Sawbones 309: Body Temperature

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Clint: 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 co-host, Justin McElroy.

Sydnee: And I'm Sydnee McElroy.

Justin: Y'know, Syd, there's certain constants in life that you tend to depend on.

Sydnee: Consonants? Like in the alphabet?

Justin: Yeah, like Q, and…

Sydnee: S. I like that one.

Justin: S is a good one. Lot of S's out there. Have you been seeing this? Lot of S's.

Sydnee: All the S's?

Justin: Yeah. No. Constants. That you depend on. Things in the universe, y'know, the sun rises in the east and sets in the west, et cetera.

Sydnee: Like Desmond.

Justin: Like Desmond. A constant. Yes. Exactly. Lost humor. A decade too late.

Sydnee: There's somebody out there who appreciated that. [laughs] There are two people who are loving this right now.

Justin: But uh, in medicine, which is always evolving, there's constants you rely on. And uh, but recently, one of those has been upended, you were telling me.

Sydnee: Yes, that's true. You've probably seen… there's been a lot of articles in the news recently that… We have certain things that we always know to be true about the human body. There's so much we don't know, and we talk about that a lot on the show, that there's so many things that we still sort of understand, but not really.

But we have relied on the fact that the inside of your mouth is a steamy 98.6 degrees. What commercial is that from? Like a gum one?

Justin: I don't know. Probably.

Sydnee: [laughing] Anyway. We have relied on the idea that that is the human body temperature. 98.6 degrees Fahrenheit, 37 degrees Celsius, in case you're a fan of Celsius.

Justin: I always remember it with the band, 98 Degrees, and six degrees of Kevin Bacon. So, 98 degrees, and six degrees, and then 98.6.

Sydnee: You can't just remember…

Justin: That's the ones together.

Sydnee: Uh, or 37.

Justin: [sighs] H'okay. Here she goes, folks. First she wants to socialize medicine, and now she wants to bring metric into it.

Sydnee: Uh, I don't think I'm alone in that. But, we've always relied on that being true, and from that stems a lot of like, what—when is your temperature too low, and when is your temperature too high, and what is a fever? And now, here—all these articles are out there that are calling that into question.

And so, we've had a lot of people, uh, tweeting and posting on our Facebook page and emailing to ask, is this true? What do we do? How do we react? Everything is so frightening right now. It's 2020.

Justin: Sure. Trying time for us all.

Sydnee: We cannot rely on anything anymore. Um, what do we do? Even in the—some of the doctor groups I'm in, there's been like… there's been a lot of upheaval. What do we do with this information?

Justin: Well, you—

Sydnee: How do we interpret it for our patients?

Justin: It's either that or talk about sports, so I'm assuming there's… kind of default to the…

Sydnee: We usually… talk about doctor stuff, but…

Justin: Yeah, I assumed.

Sydnee: Okay. Sure. Uh, thank you to Annie and Erica and Jordan and Lena for emailing about it. I know a lot of other people have tweeted and such, but I always check the emails. That's where I get the… in case I don't thank you for a tweet, that's why. Anyway.

Uh, we have discussed—

Justin: Now, by the way, that email is Sawbones@MaximumFun.org. We don't say it a lot. That's what it is.

Sydnee: That’s true. We should say it. We should say it more.

We have talked about fevers before. We've done a whole episode on fevers and what they mean, what their use is, what their purpose could be in the human body, and the use of a fever as medicine. But we never really dove into, where did we come up? How did we have a body—why do we know what our body temperature should be? Where did we get that information? Who figured that out the first time and wrote that down, and why has that become such a… kind of a law?

Justin: Mm-hmm.

Sydnee: That extends beyond medicine as just like, common knowledge.

Justin: Right.

Sydnee: And of course, in addition, if things are changing, what will that mean? What does that mean for us?

So, before we used thermometers, before there were thermometers, we measured temperature – in medicine, anyway – by, well, y'know, the way… probably your parent has checked your temperature before.

Justin: Up the butt!

Sydnee: What?

Justin: Puttin’ the thermometer up the butt, right?

Sydnee: No, this is before thermometers.

Justin: Oh.

Sydnee: Justin.

Justin: Oh. Hand on the head, then.

Sydnee: Mm-hmm.

Justin: Got it. I thought you meant before, like, digital. 'Cause you can't put the digital ones in your butt, I don't think. [snorts]

Sydnee: Um…

Justin: [trying not to laugh]

Sydnee: Okay. What—how many—how long are we gonna talk about rectal thermometers in this episode?

Justin: I don't know. You're the first one to mention them, so if there's a scoreboard, it's Sydnee one, Justin zero.

