Sawbones 538: Tetanus

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Intro (Clint McElroy): *Sawbones* is a show about medical history, and nothing the hosts say should be taken as medical advice or opinion. It's for fun. Can't you just have *fun* for an hour, and not try to diagnose your mystery boil? We think you've earned it. Just sit back, relax, and enjoy a moment of distraction from... that weird growth. You're worth it!

[theme music plays]

Justin: Hello, everybody, and welcome to *Sawbones*, a marital tour of misguided medicine! I'm your cohost, Justin McElroy!

Sydnee: And I'm Sydnee McElroy.

Justin: And, Syd, [chuckles] what a dramatic day we had this week, out in the garden.

Sydnee: I did.

Justin: It was quite a perilous situation out there.

Sydnee: I *did* have a dramatic episode out in the garden. That's the inspiration for this week's episode of *Sawbones*. So I tend to garden barefoot. That's not...

Justin: Not good.

Sydnee: ... good. Don't do that. Don't do that. Even though I do it, you shouldn't do it. And *I* shouldn't do it.

Justin: You have many great boots *just* for this purpose.

Sydnee: I do, but I like to get out in the dirt. I... I know we have talked a lot on this show about how grounding, in the sense of, you know, actually

receiving some sort of electrons from the earth that improve your health— That's not— That's pseudoscience. That's not a real medical concept.

But I think it is fair to say that, for a lot of us, activities like gardening, where you get to dig in the earth... they make you happy, right?

Justin: And it's also fair to say that the Sydnee that hosts *Sawbones* does not need to be the Sydnee that works in the garden. She contains multitudes, folks.

Sydnee: Well, thank you.

Justin: Embrace— Embrace it.

Sydnee: So I was digging in the dirt, digging in my— I was actually preparing my squash box, which is of course my raised bed that is specifically deleg... delecated— [correcting herself] *dedicated*...

Justin: [laughing] Delicate— It's a delecated delicata, delegated— It's delc— It's *dedicated* to delicate delicata...

Sydnee: Mm-hmm.

Justin: [laughs] We've dedicated it...

Sydnee: [amused] Dedicated to delicata squash. And...

Justin: [laughing softly]

Sydnee: ... I had smoothed all of my new soil. It was all prepared for planting, hopefully this weekend. And I stood up, and as I did, I stepped directly on an old, rusty screw that was jutting straight up, out of the box.

The box had— It was a raised bed, and then it fell.

Justin: Tsk...

Sydnee: But then I just used it, 'cause it fell, like, right on the ground, still intact. And so— Anyway, I stepped on a screw. Went right into my foot, my bare foot. My bare foot - which, by the way...

Justin: Did you get the screw out, by the way?

Sydnee: No, it's like...

Justin: Oh, it's part of it.

Sydnee: It's gonna be a *whole* thing.

Justin: It's a whole thing.

Sydnee: It's gonna be a whole thing, to get that screw out. But I had been...

Justin: We're not gonna get the screw out, are we? I'm realizing, right now...

Sydnee: You're gonna have to cut it. Like, you're gonna have to...

Justin: But how do you know where the screw— Like, I mean...

Sydnee: 'Cause it's flattened *under* the box...

Justin: [amused] Is, there, like, a footprint? [laughs]

Sydnee: ... and it's jutting... Oh, no—

Justin: [laughing] Is there a footprint on it?

Sydnee: No, no, no. I know right where it is.

Justin: Okay.

Sydnee: 'Cause it's on the edge of the squash box.

Justin: [laughing] Okay, okay. Alright, got it.

Sydnee: But I had been walking *in* my gardening box, in the soil, as I was... smoothing everything out. So my foot was dirty...

Justin: Yeah.

Sydnee: ... covered in not just, like... Not just I'd been walking in the grass. I mean, like, this was... planting soil. This was potting soil and mulch, and so, like, the stuff...

Justin: Fertilizer.

Sydnee: Right. The stuff you shouldn't walk barefoot in, I'd been walking barefoot in. And then I stepped on a screw. And I immediately...

Justin: It's, like, bred for funkiness. It is like...

Sydnee: Yes.

Justin: Is, like, *engineered* to be as funky [laughing] and full of gunk as possible.

Sydnee: Because the concern here...

Justin: The gunk of life. The life gunk.

Sydnee: The concern here— I wanna go ahead and debunk this myth, right now. Is the concern that the screw I stepped on was rusty?

Justin: Yes. That is the main thing with tetanus, is that if it's a rusty metal, then it can give you tetanus. That's where— The rust gives you the tetanus.

Sydnee: Mm. Okay, no. That is a myth. I was not concerned that it looks rusty...

Justin: *Clearly*, I was setting up— You're welcome, by the way...

Sydnee: [chuckles] You're welcome.

Justin: ... because I can see a trap, and I can walk into it...

Sydnee: Thank you.

Justin: ... just to keep the show moving, you know.

Sydnee: Thank you. No, I think that the idea that specifically— We are talking about tetanus, and that specifically the risk comes with something rusty is usually because it's outside, and it's old.

Justin: Is that so?

Sydnee: Yes.

Justin: Huh.

Sydnee: But it's not the rust itself that's the problem. It's more the idea that this is something that's been outside for a long time, and then has dirt particles that might contain the tetanus...

Justin: [sighs]

Sydnee: ... endospore *in* them. That is the bigger concern.

So *my* concern was not that the screw that I stepped on was rusty. It was that, one, [laughs] I'd been walking in the dirt. Two, the screw was also dirty. Three, it was a deep puncture wound.

Justin: Eugh...

Sydnee: That is— A dirty, deep puncture wound is the concern. And that's where, I think, the "rusty nail" sort of idea gets in your head, but it's not the rust.

Justin: Could you get it from a nonmetallic object?

