

TPWKY

This is Exactly Right.

Erin Allmann Updyke

"I was once again dreaming of fortune and success when my hopes were blasted by an attack of a terrible scourge that wrought destruction through the northern mines during the winter of 1848-49: land scurvy. I noticed its first attack upon myself by swelling and bleeding of the gums followed by a swelling of both legs below the knee and I was laid up in my tent, obliged to feed upon the very articles that had caused the disease and growing daily weaker without any reasonable prospect of relief. I was almost in despair with only a blanket between myself and the damp, cold earth and a thin canvas to protect me from the burning sun by day and the heavy dews by night. I laid day after day, enduring the most intense suffering from pain in my limbs which were now becoming more swollen and were turning completely black. Above me rose those formidable hills which I must ascend ere I could obtain relief. I believe I should have died had not by accident discovered a remedy.

In the second week of my illness one of our party found, strewn along a foot track, a quantity of beans which sprouted from the round and were in leaf. Someone had probably dropped them. He gathered a quantity and I had them boiled and lived entirely on them for several days, at the same time using a decoction of the bark of the spruce tree. These seemed to operate magically and in a week I found myself able to walk and with two companions walked into Coloma, there living principally upon a vegetable diet which I procured by paying \$3 per pound for potatoes. In a very short time, I recovered."

TPWKY

(This Podcast Will Kill You intro theme)

Erin Welsh

Wow.

Erin Allmann Updyke

Hi.

Erin Welsh

Hi. 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. So that was some scurvy.

Erin Allmann Updyke

Some scurves.

Erin Welsh

That was really fun and also \$3 a pound for potatoes?

Erin Allmann Updyke

A pound. I don't even think I pay that much today.

Erin Welsh

No, you don't, and in 1848.

Erin Allmann Updyke

That's like gotta be like what, \$100 today?

Erin Welsh

I mean easily \$1000 plus.

Erin Allmann Updyke

With inflation. (laughs)

Erin Welsh

All the gold.

Erin Allmann Updyke

But also magical potatoes.

Erin Welsh: Yeah, truly.

Erin Allmann Updyke: Truly.

Erin Welsh: And we'll find out why soon.

Erin Allmann Updyke: So shortly.

Erin Welsh: So today's episode we're going to be talking about scurvy.

Erin Allmann Updyke: Yeah! I'm excited.

Erin Welsh: I'm really excited.

Erin Allmann Updyke: This is our first real departure on our own from infectious disease. We've done crossovers where we talked about things other than infectious disease but this is our first solo journey down a noninfectious route.

Erin Welsh: Yeah. I'm pretty excited about it, I think it's gonna be great.

Erin Allmann Updyke: I think so too.

Erin Welsh: Actually I know it's gonna be great.

Erin Allmann Updyke: Oh good! (laughs)

Erin Welsh: Yeah. So we're gonna cover the biology, the history, and then the current status of scurvy. But before we do any of that...

Erin Allmann Updyke: It's quarantini time!

Erin Welsh: Oh yeah! What are we drinking?

Erin Allmann Updyke: Today we're drinking the Vitamin Sea Legs. (laughs) I forgot it and then I remembered it and was overjoyed by the name.

Erin Welsh: Yeah.

Erin Allmann Updyke: Yeah.

Erin Welsh: Basically it's a bunch of different citrus juices of your choosing.

Erin Allmann Updyke: Yep.

Erin Welsh: Vodka because it's made from potatoes or it can be.

Erin Allmann Updyke: Exactly.

Erin Welsh: And soda water.

Erin Allmann Updyke: Splash of soda water, yeah.

Erin Welsh: Yeah. It's great.

Erin Allmann Updyke: As always we'll post the recipe on our Facebook, Twitter, and Instagram which you can find us there.

Erin Welsh: So we've got our quarantini but don't worry cause we're also going to be providing a recipe for-

Erin Allmann Updyke: Our placeboritas.

Erin Welsh: I still like that name.

Erin Allmann Updyke: It's a fine name. Anyways, that's our non alcoholic version of our quarantinis. And those will also be on our social media.

Erin Welsh: Okay. So my drink's in my hand.

Erin Allmann Updyke: Mine too.

Erin Welsh: I am preventing myself from getting scurvy with this delicious cocktail.

Erin Allmann Updyke: Yeah!

Erin Welsh: But I wanna know what the heck, how is this actually preventing me from getting scurvy and what exactly is the beast of the disease?

Erin Allmann Updyke: I can't wait to tell you.

TPWKY: (transition theme)

Erin Allmann Updyke: Everybody knows what scurvy is, right? What do you think causes scurvy?

Erin Welsh: Lack of vitamin C.

Erin Allmann Updyke: Lack of vitamin C, boom. Biology section over. Don't worry we're gonna get into more detail than that.

Erin Welsh: Okay good.

Erin Allmann Updyke: So the first thing that I wanna say, and this is because I don't want for people to feel silly if they don't know this because I wasn't sure that I knew the actual answer to this, and that is what the definition of a vitamin is. Like I think I kind of knew but I think having a good definition is a good place to start. So a vitamin is essentially an organic compound that we cannot make ourselves and therefore we have to get it from our diet. So unlike most animals actually, humans cannot synthesize their own vitamin C. Did you know that most other animals in the world make their own vitamin C?

Erin Welsh: I did know that.