Sydnee: We—we tend to measure temperature, when we don't have a thermometer, or before humans had them, by touching someone and seeing if they feel hot. Which is still the way my mother insists on doing it, because she refuses to own a thermometer.

Justin: To own a thermometer, folks. We've brought them to their house, and they just disappear. It's wild.

Sydnee: Because she can tell, if she touches you, if you have a fever or not.

Justin: She's a human thermometer.

Sydnee: On a side note, we actually, specifically, in studies that have looked at maternal figures, maternal temperature measurement… we aren't terrible at this.

Justin: Okay.

Sydnee: Like, humans aren't actually as bad as you'd think at telling if someone has a fever just from touching them. There've been studies on this. Multiple studies throughout the decades, ever since the '50s, where we have, largely based on the idea of a mom feeling a child and trying to tell if they're febrile or not.

But uh, they did a meta-analysis of ten of the most well-done studies in 2008. It encompassed 3,694 children. And what they found is that the sensitivity of diagnosing a fever based on touch, based on… and again, a lot of these studies were a mom feeling their child to see if they thought they had a fever… ranged from 70 to 97%.

What this—and the—that's different, by the way, from the specificity, which was a lot wider. 19 to 90%. And let me break that down. What that means is that we are pretty good at ruling out a fever. I'll include myself as a maternal unit myself. We are pretty good, about 89% good at touching a kid and saying, "No, there's not a fever here." But when it comes to ruling *in* a fever… is this indeed—does this kid have a fever, we're about 50/50.

Justin: Okay.

Sydnee: So I thought that was very interesting.

Justin: Probably because of the range, right? Between like, febrile and normal. Right?

Sydnee: Yes.

Justin: You can tell if it's above normal, but not… necessarily febrile or not.

Sydnee: Mm-hmm. And also, we are pretty good at feeling a kid and going, "Nah, this kid is not—does not have a fever." So I thought that was pretty interesting, that actually, maternal touch is not completely… and I think you could extrapolate that to paternal touch, or parental touch, or guardian touch.

Justin: Yeah, why is it a gendered study? Yeah.

Sydnee: Well, these studies… they date back to the '50s, and so, I think a lot of them just…

Justin: Makes sense.

Sydnee: Yeah. Focused on that relationship. But um, but certainly, I think you could extrapolate that to…

Justin: In the '50s, it was illegal for dads to check their kids' temperature.

Sydnee: You could probably extrapolate that not just to children, but to people touching, y'know, to adults touching each other to see if they have fevers. But anyway.

Um, a thermometer is preferable. Especially if you're trying to make like, a big, major, "Do I go to the ER or not?" kind of decision. I'd say a thermometer is a better way to do that than touching someone's forehead. Which, if you're gonna do it, use the back of your hand, please.

Justin: Why?

Sydnee: You get a better, more accurate feel.

Justin: Okay.

Sydnee: But get a thermometer.

Justin: Just buy a thermometer. Yeah.

Sydnee: Uh, so, the idea that we should use a device to measure temperature is obviously a very old one, because its uses expand far beyond medicine, right? Like, that's not the only time we need to measure the temperature of something. It's when it's a human body. There are lots of situations in which knowing the temperature of anything…

Justin: I mean, candy making. Right there.

Sydnee: There you go. Cooking meat.

Justin: Good. Yes. Important.

Sydnee: Mm-hmm.

Justin: I'd rather have well-cooked meat than underdone candy, I guess.

Sydnee: I'm certain there are many industrial examples that we would nod approvingly.

Justin: Imagine, in this case, we're noting some of those that we're aware of.

Sydnee: Uh, and the idea that you could maybe use the expansion and contraction of a substance, as that relates to temperature, in order to like, define an amount of heat. Right? Like, something expanding and contracting when it's heated and cooled, to tell you how hot or cold it is. Um, that idea dates back to ancient Greece.

And you see, throughout history, all these attempts by different scientists to try to construct something that would accurately do this every time, and would give you precise results so that you could repeat it over and over. This water is always this temperature, no matter how many times I dip this thermometer in it.

A lot of these were made using water and air, and you can find all different— I mean, like, Galileo had a version of a thermometer of sorts. A thermoscope, really. Santorio, Ferdinando de Medici… There are all these different scientists who created these devices. But they weren't standardized. There was no scale yet. Like, what did that amount of heat mean? There was no…

Justin: I'unno.

Sydnee: There was no Fahrenheit yet, to name it, so… [laughs]

Justin: There was like, 'very hot,' 'too hot,' 'not hot enough.'

Sydnee: Yeah. So, there was no scale, it wasn't standardized, and they mixed, uh… because they were using like, air and water in a lot of these devices, they actually, uh—pressure would also influence the movement inside the devices. So it was both a barometer, and what we would call probably a thermoscope. So, these were not really great at measuring just temperature yet.

