

TPWKY

This is Exactly Right.

Erin Allmann Updyke

"After the operation he started mumbling loudly then became hysterical. He was given a sedative which had no effect and his body began to twist about and his legs thrash about in the air. He was moved to a side room but before he was moved the patient, thrashing about in agony, bit a nurse who told how after a routine operation the patient began growling and howling, disturbing the whole hospital. Drugs had no effect and he suffered convulsions and he was violently sick. Saliva began foaming from his mouth and he was unable to control his movements. He tried to hurl himself from the bed and before she could catch him and stop his head hitting the floor, he bit her. By then six members of staff were trying to restrain him and he appeared to be asking for water. When offered a glass, he spat water out and went mad."

TPWKY

(This Podcast Will Kill You intro theme)

Erin Allmann Updyke

Hi.

Erin Welsh

Hi.

Erin Allmann Updyke

Long time no chat. (laughs)

Erin Welsh

Yeah, I mean it's been a while. But guess what?

Erin Allmann Updyke

What?

Erin Welsh

We're back.

Erin Allmann Updyke

We are back.

Erin Welsh

And it feels really good.

Erin Allmann Updyke

Oh my gosh, the seat, it's like my butt never left it.

Erin Welsh

I know, right? It really does feel like no time has passed.

Erin Allmann Updyke

It's true.

Erin Welsh

Which is kind of scary. (laughs) I'm Erin Welsh.

Erin Allmann Updyke

And I'm Erin Allmann Updyke.

Erin Welsh

And you're listening to This Podcast Will Kill You. Welcome.

Erin Allmann Updyke

Welcome.

Erin Welsh

We're so excited to have you.

Erin Allmann Updyke

Yeah.

Erin Welsh

Because there are so many more of you than there used to be.

Erin Allmann Updyke: Yeah. Like a lot of thousands more.

Erin Welsh: I gotta admit I'm a little nervous.

Erin Allmann Updyke: Yeah.

Erin Welsh: But I think we're gonna have a really fun time.

Erin Allmann Updyke: I think this is gonna be great.

Erin Welsh: Mm-hmm. So let's just go right in, right?

Erin Allmann Updyke: Yeah let's. We have our microphones, let's do this.

Erin Welsh: We also have our very important quarantini.

Erin Allmann Updyke: Quarantini.

Erin Welsh: What do we have this week?

Erin Allmann Updyke: Oh well this week there's no question on what we're drinking. It's the Hair of the Rabid Dog.

Erin Welsh: Oh! What does that mean? Does that mean that we're doing...

Erin Allmann Updyke: Oh yeah, that's right!

Erin Welsh: Rabies.

Erin Allmann Updyke: Rabies baby!

Erin Welsh: You asked for it, you got it. Okay, so we've got the Hair of the Rabid Dog. Briefly, what's in it? Cause we are gonna post the complete recipe on Instagram, on Twitter, on Facebook, etc.

Erin Allmann Updyke: Yeah so if you're not following us on social media already, make sure you do that. And that's where you can find in addition to these delicious quarantini recipes, all of our other info about fun stuff.

Erin Welsh: Links to old episodes, information about us, and also book lists. Back to the Hair of the Rabid Dog.

Erin Allmann Updyke: Right, what's in it? Lemme tell ya. Gin, number one of course. Number two, grapefruit juice, cause that's delicious. Number three, elderflower liqueur cause we fancy. (laughs) And of course the cardinal symptom of rabies is foaming at the mouth so it's topped with a beautiful egg white foam.

Erin Welsh: Oh yes. Oh yes. Which also as disease ecologists, drinking raw egg.

Erin Allmann Updyke You should've seen us trying to make it, we were like ooh is this a right amount? How do you... is this gonna be safe for us to drink? We're taking one for the team here, guys.

Erin Welsh To make this cocktail you mix some of the liquors together and then you layer the egg white foam on top and then you're gonna place some long strands of grapefruit peel on top so that it looks like little bits of hair, hence the Hair of the Rabid Dog.

Erin Allmann Updyke So gross.

Erin Welsh I like to make things gross though.

Erin Allmann Updyke (laughs)

Erin Welsh It's beautiful at the same time.

Erin Allmann Updyke It's fantastic.

TPWKY (transition theme)

Erin Allmann Updyke All right, rabies. When I started researching, my idea for this story was to kind of start with a 'picture this: you're a little' like we did with tuberculosis.

Erin Welsh Yeah.

Erin Allmann Updyke But Teebs was really endearing and rabies is not.

Erin Welsh It's a terrifying thing.

Erin Allmann Updyke Yeah, and so I didn't wanna get too depressing right off the bat where like we start a story and then everyone ends up dying in the story.

Erin Welsh I'm sorry, which episode are we doing?

Erin Allmann Updyke Rabies. Here we go. Let's just begin. (laughs) Here's where we're gonna start. We're gonna start at the beginning which is of course with a bite. So you're bitten by let's say a dog, okay?

Erin Welsh Okay.

Erin Allmann Updyke Doesn't have to be a dog, it could be a bat or a fox or something, I don't know. Could be any number of animals. But we're gonna pretend like it's a dog. And in that dog's saliva are thousands of little viral particles.

Erin Welsh Okay.

Erin Allmann Updyke So that's our first point. Rabies is a virus, okay? And if you remember from what we've talked about last season, viruses are basically just genetic material that's surrounded by protein. That's pretty much it. In the case of rabies virus which is also called a Lyssavirus, that's the genus of virus, we're talking about five different proteins and one strand of RNA. That's the whole thing, that's all it is.

Erin Welsh

Okay.

Erin Allmann Updyke

All this mess is gonna come from five proteins and a little strand of RNA. Okay. So these viral particles happen to be shaped like little bullets, which is crazy. People are like, 'Oh they look like bullets' but then you look at a picture of them, they actually look like a bullet, like what's in a gun.

Erin Welsh

That's crazy.

Erin Allmann Updyke

Yeah, it's nuts. So you've been bitten and the saliva is now in your large, gaping wound.

Erin Welsh

Oh my god.

Erin Allmann Updyke

Let's say this wound is on your calf.

Erin Welsh

Okay.

Erin Allmann Updyke

Okay. That seems like a reasonable place where a dog would bite you. So you have a large gaping wound on your calf, it's bleeding everywhere, and it's covered in dog saliva and the saliva is filled with little bullet-shaped viruses.

Erin Welsh

Uh oh.

Erin Allmann Updyke

So what happens next?

Erin Welsh

Do I wanna know?

Erin Allmann Updyke

Oh, you wanna know. So what happens is the virus actually binds to these receptors on your muscle cells. They're called acetylcholine receptors which basically is a receptor that your nerves use to transmit signals. So that's like the normal way that your nerve would talk to your muscle is through these receptors. So the virus binds to those and then it squirms its way into your muscle cells and it starts to replicate.

Erin Welsh

Ooh.

Erin Allmann Updyke

And because it's inside of your cell, most of the time if you get a giant gaping bite wound your immune system comes over and it's like, 'Oh my god, we need to clean this up, there's saliva everywhere!' And it does a really good job of like cleaning up what's going on in that large, gaping wound. But this virus, it's already inside your muscle cells. Your immune system is basically useless because it can't attack your own muscle cells, it doesn't even know that anything's in there.

Erin Welsh

(gasps) Ooh, ugh. That's so sinister.