Erin Allmann Updyke: They don't have to eat oranges, they don't have to worry about it. They just make their own from sugar, glucose. The only animals that don't make their own vitamin C are primates, except for the lemurs who are special and still make their own, guinea pigs and capybaras, and some bats and some birds. And that's it, everything else, your dog, you don't have to share your oranges with them.

Erin Welsh: Yeah.

Erin Allmann Updyke: They make it themselves. That is so cool.

Erin Welsh: Yeah.

Erin Allmann Updyke: And we just lost that ability and so thanks a lot evolution, now we're dependent on oranges.

Erin Welsh: (laughs) Thanks evolution.

Erin Allmann Updyke: (laughs) Way to go. So the fancy scientific name for vitamin C is ascorbic acid, okay. We call it vitamin C because again it's a necessary part of our diet so that makes it a vitamin. So the question is what does vitamin C do and why is it something that's so important? How can it end up causing a disease as gnarly as scurvy?

Erin Welsh: That's why I'm sitting here.

Erin Allmann Updyke: Okay. It turns out that vitamin C actually does quite a lot of things and because I'm not a biochemist and this isn't a biochemistry podcast, I'm not gonna get too in depth on exactly the mechanisms of what it does. But the most important thing that it does and the way that you get most of the symptoms of scurvy are its effects on collagen. So collagen is this protein that makes up almost everything in your body. So collagen makes up your skin, your tendons, it's the bottom layer inbetween all of your epithelial cells, so like in your bladder there's collagen lining the entire thing, it forms your bones, it's in your eyes, it's in your hair, like everything in your body is in some way made up of collagen. Okay. So it's a really, really important protein.

Erin Welsh: Must be.

Erin Allmann Updyke: And it's a protein that's made of three different strands, so it's three single proteins that have to twist together into this triple helix-

Erin Welsh: Like a pull and peel Twizzler.

Erin Allmann Updyke: Yes, like a pull and peel Twizzler. (laughs) In order to be strong, right. So you need like strong skin, strong bones.

Erin Welsh: Strong Twizzlers.

Erin Allmann Updyke: So what happens when you have a vitamin C... SO what vitamin C does is it allows for that folding, for that twisting to happen and for the bonds between those three strands of protein to be really strong. So without vitamin C you can still make the strands of protein that make up collagen but they can't bind together in the right way. So they're weak.

Erin Welsh: I think everyone needs to go out and buy a pack of pull and peel Twizzlers and try to pull apart a single strand versus an entire rolled Twizzlers.

Erin Allmann Updyke: Oh my god, that's a great idea.

Erin Welsh: Yeah.

Erin Allmann Updyke: That's an excellent idea.

Erin Welsh: And that shows collagen.

Erin Allmann Updyke: Collagen, boom!

Erin Welsh: Boom.

Erin Allmann Updyke: Oh my gosh Erin, way to go right now. Biochemistry outreach.

Erin Welsh: (laughs) Ayo.

Erin Allmann Updyke: So yeah, so that's essentially the biggest, most important role of vitamin C in your body that we know about, like we know all of the details of this. And so when you have a lack of vitamin C and you can't make strong collagen, things in your body literally start to fall apart. So let's walk through kind of the progression of how this happens. So another thing that's important about vitamin C is that it's water soluble which means that when you ingest it you can absorb a lot of it, most of it, some of it, but you can't hold onto it in your body for very long. It doesn't store in your fat tissues that way that some other vitamins do. So you pee out any excess vitamin C that you have which means that you have to continually eat it, like you have to eat vitamin C every day, you're not gonna be able to like store up a whole bunch.

Like something like vitamin B12, you can have huge stores of that in your body so I can take a really, really long time of being deficient in something like B12 before you actually see any symptoms. But with vitamin C, even just about a month of having little to no vitamin C, basically less than 10 milligrams a day in your diet, will lead to symptoms of scurvy. Cause it'll deplete your stores and then you'll just be running on nothing. So here's what starts to happen. In about a month of no vitamin C, you'll start to feel really tired. You'll get lethargic and if you're, for example, a sailor out on the rough seas, you won't be able to do things like haul in that jib or...

Erin Welsh: Swab the deck?

Erin Allmann Updyke: Thank you! That's what I was trying to do and I couldn't remember the words for it.

Erin Welsh: I saw the motion.

Erin Allmann Updyke: Thank you. (laughs) Yeah. Your captain will be like, 'Swab the deck!' And you'll be like, 'Ugh but I'm so tired and my muscles hurt' and you just won't want to and they'll probably throw you overboard and you'll die that way. But if you don't, then you'll just keep getting worse. You'll probably start to notice a rash, especially on your legs.

Erin Welsh: Hence the name of our quarantini.

Erin Allmann Updyke: Yeah, Vitamin Sea Legs. So you'll notice this rash and it'll probably look like little red or purple spots or splotches and then those splotches might get bigger and bigger until your whole leg looks like you just went on a terrible snowboarding accident and it's like... No? Have you never been snowboarding?

Erin Welsh: (laughs) Sick reference, bro.

Erin Allmann Updyke: I'm just saying you fall a lot and then you end up with these bruises that are like the size of your entire butt cheek but like you know where that came from, right, cause you fell a lot. But with scurvy you just wake up with these giant bruises and you're like, I didn't even fall, I haven't moved out of bed. Anyways.

Erin Welsh: I snowboarded in my dreams.

Erin Allmann Updyke: Oh did you get bruises? Anyways. You'll have these giant bruises, etc. Your joints will start to hurt. Do you wanna know why?