There was one that was made with brandy that solved for this a little bit. But we still don't see, uh, a more reliable thermometer until 1714, when Daniel Fahrenheit makes one using mercury. And that's when we start to see a device that can be used, y'know, more precisely.

Justin: What are the odds, by the way, that a guy named Daniel Fahrenheit would make a thermometer? That is wild. That goes to show you, folks. You never know.

Sydnee: Well… I mean…

Justin: Fate. Mystery. It's all out there.

Sydnee: Well. I mean.

Justin: Weird.

Sydnee: [laughs] In the years that foll—we're just gonna let that go. In the years that followed, physicians started using these devices in clinical practice. Started to get the idea that we know… that we already had the concept of a fever, right? And it took—and we talk about in the fever episode, it took us a long time to figure out that fever is a symptom and not a disease in and of itself. But we understood that it was associated with a disease state.

Justin: Sure, right.

Sydnee: And so, we saw some utility in trying to accurately tell if someone's temperature was elevated or not. And so, thermometers entered medical practice.

Boerhaave was the first one to use it regularly in clinical practice. You may remember him.

Justin: [laughs quietly] Might I?

Sydnee: Uh, of ruptured esophagus fame.

Justin: Oh my my my.

Sydnee: Boerhaave syndrome.

Justin: *That* Boerhaave? You don't say.

Sydnee: When your esophagus ruptures, that's what we call it. For that Boerhaave. I—these—there—there are a handful of medical professionals who email me after things like this on our episodes that really appreciate it. You know who you are. These jokes are for you.

Justin: Yes. I hope those emails come with free coupons to the asthma store.

Sydnee: [laughs] Anyway. They're the same ones that were very excited when I talked about ringer in the lactation—ringers. Lactated Ringers. Anyway.

It is important, uh, to note that these thermometers were not easy to use, when we're talking about patients. It's one thing if you're dipping it into a vat of like, candy that you're making, right? Like, the candy… you don't have to ask it to hold still or anything. It's just there. You can kind of probably attach it to something. You don't even have to hold it.

Uh, but these—these instruments could be up to a foot long. They were anywhere from like, nine to 12 inches long, and they took about 20 minutes to register a temperature.

Justin: Dang. That's a long time to hold your butt still.

Sydnee: And you had to—[laughing] We were usually puttin' it under the arm. An axillary temperature.

Justin: Oh, okay. That's less accurate, right?

Sydnee: Yes. Uh, tends to measure lower. And you had to hold it—like I said, you had to hold it there for about 20 minutes, and you had to read it in its position. Like, you had to keep it—it wasn't something where you could like, take it out and look at it. As soon as you took it out, it would start to change, so you had to read it wherever…

Justin: Right in the armpit. Get right in there.

Sydnee: Well, it was just—I mean, it was a cumbersome device to use.

Justin: I feel like mercury thermometers, by the way, are the thing—one of the things that like, separate us from the current generation of young people. Like, I feel like if you had to… I have such unpleasant memories of having to hold this gross, glass tube underneath my tongue for extended periods of time. Do they still sell them? Can I buy them on Amazon right now?

Sydnee: Oh, I'm sure you can. I'm sure you can.

Justin: They haven't just completely done away with them?

Sydnee: No.

Justin: I—yeah. I guess you can. I guess you can still get one.

Sydnee: Yeah, you can still get them. We don't—I have never used one like, in an office, or…

Justin: Clinical… yeah.

Sydnee: Yeah, hospital setting. Um, because now, we just all use the various digital varieties. But uh, so…

Justin: Looks like mercury is not as popular anymore. Even the liquid and glass ones are… looks like there's less mercury out there.

Sydnee: Well, although most people aren't going to accidentally break them… you can.

Justin: Sure. That was always my fear, that I'd bite it in half and drink a bunch of mercury.

Sydnee: I do not think you were the only child that had that fear.

Justin: Okay, good. Good to know.

Sydnee: [laughs] So, these devices that I'm describing are the ones that Carl Reinhold August Wunderlich, I want to say… probably the—listen to it. I think I'm saying it right.

Justin: Okay.

Sydnee: … would use—

Justin: It doesn't sound like you want to say it. It sounds like you don't want to say. It sounds like you want to call him Carl.

Sydnee: I want to call him Dr. Carl. No. Wunderlich is what I would, in my American English, say. Uh, would use to conduct his landmark study on, what is the temperature of a human?

Justin: What temperature are we?