Sydnee: Any deep, penetrating wound— Oh, yeah. [amused] There are lots of different ways to get tetanus, Justin. Don't worry. [chuckles]

Justin: [sarcastically] Oh, I'm thrilled. Wow, what an exciting episode this is gonna be.

Sydnee: Uh, so...

Justin: [chuckles]

Sydnee: Let me just— And I will preface with this: I am up-to-date on my tetanus shot, as you may imagine. They require that in medicine, and with as much as we talk about vaccines on this show, it would be pretty shocking if I wasn't.

Justin: Yeah.

Sydnee: I *am* up-to-date, but at the tail-end of my 10 years. I'm around on the eight-year-ish kind of area...

Justin: Yeah.

Sydnee: ... and so I got really nervous. [laughs] 'Cause it was a *classic* tetanus-inducing type wound. So—

Justin: You got nervous, but also you just *love* getting vaccines.

Sydnee: I do.

Justin: I mean, you love these things.

Sydnee: I do, and I *will* talk a little bit more, but I had some other rationale for this.

But anyway, I did get a tetanus booster yesterday. My wonderful nurse, Courtney, gave me a booster. My boss, Matt, was nice enough to order it for me.

Justin: [laughs]

Sydnee: So I am... [chuckles] I am still up to date, I am well protected. I'm not concerned that I *got* tetanus, but I can't believe we've never talked about tetanus. It's one of those sort of classic diseases that have been depicted in art and literature throughout time, and so I don't know how we missed this.

Justin: Well, yeah.

Sydnee: It feels weird for us.

Justin: I know that we've mentioned it, um, but...

Sydnee: Yes.

Justin: I glanced off it, but I don't know...

Sydnee: I could not find anywhere in my personal documents, or anywhere on the internet, where we had talked about just tetanus.

The word comes from Greek for "rigid" or "tension," and this is related to the symptoms, which you may already kind of be familiar with, but we're gonna get into. Tetanus is caused by a bacterium, Clostridium tetani... Named for...

Justin: Yeah.

Sydnee: ... the disease that it causes. And it's mainly, as we talked about, something that happens when these endospores— So the tetanus bacteria is this sort of long, rod-shaped thing.

Justin: Okay.

Sydnee: And it can form this little endospore, this hard, hardy, little... thing inside it, that can survive in really extreme conditions. And, like, specifically conditions where there is no air.

Justin: Mm.

Sydnee: So it's an anaerobic bacteria.

Justin: Mm-hmm!

Sydnee: Doesn't want air. And so this is why these deep puncture wounds are the problem, right?

Justin: Okay.

Sydnee: 'Cause it gets— It's deep inside, where there is no air.

But these little endospores are the real issue that we're dealing with, with tetanus, okay? So basically, the endospores thrive in these environments where there is no oxygen, so you step on something— or something gets *in* you, deep in you, somehow... a puncture wound.

And it doesn't have to be metal, it doesn't have to be your foot. It could be in your arm, or leg, or it could be from an animal bite.

Justin: Hmm.

Sydnee: It could be from a sting, like an insect sting.

Justin: Or from the wrestler? ... Sting? Or from the *singer*, Sting?

Sydnee: No. You're not gonna get— I think the odds of you getting tetanus from the singer Sting is pretty low.

Justin: Okay. Fair enough.

Sydnee: Yeah. Um, injection drug use is actually a risk factor...

Justin: Higher than Sting, the singer?

Sydnee: ... for tetanus. Yes. Definitely higher than Sting, the singer.

Um, but it's some way that you're going to get these endospores deep into your tissues, and then they're gonna start reproducing, 'cause there's no oxygen, and they love that.

Um, and so they look like these little drumstick-shaped things when they have the endospore in them. They're rods when it's just the bacterium. When they form that little endospore, they look like a little turkey drumstick.

Justin: So, basically, the way I'm thinking about this is that they— It needs to be implanted...

Sydnee: Yes.

Justin: ... in us to make— find purchase.

Sydnee: Yeah, you're implanting it deep within your— And, again, I think that's the nail thing. 'Cause it's long, and if you step on it, it's a deep puncture wound.

The symptoms are caused by a toxin that is produced by the tetanus bacteria.

Justin: Okay.

Sydnee: Okay? It is— Specifically, it's a neurotoxin, meaning it affects your nervous system. And the way that it does that is it binds on two neurons, which are nerve cells. And it blocks the release of two different kinds of neurotransmitters, GABA and glycine.

Justin: Mm.

Sydnee: To not get too technical, here's the important thing to know. Neurons can cause a muscle to contract and relax, right? Nerve cells— It's like the electrical system for a muscle.

Justin: Mm-hmm.

Sydnee: It innervates the muscle, and causes it to contract and relax.

Justin: Okay.

Sydnee: Squeeze, and release. Right? Tighten, and release.

Justin: Classic.

Sydnee: Um, GABA and glycine can stop a contraction, and cause something to relax. So if you inhibit the inhibitors...

Justin: [amused] Who inhibits the inhibitors?

Sydnee: You're blocking the blockers.

Justin: Okay. [chuckles]

Sydnee: Then, a contraction can't stop.

Justin: Okay.

Sydnee: So what the neurotoxin is doing is, when a muscle action is initiated, it can't stop now, because of this toxin.

Justin: Okay.

Sydnee: This toxin stops the things that stop the con— Which is why you get some, I mean, really impressive muscle spasms and contortions, and why you see the classic depictions of tetanus with someone with their back arched, or sort of bent into an uncomfortable position. Because their nerves can't stop it.

Justin: Mm.

Sydnee: Their nerves cannot stop that muscle contraction that has occurred.

Justin: Mm, okay.

Sydnee: And then the first, I think...