Erin Welsh: Of course.

Erin Allmann Updyke: Your muscles are breaking down and bleeding into the spaces of your joints. And all those purple spots that you're seeing? That's tiny blood vessels just breaking and leaking blood underneath your skin.

Erin Welsh: Is it because they can't handle the pressure of the blood flow and the collagen is so weak? Is that why?

Erin Allmann Updyke: Yeah, exactly. Because you can't make any new collagen and so collagen literally lines all of your blood vessels, like the bottom of the cells of your blood vessels are made of collagen. And so yeah, there's just collagen lining layers and layers of your blood vessels so when that collagen becomes weak, then it just starts to burst and break.

Erin Welsh: Ugh. Leaky pipe.

Erin Allmann Updyke: Leaky pipes. And then your joints are hurting, your muscles are tired, you're bleeding under your skin. And then you might go to take a bite of, I don't know, that stale bread or something that you've been eating for some reason, and your tooth might fall out. Because your teeth are held into your gums and your gums are full of collagen and your gums' collagen is broken down. So they're bleeding, your gums are bleeding absolutely everywhere.

Erin Welsh: It's horrifying.

Erin Allmann Updyke: Yeah, bleeding gums is one of the sort of hallmark signs of scurvy. So it's not really a great way to go.

Erin Welsh: Are any of the diseases we've talked about a great way to go, would you say?

Erin Allmann Updyke: I mean, no. Not really.

Erin Welsh: (laughs) Okay. Just checking.

Erin Allmann Updyke

Yeah. I mean that's pretty much what scurvy is, that's pretty much how it happens. You can't make collagen, all of the collagen in your body starts to break down and you bleed out. You can - really fun times - if you start to bleed into the sheaths that surround your nerves... So your nerves they travel in your body sort of bundled together, a nerve is a bundle of a whole bunch of individual nerve cells and they're usually surrounded by these sheaths. And if your blood vessels start to leak all over the place and leak into those sheaths, you can compress the nerves and end up with paralysis and also a lot of pain because you're compressing these nerve fibers. So that's fun.

Erin Welsh

So you die by bleeding out, basically.

Erin Allmann Updyke

That's one of the ways, yeah. That's one of the common ways that you can die is just by bleeding out. You also, it's very common to die from secondary infection because vitamin C is also important in your immune system and also collagen is just important in helping all of your cells work properly and so you can die by secondary infection because your body just can't fight anything off because it's just trying to keep you alive. And doing a poor job of it. So yeah. I mean that's scurvy. Do you have a question?

Erin Welsh

I do have a question. You mentioned briefly that vitamin C is important in your immune system. And I've known for a while there are so many studies and products that are related to vitamin C and your immune system, the Emergen-C packets or whatever. And if you take vitamin C your cold will be shorter.

Erin Allmann Updyke

Yeah.

Erin Welsh

What is the actual verdict? What do clinical trials show?

Erin Allmann Updyke

Great question, excellent question. Here's the thing about vitamin C. We know a lot about what happens when you do not have enough vitamin C. So if you have less than 10 milligrams a day then you will end up with symptoms of scurvy and you will probably die if you don't get access to vitamin C.

Erin Welsh

For a prolonged period of time. Not just a day.

Erin Allmann Updyke

Yes, exactly, yeah. For a daily basis for like a month, couple months. Many months. So we know that you need at least 10, that's like the bare minimum. Beyond that there is no evidence that increasing amounts of vitamin C are beneficial in any way.

Erin Welsh

Okay.

Erin Allmann Updyke

So we know that there's a minimum that you need to have in order to function normally. There is no evidence that taking things like Emergen-C have any effect whatsoever on your immune system, in fact there's been many studies and meta-analyses that show there is no additional immune boosting effect whatsoever.

Erin Welsh

Okay.

Erin Allmann Updyke So it's not gonna help you kick that cold faster, etc. There is evidence that having relatively low levels of vitamin C, so maybe your above that scurvy level but your still kind of low level, it can put you at higher risk for diseases like coronary artery disease. So it could be beneficial to have a little more than absolutely nothing, right. But beyond that there's no evidence that having more than say 150 or 200, which is like the equivalent of eating a bell pepper a day, it's not any better. There's no impact on your overall mortality rate.

Erin Welsh Okay.

Erin Allmann Updyke Yeah. There's not even a standard number for the recommended daily value, it totally depends on the country. So every country has their own version of the recommended daily amount of vitamin C and it varies.

Erin Welsh Okay. Okay.

Erin Allmann Updyke But yeah, so that's the best news about scurvy is that it's totally preventable and even if you end up with pretty severe symptoms like gums are bleeding, maybe your bones are starting to go, you're bleeding into all your joints. All of that is reversible if you give the person vitamin C. So even pretty severe symptoms are totally reversible, so it's a very preventable and very treatable disease.

Erin Welsh Yeah. That's cool.

Erin Allmann Updyke Yeah. So talk to me about how we figured out that scurvy was a thing and how we got to be where we are today.

TPWKY (transition theme)

Erin Welsh When I suggested that we add scurvy to our list of episodes, I didn't really know what I expected to find. The word 'scurvy' reminded me of pirates and sailors and oranges and how my mom used to tell me that I was going to get scurvy because of how much candy I ate. (laughs)

Erin Allmann Updyke (laughs) Dude.

Erin Welsh And I would only eat broccoli with cheese poured over it.