Sydnee: And Dr. Wunderlich, he was a German physician from the mid-1800s. And like I said, he wasn't the first one to use a thermometer in clinical practice, but he was one of the first ones to uh, say, well, I mean, this is cool we can do this, but what do these numbers mean? We don't have any kind of standard. Like, what's the reference? Your temperature's 99. Okay. Next. Y'know, what do we do with that information?

Justin: What do we do with that information?

Sydnee: So he was the first one to put all that together. Uh, so, some things about this physician, so that we kind of know what kind of… what kind of fella he was. He practiced internal medicine, and psychiatry, and he wrote in defense—even before his kind of landmark work, the thing he is most well-known for, I would say, is this temperature stuff we're gonna talk about. Even before then, he wrote in defense of the scientific method a lot. Which, I mean, I like.

Justin: Yeah. It's weird that he has to do that, but I guess that's the 1800s for ya.

Sydnee: At this point in medicine… it's really interesting. It was kind of a crossroads for the practice of medicine, in terms of, should we be more philosophical in our approach to medicine? Which is how doctors had practiced since the beginning of history. Uh, and kind of like, diseases and diagnoses and treatments should fit into these like, high-minded kind of theoretical views about the human body and the human psyche and like, our place on earth, and all these things.

Justin: More art versus science.

Sydnee: Right. Or should we just, like, study things, figure out what works, and do that? And he was a strong believer in introducing the scientific method to medical practice, which does not sound like it should be…

Justin: Revolutionary. [laughs]

Sydnee: Controversial.

Justin: Yeah, right.

Sydnee: Uh, but was. And he, like I said, wrote articles begging other doctors, like, "Could we do this science-like? Could we be scientists please? Thank you." And one of the ways in which he sought to improve medicine as a science was by using… y'know, standardized devices to measure and record things. To observe and record. That's part of scientific method, right?

So, he used the thermometer to standardize what our understanding of a normal human body temperature is, in order for us to further define what an abnormal human body temperature is. And he did this by measuring lots and lots and lots… of temperatures.

Justin: Everybody's got a temperature. Everybody's got…

Sydnee: That's true.

Justin: Five minutes. Or however long.

Sydnee: 20 minutes.

Justin: 20 minutes still in this period.

Sydnee: 20 minutes. That's the thing. That's the thing you have to remember. So, when he collected all this data that he would eventually publish, uh, he was using one of these, um… there's one in the Mütter Museum you can look at now, if you are interested, in Philadelphia. They have one of his actual thermometers that he used. Um, obviously, there was more than one.

Justin: [snorts] Gross. Yeah.

Sydnee: The one they have on display, I think, is like nine inches long. But the instruments could be anywhere from nine to 12 inches. They would

measure—they would try to measure every patient twice a day. Like I said, these were axillary, so under the armpit temperatures, and about 20 minutes a pop for these measurements taken while they were in position.

So, a cumbersome process to collect all this data. Uh, because he did this for about 25,000 patients.

Justin: Wow.

Sydnee: So a lot, a lot, a lot of data. Um, I mean, really, if you start thinking about, for anyone out there who does like, data analysis, statistical analysis… how many numbers he was compiling with paper and pen. I mean, that's—

Justin: That's wild. Yeah.

Sydnee: That's how he was doing this. He was just writing all this down. And so, he collected all this data. And in 1868, he published his work on the subject, uh, that literally, translated from the German, was "The Behavior of Self-Heat and Disease," or, when it was published in English, "On the Temperature and Diseases: A Manual of Medical Thermometry."

Um, and in this landmark work, published in 1868, he defined a normal human body temperature as 98.6 degrees Fahrenheit, or 37 degrees Celsius. And in addition, he made some other… y'know, there were a lot of observations about human temperature. This is the most well-known, but he also noted that our temperatures tend to be lower in the morning. So like, your body will hit its low between two and eight AM, and it will be higher in the evening, so sometime between four and nine PM, your body temperature is the highest.

Generally speaking, he found that, uh, women had higher body temperatures than men. He also thought that women's temperatures could fluctuate more readily. Uh, and old people tend to have lower temperatures than younger people. He also, within this work, defined a fever as a temperature of 100.4 Fahrenheit, or 38 degrees Celsius. This is how old that definition is.

Justin: I wonder how he did the second one. The first one makes sense, it's just averages. But the second one seems like… you're kind of making a little bit more of a… I mean, your own sort of distinction, there.

Sydnee: It's a centigrade higher than normal.

Justin: It makes more sense… it all—it's all so much easier to keep track of.

Sydnee: If you—yeah. If you go with Celsius. Yeah. Yeah. So… [laughs]

Justin: Celsius is metric, right? I don't have that wrong, do I?

Sydnee: No, it's metric.

Justin: It's metric. Okay, good.