Erin Allmann Updyke

Yeah, it's great. So it just sort of hangs out in your muscle cells for a while, replicating itself and building up its own little army. Then once it's got its own little bullet army, it bloops its way out of your muscle cells, it travels across the space between your muscle and your neuron that we know is right there, and then it weasels its way into the neuron using the same receptors that were on the muscle cell. Right, so it's the same receptor on both the nerve and the muscle, and it just goes bloop-bloop.

Erin Welsh: So it just makes this easy little transfer.

Erin Allmann Updyke: Just a little jump, yeah.

Erin Welsh: Okay.

Erin Allmann Updyke: Just a little jump. And then it travels up the nerve. So it travels from your calf up your nerve all the way to your central nervous system, to your spinal cord.

Erin Welsh: That sounds really bad.

Erin Allmann Updyke: And then it travels all the way up your spinal cord to your brain. And that is how you get rabies. And it does this kind of slowly. I mean, I got actually very mixed results when I was trying to figure out exactly how fast it's traveling up your nerve. Like the first source that I found was like, 'Oh it travels at a rate of 1-3 millimeters a day' and I was like that's wicked slow, that's like very slow.

Erin Welsh: Yeah, yeah.

Erin Allmann Updyke: And then the next one was like, '12-100!' And I was like that's an insane amount of... 100 or 12?

Erin Welsh: Yeah.

Erin Allmann Updyke: So the WHO expert on rabies says 8-20, so I'm gonna go with that.

Erin Welsh: That sounds good.

Erin Allmann Updyke: Okay. So what that means is it takes about 1-3 months most of the time for it to make its way all the way to your central nervous system. So the incubation period for this virus is on average 1-3 months. But if you get bit somewhere like your face, where A) you've got a bunch of nerves there that it could travel on, and B) those nerves are real close to your brain, then the incubation period can be a lot shorter.

Erin Welsh: Okay, that makes sense.

Erin Allmann Updyke: Yeah. But isn't that crazy? Like this virus hitches a ride inside of your neuron.

Erin Welsh: Right. Let's talk about how crazy that is.

Erin Allmann Updyke: It's ridiculous!

Erin Welsh: Because what is the blood-brain barrier?

Erin Allmann Updyke: Okay. So the blood-brain barrier, it basically prevents crazy infections from getting into your brain. There's not a ton of other pathogens that do this, that make their way into our nervous system. There are some, something like herpes virus, something like varicella or chickenpox. Those viruses are also very good at hiding out in our nervous system which is a great way for your body to not be able to recognize it because our body doesn't want to attack our nervous system because we need that, especially our central nervous system. If something goes wrong there, we're really, really screwed.

Erin Welsh

Mm-hmm.

Erin Allmann Updyke

And so even your own immune cells have a hard time making it into your nervous system to be able to fight off invaders. Most of the time, the blood-brain barrier keeps those invaders out to begin with.

Erin Welsh

Okay.

Erin Allmann Updyke

So it's already there, it's ridiculous. And it just traveled there on your nerve. And so then it's basically there, like once it's in your central nervous system, there's not really much that you can do. There happen to be five main phases of infection with rabies virus. Incubation, which is what we pretty much just talked about, it's that period that on average lasts 1-3 months but it honestly can be from like a couple of weeks to years.

Erin Welsh

That's terrifying.

Erin Allmann Updyke

It's terrifying and it really depends on how many viruses get into your system from the very beginning. So if you got bit on the calf by a dog full of saliva that's full of viral particles, then the incubation period is probably gonna be shorter even if you got bit on your calf because it's not gonna spend as much time in your muscle cells, it's just gonna be able to hop straight into your nerves more quickly.

Erin Welsh

Okay, okay.

Erin Allmann Updyke

Whereas if you maybe got bit and you had like two viral particles, then it could lay latent for a longer period of time. Crazy. So that's the incubation period. Then you have the prodrome, which I'll talk about in a second, acute neurological symptoms, and then coma and death. And basically yeah, those are the five stages. And we'll talk more about why death is just like a stage of rabies infection at this point for humans.

Erin Welsh

Yeah.

Erin Allmann Updyke

Okay. So the virus has already had this crazy journey and sometimes you might actually start to enter the prodrome stage which is the second stage while the virus is still in your peripheral nervous system, so in the nerves in your arms or your legs or your body.

Erin Welsh

Okay.

Erin Allmann Updyke

And that stage is basically like you might have some tingling, some weird nerve tingling in your arms or legs, you might have some muscle spasms, you might just have some weakness. But it's really not specific and it actually really mimics some other diseases like Guillain-Barre.

Erin Welsh

So can you tell me what prodrome is usually used to refer to? Like what does it mean?

Erin Allmann Updyke

So prodrome usually means the lead up to or the build up to a disease phase, at least in terms of disease. Yeah. And then once it makes it into your central nervous system, you'll start having these nervous system effects. And the thing that's such a bummer about rabies is that there's pretty much almost no hope for you once you get to that stage. So once you start showing clinical symptoms, the average time 'til death is like a week.

Erin Welsh

Wow.

Erin Allmann Updyke

And that's pretty much it. So there's two forms of rabies once it hits the clinical stage. And one of them is called furious rabies.

Erin Welsh

Whoa.

Erin Allmann Updyke

And it's exactly what you think of as rabies, like when you think rabies, you're thinking of furious rabies.

Erin Welsh

Okay.

Erin Allmann Updyke

And so we'll talk about all the symptoms of furious rabies in a second.

Erin Welsh

Okay.

Erin Allmann Updyke

The other form is called paralytic rabies and it's just as deadly, it's just instead of having the furious form you have exactly what it sounds like, paralysis.

Erin Welsh

Okay.

Erin Allmann Updyke

So that one you tend to die a little bit more slowly.

Erin Welsh

Oh god.

Erin Allmann Updyke

And then in furious form you die usually within 5-7 days. With paralytic you might last like 11.

Erin Welsh

What a blessing.

Erin Allmann Updyke

Yeah.

Erin Welsh

What's the split on this?

Erin Allmann Updyke

What do you mean the split?

Erin Welsh

What proportion-

Erin Allmann Updyke

Oh yeah, great question. So it's almost 70-80% furious and then 20-30% paralytic. So furious is definitely... The reason it's the most well-known is also because it's the most common.

Erin Welsh

Okay.

Erin Allmann Updyke

Yeah. Okay so I know you wanna know about the symptoms.

Erin Welsh

Yeah, you know it. You read my mind.

Erin Allmann Updyke

But you also already know a lot of the symptoms, right?

Erin Welsh

Yeah, yeah.

Erin Allmann Updyke: So what do you think of when you think of rabies?

Erin Welsh: I think of fear of light, fear of water.

Erin Allmann Updyke: Okay.

Erin Welsh: Sort of angry spells but also calm periods of like not comatose but just sort of not moving.

Erin Allmann Updyke: Okay.

Erin Welsh: Oh, foamy mouth, sorry.

Erin Allmann Updyke: There we go. Yeah so all of those are exactly what the rabies symptoms are. And so I wanna talk about how those actually happen because it's ridiculous.

Erin Welsh: Yeah.

Erin Allmann Updyke: So the first one is actually, we can talk about how two symptoms happen with one effect and that's both hydrophobia, the fear of water, which like what kind of a symptom is that? I'm afraid of water, that's weird.

Erin Welsh: I know, it's really weird.

Erin Allmann Updyke: So hydrophobia and foaming at the mouth, which is caused by excessive salivation, those are caused by the same thing. This is crazy, okay?

Erin Welsh: Okay.