Erin Allmann Updyke Okay, two things, Deb.

Erin Welsh She's a nurse!

Erin Allmann Updyke I know but also broccoli is full of vitamin C, one of the highest vegetables. And two, a lot of gummy candies have ascorbic acid in them.

Erin Welsh What's up, Mom? (laughs) Okay I should warn you right now though because I mentioned the word 'pirates' doesn't mean that I talk a lot about pirates. Because I talk about sailors and in that I include pirates, so they're just kind of lumped in with all those other ones.

Erin Allmann Updyke That's fine.

Erin Welsh Also pirates didn't really keep the best records as far as I know.

Erin Allmann Updyke

I'm shocked. They just had maps right, with the dots and X's, that all they did.

Erin Welsh

Yeah exactly. X marks the spot where you'll get scurvy. Okay. But when I started my research, right off the bat I read a line that gave me an idea of just how rich and important scurvy's role in history was. Are you ready?

Erin Allmann Updyke

Yeah.

Erin Welsh

Quote: "If we exclude straightforward famine, scurvy is probably the nutritional deficiency disease that has caused the most suffering in recorded history."

Erin Allmann Updyke

Whoa.

Erin Welsh

Yeah. That was a little surprising to me. I mean I knew scurvy must have been important but I didn't have any idea of the scope and the scale of the history of this disease. So let me tell you.

Erin Allmann Updyke

Tell me.

Erin Welsh

Let's start at the beginning. Scurvy is mentioned in several early texts starting as early as 1500 BCE in Ancient Egypt.

Erin Allmann Updyke

Yes!

Erin Welsh

We're finally back in Egypt.

Erin Allmann Updyke

I love it.

Erin Welsh

In the Ebers Papyrus, I don't know how you pronounce it, it's a medical papyrus. It has also been found in writings from Ancient India, Greece, Rome, China, etc dating back thousands of years. For the most part, these ancient texts focus on the clinical description of scurvy and recommendations for treatment rather than identifying risk factors or any sort of pattern in disease incidence.

Erin Allmann Updyke

Interesting.

Erin Welsh

But it's pretty much a certainty that the disease existed during this time due to seasonal scarcity, crop failure, or during times of crisis like prolonged sieges during warfare. So it's interesting that there doesn't seem to be a consistent history of the burden of scurvy throughout these early years. There could be several reasons for this. For instance, if you were in the middle of a prolonged siege with little food, you probably had multiple nutritional deficiencies and so scurvy could have had different appearances depending on the exact conditions of your setting. But what I find really interesting about scurvy in these texts is not the apparent gap in its history but the effective treatment for the disease was discovered, lost, rediscovered, debunked, rediscovered, ignored, rediscovered etc.

Erin Allmann Updyke

Oh my god.

Erin Welsh

For thousands of years. Actually thousands of years. That Ancient Egyptian papyrus that I mentioned earlier?

Erin Allmann Updyke: Yeah.

Erin Welsh: It recommends a diet of fresh fruit and vegetables to cure the condition.

Erin Allmann Updyke: Whoa.

Erin Welsh: In 1500 BCE! 3500 years ago.

Erin Allmann Updyke: Wow.

Erin Welsh: And yet despite this knowledge, millions of lives would be lost due to scurvy in those 3500 years.

Erin Allmann Updyke: Wow.

Erin Welsh: Isn't that crazy?

Erin Allmann Updyke: That is really crazy!

Erin Welsh: I'll tell you why, don't worry.

Erin Allmann Updyke: I was gonna say it's just because like nobody paid attention... Like so much of Ancient Egypt was lost for so long. You know?

Erin Welsh: It was but it's more complicated than that.

Erin Allmann Updyke: Ooh, good.

Erin Welsh: Yeah. From around the 4th century AD or so, scurvy rarely shows its face in writings for about 1000 years. In the 1400s scurvy suddenly picks up steam and is everywhere. Can you guess why that might be?

Erin Allmann Updyke: Travel?

Erin Welsh: Yeah.

Erin Allmann Updyke: I thought I was gonna get it wrong.

Erin Welsh: No. Because people started sailing really long distances which meant potentially long periods of time without any fresh fruit or vegetables. As a result, descriptions of scurvy during this time and the next few hundred years focus on it as being a disease of sailors, including pirates, which would of course complicate things when trying to identify the cause of the disease.

Erin Allmann Updyke: Yeah.

Erin Welsh: But I'll get to that. The more that a culture or country was involved in oversea trade, exploration, or colonization of distant lands - like Portugal, looking at you - the more we see scurvy descriptions. And obviously there were many names for the disease, in Portugal it was known as the curse of the mouth, for instance.

Erin Allmann Updyke

Bleeding those gums.

Erin Welsh

Mm-hmm. We know that scurvy started appearing more and more in the 1400s and 1500s because people were sailing longer and longer distances but why did people start doing this? Why did they start sailing longer and longer distances then? The simple answer is that shipbuilding technology had been greatly advanced by Portuguese sailors during that time and better ships combined with better navigation, like improved compasses, meant that you could point in a specific direction and actually go there rather than just crossing your fingers and hoping for the best.

Erin Allmann Updyke

Right.

Erin Welsh

But why this surge in navigational technology? There's a point to this rabbit hole. Let's take a quick look at what happened between the years 1350 and 1500. If you remember from the plague episode, the Black Death took place from around 1347-1352, during which time it wiped out 1/3 to 1/2 of the entire population of Europe. As I mentioned during that episode, the consequences of such enormous population loss were incredibly far reaching.

