that's going to help foster the survival of ticks.

Aside: I mean, I get it. Barberry is pink, it's cute, its evergreen. But barberry, GTFO. I hate you now.

Alie: So, down with the barberry.

Neeta: Yeah, definitely. If you have barberry you should consider removing it from your yard. Please don't ever buy barberry at your garden center. Find something else to plant. The other thing in backyards that people have besides just like a wooded edge is, in this region, people have this ground cover vegetation, like pachysandra or myrtle. And that is very low to the ground and then underneath it is a very moist environment. So, this tick species, the blacklegged tick, really needs a very high humidity, like 80-95% humidity to survive well.

It spends a lot of time down in that moist environment. So, people who have this pachysandra, it looks very nice but it's a great tick haven. And so that's, again, something to consider in your own landscape. Like, "Should I remove it?" Or if you're going to treat with a tick control product, you want to treat not just the wooded edge but also ground cover vegetation where the ticks may also be abundant.

Alie: So, pachysandra and barberry: cancelled.

Neeta: Canceled. Yeah. Or treat your yard. But certainly, barberry's bad for so many reasons, not just for ticks. It just shouldn't be in our forests.

Alie: Oh, that's good to know. I had no idea.

Neeta: Yeah. Yeah, the truth is, just knowing about whether or not you are in a risky environment for getting a tick bite can go a long way. Taking preventative action and knowing what a tick looks like is huge. So, a lot of people send us pictures of ticks or things they have found, they send us stuff in the mail and it's not a tick. If you are able to know just the key distinguishing features, it can go a long way towards keeping people safe.

So yeah, I am in full agreement. Lyme disease is a major problem. Tickborne illnesses are a major problem in the US and, you know, we're really focused on trying to prevent that. But I think, because we're dealing with humans… We're pretty good actually at controlling ticks and we're not very good at controlling humans. We find that people don't always get good at prevention until they've been sick themselves or someone in their family has been sick. What we need is people to be thinking about it *before* they're sick and taking action *before* they get a tick bite, not waiting until that happens and it scares the bejesus out of everyone, and then they go running around trying to figure out what to do.

And the other issue we have is that there's a lot of misinformation out there in terms of even prevention, which you think is a benign topic. Just this morning on our community social media pages someone asked for advice about preventing backyard ticks and the responses really varied from stuff that's science based to, you know, totally erroneous and not science based. And so, the age of information has kind of put us in a place where people have to think critically about, "Is this good information and should I use it?" And so that's something we're battling now, is trying to understand human behavior and how we can get people to take action and feel empowered to take action in a way that is going to be effective.

Alie: I think that people are a little bit, just, kind of stunned and don't know what to do, so they're just afraid of getting it without really knowing how to prevent it. They're so little and sneaky that it just seems like getting bitten by a ghost. Like, what are you gonna do? So it's good to know that there are measures that you can take to prevent that.

Neeta: Yeah, and just understanding that it takes some time before a tick actually can suck your blood. It's a whole process. They have to salivate, and they have to fight your immune system, and then they salivate this cement so they can really stick on you and never come out. Not never, but not while they're feeding. And then the blood is accumulating, and they

feed really slowly at first. Really, people have the tick, it's been on them for an hour, they take it off, they have a red mark, and all of a sudden, they're like, "I need three weeks of doxycycline!" And that's not necessarily always the case. Sometimes the red mark is just that you're having a reaction to a tick bite.

It's knowing these small bits of information about how these ticks behave or what a tick looks like that can really help you know if you need to run and get three weeks of doxycycline, which has its own issues. We worry about antibiotic resistance and all of that. It's getting to know the information, but that's true for all diseases, right? Like, you're supposed to be good at preventing tooth decay and so you brush every day. But that's a habit, right? So, are you checking for ticks every day?

Aside: What's our new motto? Be your crevices' best friend.