Justin: Like, you lose the brake pedal.

Sydnee: Yeah! Yeah.

Justin: You're just going full speed...

Sydnee: Exactly.

Justin: ... in movement. You're just kind of locked where you're at.

Sydnee: You're locked there.

Justin: Yeah.

Sydnee: Which leads to the first sign, the classic "lockjaw." Trismus, locking of the muscles of the jaw. And then you can get trouble swallowing. Obviously, the muscle spasms... anywhere. The stomach is classic, but I mean, the back can arch. There's muscle stiffness all over the body.

It can lead to seizures, headache, fevers, changes in your autonomic nervous system - so, like, your blood pressure and heart rate can start to be affected.

Justin: What is the...

Sydnee: And it can be deadly, in many cases.

Justin: What is the speed at which this is, like, worsening? Is this, like... I know you said between three and 21 days, but like, how quickly are these symptoms progressing, once they start?

Sydnee: They're progressing pretty quickly. I mean, once— The average is around eight days, that you're gonna have a lot of these symptoms. So, I mean, things can happen pretty fast, which is why it is necessary to get to supportive care pretty quickly, if you begin to develop symptoms of tetanus.

And that really accounts for - and we'll get into this later in the show, but - the differences we see, especially today, in the case fatality rate. Like, how likely are you to die from tetanus?

I mean, certainly there are personal risk factors: your own health and age, and things like that. But it has a lot more to do with how much access you have to supportive care. To, like, an intensive care unit, to a ventilator, to things like that.

Justin: Mm-hmm.

Sydnee: The more access you have to those things, the more likely you are to survive. The less access you have, the less likely, unfortunately, you are to survive.

It can be very hard to get the bacteria from the wound. Most often, they don't. So, like, I don't know if I introduced tetanus into my foot. This is so creepy for me to think about. Um... I don't know if there's tetanus in my foot right now, from stepping on that screw the other day. But it would be really hard, if you stuck a little culture swab up in there, to try to get some of the bacteria...

Justin: Blah!

Sydnee: ... and then grow it...

Justin: That sucks to think about.

Sydnee: It does, 'cause the hole is very tiny. It's deep, but tiny. And so you... Eugh, it would hurt. Anyway...

Justin: Could you swap the— Okay, now let me ask you *this*. Could you swab the nail?

Sydnee: You could, but again, it would be very hard to— It's hard to grow this stuff.

You can. I'm not saying it's impossible. But it's just hard. We don't *usually* diagnose tetanus by growing it in a petri dish.

Justin: Okay.

Sydnee: Like, we do with many other things, right? Like, if you've got a big ol' abscess, which a "boil" is often the colloquial term...

Justin: Mm-hmm.

Sydnee: You got a big ol' abscess. And we make a hole in it, stick a culture swab in there, a little Q-tip, rub it on a petri dish, and grow it. I can probably grow staph, or strep, or whatever's causing that big old boil... pretty easily, okay?

Justin: Mm-hmm.

Sydnee: And that's how I'm gonna not just diagnose you with what bacteria caused this infection, but I'm also gonna test it against a bunch of antibiotics, and be like, "This is the one that works."

We can't always do that, when we see something in medicine. And tetanus is one of those cases where it's a lot harder to do that. So we diagnose it mainly on presentation. On the symptoms, on the history... "Do you have a wound that would make this likely?"

There is a specific test that can be used. You can find, like, a report on it in the *American Journal of Tropical Medicine and Hygiene*. So you can see, this is not... This is not necessarily a test we would do often. I was not trained in this in the US, let me say.

Um, but it's called the Spatula Test. And basically, you're going to use some sort of soft-tipped instrument - you can use a... When they say "spatula," they don't mean a kitchen spatula.

Justin: Mm.

Sydnee: There is a tool that we use in medicine called a spatula that's, like, a little... uh, flat, wooden, thin, and it's kind of... I don't know, shaped like the... Do you see the spatula? Are you looking up a...

Justin: Uhh...

Sydnee: ... a medical spatula?

Justin: Yeah. It's just, like, I mean...

Sydnee: We're taking a long, thin, flat object, and we're poking the back of the throat.

Justin: That's... So are—

Sydnee: That's the spatula test.

Justin: When you— Okay, but when *you* think of "spatula," you're thinking of, like, a wider spatula. In my head, like, I don't think of a spatula— I think of spatulas...

Sydnee: An offset spatula?

Justin: Yes! I was thinking offset spatula, which - it looks closer to an offset... [laughs] It looks closer to—

Sydnee: The metal spatula, yeah.

Justin: Yeah.

Sydnee: And they're a wooden—

Anyway, the point is, you're using an object. You're poking the back of the throat...

Justin: This is not a show about spatulas.

Sydnee: It is not. [chuckles softly]

Justin: But a lot of times, people say "spatula" when they mean, like, a flipper, or a fish turner. That's all I...

Sydnee: Mm-hmm. I gotcha.

Justin: I don't wanna get on a case about it.

Sydnee: So if I...

Justin: Okay.

Sydnee: If I were to do that to you right now, I would expect a gag reflex.

Justin: Okay.

Sydnee: Right? Because...

Justin: Then let's go. [laughs]

Sydnee: If I poke the back of your throat, what we expect to see is an attempt, an involuntary attempt, to push the spatula back out. That's what the gag reflex is.

Justin: Okay.

Sydnee: It's you trying to go, like, "Hey, get out of my mouth!" [laughs]

Justin: But the tetanus would keep that from happening...

Sydnee: You'd clamp down on it.

Justin: Mm! Mm, okay.

Sydnee: That's when you're worried about tetanus, is when they bite down.

Justin: So rather than a— Oh, okay. Interesting.

Sydnee: Yeah.

Justin: Oh, I gotcha.