Erin Allmann Updyke

Oh my god.

Erin Welsh

Before the plague, most books were in Latin, making them largely inaccessible to the majority of the population. But after the plague many were translated into the vernacular making education much more widely acceptable. Also the economy boomed because so many people suddenly had more disposable income than they knew what to do with, the result of multiple inheritances from so many of their relatives dying.

Erin Allmann Updyke

Oh my god.

Erin Welsh

The overland Silk Road connecting Africa, Asia, and Europe was dangerous, not fast enough to keep up with demand, and there were too many middle men to pay for your goods to be delivered. This created a demand for an alternate route between Asia and Europe which led people to the sea to venture on these long voyages with no end in sight. During these long months at sea, sailors primarily survived on preserved rations, stopping occasionally to restock their stores but the lack of fresh vegetables and fruit led the way to a huge increase in scurvy. Portugal led the world in these long voyages and so it's in the journals and ship logs of those sailors that we see scurvy debilitate and destroy a ship's crew as it would for the next 400 years.

Erin Allmann Updyke

Whoa.

Erin Welsh

From the Black Death to economic boom and technological development to exploration to scurvy. Everything is connected!

Erin Allmann Updyke

Oh my god!

Erin Welsh

Isn't that thrilling?

Erin Allmann Updyke

That is awesome!

Erin Welsh

I mean it's a really oversimplification of things and there were many factors but that's why I love the historical context, everything is stinking connected.

Erin Allmann Updyke I love this so much and I feel like I really wish that when I had taken history for most my entire life up to this point that any teacher I had ever did things like this.

Erin Welsh It's just so silly to study things in isolation.

Erin Allmann Updyke Yeah, I agree.

Erin Welsh Even scurvy, even the Black Death, all of these things, everything is connected.

Erin Allmann Updyke Right.

Erin Welsh Shipbuilding technology, who knew that had a link to the Black Death or scurvy or inheritance tax.

Erin Allmann Updyke And like of course it does because everything if connected.

Erin Welsh Everything is connected.

Erin Allmann Updyke But like to see those connections is awesome.

Erin Welsh Yeah.

Erin Allmann Updyke Oh that is so cool.

Erin Welsh Back to scurvy. Scurvy is beginning to be mentioned more and more as a problem on these oceanic voyages but exactly how big of a problem was it? Let's see this by the numbers. Vasco da Gama was a famous Portuguese navigator who, sidenote, died of malaria and was also a really big a-hole, just check out his Wikipedia page if you're bored sometime. During his circumnavigation of Africa, da Gama lost 30 men out of a crew of 140 to scurvy, estimates vary, could be a little higher actually.

Erin Allmann Updyke Okay.

Erin Welsh And only a handful could operate the ships during times when everyone, like 7 or 8 could operate the ships out of his whole crew cause everyone else was sick with scurvy.

Erin Allmann Updyke Oh, so even those who didn't die, pretty much everyone had it at some point, okay.

Erin Welsh Everyone had scurvy. The numbers would have been a lot higher if they hadn't stopped for some oranges in Mombasa. Another name that you may have heard of is Ferdinand Magellan.

Erin Allmann Updyke Yes, are you Gellin'?

Erin Welsh I'm Gellin'.

Erin Allmann Updyke Like Magellan! Look at him yellin', he's so not gelling. I'm gelling!

Erin Welsh (laughs) I'm gelling!

Erin Allmann Updyke: Anyways.

Erin Welsh: Anyways. So Magellan, also a famous Portuguese explorer, is probably most famous for his attempt to circumnavigate the globe. His ships made it, he didn't. He was killed in a conflict in the Philippines. But along the way 76 men out of the 237 that started the journey died of scurvy. In an English expedition in 1740 to capture a Spanish treasure ship-

Erin Allmann Updyke: Pirates. I'm sorry, I'll stop.

Erin Welsh: Maybe they were pirates, I don't know. 855 men out of 1000 sailors.

Erin Allmann Updyke: (gasps) Died of scurvy?

Erin Welsh: Died of scurvy.

Erin Allmann Updyke: 855 out of 1000? That's 85.5%!

Erin Welsh: It's very high.

Erin Allmann Updyke: Holy cow!

Erin Welsh: Yeah. An English sea captain named Sir Peter Hawkins in 1590 said that during the 20 years he worked at sea, he could count at least 10,000 sailors that had died from scurvy. During the Age of Exploration, so between 1500-1800 roughly, an estimated 2 million sailors died of the disease.

Erin Allmann Updyke: Oh my god.

Erin Welsh: It's big.

Erin Allmann Updyke: I had no idea.

Erin Welsh: Yeah. Sidenote, #notallsailors, not everyone who went on these voyages died of scurvy. Captain Cook for instance constantly restocked his ships with fresh fruit and vegetables wherever they stopped and I think he had just like one case of scurvy in his crew.

Erin Allmann Updyke: Wow, wow.

Erin Welsh: Yeah. And just because you were on land during this time didn't mean you were safe from scurvy. In fact around the same time that people started sailing these long distances, they started to settle in unfamiliar far off lands where they didn't really know how to survive. For instance in the first year of the English settlement of Jamestown in Virginia, many people died of scurvy along with many other illnesses and just straight up starvation.

Erin Allmann Updyke: Yeah.