Sydnee: Yeah, it's—so, 37 is normal, 38 is a fever. That's… according to Wunderlich and this study, from 1816, that uh… and this definition, as I said in the fever episode, exists today. This is still what we are teaching, maybe at this very moment, in medical schools across the country. Across the world. 100.4, or 38, depending on where you are.

Justin: So how did it all get messed up?

Sydnee: Well, I want to dig into all this data to help us understand why this is in question. But before we do that… let's go to the billing department.

Justin: Let's go.

[theme music plays]

[ad break]

Justin: Alright, so how did we continue to look at this data that is way older than I thought it would be?

Sydnee: Yes. So, there are obviously some issues that I've already kind of eluded to, that you may—if you were someone like me who, every time I—every time I read a study, I start trying to look for holes in it. [laughs] Not because I'm a skeptic, but because I want to make sure that I can believe all the data that's being presented, and the conclusions that are being presented. And the stuff that is in there actually leads to the conclusions at the end of the paper.

Justin: Right.

Sydnee: That's important to know. And uh, and there are some issues. First of all, of course, axillary temps are not—

Justin: What's that?

Sydnee: The um, axilla. Taking a temperature under the armpit.

Justin: Okay.

Sydnee: Is not the preferred method. So already, my doctor mind was going, "Well, that's not the best way you should take a temperature." But if I'm doing this episode because there's data that shows, perhaps, the human body temperature is actually lower than we suspected, uh… then, the axillary temperature should've been lower, not higher.

Justin: Right.

Sydnee: So already, this is thrown off a little bit. Um, reading the device twice a day, 20 minutes in place… I mean, it was all very cumbersome to collect that data.

Justin: But you would assume that 25,000 people, that would equal… equalize, with that many different…

Sydnee: You would assume. Now, he did have a fairly large margin of error. He felt that half a degree centigrade, or point nine Fahrenheit wiggle room…

Justin: Considerable.

Sydnee: … was allowable. Yes! That is a considerable amount of wiggle room, when we start talking about the, like, what we think that the human body temperature actually is. I mean, we're not talking about giant fluctuations, necessarily, in terms of like, sheer numbers. It's, what does it mean, that's more compelling.

But there's also, as I said, a statistical point to be made. How do you analyze 25,000 patients' worth of data without a computer?

Justin: Hmm. Just hard to do the actual math.

Sydnee: I mean, I'm not saying you can't. Of course, people did. Of course, people functioned before computers.

Justin: Sure.

Sydnee: But it's a lot harder to decide, uh, do I have a representative sample? Am I making sure… I mean, he was checking both sick and healthy people. Randomly. How can he make sure that he got an even split of genders, that he got an even split of ages, that he got an even split of healthy and sick people of different times of day, of different… y'know, things like, um, throughout a menstrual cycle that can influence temperature or pregnant or not pregnant. All these different things that can influence a body temperature. How do we know that he got an even split and a representative sample?

Those are hard—that's hard analysis to do without pencil and paper. And especially, at this point history. So, all the ways that we analyze data, when we collect a ton of numbers and then try to make conclusions from them… a lot of those statistical methods of analysis had really become set in place in the 1830s. We're not that far out from then at this point.

And so, the idea that they would be in widespread, easy use by, y'know, Wunderlich and all of his researchers that he must've had working with him… I mean, he couldn't have done all this alone.

Justin: That's a lot of armpits for one guy.

Sydnee: [laughs] This would be very difficult to do. And again, that's not me saying it's impossible. Clearly, people collected and analyzed data before they had a computer to do it. But it would've been quite a challenge, and the idea that there is error in those numbers is not wild to think.

Justin: Sure.

Sydnee: It's not a stretch to say, "Eh, well, maybe the results aren't quite as reliable as we thought." Um, which is why… by… I mean, really by the 1980s, people were starting to ask, "Did we get this right?"

Justin: Mm-hmm.

Sydnee: "Is this really… is 98.6 really the average body temperature? Is 100.4 really a fever? Should we really trust this data, or maybe, since it's been a while, should we…"

Justin: Check again.

Sydnee: Check again. [laughs]

Justin: Let's just check again.

Sydnee: And I think it's interesting. Because he was so committed to the scientific method, and because he really did try to do the best he could with the tools and the instruments he had of the day, a lot of researchers were kind of daunted by the number of participants they'd have to have in a study to confirm or deny the results.

Justin: Right.

Sydnee: I mean, he did 25,000 patients.

Justin: That's a lot.

Sydnee: That's a lot! That's a lot of people! And so, a lot of researchers were kind of reluctant to tackle this. Um, so, we start to see smaller studies to try to reproduce these results. Back in the '90s is when you first start to see people saying like, "Well, what's an easy place to start? I mean, let's take some temperatures and average them out, and see what we're getting." And smaller groups of studies seem to indicate that, eh, maybe 98.6 isn't completely accurate.