Sydnee: Yeah. And it's got a high specificity and sensitivity, too, so it's a pretty good test. If you have no idea if somebody has tetanus or not, and you're not really sure, this could be a good test to use.

Justin: So that's fun. You could just walk up to people, and do that. Like, real quick.

Sydnee: [chuckles]

Justin: "Would you like to know if you have tetanus?"

Sydnee: "Here."

Justin: Like, "I can tell you pretty authoritatively."

Sydnee: I wouldn't recommend... doing that.

Justin: Okay.

Sydnee: I mean, without— I mean, obviously you wanna obtain consent.

Justin: For sure.

Sydnee: Before any medical test, or procedure.

Justin: Yes.

Sydnee: Or...

Justin: Anything, really.

Sydnee: Anything. Yeah.

Justin: Anything. Like, that's our policy, and if that's too restrictive, that's fine. [laughs]

Sydnee: [laughs]

Justin: We're okay with being—

Sydnee: We're fine.

Justin: Just, like, get consent for everything. [laughs]

Sydnee: Just be— Yeah, obtain consent for everything.

Justin: [snorts, laughs]

Sydnee: And— [laughs] And especially, like... I mean, like, in this case specifically, I'm saying, "I'm gonna stick this thing in your mouth."

Justin: Yeah.

Sydnee: Like...

Justin: Yeah. Now, I didn't actually feel like it would be a good way to, like, pass the time, to do... It was kind of more of, like, a goof of the show. [laughs] Like, I don't *really* think that we should be...

Sydnee: I feel like... [laughs]

Justin: ... doing random— [amused] random tetanus tests.

Sydnee: No, this is a hard— This really butts up against something, though, that's hard for—

Justin: Should not use the butt. That is not an ideal...

Sydnee: [sighs] No.

That’s hard for our kids to understand. ‘Cause I will say, it is not uncommon for Cooper to walk up to me, and she has something in her hand. And she’s like, “Open your mouth.”

And I’m like...

Both: [simultaneously] “No.”

Sydnee: She’s like, “No, trust me.”

“No, I don’t.”

Justin: No.

Sydnee: “See, I love you very much, but I don’t know what...” And it could be a piece of candy.

Justin: Uh-huh.

Sydnee: And it could be wonderful, or it could be...

Justin: An Oreo with mayonnaise on it.

Sydnee: Yes.

Justin: Which they got me with once, and now they try to do again!

Sydnee: Mm-hmm.

Justin: No, *thank* you. I don’t care! Make boo-boo eyes all you want; I’m not eating another mayonnaise Oreo as long as I live.

Sydnee: Or, *or* it could be that I have COVID, and I can’t— I’ve lost my taste, and I can’t taste anything, and so we think it’s funny to make Mommy drink things that are gross, including, uhh, mouthwash! [laughs]

Justin: Yeah...

Sydnee: Which Mommy couldn't taste, but Mommy felt the burning! [laughs] And said, "Woah, woah, woah!"

Justin: That was a...

Sydnee: "What was in that!?"

Justin: What a— What a challenging time that was. [wheezing laugh]

Sydnee: That was a challenging time! [laughs]

Justin: [through laughter] That was a challenging time, when the kids were making you drink mouthwash, you know?

Sydnee: It was just a tiny bit of mouthwash. I don't want anyone to think I was...

Justin: [bursts out laughing]

Sydnee: I wasn't harmed.

Justin: [through laughter] Our kids are just a tiny bit bad.

Sydnee: No, they didn't know.

Justin: [snorts, laughing]

Sydnee: They didn't know...

Justin: It was a tiny bit.

Sydnee: To be fair, it led to a really great conversation as to why you don't drink mouthwash. [laughs] Why it's dangerous, and please don't do this.

So, Justin, we've kind of gone through tetanus, what it is, and why we're concerned about it. Obviously, these symptoms are very severe, and as I have alluded to, and depending on where and when in history you have gotten this disease, you *can die* from tetanus, and many people have.

Justin: I would rather not.

Sydnee: How long have we known about it?

Justin: At least 80 years.

Sydnee: Longer than that, Justin.

Justin: Okay, 100?

Sydnee: Much longer. You can—

Justin: 200 years.

Sydnee: No. Much longer. I'm gonna let you contemplate that, while we go to the Billing Department.

Justin: It can't be longer than 6,000. I will just say that. Just... it can't. Just think about it, it can't.

Sydnee: This is a science show.

[theme song plays]

[ad break]

Justin: Sydnee, unless I missed my guess, you were alluding before the break that we have known about tetanus for upwards of 300 years. Is that possible?

Sydnee: Much longer. We have known about tetanus...

Justin: *400*!?

Sydnee: ... since ancient times. I think it's another one of those...

Justin: So 800 years. [laughs]

Sydnee: We talk about these diseases sometimes on *Sawbones*, where if something has really obvious, dramatic, clinical presentation - like, signs and symptoms that are very dramatic...

Justin: Yeah.

Sydnee: ... we can kind of trace that history back further. Because even before people were calling it "tetanus," necessarily, and certainly *long* before we knew *why* it happened...

Justin: If memory serves, it's been a while. Like, epilepsy was one of those.

Sydnee: Yes!

Justin: Where, like, that's even one where it's obviously not addressed in an appropriate way, but like, there's allusions to seizures, things like that. Like, even biblically, and stuff like that, it's very...

Sydnee: Exactly. And te—

Justin: Not to say that epilepsy's the only thing that causes seizures, but still.

Sydnee: No. No, but that is a good example, because tetanus similarly can have very dramatic symptoms, and so we've been documenting those symptoms for a very long time. There are some descriptions from ancient Egypt where they talk about— Here's one who has a gaping wound in his head, which has penetrated to the bone and violated the sutures of his skull, who has a toothache, whose mouth is clenched. Who suffers from stiffness in his neck, an ailment for which nothing is done.