Erin Welsh: Of the 500 that arrived in August of 1609, only 60 were left alive in May, 1610. So less than a year later.

Erin Allmann Updyke: Oh my god. Holy cow.

Erin Welsh: Yeah, Jamestown almost failed completely.

Erin Allmann Updyke: Wow.

Erin Welsh: Yeah. Several French expeditions to the great white north of Canada were also debilitated by scurvy when they stayed too long and had to overwinter in Quebec and around there.

Erin Allmann Updyke: Is that where our firsthand account came from?

Erin Welsh: No our firsthand account came from the California Gold Rush.

Erin Allmann Updyke: Ah.

Erin Welsh: Mm-hmm. If you're interested in this, you can read all about these expeditions and so, so, so many more that we just don't have time for in Kenneth Carpenter's 'The History of Scurvy and Vitamin C'. Clearly scurvy had become a pretty big problem in a short amount of time and its impact was only continuing to grow, especially as commercial shipping increased throughout the 1600s and 1700s. With so many lives aka wealth at stake, finding a cure or preventative for scurvy was a pretty pressing matter.

Erin Allmann Updyke: Yeah.

Erin Welsh: And you would think based on the fact that valid remedies had been written about thousands of years before and that many people on these voyages reported getting instantly better after landing somewhere and eating fruits and vegetables for the first time in 10 weeks that the issue of prevention and treatment would be more about the logistics of keeping these fresh fruits on board rather than actually identifying what it was that would stop the scurvy outbreak.

Erin Allmann Updyke: Yeah but I'm guessing it's not from your tone. (laughs)

Erin Welsh: No. (laughs)

Erin Allmann Updyke: Oh dear.

Erin Welsh: There was still no consensus amongst physicians and ship captains on what was the best antiscorbutic. But before we dismiss them as being stupid or unobservant, whatever-

Erin Allmann Updyke: Inattentive.

Erin Welsh: Let's consider how these scurvy patterns would've appeared.

Erin Allmann Updyke: Okay.

Erin Welsh: First: cause. If you're a ship captain, you noticed that after weeks and weeks at sea, your crew has bleeding and swollen gums and their legs are full of sores.

Erin Allmann Updyke: Yeah.

Erin Welsh: You think well, it's probably because they're lazy, they're not moving around, and plus there's that stagnant, damp, dank air in the ship's belly that's probably not helping things.

Erin Allmann Updyke: Okay, probably true.

Erin Welsh: Plus if your diet is extremely limited for a long period of time, you're probably suffering from a number of different nutritional deficiencies in addition to scurvy which makes these disease symptoms inconsistent from case to case and from ship to ship and journey to journey.

Erin Allmann Updyke: Okay. All right, I'll buy that.

Erin Welsh: Now treatment. You get to land and begin to chow down on the food that's newly available because you're really tired of the same salted meat and porridge or whatever. Suddenly everyone starts to rapidly improve, scurvy's gone. Might be the air on land is different. You think back to what your captain pal has said about the restorative powers of citrus and you're like, 'Oh okay, that could be it. Better take some back with us before we set off again.' And you do. You tell your crew to eat one lemon a day until you run out. But you do run out and scurvy doesn't immediately reappear. In fact, it takes weeks before it starts to creep back. Okay so maybe it's not the citrus necessarily that prevents scurvy. But you're not completely willing to give it up. So the next time you set off on an expedition, you try to find a way to bring citrus fruit with you. Storing crates of fresh fruit onboard isn't a realistic solution since they would all spoil before you got to your destination.

Erin Allmann Updyke: Yeah.

Erin Welsh: So maybe you make a drink out of it to store it, but you have to preserve it in some way, like maybe you boil it. So the next time you go you bring barrels of boiled lemon drink.

Erin Allmann Updyke: Uh oh.

Erin Welsh: Which little do you know is actually useless against scurvy because the boiling actually inactivates the vitamin C.

Erin Allmann Updyke: Yeah it does guys, it does.

Erin Welsh: When your crew gets sick from scurvy even while drinking the lemon juice, you're like, 'Well okay, I guess it's not citrus.' And the links between what caused scurvy, what prevented it, and what treated it, they just weren't very straightforward.

Erin Allmann Updyke: All right.

Erin Welsh: Throw into that the fact that scurvy was also successfully treated by certain plants and the consumption of fresh meat and you can see why it remained such a mystery and problem for so long even with all this knowledge.

Erin Allmann Updyke: It's interesting though that in Egypt their remedy was just a blanket fresh fruits and vegetables which is more broad, right, we're not trying to get so specific like you need to have a citrus fruit. It's interesting, but I buy it I guess, they're just like, it's hard.

Erin Welsh: It's interesting and I do that we have a tendency to look back negatively on the observational powers of people.

Erin Allmann Updyke

For sure, absolutely.

Erin Welsh

And I think that's not fair necessarily considering the context in which they lived.

Erin Allmann Updyke

Yeah and I think the way that you put it in context really makes it a lot more clear. So thank you.

Erin Welsh

Oh, of course. But people had to do something. Money and goods, I mean lives, are being lost. (laughs) In walks James Lind, an officer in the British Royal Navy who in the 1700s decides to run a clinical trial for scurvy curatives.

Erin Allmann Updyke

Oh my gosh, wow.

Erin Welsh

Very exciting.

Erin Allmann Updyke

Yeah.

Erin Welsh

I'm not sure that it would pass a medical ethics review board today but that's not really the issue.