Neeta: Maybe not, so how can we turn it into a habit? If you can help me figure that out, I'd love that.

Alie: Significant others can always be a tick check buddy. I'm sure.

Neeta: Totally! And if we know that tick checking is protective and we know that showering is protective, maybe you could make that into like a, you know, activity together.

Alie: Yeah. Like, ticks, but make it sexy.

Neeta: Totally. Yeah. I mean, why not? If that's what it takes. I'm trying to imagine what that infographic that we promote next is going to be, but why not? I mean, I think at this point, if it's going to grab your attention and make you take action, then we'll do it.

Alie: Right. Can I ask you a couple more listener questions?

Neeta: Sure.

Alie: Is that cool? Dawn Ewald wants to know: There've been some studies about mosquitoes and their possible preferences for certain blood types. Are there any studies on blood types that ticks prefer?

Neeta: Oh, so it's interesting. There are no studies, that I'm aware, that show that ticks have a host preference. We do know with mosquitoes that they do. They will tend to seek women over men and brunettes over blondes.

Aside: Okay side note, apparently there's something to do with the contrast that the mosquitos just really dig. So likewise, if you are a brunette on a light sandy beach, just watch out, and don't swat 'em. Mosquitos, when you swat them, are like, "Oh there you are!" and then they just keep biting you. Just FYI.

And also, as long as we are just going down several holes on this, blondes report feeling more emboldened socially, but brunettes out-earn blondes. For more on why we judge each other for stupid stuff that doesn't matter, see the two-part Kalology episode about beauty standards. Also, should I mention that one study said that redheads have the spiciest romantic lives? No, I don't want to mention that. That's gross. Oops, I did. Okay, I don't know how ticks feel about me though.

Neeta: With ticks, we don't know. I think there's some question about that because you hear from people all the time, "My husband and I are both always working in the yard, but he always gets ticks and I never do. He's more tick attractive." But in terms of whether or not any of that is true, we don't know. What we do know, particularly about the blacklegged tick, is

that it will feed on everything. It feeds on mammals, it feeds on birds, it feeds on reptiles. And it really is opportunistic. It feeds on large mammals, on small mammals.

This particular tick species, the Lyme perpetrator, is pretty easy going when it comes to choosing a host. But whether or not it might choose you over me if we were standing right there presenting ourselves as hosts? I don't know the answer. We do talk about it a lot and I think it needs further study.

Aside: Neeta's body, though, lets her know when she's got a sucky blood barnacle.

Alie: I think it's great that you have essentially a very loud car alarm in your body. That's like, "Mrr! Mrr! Mrr! You've got a tick! You've got a tick!" I think it's helpful that you have an immune response to it, perhaps.

Neeta: Yeah. And actually, some researchers are trying to capitalize on that because there are people who are very reactive to ticks, so can there be a vaccine that is an anti-tick vaccine? And it will make you itchy or reactive to a tick bite so that you catch it before it has time to transmit anything. So, using those reactive properties that some people have to try and create a vaccine.

Alie: Right. This last listener question is Deli Dames wants to know: How does the town of Lyme feel about having a disease named after it?

Neeta: [*laughs*] You'd have to ask the town of Lyme residents. I really don't know. They're, yeah, sort of famous for this and I don't know. I guess it's good to be on the map for some reason. Actually, there was a woman who really was the start of all of this becoming known and her name was Polly Murray. She was a very astute mother who was noticing that there were a lot of kids getting arthritis around the area. And so, if it weren't for her real great powers of observation, it might've taken a lot longer to come up with that.

I think the town of Lyme should be very proud. Why not be proud of that and having someone who is astute enough to say, "Okay, something's going on here." There was some kids' movie I was watching it with my kids. I think it was like *Madagascar* or something like that, and Chris Rock, his character was like, [*clip from Madagascar: "Come on, what does Connecticut have to offer us?" "Lyme disease." "Thank you, Melmon."*] And I'm like, "Aw, poor Connecticut. That's what we get as what we're known for."