Erin Allmann Updyke: Let me tell you about it, I'm really excited.

Erin Welsh: (laughs)

Erin Allmann Updyke: Okay so the rabies virus has traveled on your nerves all the way to your central nervous system, right? It's made its way to your brain.

Erin Welsh: Yeah.

Erin Allmann Updyke: Once it's in your brain, it keeps going and it'll travel to your salivary glands. Okay? But it's not only in your salivary glands, it's infected all of the nerves that innervate the muscles of your mouth and your throat. So if you try to swallow, it causes an extremely painful muscle spasming. Your throat, your mouth, it spasms and it's extremely painful. And this is because your salivary glands are where this virus replicates again. So it's replicating like crazy in your salivary glands which is what produces excess saliva. That's why you get foaming at the mouth. Viral replication in your salivary glands. It infects all of the nerves in your mouth and throat because if you were to swallow that saliva, you could not transmit the virus.

Erin Welsh: So it's like 'Don't dilute me, bro'?

Erin Allmann Updyke: Exactly.

Erin Welsh: That's terrifying.

Erin Allmann Updyke: Isn't that crazy? So the reason that people have fear of water is because if you were to be able to drink water, you'd wash away all the viral particles in your mouth.

Erin Welsh: How did this evolve? (laughs)

Erin Allmann Updyke: That I do not know. (laughs) But isn't that crazy?

Erin Welsh: That's insane. This is like fiction.

Erin Allmann Updyke: It's like a Michael Crichton novel.

Erin Welsh: (laughs) Stephen King. Well, it is.

Erin Allmann Updyke: Stephen King! Yeah, well yeah. Cujo, by the way. But yeah so that's why you get that crazy excessive salivation and the foaming at the mouth and it's transmitted by biting because that's where all of the viral particles are is in the saliva.

Erin Welsh: Oh my gosh. That's crazy!

Erin Allmann Updyke: It's crazy and it gets crazier.

Erin Welsh: How?

Erin Allmann Updyke: Because the other thing that you mentioned was aggression, right?

Erin Welsh: Yeah.

Erin Allmann Updyke: Or at least like behavior modification. I really wanted to know how the rabies virus could cause this, like how does it end up causing this intense amount of aggression. And I actually didn't get quite as great of an answer as I was hoping for, like I wanted one nice mechanism like 'it infiltrates your frontal lobe and releases inhibitions' but I didn't see anything like that.

Erin Welsh: Okay.

Erin Allmann Updyke: What it seems happens is that your neurons kind of just get very, very full of virus and this virus is very good at two things. The first is that... Okay, so we'll do a little background on how your immune system works.

Erin Welsh: Okay.

Erin Allmann Updyke: If you get infected with a virus in one of your cells, you have immune cells, T cells that come around and your cell can send out a signal that's like, 'Hey! I'm infected, come kill me.' And then that T cell comes over and it kills the infected cell.

Erin Welsh: Okay.

Erin Allmann Updyke: And it does that by what's called apoptosis which just means cell-killing, essentially.

Erin Welsh

Yeah.

Erin Allmann Updyke

So in theory, neurons especially that are infected signal to the T cells to say 'come and kill me.' And killing neurons is actually really bad because your neurons don't regenerate.

Erin Welsh

Right.

Erin Allmann Updyke

That's not what happens in rabies. Rabies actually inhibits your immune system from killing any of the neurons. So you don't see widespread neuronal death in rabies.

Erin Welsh

Okay. Like you would expect to see if cell death were happening the way it should under the principles that...

Erin Allmann Updyke

Yeah. Yeah, yeah, exactly.

Erin Welsh

Okay.

Erin Allmann Updyke

And on top of that, so not only does rabies basically take away the signaling molecules that your neurons would normally use to tell your immune system to like come and help out, so it basically pulls those in and puts them away so that your immune system can't come in and help out. But then if your immune system does happen to come in because it heard about it from a friend or whatever and it comes over, it kills off your T cells. So it induces apoptosis in your T cells. So now your immune system is just kind, boom-boom, killed killed. And your neurons are like, 'I'm gonna live forever full of rabies.'

Erin Welsh

Oh my god! How did this happen again? What is going on? I don't understand.

Erin Allmann Updyke

It's crazy. And then on top of all that, so literally just imagine it filling up your neurons, like blocking them in some places, blocking signals from being transmitted because there's just so many viral particles there and also other things that come to be like, 'What's going on?' And everything just clocks your neurons. On top of that, there's at least some evidence that the virus can modulate the release of certain molecules like serotonin, if you've heard of serotonin. Serotonin is a neurotransmitter that basically your brain uses, it's one of the happy transmitters.

Erin Welsh

Right.

Erin Allmann Updyke

So a lot of depression medications increase the amount of serotonin in your brain, that's how they work. So this can inhibit the release of serotonin, right. And it can inhibit the release of other neurotransmitters as well. So it basically just completely screws up all of your brain's normal signaling and that's what can result in this aggression and also just weird behaviors. It's wacky. Like it comes in and it just destroys the way that your brain normally communicates with itself and with rest of your body.

Erin Welsh

It fully takes over.

Erin Allmann Updyke

It fully takes over. And that's it. So then you have viral encephalitis because your brain is just so full of this viral particle, it's like swollen, you've got immune cells trying to come in and just dying, so then you've got these dead cells everywhere. And then you die. Yeah.

Erin Welsh

And death just... Why? How do you die?

Erin Allmann Updyke: So actually most of the time it's either cardiac or respiratory arrest. So either your brain just tells your heart to stop beating or your lungs to stop breathing or something. Yeah.

Erin Welsh: That's terrifying.

Erin Allmann Updyke: It's not great.

Erin Welsh: And talk to me about mortality rate.

Erin Allmann Updyke: (laughs) It's not 100%. If it's untreated it's 100% essentially. Even if treated, if you get to the point where you have any sort of clinical symptoms, it's also almost 100% fatal. We essentially have no treatment. We do have what's called post-exposure prophylaxis but that is not treatment, we don't have any antivirals that work on rabies virus. Yeah it's bad.

Erin Welsh: So what is post-exposure prophylaxis?

Erin Allmann Updyke: Yeah so if you get exposed to rabies you will get post-exposure prophylaxis which consists of a vaccine which is in this case just killed viral particles. And so by putting these viral particles that are dead, they don't replicate, they don't cause disease into either your muscle, it's either injected intramuscular so into your muscle just like your tetanus shots are or intradermal, so right under your skin like maybe your TB test is. You can do either, there's two different vaccines. That allows your immune system to actually generate antibodies. Antibodies can make it into your brain and your nervous system and actually attack this virus. Right.

Erin Welsh: Oh okay. So it's actually giving your body the opportunity to defend itself before it gets all the way there.

Erin Allmann Updyke: Exactly. Right.

Erin Welsh: Okay.

Erin Allmann Updyke: And so you'll get those and then depending on the sort of category of your exposure, in addition to the vaccines, you're also going to get immunoglobulins. So these are actual antibodies that they make in a lab that are specific to the rabies virus and they're gonna give you those near the site of potential infection, like near your bite wound or whatever and then they're also gonna give you vaccines. Because you want as much possible protection, as many antibodies as your body can generate plus some extras to really try and kill this virus.

Erin Welsh: Yeah. Yeah.

Erin Allmann Updyke: Yeah. And it's intense, like it's an intense course. Even if you've had the rabies vaccine beforehand, it's still at least 2-4 vaccinations afterwards. If you've never had any sort of rabies vaccine then it can be up to 12, so yeah. It's not great.