This is a patient with lockjaw resulting from a penetrating wound, probably. Probably tetanus. And some of those writings date back to, like, 3000 BCE. So we have very, very ancient writings.

There is some thought— I've found some descriptions, as I was reading about the history of tetanus. There *are* biblical references, possibly...

Justin: Mm. That makes sense.

Sydnee: ... by the way, as you mentioned epilepsy. There are— But, I mean, there gets to be a lot of debate, when it comes to "Is this a biblical reference to this disease?"

Justin: I would guess, though. Even if you're just using... If it was a disease where— I think anything where you lose control of, like, your body, or things like this, where some sort of— It would look like you are being tortured, or something like that. Like, I feel like *that* always gets tied with possession, you know, a lot.

Sydnee: Exactly. And I think, because a lot of those writings are seen through that lens, it can be really hard. I mean, these are not clinical descriptions, right?

Justin: Sure.

Sydnee: And we're not— We don't have, like, a scientist who's trying to, very clearly, document objective truth. Like, "Here is what I'm seeing..."

Justin: Right.

Sydnee: ... without any sort of editorializing. You know, if you have writings that have a *purpose*, if they're trying to convey a spiritual or faith-based understanding of the world, they're probably not going to be an objective...

Justin: Rigor is not your...

Sydnee: Yeah! That's just not the purpose.

Justin: [crosstalk] is not your— Right.

Sydnee: Um, the— We also see Hippocrates wrote a very early description of tetanus, in which he describes the commander of the large ship. The anchor crushed his forefinger, and the bone below it, on the right hand. The inflammation developed, gangrene and fever. He was purged, moderately.

So we get into some of the treatments, by the way, in this description, as well. So it would be very common, in the Hippocratic tradition, because we believed in the four humors, you gotta balance the four humors. And so making someone either puke or poop would be a very common treatment—or pee. Something. Just get *something* out. Bleeding, obviously - just free some of the humors, to balance them out better.

Mild fevers and pain. Part of the finger fell away - oops.

Justin: [laughs]

Sydnee: After the seventh day, [chuckles] a satisfactory serum came out. This was, again, a belief of the time, that if you could irritate a wound, and make stuff come out of it, that this was a good thing. That pus was a good thing - not necessarily.

Um, after that, problems with the tongue. He said he could not articulate everything. So we're starting to see lockjaw, we're starting to see the symptoms of tetanus develop. Prediction made that... [extended pause] opisthotonus... [chuckles]

Justin: [holding back laughter] Really clean.

[laughing]

Sydnee: [amused] I'm having— I should just say, I'm having a lot of trouble pronouncing this word.

Justin: Okay, yeah.

Sydnee: Opisthotonus.

Justin: Okay.

Sydnee: That's, like, the arching of the back.

Justin: Rachel, please leave all of that in. Otherwise, none of this will make any sense. Okay, so it was...

Sydnee: Opisthotonus.

Justin: Op— One more time?

Sydnee: Prediction made that opisthotonus would come.

Justin: [holding back laughter] Why not?

Sydnee: His jaws became fixed together. Then, it went to the neck. On the third day, he was entirely convulsed backwards with sweating. On the sixth day, he died.

So, you see, this is a pretty good description. There you go, like, an objective "Here is the order of events." Um, I like that Hippocrates is like, "Prediction." He's, like, doing the Johnny Carson thing with the envelope.

Justin: Mm-hmm.

Sydnee: Like, he just wants everybody to know what's happening.

Celsus went on to describe— And I think, again, this description tells you why we have so many documentations of this throughout history. He writes, "There is, however, no disease more distressing, and more acute, than that by a sword of rigor of the sinews. Now draws down the head to the shoulder blades, now the chin to the test. Now, stretches of the neck straight and immobile." So you can see...

Justin: Okay! Okay.

Sydnee: ... that's a very distressing— Like, your body being contorted against your will, you're *clearly* in a lot of pain... You can see why *so* many people took the time to write, and draw, and paint these depictions.

Justin: He says there's *no* disease more distressing than this. Like, that's gotta be pretty intense, 'cause I bet a *lot* of stuff was distressing back then. [laughs]

Sydnee: And he writes, "These diseases are often fatal within four days." So there gives you an idea of how fast tetanus can progress. If the patients can survive that, they're no longer in danger, but often they couldn't. And then, they treated with bloodletting.

So these were a lot of the common treatments at the time. In addition to the purging, and the pooping, and the bloodletting, you would try to wrap 'em in oil-soaked cloths, drink strong wines... In ancient China, they might put needles around the patients' ears. That was a common treatment. In the Renaissance era, they would cover you in *manure*, which would be...

Justin: Bad!

Sydnee: ... bad.

But there wasn't necessarily a lot of *progress* made, in terms of "What is tetanus? Why is it happening?" We definitely, by the 19th Century, had this concept that wounds can lead to tetanus.

Now, obviously, there are other ways to get tetanus. But by and large, the association that some sort of wound...

Justin: Right.

Sydnee: ... can then cause these muscle, nervous issues... that was definitely known. And then, as you move into the 1800s, you start to see a lot of, like, battlefield depictions of it, tying it even more closely to somebody who's been wounded.

Justin: Okay.

Sydnee: Right? That makes sense, like...

Justin: Yeah.

Sydnee: You know, because a penetrating wound could often result from some sort of battlefield injury...

Justin: [cheekily] And, as always, war provides such a great laboratory for quickly repeating... [laughs] these sorts of experiments.

Sydnee: Yes.

Justin: [amused] Like, it makes it really easy to trace the last time you were punctured with something.