Erin Allmann Updyke

They usually wouldn't.

Erin Welsh

No. One group of men with scurvy would be given oranges and lemons, another apple cider, and a third nothing.

Erin Allmann Updyke

Okay.

Erin Welsh

And there were other treatments in there as well. As you might predict, the ones who ate the oranges and lemons recovered the fastest followed by the apple cider group and the third group just didn't get better.

Erin Allmann Updyke

Did they eventually give them oranges or did they let them die?

Erin Welsh

I don't know. I don't know. This was a pretty resounding answer though to how to prevent scurvy. Eat citrus.

Erin Allmann Updyke

Yeah.

Erin Welsh

Lind wrote up his results and thoughts which were widely read but it would take about 40 years for his advice to be heeded. In the late 1700s the practice of providing lime or lemon juice to British sailors began, hence the nickname 'limey'. Also the words for lemon and lime were interchangeable both in English and many other languages as we have learned.

Erin Allmann Updyke

Limon!

Erin Welsh

Limon. (laughs)

Erin Allmann Updyke

I have a question.

Erin Welsh: Yeah.

Erin Allmann Updyke: You keep saying that they would eat lemons. Would they just like chow down on a lemon? Were lemons different back then because I cannot imagine just chowing down on a lemon.

Erin Welsh: Mostly it would be lemon juice is what they would do.

Erin Allmann Updyke: Okay so they would maybe add sugar, okay. I was just picturing them like, 'Here son, chew on this lemon.' And I was like wow, people were bold back then. (laughs)

Erin Welsh: No, no, no. So even though sailors were being given lemon and lime juice, this didn't really mean that scurvy disappeared at all. Throughout the 1800s it still popped up on some of the ships that were giving their crew lemon juice mostly because during the preparation, the vitamin C was inactivated in some way. But it also started appearing more and more on land, in prisons for instance where certain prisoners were denied potatoes and onions, I don't know why. In California Gold Rush country like our firsthand account. So if you wanted to try your hand at gold prospecting, you had to either travel by land in a wagon across the entire U.S., you could travel by sea from a port like Boston all the way around the tip of South America and back up.

Erin Allmann Updyke: Oh my god.

Erin Welsh: Yeah. Or you could take a boat down to Panama and walk across the narrowest part of the country, cause there was no canal yet. And then you would take a boat on the other side of Panama up to northern California.

Erin Allmann Updyke: Wow.

Erin Welsh: But basically the journey was very long and scurvy was almost inevitable. And if you didn't come down with scurvy on your way to California, you were sure to get it once you were there.

Erin Allmann Updyke: Oh god.

Erin Welsh: That part of California was fairly remote at that time with few farms, so gold miners mostly ate flapjacks and molasses.

Erin Allmann Updyke: Yeah, 49er flapjacks, that's a thing.

Erin Welsh: Mm-hmm. If you wanted to eat onions or potatoes, get ready to fork over all of the gold that you found.

Erin Allmann Updyke: That's so... Man, capitalism.

Erin Welsh: (laughs) Right.

Erin Allmann Updyke: Starts way back when.

Erin Welsh  
Scurvy was also really common in many arctic and antarctic expeditions unless they found enough seals or penguins to eat, as long as they ate the meat mostly raw. Unlike humans, not all animals as we've mentioned have to acquire their vitamin C through diet. And so if you ate the flesh of these animals that produce their vitamin C like many people who are native to those parts of the world, they would just eat raw or barely cooked meat and replenish vitamin C.

Erin Allmann Updyke  
Beautiful sear on that penguin breast and that's all you need.

Erin Welsh  
Yeah it's very cool, I like that a lot. Also during the Great Famine in Ireland in the 1840s, scurvy appeared alongside starvation since the potato crop, which had failed, was the usual source of vitamin C for those populations. In the late 1800s and early 1900s scurvy starts appearing unexpectedly in a strange population.

Erin Allmann Updyke  
Uh oh.

Erin Welsh  
Babies born to wealthy families.

Erin Allmann Updyke  
Oh I know exactly where this is going from.

Erin Welsh  
(laughs) Yep. Basically these mothers weren't choosing to breastfeed and instead they gave their children formula which they could afford to buy, mixed in with milk which had been pasteurized and its vitamin C inactivated.

Erin Allmann Updyke  
Yeah.

Erin Welsh  
Yep. In the past, these mothers would have given their infant to a wet nurse so the kid would have gotten vitamin C that way.

Erin Allmann Updyke  
Yeah cause your breast milk is full of vitamin C as long as the mother has adequate vitamin C intake.

Erin Welsh  
Yeah. Amidst all these outbreaks of land scurvy was a renewed interest in finding out what the cause of the disease really was. And people had some nifty new ideas. In most of the episodes of this podcast, this is when germ theory pops up as a shining beacon to light the way for vaccines and antibiotics. But not so for scurvy.

Erin Allmann Updyke  
No, not so?

Erin Welsh  
No. Because scurvy isn't an infectious disease.

Erin Allmann Updyke  
Yeah.

Erin Welsh  
But that's not what a handful of people thought in the mid 1800s.

Erin Allmann Updyke  
Ooh, fun!

Erin Welsh  
So when germ theory began to catch on-

Erin Allmann Updyke  
(laughs)

Erin Welsh: Pause for laughter.

Erin Allmann Updyke: Sorry.

Erin Welsh: (laughs) It was trendy to call every disease contagious.

Erin Allmann Updyke: I love this.