Erin Welsh: No. So we talked about the fatality in humans or the mortality rate in humans.

Erin Allmann Updyke: Yes.

Erin Welsh: What about dogs? What about bats? What about other mammals?

Erin Allmann Updyke Great question. It's not 100% fatal in bats.

Erin Welsh Okay.

Erin Allmann Updyke I don't know what the exact fatality rate is but I do know that not every bat who gets infected with rabies is gonna die. And for dogs at least one source that I found said about 14% of dogs infected with rabies can actually survive the infection.

Erin Welsh Wow. Okay.

Erin Allmann Updyke Yeah. Which is way higher than I expected.

Erin Welsh Yeah. Okay, that's interesting.

Erin Allmann Updyke So what the heck dude? How did we get to have this insane virus that kills so many people...?

Erin Welsh I can answer some of those questions with my own flavor in there.

Erin Allmann Updyke (laughs) Perfect. Should we make more drinks?

Erin Welsh Should we get more drinks? Yeah.

Erin Allmann Updyke Yep.

TPWKY (transition theme)

Erin Welsh During our long, long hiatus we got many requests for rabies and we've been, as we mentioned, very happy to oblige. And yeah, it's actually been at the top of our long list of diseases that we've wanted to cover for many good reasons. Some of them you just heard about. I mean it's just a super exciting disease, right?

Erin Allmann Updyke Yeah.

Erin Welsh And I feel like it's been part of social consciousness for millennia and as it turns out it actually kinda has been there for millennia.

Erin Allmann Updyke Yes, oh my god.

Erin Welsh Whereas many of the diseases that we covered in our first season left these big imprints on society through huge outbreaks and the victim counts in the tens of thousands, the hundreds of thousands, the millions. Rabies seems more insidious in its effect on culture and humanity. The threat of madness and an agonizing death lurking in every shadow-

Erin Allmann Updyke Maybe Darth Sidious was rabid and that's why he was so evil.

Erin Welsh (laughs) Even for a science podcast, that was really nerdy.

Erin Allmann Updyke (laughs) I'm proud of it.

Erin Welsh (laughs) I'm proud of you. Yeah so but even with this relatively low death toll, it's no wonder that rabies has led to the creation of laws, inspired supernatural tales-

Erin Allmann Updyke Oh my god.

Erin Welsh And continues to terrify even today.

Erin Allmann Updyke Oh my god.

Erin Welsh Before modern medicine and germ theory, the link between exposure and disease was, let's say, tenuous and often incorrectly assigned. Bad air, an imbalance of the body's humors, cats, demons - the same thing, just kidding. Whatever.

Erin Allmann Updyke So hurtful.

Erin Welsh I take it back, I take it back.

Erin Allmann Updyke But also they weren't wrong about cats, I mean there's a lot of disease there.

Erin Welsh Sure, sure. But they're often blamed more than they should be.

Erin Allmann Updyke Your right. We talked about that.

Erin Welsh We did.

Erin Allmann Updyke Yeah.

Erin Welsh But people needed an explanation for why they were sick and so they received one, incorrect though it may be.

Erin Allmann Updyke Doesn't matter.

Erin Welsh Sometimes the link was more easily drawn, such as in the case of rabies which I think is pretty interesting also.

Erin Allmann Updyke Ooh, that is interesting.

Erin Welsh Yeah. You get bitten by a mad dog and you'll soon become mad yourself.

Erin Allmann Updyke Huh.

Erin Welsh Yeah. But how far back does this knowledge of this link extend?

Erin Allmann Updyke Just tell me, I need to know!

Erin Welsh (laughs) So I couldn't find anything about evidence of rabies virus and ancient DNA but we do know a couple of things about its early history or prehistory.

Erin Allmann Updyke Okay.

Erin Welsh: Okay so one of the things that we know is that it originated in bats. Even though we probably most commonly associate rabies with dogs, studies of the different strains of rabies virus show that it first spilled over from bats into dogs thousands of years ago with additional spillover events occurring every so often and probably still happening today. And they needed to happen, these spillover events needed to happen because the rabies virus would kind of burn itself out by killing all the dogs.

Erin Allmann Updyke: Yep.

Erin Welsh: And it turns out that several types of rabies viruses are exclusive to insectivorous bats.

Erin Allmann Updyke: Ooh!

Erin Welsh: So that means bats that eat insects. And some researchers think that around 7000-12,000 years ago, one of these bats picked up a virus similar to the rabies virus from an insect it ate and it either recombined or mutated into the rabies virus that we know and love today.

Erin Allmann Updyke: Stop it. Stop it.

Erin Welsh: Yeah.

Erin Allmann Updyke: They think it came from an insect virus?

Erin Welsh: Yes.

Erin Allmann Updyke: This is why I'm an entomologist.

Erin Welsh: (laughs)

Erin Allmann Updyke: Are you kidding me?

Erin Welsh: Yeah, I didn't dig too deep but it seems fascinating that, yeah.

Erin Allmann Updyke: Oh that is freaking awesome.

Erin Welsh: I know, it's really cool. Despite the fact that rabies came from bats, most of the early references to rabies center around man's best friend, the dog.

Erin Allmann Updyke: The pooches.

Erin Welsh: Which brings me to the other thing that we know about early rabies. We know that it has been observed and feared by humans for millennia, largely in association with dogs.

Erin Allmann Updyke: Wow.

Erin Welsh: This comes from the first written references to rabies, a law in the Mesopotamian Codex of Eshnunna, or something like that, from around 4000 years ago. So like 1930 BCE.

Erin Allmann Updyke: They had a law about rabies 4000 years ago.

Erin Welsh: Yeah. 4000 years ago.

Erin Allmann Updyke: And they wrote it down.

Erin Welsh: Yeah.

Erin Allmann Updyke: That's how important of a law it was.

Erin Welsh: Especially considering that rabies only spilled over a few thousand years before that.

Erin Allmann Updyke: Yeah.

Erin Welsh: Crazy.

Erin Allmann Updyke: Oh my gosh.

Erin Welsh: So under this law if you had a rabid dog and didn't watch over it and then it ended up biting someone and killing them, you would be fined. From that point on we see a lot of references to rabid or mad dogs, we see descriptions of disease progression, incantations or treatment options.

Erin Allmann Updyke: Ooh.

Erin Welsh: Ancient Greece lags a bit behind in their medical knowledge of rabies which is unusual for Ancient Greece but they make up for it by giving the name to the family of viruses that rabies belongs to. So the rabies virus, as you mentioned, is known as a Lyssavirus, and that is L-Y-S-S-A.

Erin Allmann Updyke: Yep.

Erin Welsh: The word 'lyssa' has origins either in 'lycus' for wolf or 'lud' for violent.

Erin Allmann Updyke: Ooh!

Erin Welsh: It's kind of debated.

Erin Allmann Updyke: Which one it is?

Erin Welsh: Yeah.

Erin Allmann Updyke: That's cool.

Erin Welsh: Yeah. And Ancient Greeks used this word poetically to describe a primal, animalistic rage. So like Homer wrote about Hector viciously attacking the invading Greeks in the Trojan War, he was in a lyssa.

Erin Allmann Updyke: Oh interesting.

Erin Welsh: Yeah. And let's not forget Cerberus' spit which I talked about in our crossover episode with In Defense of Plants many months ago.

Erin Allmann Updyke: Yes! Oh, go listen to that if you haven't, it's great.