Alie: Now what is something about your job – last two questions I always ask – that you really hate, what sucks about ticks or your job?

Neeta: What sucks about ticks? You were making a pun. That was great. [*DJ airhorn*]

Alie: Oh no!!

Aside: I swear I wasn't. I swear! But I fully understand that have no credibility anymore when it comes to denying dad jokes. Okay, but yes what slices her open and takes a bloodmeal out of her day? What suuucks?

Neeta: I love my job. I feel so lucky that I can study an organism that I absolutely think is very important and also really very cool from the biology standpoint. As someone who is trying to run research studies, I guess sometimes there's a lot of paperwork. Stuff like that, that's probably the hardest part. But I think that, other scientists may like that more, but not really for me. I feel really lucky that this is something that I get to do for my job. I really love it. I want nothing more than to be out in the field, doing the field work, collecting the ticks.

Last summer we had a study where we were actually laying down, and we were sitting, and we were kneeling. We were trying to figure out what activities are more risky than others. I could do that all day. It's my favorite thing. When I have to stay inside and do a budget or report, I feel so sad to watch everyone go out without me, because I would do it all day long every day. I love it.

Aside: Her favorite thing about her job is lying down to have ticks literally eat her alive. God, I love her. I love ologists so much!

Alie: What *was* the position that got you the most ticks?

Neeta: Stay tuned. We only did a pilot and we're going to scale it up a little bit this year. But, I think surprisingly to many people, we found that a lot of our ticks were found above the knee from these activities. A lot of people think, "If you're walking through the woods it's going to end up on your shoes." And it may be that it's when you kneel down to pull a weed, or when you drop down to pick up a stick, or you're clearing brush in your yard, you might get it on your arm.

And certainly, laying down is a risky thing to do in the woods. [*laughs*] I don't know how many people do that, but we did it. I think it was either sitting down or laying down that exposed us to the most nymph stage ticks. And yeah, it's fun. I don't say that lightly. I know that ticks are a majorly risky thing. But just to give you an idea of the things that we do to improve prevention, we put ourselves out there.

Alie: Well, my last question is always, what's your favorite thing about your job? But apparently yours is lying in the woods waiting for ticks.

Neeta: Yes, I love it. I love collecting ticks. I also love looking at the ticks under the microscope. They're just… they're amazing. If you look at one up close, it's pretty astounding to see. Their anatomy is really complicated. If you could look at a picture of the tick hypostome, that's their feeding tube, it has multiple teeth on them. And they're barbed so the tick easily can go in but it's harder for it to come out. It's very elaborate and different tick species have different 'dentations'. It's the different numbers of these little teeth-spines. It's really incredible to look at up close. So, I recommend everyone take a look.

Aside: It really looks like if a knife grew more knives on the surface of the knife, it's a micro-horror.

Alie: I mean, I love bugs, and I have to say that ticks are kind of the ones on my shitlist. Ticks and cockroaches. I feel bad because I do think that it's really great to respect them for how stealthy they are. So, I think that's a great thing to just outsmart them. Don't hate them, just outsmart them, maybe.

Neeta: I think that's a really great approach. I like it.

Alie: This has been on my list forever. Thank you for being so passionate. I'm so glad that you got headlice as a child!

Neeta: [*laughs*] Me too, it really formed who I am as a person. And I actually had sort of forgotten about that and I was telling this story to someone not that long ago. And then I'm like, "Oh yeah! That could've been the moment."

Alie: We're all better for it. So, thanks for getting headlice.

Neeta: Well, you're welcome? I don't know.

Alie: Yes.

Neeta: Bye.

Alie: Bye.

So, hop on a phone and ask smart people stupid questions because the world is a mysterious, and dark, and interesting place. And I know we are all terrified of ticks, but they did a lot of evolving to get where they're at. And we have pretty big squishy brains, so let's just try to outsmart them.