And so, the first thought was, well, maybe it was the instrument. Maybe thermometers were different. Maybe they're better now. I mean, certainly, they're better now. So, why don't we get that, uh, thermometer from the Mütter Museum and check it out?

Justin: How?

Sydnee: Well, we just get it, and we measure some stuff with it. And we use a modern thermometer next to it.

Justin: Yeah, that makes sense.

Sydnee: Yeah, right? And see how accurate it is.

Justin: Yeah. I guess, though, I would worry that like, something has cha— I mean, it's very old at this point, right? It's a very old thermometer. I would worry that like, something could've… changed about the thermometer itself.

Sydnee: Hmm. What could've changed, Justin? What would it have been made of, these old thermometers?

Justin: Glass.

Sydnee: Yeah.

Justin: The mercury got old in it.

Sydnee: Well, yes, but the glass. The glass is the thing here.

Justin: What—I don't know.

Sydnee: Glass can change over time.

Justin: That's true, 'cause it's all sand.

Sydnee: Could expand and contract.

Justin: It's all hard sand. Moving around. Little grains of sand, moving around over time.

Sydnee: You're thinking—you're thinking more critically.

Justin: Hmm. This is a first. This is as close to a compliment as you get. I'm going to savor the moment. Please continue.

Sydnee: [laughs] I appreciate that you're thinking that way, 'cause that is exactly one of the thoughts. So, they did this. Let me start with, they did this study. They took the thermometer that they have at the Mütter Museum, and they, um, in the '90s, and some researchers used some like, standardized temperature water baths. Y'know, we know exactly what temperature this water bath is. And let's measure it with this thermometer, and we can compare to a modern thermometer and see how close we can get.

And uh, the old thermometer that Wunderlich would've used was, uh—did measure higher, consistently, they found. Higher than the temperature.

Justin: Okay.

Sydnee: So, that was very interesting data. And so, then, some people said, "Well, that's the problem, then. That's why we've had it wrong all these years, because…"

Justin: The thermometers were wrong.

Sydnee: The thermometers were wrong. And that seems to be an easy solution to this question. Now, what you said, though, is true. A lot of researchers noted, glass does change over time. And the smallest change in the size of the bulb could change what the eventual result on the thermometer, what the reading would be. So, this is a really old thermometer. Are we sure it wasn't more accurate, y'know, a hundred years ago?

Justin: Yeah.

Sydnee: Than it is now? Um, but it did call some things into question. So, they continued to repeat studies throughout the later '90s and into the early 2000s on smaller groups of participants, at first. And they consistently showed lower average temperatures than the 98.6. They consistently got—the first one was like, 98.2, which is 36.8 was the average. Uh, and then there was a more recent one that was 97.7.

Justin: Hmm.

Sydnee: And the most recent in uh, 2017, analyzed over 35,000 patients. That's a lot of temperature readings.

Justin: That's a lot. Yeah.

Sydnee: That's like 250,000 temperature readings, I think? And they uh, they came out at 97.9.

Justin: Wow, so pretty low. Considerably less.

Sydnee: Yes. So, we're beginning to think, like, maybe… it wasn't… maybe it wasn't just thermometer difference. Maybe… I don't know. Are humans getting colder? So that's one of the two questions.

Justin: That's not where I would jump to, I wouldn't think.

Sydnee: That is—I mean, if you're—you have to keep an open mind. Remember, you have to ask the question. And the two questions that arose from this, all this data, and I think one is the one that I am hearing asked most frequently right now of me, because of these news stories. The number one question is, what is a fever?

Justin: Mm-hmm.

Sydnee: Uh, because I think that there are a lot of proponents of the uh, the so-called low-grade fever, who are now rejoicing in triumph.

Justin: You just raised your eyebrows at me in a very challenging way. All I'm saying is that if it's over 100, you're sick. That's all I'm saying.

Sydnee: There are a lot of people who have, for a long time, contested that a 99 anything. 99 point literally anything degree temperature is a quote unquote "low grade fever." And we are taught in medicine that there is no such thing, really, as a low grade fever. Unless what you mean is, 100.4 is the lowest possible fever, so I guess that is a low grade fever as compared to 101, 102, 103, which would be a higher grade fever.

These really aren't distinctions, though, that have a clinical significance to us. So like, it's not necessarily something that I'm gonna base any decision making off of. And we have always dismissed that like, well, 99 isn't a fever. It's not—it's a low grade nothing. It's just not a fever.

However, based on these new numbers, in theory, a fever would start around 99.5 degrees Fahrenheit. And so, then the question is—

Justin: If the different—if the difference is the same.