Erin Welsh: So when brought from the underworld to the surface of the earth, the three-headed watchdog foamed at the mouth and thrashed about because he probably saw sun for the first time ever.

Erin Allmann Updyke: Oh wow.

Erin Welsh: He was afraid of light. So it sounds like rabies, yeah.

Erin Allmann Updyke: For sure. Or also just he was slobbery, I mean we all know those dogs.

Erin Welsh: Lyssa' also meant straight up rabies to the Greeks in a medical sense.

Erin Allmann Updyke: Okay.

Erin Welsh: The best early medical description of rabies comes from the Sushruta Samhita which is a Sanskrit text of ancient Indian medicine and it actually does a really good job of describing the posture of rabid dogs, the fear of water, the inevitable death of a sufferer. So it did this comprehensive, yeah you could look at that and go, 'Ah, that's rabies.'

Erin Allmann Updyke: Like clinical diagnosis, check.

Erin Welsh: Yes, exactly.

Erin Allmann Updyke: Cool.

Erin Welsh: To some, rabies was a disorder of the mind. Madness sprung up spontaneously in a dog who then transferred it to you, while to others rabies was a venom similar to that of a snake or a scorpion.

Erin Allmann Updyke: How interesting.

Erin Welsh: Yeah. And whichever cause your doctor believed in dictated the treatment, which let's be honest, wasn't going to work.

Erin Allmann Updyke: Yeah no.

Erin Welsh: No. At first bite, cupping or cauterizing the wound was a pretty routine option, maybe filling it with clarified butter which the victim was then supposed to drink. (laughs)

Erin Allmann Updyke: Wait, what? You're telling me that they took your calf wound, they filled it with ghee, and they told you to lick it out of your own calf wound?

Erin Welsh: Yeah, mm-hmm. They might add some wine or something to it, but yeah.

Erin Allmann Updyke: Nah, dude.

Erin Welsh: Oh that's like the most vanilla of all of these cures. And this is also where we get our 'hair of the dog' saying.

Erin Allmann Updyke: Oh!

Erin Welsh: Rubbing a few hairs from the dog that bit you. So 'hair of the dog' is short for 'the hair of the dog that bit you'.

Erin Allmann Updyke: Yes, yeah.

Erin Welsh: So rubbing a few of those hairs or maybe the burnt ashes from the dog's tail - yikes.

Erin Allmann Updyke: Ooh does that mean they burnt the whole tail?

Erin Welsh: Yeah.

Erin Allmann Updyke: Oh poor pooch.

Erin Welsh: Yeah. Into the bite wound was supposed to protect you against rabies.

Erin Allmann Updyke: Oh my gosh, wow. That's a terrible idea.

Erin Welsh: Another common preventative for rabies was to cut the ligament attaching the dog's tongue to its lower jaw, called the lyssa or worm, and then carry that around with you.

Erin Allmann Updyke: (laughs)

Erin Welsh: Well you're supposed to walk around a fire three times and then put it in your shoe or a pouch.

Erin Allmann Updyke: So you don't carry the whole tongue, it's just that little nuper thing?

Erin Welsh: Yup, yup. So if you did it right, neither you nor the dog would get rabies.

Erin Allmann Updyke: Oh it's like, 'I wanna save my dog!'

Erin Welsh: Yeah so they would do it to puppies and stuff like that.

Erin Allmann Updyke: Oh, babe.

Erin Welsh: And unfortunately this very inhumane practice was carried out through the early 20th century.

Erin Allmann Updyke: Wow! Seriously?

Erin Welsh: Mm-hmm. I think that just goes to show what superstition and fear surrounds this.

Erin Allmann Updyke: Yeah! Like we knew that's not gonna do anything by then. Like what the heck?

Erin Welsh: I know. Okay. So if those cures seem a little crazy to you...

Erin Allmann Updyke Yeah?

Erin Welsh Hold onto your butts.

Erin Allmann Updyke Oh, clenching!

Erin Welsh (laughs) Because I'm about to tell you what Pliny the Elder had to say on the matter.

Erin Allmann Updyke Wait, we've talked about Pliny before, right?

Erin Welsh Oh yeah, he was pretty indiscriminate about where he got his information and just sort of kitchen sinked it. It was actually Pliny who came up with the hair of the dog treatment, maybe, probably, who knows.

Erin Allmann Updyke Oh. Okay, all right.

Erin Welsh But he didn't stop there. Oh no.

Erin Allmann Updyke Oh no.

Erin Welsh How about rubbing... I apologize in advance.

Erin Allmann Updyke Oh just skip forward 22 seconds.

Erin Welsh Yeah. Okay what about eating the dog's head?

Erin Allmann Updyke (gasps)

Erin Welsh No? Okay, all right. Well you can also administer the ashes of the tail of a shrewmouse but only if the shrewmouse survived the tail removal and then was set free.

Erin Allmann Updyke (laughs)

Erin Welsh That's the only way that's gonna work.

Erin Allmann Updyke (laughs) How do you administer? How do you administer the tail of a shrewmouse?

Erin Welsh So here's my favorite, though. The old skin of a snake that has been cast in spring - I don't know what that means. (laughs) Beaten up - wait - with a male crab in wine. (laughs)

Erin Allmann Updyke (laughs) I can't. Beating it to death, snakeskin...

Erin Welsh With a crab.

Erin Allmann Updyke Male crab.

Erin Welsh A male crab in wine. In wine.

Erin Allmann Updyke Don't forget, you don't want those ovaries in there.

Erin Welsh: What kind of wine? Yeah.

Erin Allmann Updyke: (laughs) Oh, that's a good question.

Erin Welsh: Could be anything!

Erin Allmann Updyke: Oh my god.

Erin Welsh: Yep. So I don't know what you do with that.

Erin Allmann Updyke: Yeah but it doesn't say what you do with it, it's just like, 'Beat up a snakeskin'?

Erin Welsh: But besides curing rabies it also will keep moths out of your chests and drawers.

Erin Allmann Updyke: (laughs)

Erin Welsh: I'm not joking, this is Pliny the Elder, this is not me.

Erin Allmann Updyke: I love everything about the things that you find, Erin.

Erin Welsh: (laughs) I know, me too.

Erin Allmann Updyke: I'm sorry, Dr. Erin.

Erin Welsh: Ooh! Dr. Erin, thank you.

Erin Allmann Updyke: It's so good. Wow.

Erin Welsh: Okay. In any case, the extremely wide variety of rabies preventatives or "cures" in quotes-

Erin Allmann Updyke: Wait so was the crab and snake thing a prevention or a cure?

Erin Welsh: Who knows? Both!

Erin Allmann Updyke: A little bit of everything.

Erin Welsh: Yeah. Most of these are preventions, I guess preventatives if you were bitten.

Erin Allmann Updyke: Okay, all right, okay. post-exposure prophylaxis, if you will. (laughs)

Erin Welsh: Yeah. I will.

Erin Allmann Updyke: Yes.

Erin Welsh: So the wide variety of these is a pretty good indication that desperation drove people to try all kinds of things to prevent themselves or their loved ones from dying a pretty horrific death.

Erin Allmann Updyke

That's true. Makes you feel sad for laughing at it.

Erin Welsh

And sometimes these cures probably appeared to work either because the bite from the dog didn't break the skin or the dog was just angry and not rabid. But really no actual advancements in effective treatment or knowledge about rabies were made at all throughout ancient times and up into the Middle Ages, past the Middle Ages. Really until Pasteur set his mind to rabies in the 1800s. But we'll get to that later.