Again, so much info is up at TickEncounter.org, and Neeta's videos are at SpraySafePlaySafe.org. I will put a link to the site in the show notes, you can find all the stuff there. And remember, daily tick checks. Be your crevices' best friend. You can follow Neeta, because she's amazing. She's @TickLab on Twitter, on Instagram, on Facebook. Just @TickLab. God bless her for that uniformity. And her lab website is WCSUTickLab.com and I will put a link in the show notes.

Ologies is @Ologies on Twitter and Instagram, say hello there. I'm @AlieWard on both. Thank you Hannah Lipow and Erin Talbert for adminning the Facebook Ologies podcast group full of curious non-jerks who are so sweet to each other. And OlogiesMerch.com has all of your Ologies podcast merch needs; shirts, and totes, and pins, and hats. If you post a photo to Instagram tagged with # #OlogiesMerch I repost them on Mondays.

And thank you to Shannon Feltus and Boni Dutch for helping manage that the last two years. They're two sisters who have a brand new, hilarious, and charming podcast called *You Are That*, and it's out now wherever you get podcasts. So find it, subscribe, and get to know them in episode 0. And then on June 10th their first episodes drop, and you will love them. Also, happy birthday to Aidan Feltus on June 10th!

Assistant editing was done by Jarrett Sleeper of Mindjam Media, he also hosts the mental health podcast *My Good, Bad Brain* which has the best theme music ever. Just trust me, go listen, you'll get it stuck in your head all day and be so happy about it. Also, thank you to Steven Ray Morris of *The Purrrcast*, and *See Jurassic Right* for stitching all this together every week. This week it's up a little late because someone I love very much was in the hospital, so I was out of town helping out. And also, I had a few back-to-back shoots in the middle of moving, so I'm just getting my bearings, and everything will be good and normal next week, I promise!

Which brings me to the secret. At the end of an episode, I think two weeks ago I told you all my wallet was stolen at Wal-Mart. Guess what? Guess what happened! The sheriff called and someone found it in a bush near Wal-Mart, with everything in it but the cash. Which at this point is fine, and it's very good because I hadn't even had a chance to tell the DMV that I needed a new ID, and I'm getting on another plane in a few hours, and the TSA, side note, does *not* appreciate expired passports as ID. They punish you with a booty massage in front of all the other passengers. But, joke's on them because sometimes they squeeze your feet while doing a pat down, and honestly it's very comforting and I like it.

You gotta check your crevices yourself though. They don't do tick checks. Don't even ask. Not their job.

Okay, berbye.

Transcribed by Michelle Gault

Final touches by Kaydee Coast

Some additional links you may enjoy:

A Donation was made to TickEncounter.org

How ticks feed in delightful, disgusting detail

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3826218/

There are cheese mites?!

https://en.wikipedia.org/wiki/The_Cheese_Mites

CDC explains the tick lifecycle

https://www.cdc.gov/ticks/life_cycle_and_hosts.html

CDC list of tick borne diseases

https://www.cdc.gov/ticks/diseases/index.html

Premethrin: tick buster

https://www.pdr.net/drug-summary/Elimite-permethrin-2629

Some reeks for tick repellent and flea collars

http://nymag.com/strategist/article/effective-tick-repellents.html

"Under Our Skin" documentary trailer

https://www.youtube.com/watch?v=z5u73ME4sVU

Lyme Disease outbreaks: maps & historical data

https://www.cdc.gov/lyme/why-is-cdc-concerned-about-lyme-disease.html

TickEncounter.org's tick ID chart (with engorged ones)

https://tickencounter.org/tick_identification/tickid_nonflash

Haircolor and income

https://www.dailymail.co.uk/femail/article-1060195/To-dye-Blondes-really-fun-study-reveals-women-lighter-hair-confidence.html

For comments and inquiries on this or other transcripts, please contact OlogiteEmily@gmail.com