Sydnee: That's— Justin, you're exactly right. And that's why we have so many medical and surgical developments that come from... the military. That come from the battlefield. And that led to, uh, following the Battle of Waterloo, Scottish physician Sir Charles Bell - yes, *that* Bell...

Justin: Of Bell's postulates?

Sydnee: No. Not postulates.

Justin: Bell's...

Sydnee: Koch was the one with the postulates.

Justin: *Koch* had the postulates. Bell had a palsy.

Sydnee: Bell has a palsy.

Justin: Alright!

Sydnee: Yes, *that* Bell, of palsy fame.

Justin: Thank you.

Sydnee: Dr. Charles— or Sir Charles Bell. Doctor... Sir... Sir Doctor, Charles Bell... Dr. Sir? What do you think he preferred?

Justin: Um...

Sydnee: Dr. or Sir? ... I don't know. Either way. Either way...

Justin: Just [crosstalk], for dinner, right? [laughing hard]

Sydnee: He... He was one of the physicians who was attending to people recovering after the Battle of Waterloo, and he, uh, painted a soldier with tetanus in 1809. And you can look up this... uh, "Opisthotonus" as the title of the painting by Charles Bell...

Justin: Spelled just the way Sydnee's pronouncing it.

Sydnee: [laughs] I had to practice this so many times. This depiction of tetanus, I have seen *so* many times in my medical education.

Justin: Yeah.

Sydnee: Doctors really love when somebody took the time to, like, paint a disease. And then we can be, like, "Look how old this disease is! Here's a soldier."

Justin: Can I say something, though? If you think about it... You could think about— having a depiction like this would actually serve a practical purpose, too, right? Because we didn't have photography.

Sydnee: Mm-hmm.

Justin: The written word is only so good. If you have a very *evocative* way of saying "This is tetanus," that... I have a saying that I came up with that a picture *is* worth a thousand words.

Sydnee: Ooh.

Justin: So...

Sydnee: [sarcastically] That's a really clever saying, Justin. You came up with that?

Justin: And a painting is worth at least 10 times that, because someone had to... do it all, you know?

Sydnee: I know. He had to do it all.

Justin: Yeah.

Sydnee: He had to do this whole painting...

Justin: And the whole painting is—

Sydnee: It's a wonderful depiction of tetanus— That sounds weird to say. I mean, it's not wonderful. I mean, it's sad. The guy looks like he's in pain. But it's a very— *accurate*, how about that? Accurate depiction of tetanus.

Although typically, my patients, when I'm caring for them, aren't naked. So...

Justin: Well, yeah. Maybe that's for the painting. I don't know.

Sydnee: That's probably just for the art part.

Justin: But, that's for the— Well, no. Maybe also, more importantly though, for the, um...

Sydnee: The musculature.

Justin: The musculature, right?

Sydnee: Yeah. To show the rigid...

Justin: Like, to show... yeah.

Sydnee: Yeah. The contracted muscles.

Justin: Mm-hmm.

[amused] Now, what was hard is asking that guy to just not move. [laughs] "Just please stay exactly like that, please."

Sydnee: Well, it probably wasn't hard, Justin, 'cause he couldn't. [laughs]

Justin: Oh, that's true! Yeah. Oh, that's a good point.

Sydnee: Maybe it was just that he made a perfect... subject.

Justin: Yeah. Maybe it's like, "I have to paint you. This... I'm sure this sucks for you, but..."

Sydnee: He was documenting it for medical rigor.

Justin: Yeah.

Sydnee: For the halls of academia. So like I said, there was not a ton of progress made in what we do with it.

Justin: Mm-hmm.

Sydnee: I did read this great account of a physician, Luigi Ferrini, who back in 1838 presented to the Medical Surgical Society of Bologna that he was treating tetanus using electricity. And it would relieve the spasms.

Justin: Mm-hmm.

Sydnee: I found this kind of fascinating, because— I mean, I guess that... that could work, right? Like, if you're counteracting— I mean...

Justin: You're shocking, yeah.

Sydnee: Your nervous system is not— I mean, it's similar. So you're shocking. Like, we know that we can affect the body through shock. That's how we...

Justin: Sometimes we'll [crosstalk] a heart, right?

Sydnee: Right, that's how we try to jumpstart, and restart, and fix the heart, when it's in a series of different electrical malfunctions.

Justin: Also for muscle— like, for pain, and stuff like that...

Sydnee: Mm-hmm.

Justin: ... people use those little shocky things.

Sydnee: Yeah, electric stimulators.

Justin: Yeah.

Sydnee: And we do testing, nerve conduction studies, and electrodes, and...

Anyway, so he's kind of hitting on something, the idea that it has something to do with the nerves. But unfortunately, doing something like that, even if it does relieve a contraction, what he documented is that it only lasted about 30 minutes, and then you're right back into tetanus. But it was very interesting and, probably, helped further elucidate what was happening with tetanus.

Justin: Mm-hmm.

Sydnee: It wasn't until 1884, when Drs. Carle and Rattone did infections where they basically took pus from a person who had had tetanus from the wound, and they injected it into rabbits.

Justin: Mm-hmm.

Sydnee: And the rabbits developed tetanus, and they were able to isolate from these rabbits Clostridium tetani, the bacteria that we knew eventually, you know, caused tetanus. Even at that point, all that they were doing was saying, like, "There's something in here that causes tetanus." It wouldn't be until Arthur Nicolaier looked at that under a microscope, and was able to further elucidate what exactly is this bacteria— I mean, it's like a lot of things. We see this sort of...

Justin: As equipment improves.

Sydnee: ... domino effect.

Justin: Yeah, like our technology— Our understanding gets better...

Sydnee: Mm-hmm.

Justin: And also, the equipment gets better. And so the equipment improves the understanding, and...