Erin Allmann Updyke

Oh.

Erin Welsh

Okay this one more is just for you.

Erin Allmann Updyke

Okay.

Erin Welsh

This is a Middle Ages cure.

Erin Allmann Updyke

Kay.

Erin Welsh

If you are bitten by a rabid dog, I want you to grab a live rooster, pluck all of the feathers from around its anus, and then hold said anus to the bite wound.

Erin Allmann Updyke

(snorting)

Erin Welsh

Now. No, wait, wait.

Erin Allmann Updyke

I can't wait.

Erin Welsh

If the rooster swells up, it has sucked the poison out and you'll be fine. But if not, it was nice knowing ya.

Erin Allmann Updyke

(laughs) I don't have any words. That poor freaking rooster, man.

Erin Welsh

I know right?

Erin Allmann Updyke

Also I think it's called a cloaca.

Erin Welsh

I know, that's what I loved the best about this.

Erin Allmann Updyke

Is that they called it an anus.

Erin Welsh

The anus. And I was like well wait a second, there's just one hole as far as I'm aware. (laughs) Okay.

Erin Allmann Updyke

Oh yeah. Check that Ologies egg episode if you don't know what a cloaca is, by the way.

Erin Welsh

At this point in our rabies history, we've just kind of breezed past the Middle Ages, the Renaissance.

Erin Allmann Updyke

Of course.

Erin Welsh: You know, we're well into the Victorian era.

Erin Allmann Updyke: They don't have it figured out.

Erin Welsh: Yeah. So we're well into the 1800s with little to nothing to show for it besides a laundry list of cures that don't work, are more often than not inhumane, and probably smell really bad.

Erin Allmann Updyke: (laughs)

Erin Welsh: But we've also got fear. After all these thousands of years, the bite of a rabid dog carries as much horror as it did from the very beginning.

Erin Allmann Updyke: That's true.

Erin Welsh: The reputation of rabies as a viciously contagious and violent disease grew throughout this time and it grew somewhat out of proportion to the actual risk of disease as per usual.

Erin Allmann Updyke: Mm-hmm.

Erin Welsh: Fear drove the widespread belief that a bite wasn't necessary for disease, a lick alone from a rabid dog would also lead to inevitable death. So while you mentioned that a lick can actually, it's very rare. It's likely that an actual increase in rabies cases was responsible for some of this fear but with it came some tragic consequences. Mass extermination of dogs following rabies outbreaks, a dog tax in Britain and France that restricted the ownership of dogs to the wealthy as if only dogs from poor people could transmit rabies. And fear of rabies was probably responsible for adding a whole lot of color and depth to two classic figures in literary horror. The vampire and the werewolf.

Erin Allmann Updyke: (gasps) Both of them?

Erin Welsh: Both of them.

Erin Allmann Updyke: Oh!

Erin Welsh: Okay let's talk about this. Werewolves have been around for ages. They probably have their roots in a Greek myth about Lycaon, a king who according to one version of the myth tried to serve the roasted flesh of his own son to Zeus to test Zeus' all-knowing abilities. Zeus being all-knowing found out immediately, raged out, killed a bunch of Lycaon's sons, and turned Lycaon himself into a wolf.

Erin Allmann Updyke: Ooh!

Erin Welsh: Who kind of loses it. And these elements, transformation into a wolf or dog-like creature, loss of control, and violence make up the hallmark of a werewolf when the legend boomed in popularity in the 1600s-ish with one crucial thing added to the mix. The bite or scratch of a werewolf could turn you into one.

Erin Allmann Updyke: Yeah.

Erin Welsh: And this is still more or less how the werewolf is portrayed today with a few exceptions.

Erin Allmann Updyke You mean wrong ones? Cause that's right, that's how you become a werewolf.

Erin Welsh (laughs) It is law.

Erin Allmann Updyke It is correct.

Erin Welsh At some point the full moon became also crucial in a werewolf transformation.

Erin Allmann Updyke Oh yeah, that is true. That is true.

Erin Welsh Which I will also point out was thought to correspond to times of increased rabies risk, I don't know why.

Erin Allmann Updyke Okay.

Erin Welsh Yeah. But there do seem to be too many parallels between rabies and werewolves to ignore.

Erin Allmann Updyke Yeah.

Erin Welsh On the other side of this coin in the vampire.

Erin Allmann Updyke Yeah!

Erin Welsh Vampires have been around for millennia and many different cultures have their own version of a vampire or creature with vampire-like qualities, so pinning the creation of vampires on rabies is a little bit more difficult. But let's talk about the form of vampire that most of us are probably familiar with: Spike from Buffy.

Erin Allmann Updyke (laughs)

Erin Welsh Just kidding. (laughs)

Erin Allmann Updyke No.

Erin Welsh No? Okay. The Dracula type. All right.

Erin Allmann Updyke Yes, thank you.

Erin Welsh This is the kind of vampire created in the early 1800s and popularized by Bram Stoker in Dracula. As with werewolves, hypotheses as to the origin of vampires abound. But let's go through the evidence for rabies and see what we think.

Erin Allmann Updyke Yeah.

Erin Welsh Okay, we've got fear of sunlight.

Erin Allmann Updyke Check.

Erin Welsh Check. No reflection, check.

Erin Allmann Updyke

Wait, why?

Erin Welsh

A historic method for testing if someone had rabies was if they could recognize their own reflection. If they couldn't, it meant that the rabies madness had seized them and they were doomed.

Erin Allmann Updyke

Interesting. That is super fascinating.

Erin Welsh

Yeah. Okay. A sexual nature, check. So I'll keep this as PG-13 as I can. Male sufferers in particular or rabies are reported to frequently get erections or ejaculate many times, up to 30 in one day I read somewhere.

Erin Allmann Updyke

Human males?

Erin Welsh

Human males. I don't know, citation needed.

Erin Allmann Updyke

Citation needed, I'd say.

Erin Welsh

Well but anyway, the whole sexual nature, maybe that's part of it. I don't know.

Erin Allmann Updyke

All right, cool.

Erin Welsh

Bats.

Erin Allmann Updyke

Most def.

Erin Welsh

Kind of check is what I'm gonna say because-

Erin Allmann Updyke

Okay.

Erin Welsh

Because it wasn't really until the 20th century, so the 1900s, when people started linking the poison of some vampire bats to an illness in cattle that turned out to be rabies.

Erin Allmann Updyke

I see, so it's like we know now that it's bats but when people were inventing this Bram Stoker's Dracula, they didn't know that it was bats necessarily.

Erin Welsh

Necessarily, yeah.

Erin Allmann Updyke

All right, okay, all right.

Erin Welsh

And last but not least, biting.

Erin Allmann Updyke

Yeah.

Erin Welsh

Kind of check again.

Erin Allmann Updyke

Yeah.

Erin Welsh: Because dogs and other mammals definitely become aggressive and bitey when infected with rabies but the disease doesn't really seem to necessarily make humans bite or to be able to transmit rabies through a bit, maybe because our teeth just aren't as good at breaking skin.

Erin Allmann Updyke: Yeah, I mean there is not really a lot of cases of human to human transmission and that's in part because the disease doesn't necessarily progress to that exact... Like the symptoms aren't exactly the same between humans and dogs for example, right, or foxes.

Erin Welsh: Right.

Erin Allmann Updyke: So we might become aggressive but not in a bitey way because humans don't bite as a general rule, right. Whereas carnivores like a dog or a fox, that's what they do when they get aggressive is they bite.