Sydnee: Yes.

Justin: Consistently. Okay.

Sydnee: So, the question is, uh, have we been wrong to use this cutoff for a fever? That's one big question that arises from this kind of shift. Um, I would say that, before everybody freaks out and starts checking their temperature, and thinking about all the times that maybe they were sick and they…

Justin: And they didn't know it.

Sydnee: And they didn't know it… um, I would clarify – and this is an important point. The people who did this study, the researchers, the doctors who actually did this study, are not proposing that we change any standard temperatures, guidelines, definitions, any normal ranges based on this study. They say that. They're not proposing that we change this. They're just saying, this is interesting, we need to think about it.

Justin: You gotta give it to these guys that measured, y'know, 35,000 different people, and at the end, they were like, "Hey, listen. This was a big waste of time. Don't do anything different. Just throw us in the trash. We're sorry. This was a big waste of time."

Sydnee: No! [laughing] They're good scientists.

Justin: "Keep with your other—your old thing."

Sydnee: They're good scientists, because they're saying, this is compelling to know, but we don't necessarily know that it changes what we do as doctors. Like, it changes maybe some things we knew about the human body, but should that change our medical practice?

We've used 100.4 as the cutoff for a clinically significant infection for a really long time now.

Justin: And we've made it this far. Is that the argument? Like, we've made it this far.

Sydnee: Well, we've based our management strategies on this, right?

Justin: Sure, right.

Sydnee: And we don't really have any compelling data to suggest that, if we had been calling 99.5 a fever all these years, that we would've done anything different. Or treated people differently, or saved a life, or prolonged a life, or started in medicine sooner. Y'know, I mean, this—I think it's hard to make that kind of case, because we've used that standard for so long.

I'm not saying it's impossible. I just think it's… to draw that conclusion from this study would be, I mean, completely out of—that would be out of bounds. That would be a complete over exaggeration of what the data really says.

Uh, a fever is a symptom. It is not dangerous. We know that the top ends… We still know, like, the temperatures that we need to worry about, right? Like, if you have a fever of 101, of course, you're sick. But that 101 degree temperature's not gonna harm your body. If you have a fever of 106, please get to the hospital immediately.

Justin: Right.

Sydnee: Yes, that is concerning. Those numbers haven't changed. And we still over treat fevers, as we talked about in our fever episode. Just because you have a fever doesn't necessarily mean we have to do anything about it. About the fever itself.

Justin: Sure. Right, right, right. 'Cause it's a symptom.

Sydnee: Yes. Yes. So, I would say that, does this change our understanding of a fever? Not in a huge, clinically significant way. It's interesting. And certainly, if you're feeling sick, and your temperature is

99.5, maybe you're a little more inclined to take the day off, stay home, and recuperate.

Justin: Yeah.

Sydnee: And you don't have to feel like you gotta justify it with a temperature of 100.4 to you or your boss or anybody else. But I would say that it doesn't really change a lot about what we understand about a fever.

But the second question is really the more interesting one, because what if it is that we're getting colder? What if it isn't that their thermometers were wrong? What if the human body has actually gotten colder?

And the most recent study, the reason this is in the news, is because of a study that was just published, that looked at all this data from all these different studies and said, "Can we figure out if humans are actually getting colder, and it wasn't the thermometers?"

And so, researchers took data from, like, human temperature data that was collected between 1862 and 1930, another chunk that was collected from 1971 to 1975, and a third chunk that was collected from 2007 to 2017, and compared these three different data sets over time.

Justin: Mm-hmm.

Sydnee: And found that we are, indeed, trending downward in body temperature.

Justin: That's wild! Why would that be?

Sydnee: A steady, downward trend in body temperature.

Justin: Why?

Sydnee: This was led by Dr. Julie Parsonnet, and it was, I believe, it was like, every decade, we go down like, 0.05 degrees.

Justin: Weird.

Sydnee: Yeah. And uh, it was really interesting. And they found a way to control—because they had like, the dataset, uh, the earliest one that was from 1862 to 1930, that's a pretty wide range. They could control from decade to decade, which removes a lot of the thermometer variability, and they still found the downward trend.

Justin: That's so weird.

Sydnee: So they really don't think it's a thermometer tech issue. It really appears to be, based on this study, it really appears to be that we are getting colder. Um, and again, they say the same thing. We're not proposing that you change any guidelines. Please just continue, doctors, with your current standard of medical care.

Justin: It's just a—thing is, we're all getting colder. But everybody just be, if you'll pardon the pun, chill about it.

Sydnee: If everybody could just calm down, we got bigger problems right now. You just happen to also be getting colder. So, why? Why are we getting colder?