Sydnee: Yes.

Justin: Yeah.

Sydnee: We didn't actually isolate the actual agent, so we kept seeing things. We kept being able to transmit things. The actual agent was isolated by a Japanese physician, Dr. Shibasaburō. And he was also, by the way, one of the co-discoverers of the Bubonic Plague.

Justin: Ooh!

Sydnee: Yeah. Along with Alexandre Yersin, which is why it's called Yersinia pestis, by the way.

The point is, this is where— We're into, like, the late 1800s, before we really understand *this* is what causes tetanus. Here it is, we've named it. We know what it is, we know how it happens. We know there's a toxin. What do we do about it?

And in 1890, we see a group of German scientists who are able to produce the first serum that can counteract tetanus toxins. And the way we do that is, if we have somebody with tetanus, we can take some of the serum from their blood, and isolate the things that are counteracting...

Justin: What serum, again?

Sydnee: The part of the blood. Like, if you separate out the cells, the rest of the stuff, the plasma, the stuff that's in the blood that isn't, like, the red blood cells, and all the other cells.

We're looking for all the other things that are floating around in there, so if you have somebody with tetanus, you can find antibodies against it, right? Or antitoxins, in this case. Things that are fighting the Texas... the tetanus— Not the Texas toxin.

Justin: Texas toxin!

Sydnee: The Texas toxin...

Justin: That's what they always called tetanus...

Sydnee: [chuckles]

Justin: ... the Texas toxin.

Sydnee: And that was— for a while, like, if we looked to World War I, again a lot of people developed tetanus as a result of battlefield wounds. You see a lot of people treated with this passive antitoxin.

So basically, we found it in humans, and so then we started injecting tetanus into horses. And then getting serum from the horses with the antitoxin in it that they naturally developed, because they were exposed to it. And then giving that serum to people who were infected with tetanus.

Does that make sense?

Justin: Yeah!

Sydnee: As a way of— and I will say, today, even though this isn't something where I'm gonna get from a horse, we can treat somebody with tetanus antitoxin, IVIG, so IV immunoglobulins against tetanus, that could be a treatment.

So let's say that I had been, especially with the wound that *I* got the other day... If I had not been vaccinated against tetanus *ever*, so I was completely non-immune...

Justin: Mm-hmm.

Sydnee: ... and I waited longer, I might have gone to the ER, and said, like, "This happened to me." And they may have given me tetanus IVIG, which is very similar to what they were doing back in World War I.

Justin: Huh!

Sydnee: But again, this is sort of a reactive thing. We're not *preventing* tetanus, at this point. That wouldn't be until we found a way to isolate just the toxin, the tetanus neurotoxin...

Justin: Mm-hmm.

Sydnee: ... that causes the problems. And inactivate it, creating a toxoid...

Justin: Great word.

Sydnee: Yeah. With formaldehyde. So we take the toxin, we inactivate it with formaldehyde, we create the toxoid, and the toxoid vaccine is what we still use to this day.

Justin: Amazing.

Sydnee: Yes! And that was, uh, in 1923, by Dr. Ramon.

Justin: Um... Okay. Just, uh... Okay, I thought as much. It looks like Toxoids are in *Metal Heroes*, and uh, *Stellaris*. And *World of Warcraft* has a character named Toxoid. I just want to make sure that the word "toxoid," enough people had heard that and thought, "I'm gonna name something Toxoid."

Sydnee: That's a good one.

Justin: But yes, a *lot* of things have been named Toxoid. Thank you, human race, you rule.

Sydnee: And it really— like, after we introduce this vaccine... And we see a lot more studies to refine it. Like, it has an aluminum adjuvant in it, and the reason is because it's much more effective.

Justin: Yeah.

Sydnee: And it is completely safe. So when you hear about things like, "There's aluminum in a vaccine," it's because it makes the vaccine work better, and because we've also done extensive trials to say that putting aluminum in a vaccine in tiny amounts is safe, and makes it work better, and protects you from getting tetanus.

Justin: There's also iron in your Wheaties! Calm down!

Sydnee: [laughs]

In 1948, we first put the tetanus vaccine in a combined vaccine with diphtheria toxoid and pertussis for whooping cough.

Justin: Tdap.

Sydnee: Yep. The Tdap, or DTaP, um, related to those...

Justin: Why?

Sydnee: I'm gonna tell ya. Hold on.

Justin: [laughs] Okay.

Sydnee: Uh, we introduced them into routine childhood vaccines in the late '40s. At that time, there were between 500 and 600 cases in the US each year, okay?

Justin: True.

Sydnee: After the ‘40s, we saw them drop precipitously because, you know, vaccines. There were about 50 to 100 cases by the mid-‘70s, and as of last year, there were about 30 cases. There were about 15, the year previous.

So you can see, very few cases in the US at this point. At this time of recording - I feel like things change so quickly - every state still requires children to receive their series of DTaPs, which included tetanus...

Justin: [amused] As of April 25th 2025.

Sydnee: Right. But we can see that not only have we watched *cases* of tetanus drop precipitously, but we are much better at managing it now. In 2018, we had 23 cases, and no deaths. We have very few deaths from tetanus now.

In the US, because we do— In most places, not all. But in most places, you *do* have the availability of an intensive care unit, a ventilator, supportive medications, and all the things that we do to help manage tetanus. The fatality rate is 10% or lower.

Justin: What—

Sydnee: In other parts of the world, I just should clarify, it can be much higher. It depends on if you can access those supportive, you know, resources from healthcare *while* your body is going through, sort of, the height...

Justin: How long do you have to, like, get— ‘Cause you obviously got your shot the day after you got the wound. What’s, like, the countdown?