Erin Welsh: But yeah, so there we have it.

Erin Allmann Updyke: Okay.

Erin Welsh: Some decent evidence for rabies as at least a partial inspiration for the modern vampire.

Erin Allmann Updyke: Cool.

Erin Welsh: There is a third supernatural creature linked to rabies that you may have noticed I've conspicuously left out, the zombie.

Erin Allmann Updyke: The zombie!

Erin Welsh: And that is because we are going to take a special episode to cover this topic in much more detail at another time.

Erin Allmann Updyke: Yep.

Erin Welsh: So stayed tuned.

Erin Allmann Updyke: Just get like really excited about it.

Erin Welsh: Cause we are. Whether or not rabies inspired the legends of werewolves and vampires, it was clear that the disease had insinuated itself into public consciousness and by the 19th Century, fear of it had risen to historic levels. In the western U.S. were tall tales of quote "phoby cats", phoby being short for hydrophobia, rabies tell-tale sign.

Erin Allmann Updyke: Ooh, yeah.

Erin Welsh: These animals, normally quite shy, would come wandering into a cattle herder's camp and bite indiscriminately when rabies-infected with nearly 100% fatal outcomes from the poor souls bitten.

Erin Allmann Updyke: Aw.

Erin Welsh: Do you wanna know what these phoby cats are? Do you have any idea?

Erin Allmann Updyke No. (laughs) You look so excited though, I just need to know.

Erin Welsh They're just skunks.

Erin Allmann Updyke Wait, skunks? (laughs)

Erin Welsh Yeah. That's a phoby cat.

Erin Allmann Updyke That's a phoby cat?

Erin Welsh That's how they were known for a long time.

Erin Allmann Updyke I'm gonna call them that from now on, that's a really cute name.

Erin Welsh Yeah, phoby cat.

Erin Allmann Updyke A phoby cat? A skunk? I love it.

Erin Welsh They were apparently one of the most feared animals on the western plains.

Erin Allmann Updyke Oh my gosh.

Erin Welsh Alongside the rabid wolf which lived up to its fear because in one account, one rabid wolf bite 12 men, 11 of whom died from rabies.

Erin Allmann Updyke Oh man.

Erin Welsh Yeah. And it wasn't just in the great outdoors that fear of rabies had grown. In cities and small towns all over the world the fear was apparent. And it makes sense. One day your beloved canine companion is snuggling next to you while you read-

Erin Allmann Updyke Stop, I'm gonna cry.

Erin Welsh And the next it's bite could spell certain death for both of you. It would've felt like a terrible, tragic betrayal in some ways.

Erin Allmann Updyke Yeah.

Erin Welsh Dr. Jekyll, Mr. Hyde, these kinds of stories really led to that. It was amidst this rabies-inspired fear and hysteria that Louis Pasteur grew up and trained to be a scientist. He was a pretty important dude, as you know.

Erin Allmann Updyke (laughs)

Erin Welsh Pasteur claimed to be driven by a desire to alleviate the world of unnecessary suffering and he set his eyes on vaccination as a way to do so. He developed his first successful vaccine against anthrax, then it was time for rabies.

Erin Allmann Updyke Yeah.

Erin Welsh: It's kind of curious why he chose to tackle rabies since it wasn't one of the big killers of the day and if he really wanted to alleviate human suffering, the research, time, and money may have been better spent on another disease whose death toll was much higher, like malaria, cholera, tuberculosis, something like that. And even Pasteur's own students suggest that Pasteur was drawn by the flashiness of rabies as a way to gain maximum interest in his research.

Erin Allmann Updyke: Ooh, all the way back then.

Erin Welsh: Yeah. Sort of showmanship kind of a thing.

Erin Allmann Updyke: No changes.

Erin Welsh: But whatever, he went to work. He learned that you could collect the virus in the brain of an infected animal, which is still the way they test for rabies today, and this greatly reduced the danger of lab work. Now that they had the agent they needed to find a way to attenuate it to make it less harmful so when introduced by vaccine, it would not kill the person but induce them to start making protective antibodies against it. Pasteur found that air drying the spinal cord of intentionally infected rabbits would lead to a weakened virus.

Erin Allmann Updyke: Air Drying it?

Erin Welsh: Yep.

Erin Allmann Updyke: Just like hang it out on your laundry line?

Erin Welsh: I don't know. He tested a vaccination schedule in dogs, or inoculation schedule, both as a preventative and as a post-exposure treatment. The routine consisted of 13 or so shots and started with the oldest, driest bit of spinal cord and progressed into the last shot was a much more recent, much less weakened version of rabies.

Erin Allmann Updyke: Interesting, so he just used like straight up spinal cord from a rabbit.

Erin Welsh: I don't know exactly. Like I don't think he was able to culture rabies.

Erin Allmann Updyke: Right, yeah.

Erin Welsh: I think he just used some sort of inoculation of the spinal cord.

Erin Allmann Updyke: That is so cool.

Erin Welsh: Yeah. And it worked in dogs. Pasteur was still very hesitant to try this out in humans but he was soon confronted with a decision that didn't leave him long to waffle.

Erin Allmann Updyke: Uh oh.

Erin Welsh: In July of 1885, a young boy had been bitten 14 times by a grocer's dog.

Erin Allmann Updyke: Oh my god!

Erin Welsh: Likely rabid, just all over his body.

Erin Allmann Updyke Ugh.

Erin Welsh Pasteur's rabies research by this point was well-known and the family went to Paris to seek help from the man himself. Secretly terrified but outwardly confident - very important.

Erin Allmann Updyke That's my life.

Erin Welsh Yeah, right?

Erin Allmann Updyke I wish actually.

Erin Welsh (laughs) Pasteur agreed to treat the boy with the 13 inoculations. He waited through many sleepless nights, sure that he had condemned the boy to death. But the inoculations proved successful and the boy made a full recovery. The news of this achievement spread like wildfire across the globe and soon people began flocking to Paris to seek treatment.

Erin Allmann Updyke Wow.

Erin Welsh Yeah. Soon it was apparent that these inoculations, when given to a bite victim before any symptoms or signs of disease began represented the first actual successful prevention for rabies.

Erin Allmann Updyke That is so cool. And what year was this again?

Erin Welsh 1885

Erin Allmann Updyke Wow.

Erin Welsh Yeah it was pretty big.

Erin Allmann Updyke Yeah.

Erin Welsh And so the development of this vaccine marked a huge turning point in the history of rabies. Prevention was finally possible and many countries who could afford to either manufacture or purchase rabies vaccine - the emphasis being on who could afford-

Erin Allmann Updyke Right.

Erin Welsh -began to attempt eradication. And some were pretty successful actually, so the U.K. has been declared rabies-free for almost 100 years.

Erin Allmann Updyke It's an island so they've got that going for them.

Erin Welsh Yep. So even though the vaccine was in use and cases were dropping, people still get rabies and still die from rabies. Almost all of them. Almost.

Erin Allmann Updyke Almost.

Erin Welsh Not Jeanna Giese who in 2004 was bitten by a bat. The 15 year old Wisconsin native tested positive for rabies and was put into a medically-induced coma to help her body fight off infection.

Erin Allmann Updyke Whoa.

Erin Welsh Yeah. And after 7 days in the coma, the infection seemed to be going away and doctors slowly brought her out of the coma, which is unheard of.

Erin Allmann Updyke It's crazy.

Erin Welsh Yeah. Recovery was slow but steady and Jeanna made a full recovery.