Justin: Earth's getting hotter. We're balancing it out.

Sydnee: Okay. Both of these things are true, that we are getting colder and earth is—well, we think. We know the earth is getting hotter. We think that we are getting colder. However, that is not… a causal relationship.

Justin: Mine's not bad. You do have to—

Sydnee: That is not causal.

Justin: You have to ask the question. A wise woman once told me, you have to ask the question, Sydnee.

Sydnee: [laughs] Yes. And I am telling you, no, it is not. While the earth is, indeed, getting warmer, it is not because the earth is getting warmer that humans may well be getting colder.

Justin: Got it. Earth's getting warmer, humans getting colder… we are in agree—

Sydnee: No relation. [laughs]

Justin: We're in agreement about this fact.

Sydnee: Well, so, the theory that, uh, Dr. Parsonnet puts forth in the study, and then, the other researchers. Because we're not—we're not sure. But the theory is that… back before we lived, most of us, in homes with temperature control, and like, regular hygiene, and the ability to change our clothes and wash ourselves, and eat food that isn't contaminated, and get vaccines, and all these different things…

Justin: Mm-hmm.

Sydnee: Back before all of that, humans were exposed to a lot more microbes on a regular basis. We were constantly being invaded by bacteria and viruses and fungi and parasites and all this. And so, we always had this sort of baseline, maybe inflammatory cytokine release in our bodies.

So if you took our temperatures, you were much more likely to find these elevated temperatures, because we were always kind of hot. 'Cause our bodies were always in the midst of reacting to something.

Justin: So like a low level, body was working overtime with all these different bad invaders.

Sydnee: Yes.

Justin: And now, the environment is doing a bit more of that for us.

Sydnee: Yes. So I think it's a combination of less inflammation, because of our environment, and uh, temperature control, because most of us tend to live indoors now. Um, and that the combination of those things has just led us to be… colder, now. We're just colder. Our temperature tends to be 97.9. Around that, it seems to be, but something lower.

What does that mean for the future of humans? I mean, I don't think anybody really knows. I don't think it's necessarily… no one is suggesting that it's detrimental or bad.

Justin: No one's saying anything about it, it sounds like. They're just saying we're getting colder, and everybody just go about your day.

Sydnee: And it won't continue forever. I mean, certainly, everybody would assume it would level off at some point.

Justin: You would hope!

Sydnee: Uh, but it seems like… and again, this is one study that indicates this. And it is always important. The reason I talk a lot about like, the way that I approach a study… you can't, every time you read a scientific study, even a really well done one. Even one that I can't, with my little skeptic scope, poke holes in.

Justin: That's available at McElroyMerch.com. The Sydnee McElroy Skeptic Scope.

Sydnee: [laughs] Even if it's a really well done study, and the evidence is really compelling that they have arrived at, the conclusion's really compelling, and the data supports them… um, one study cannot change a complete scientific paradigm. We cannot shift our entire understanding of a scientific principle, of a medical principle of the human body, of the world, of the earth, based on one study.

It's gotta be reproducible. We have to continue to be able to see those same results when we check it again and again and again. Otherwise, you could miss something. Otherwise, there could've been a variable you didn't know

about. Something that confounded it. And so, it's always important, when you hear these things in the news, it's really interesting. Of course, everybody wants to hear about it and read about it. It's fascinating.

Justin: Right.

Sydnee: What does it mean? We're getting colder. Why? Who knows?

Justin: I don't know, why? Nobody knows.

Sydnee: Uh, but it's—I would not approach it with fear or trepidation. It's interesting. Perhaps we've expanded our knowledge of the way the human body works, the way we're constantly changing and evolving and adapting to our environment. It's fascinating, it's interesting. We can incorporate it into our vast body of medical knowledge. But it is nothing to fear. It is nothing to like, change your entire perception of what your body temperature and what your body's doing and what a fever is, and…

Justin: Alright.

Sydnee: And of course, any good scientist would tell ya – we gotta try it a few more times before we're sure about the results.

Justin: Uh, folks, thank you so much for listening to our podcast, Sawbones. Hey, if you want to come see us live, you can do that. If you go to bit.ly/TwentyFunny, you can uh, get tickets to see us in Cincinnati on February 19th, opening for My Brother, My Brother, and Me. There's a link to get tickets there. Act fast, though. Uh, those are running low.

We have a book called The Sawbones Book, and you can pick it up at Amazon, or wherever fine books are sold. Thanks to the Max Fun network for letting us be a part of their extended podcasting family, and thank you to the Taxpayers for the use of their song, Medicines, as the intro and outro of our program.

Uh, that is gonna do it for us, though, for this week. So 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 music plays]

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