Sydnee: It’s recommended that if you need a booster— If you get a wound like that, and you need a booster, it’s recommended you get it within the first 48 hours. Now, I will say, we have up to 21 days following an exposure to give you the vaccine or the IVIG. We have a *long*...

Justin: But once the symptoms have set in...

Sydnee: It takes a long time for things to develop. But once the *symptoms* develop, you need to get to the hospital, because you're probably gonna require some amount of supportive care to get you through this. Um, which we are capable of doing in many, many— *most* cases, but not all.

And, certainly, in other parts of the world where you don't have easy access to an ICU, we see a higher fatality rate because of that.

Justin: Mm.

Sydnee: The most important thing you can *do* is get your tetanus vaccines, your toxoid vaccines, on the recommended schedule.

So Justin, you asked specifically: in kids, they get the DTaP. This has to do with, um, how much of different things are in there.

Justin: Okay.

Sydnee: Diphtheria, tetanus, acellular pertussis. That's what DTaP stands for. And in children, the DTaP is what they get. So at two months, four months, six months, you get another booster at 15 through 18 months, and another booster four to six years, okay?

Justin: Yeah.

Sydnee: That's when the DTaP comes into play. Now, for all of us adults and preteens, so you're gonna get a Tdap. At 11 or 12, you're gonna get your first Tdap, and then from then, it's every 10 years you can either get a Tdap, or a Td, which is just tetanus-diphtheria.

Justin: Mm-hmm.

Sydnee: Now, why am I suggesting that a Tdap is what I wanted, and what I received?

Justin: I dunno.

Sydnee: On a side note, pertussis is part of the Tdap, as we've discussed, right?

Justin: Mm-hmm.

Sydnee: And the, uh, pertussis, which is whooping cough, we've done an episode on pretty recently. The immunity to pertussis, even though we still say you should get your Tdap every 10 years... the immunity to pertussis may wane sooner.

Justin: Mm-hmm.

Sydnee: To tetanus, it's pretty good at 10. It's gonna last you those 10 years, probably.

Justin: Mm-hmm.

Sydnee: For pertussis, there's a little more variability, and your immunity to whooping cough may be gone as early as five years. You may last up to that 10 years, but it may be five years.

Justin: Mm.

Sydnee: There are currently outbreaks of whooping cough in many places in the country. Specifically, there's been one in West Virginia. I had already been debating, since I was coming up on my 10 years and I was getting closer, should I just go ahead and get that Tdap booster a little early for the pertussis component? Obviously, this puncture wound tipped me over the edge, and said, "Just go ahead, and get the Tdap."

For me, every 10 years, I'm gonna keep getting the *Tdap*, and keep that pertussis booster in there. Because we are seeing more and more cases of whooping cough.

Justin: Mm-hmm.

Sydnee: And while it certainly does not have the fatality rate that *tetanus* does, by any stretch, *I'd* rather not get whooping cough, and I certainly

don’t wanna communicate it to somebody who may be more medically vulnerable than myself to something like that.

Justin: Mm-hmm.

Sydnee: *So*, if you are not sure, if you get a puncture wound and you don’t know when your last tetanus booster was, it is safe to go get one. If it’s been too— I have received tetanus boosters early multiple times because of pregnancy.

Justin: Mm-hmm.

Sydnee: That is safe to do. If you go to the ER, and they say, “We think you need a tetanus shot. Have you had one within the last 10 years?” and you have no idea... It is safe to opt and get a tetanus booster.

Now, obviously, if you have concerns, ask your healthcare provider. If you have allergies to certain vaccine components, *please* discuss that with your healthcare provider. There are reasons, at times, why people are allergic and can’t get the Tdap.

Justin: Mm-hmm.

Sydnee: And so, certainly, I’m not advising you to, if you’re allergic to it.

Justin: Good call, yeah. I agree.

Sydnee: Yeah. Don’t take things, or receive things that you are allergic to.

Justin: We’ve been very consistent about that [laughs] here on *Sawbones*.

Sydnee: Um, but it is definitely something— And I will say, people who are pregnant also get the Tdap vaccine. Again, for the whooping cough component, but that’s a nice little boost, that you also get your tetanus in the same shot!

So that’s the most important thing: you don’t have to get tetanus. The vast majority of people who *do* get tetanus are because they either were not

immune to tetanus, they never got a vaccine, or they have fallen behind on their immunization schedule.

Justin: Thank you, Sydnee, for that update. And thank you for staying up to date on your boosters. As somebody who really relies on you every day, I'm happy you're taking care of yourself.

Sydnee: Aw. No problem, Justin. I *really*, I really don't wanna get— It does look very dramatic, you know?

Justin: Yeah, but probably not worth it.

Sydnee: And I do like drama, but...

Justin: Easier ways to get attention, for sure.

Sydnee: Yeah, but I would rather get attention in a more positive way.

Justin: Thank you so much for listening to this program.

May 3rd is coming up very soon. We're going to be at the Harmony House Ren Faire. It's at Harris Riverfront Park. You can get tickets at bit.ly/harmonyhouserenfaire with an E. You can go there and get tickets.

We're gonna be doing a live *Sawbones*, we're going to be doing some signings for *The Adventure Zone*. And for all the information, go to bit.ly/harmonyhouserenfaire, get tickets. It's gonna be a lot of fun.

Sydnee: Yeah. It's gonna be so much fun. Please, everybody, if you can, come. I mean, it's gonna be such a big event. My mom is organizing it, and it's gonna be... quite the to do.

Justin: Thanks to The Taxpayers for the use of their song, "Medicines," as the intro and outro of our program. And thanks to you for listening!

That's gonna do it. Until next time, my name is Justin McElroy.

Sydnee: I'm Sydnee McElroy.

Justin: And as always, don’t drill a hole in your head!

[theme song plays]

[acoustic sting]

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