Erin Allmann Updyke Wow.

Erin Welsh She was the first known person to survive rabies without having received any portion of any rabies vaccine.

Erin Allmann Updyke Yeah.

Erin Welsh She did receive some immunoglobulin but no portion of any vaccine, which is insane.

Erin Allmann Updyke Right. Yeah.

Erin Welsh Yeah. Since then, other people have used this so-called Milwaukee protocol, which is putting it into the coma, putting a person into a coma.

Erin Allmann Updyke That was like developed by the guy who treated-

Erin Welsh Rodney Willoughby?

Erin Allmann Updyke Right.

Erin Welsh But it's with varying success. And so its effectiveness is still really heavily debated amongst physicians.

Erin Allmann Updyke Yeah.

Erin Welsh So even though we may not have a treatment, we do have a vaccine. Erin, tell me where do we stand with rabies today?

TPWKY (transition theme)

Erin Allmann Updyke Okay. It's a good question. I actually - this is not a good way to start our first episode of Season 2 - I don't know.

Erin Welsh (laughs)

Erin Allmann Updyke Let me tell you why because it's interesting. The World Health Organization, according to their most recent reports there are 59,000 deaths per year from rabies.

Erin Welsh 59

Erin Allmann Updyke 59. So almost 60,000 deaths from rabies.

Erin Welsh That's a lot.

Erin Allmann Updyke And they say about 60% of these deaths occur in Asia and 35% are in Africa. And actually those 59,000 only account for canine-associated rabies.

Erin Welsh Okay.

Erin Allmann Updyke And that accounts for about 99% of all the rabies in the world.

Erin Welsh Okay.

Erin Allmann Updyke So that's what the World Health Organization says. And that report comes from a paper that was written in 2015. The problem is there's another paper that was also written in 2015 which estimates 17,400 deaths from rabies.

Erin Welsh That's quite a different number.

Erin Allmann Updyke Yeah. So that paper came from the global, regional, and national life expectancy all-cause mortality and cause-specific mortality. So it wasn't specific to rabies, it was this paper that looked at the overall causes of death across the world from 2005-2015, so trying to see what kind of progress we had made on various different infectious and noninfectious diseases and other causes of mortality. And their estimates of rabies were so drastically lower than this one single paper that now the whole World Health Organization and everyone else is citing that came out in 2015. So I feel very like I honestly don't know. And so maybe people will yell at us one way or the other about this but I don't know who to believe quite honestly in this case because the problem is that the vast majority of rabies deaths are not reported.

Erin Welsh Right.

Erin Allmann Updyke And that's what it really comes down to is that all of these estimates are based on mathematical modeling and are based on our best guesses in all these various countries, based on risk factors, based on demographics. And so we don't know how bad rabies is. What we do know is that in Africa and Asia especially canine rabies is still a big problem. There are definitely tens of thousands of deaths that are occurring there due to dogs that are infected with rabies. The Pan American Health Organization which is the World Health Organization for the Americas, essentially, and they had a really huge campaign and their goal was to eliminate canine rabies by 2015 throughout the Americas.

Erin Welsh 2015

Erin Allmann Updyke Yeah. They didn't quite hit that but they have reduced, canine rabies is almost nonexistent throughout the Americas, not just in the United States.

Erin Welsh Right, right.

Erin Allmann Updyke Which is incredible. So now throughout the Americas, the real route of transmission is through bats and through other wild animals. And so what is sort of the new goal, there is a quote "united against rabies collaboration".

Erin Welsh Okay.

Erin Allmann Updyke And it is a combination or a cross-sectional effort between the World Health Organization, the World Organization for Animal Health, the Food and Agricultural Organization, the FAO, and the Global Alliance for Rabies Control. So these four - is that right? One, two, three, four. Yeah. Four organizations all working together have this new united against rabies collaboration and their goal is to have zero human rabies deaths by 2030.

Erin Welsh Okay.

Erin Allmann Updyke So they've got some time which I think is respectable, granted this thing literally just was published in June of this year. That's sort of where it stands now. There's a really big push to kind of get a better handle on what the disease burden really is and really the real push is to vaccinate dogs, and so it's massive dog vaccination campaigns and trying to rid the world of canine rabies which in theory rids the world of almost all human rabies because there are very few cases of rabies outside of dogs. The World Health Organization stance and the CDC stance is that with proper vaccination and post-exposure prophylaxis, this is a preventable disease.

Erin Welsh Right.

Erin Allmann Updyke So it's preventable by many different mechanisms. Number one, if you have a domestic animal you need to vaccinate it. Like it's not an option.

Erin Welsh It's a law.

Erin Allmann Updyke It's a law but that doesn't mean people follow it, right. And if you have interaction with an animal that you have any suspicion might be or any bat whatsoever, then go to your doctor and say, 'I got bit by a bat' and then you can be treated. And yeah. I mean the World Health Organization, I will say, the numbers that they do know for sure is that 15 million people around the world receive post-exposure prophylaxis. That means that we know that potentially hundreds of thousands of lives are being saved by the fact that this exists. It's pretty much 100% effective, so.

Erin Welsh And wait and see will kill you.

Erin Allmann Updyke Yes.

Erin Welsh If you are infected.

Erin Allmann Updyke Yeah. Not to scare you.

Erin Welsh No, no, no. Not to scare you because it has a very low incidence relative to some of the other diseases that are out there and it's entirely preventable.

Erin Allmann Updyke Yeah.

Erin Welsh: And so waiting and seeing, it's not worth it.

Erin Allmann Updyke: Right. Yeah. Oh, was that fun?

Erin Welsh: That was so much fun. This is one of the craziest diseases we've covered.

Erin Allmann Updyke: It is. It's a fascinating virus from a biology perspective and it's so interesting the way that it's sort of crawled up the neurons of our collective consciousness.

Erin Welsh: Ooh I like that. Yeah, exactly, exactly.

Erin Allmann Updyke: You know? Yeah.

Erin Welsh: Just the way it manifests in your body.

Erin Allmann Updyke: Yeah it's very crazy.

Erin Welsh: That's wonderful.

Erin Allmann Updyke: Yeah.

Erin Welsh: Okay, well. All right.

Erin Allmann Updyke: We as always will post all of our links to our sources on our website thispodcastwillkillyou.com. And I'll give a specific shout out to Dr. Thiravat Hemachuda, I think that's their name, who wrote a lot of the articles that I read and who is one of the World Health Organization experts on the rabies committee.

Erin Welsh: Cool. Okay.

Erin Allmann Updyke: I'll post all of the articles.

Erin Welsh: Yeah. I read a couple of books. There's a book called 'Rabid' by Bill Wasik and Monica Murphy and that's a popular science book which is about the history and culture of rabies. And I also took from a book called 'Historical perspectives of rabies in Europe and the Mediterranean Basin'. Finally the information on the evolutionary history of rabies virus I took from an article called 'Host Switching in Lyssavirus History from the Chiroptera to the Carnivora Orders'.

Erin Allmann Updyke: Oh my god, I wanna read that.

Erin Welsh: Yeah it's really interesting.

Erin Allmann Updyke: That sounds so fascinating. Chiroptera are bats, by the way.

Erin Welsh: Yes, yes, thank you. But yeah as always, thank you so much for listening.

Erin Allmann Updyke: Yeah this was really fun.

Erin Welsh: Thanks to Bloodmobile for providing all the music. And you know what? Wash your hands.

Erin Allmann Updyke

Ya filthy animals! (laughs)