Erin Welsh: Isn't it amazing?

Erin Allmann Updyke: Yeah. But I do feel like to their credit, scurvy has a lot of symptoms that I would totally believe seem infectious, right.

Erin Welsh: Absolutely.

Erin Allmann Updyke: You're bleeding from your gums, you've got these bruises and sores everywhere, like that totally looks infectious. And you can often get secondary infections on top of it, so...

Erin Welsh: And also it doesn't usually happen to just one person.

Erin Allmann Updyke: Yes, that's true! Yeah it's like groups of people. Yeah.

Erin Welsh: For instance, the guy who showed that tuberculosis was contagious, his name is Jean Antoine Villemin, I don't know how you say his name, said quote: "Scurvy is a contagious miasm, comparable to typhus which occurs in epidemic form when people are closely congregated in large groups. It is ridiculous to suppose that a lack of fresh vegetables is the cause of the disease."

Erin Allmann Updyke: (laughs)

Erin Welsh: And we're laughing at you, sorry, from 150 years later.

Erin Allmann Updyke: Sorry. No I mean yes, we're laughing at you but also it's in a cute way.

Erin Welsh: Yeah, sure. Another person suggested that lime juice was effective because it acted as an antibacterial mouthwash.

Erin Allmann Updyke: Oh I loved that.

Erin Welsh: These opinions were in the minority but it just speaks to the fact that there was still active debate on the cause and thus the treatment of scurvy.

Erin Allmann Updyke: Mm-hmm.

Erin Welsh: Viewing a disease as a deficiency rather than as a positive state was a really difficult thing for people to conceptualize especially when everyone was looking for the thing, pathogen, toxin, whatever, that actively caused a disease. It was way past time for some real experiments to begin. Fortunately in the 1900s, experimental studies of scurvy became popular and more importantly possible thanks to a very lucky choice of animal model.

Erin Allmann Updyke

Oh my god, I was just gonna say how could they have done... Did they just happen to choose guinea pigs?

Erin Welsh

Yeah.

Erin Allmann Updyke

Are you serious?

Erin Welsh

Okay, okay. So there's a reason behind this.

Erin Allmann Updyke

I am amazed right now because of all the animals a freaking guinea pig, you choose?!

Erin Welsh

Yep.

Erin Allmann Updyke

Oh my gosh.

Erin Welsh

I don't remember if we've talked about what animal models are before in this podcast.

Erin Allmann Updyke

I don't know, we've kind of mentioned them but we haven't explained them necessarily.

Erin Welsh

Yeah.

Erin Allmann Updyke

Yeah.

Erin Welsh

I mean basically in medical research, if you're trying to learn more about a human disease or a treatment for a disease, you can't really do a lot of experimental research on humans directly so it's really important to have an animal in which the disease acts similar to the way it does in humans.

Erin Allmann Updyke

Yeah.

Erin Welsh

Anyway, the issue of an appropriate animal model for scurvy had come up before because as I mentioned, some animals can synthesize their own vitamin C.

Erin Allmann Updyke

Yep.

Erin Welsh

So rats had been a popular lab animal at this time. Lab rats and pigeons, actually. But lab rats were viewed as infection-carrying and gross, like the tide has turned against rats around this time and they were really gross. But guinea pigs had started to be imported as pets for children and as little just cute things, and so possibly lab animals.

Erin Allmann Updyke

Oh my god.

Erin Welsh

So some guy named Axel Holst somewhat randomly chose a guinea pig as a model for scurvy and it just happened to work.

Erin Allmann Updyke

The amount of coincidence in science and scientific discoveries is phenomenal.

Erin Welsh: Yeah. So now the experiments could begin and they would show that scurvy was directly related to diet and fresh fruits, vegetables, raw milk, some kinds of meat, prevented scurvy. There are so many important names that contributed to this research but I wanna quickly shout out Dr. Harriette Chick whose lab in London consisted almost exclusively of women because all men were at army labs during WWI.

Erin Allmann Updyke: Ooh! I love it.

Erin Welsh: And her research showed that the amount of raw milk fed to a guinea pig determined whether or not the animal would get scurvy.

Erin Allmann Updyke: Wow. Harriette.

Erin Welsh: Harriette. So they knew that scurvy was related to diet but what was the unifying thing in all these antiscorbutic foods? Vitamin C which at that point was still unknown, it was just called vitamin C because vitamin A and B had already been found as nutritional factors that were necessary for the growth of rats.

Erin Allmann Updyke: Wait, so they just found these compounds and they just were like, 'Okay we'll call this one vitamin A and we'll call this one vitamin B.' And so with this when they were trying to figure out scurvy they were just like, 'Well we know it's something different so we're gonna call it vitamin C but we have no idea what it is.'

Erin Welsh: Yeah it's just a numbering system, a naming system.

Erin Allmann Updyke: For things they don't know.

Erin Welsh: Yeah.

Erin Allmann Updyke: That's amazing!

Erin Welsh: I think A and B might have been known, I'm not sure about that.

Erin Allmann Updyke: Okay, yes.

Erin Welsh: C was not.

Erin Allmann Updyke: That is so hilarious.

Erin Welsh: Yeah. In 1930 a Hungarian chemist named Albert Szent-György isolated a compound which was later named ascorbic acid. Also antiscorbutic, ascorbic, yeah.

Erin Allmann Updyke: Oh you just blew my brain.

Erin Welsh: What's up? (laughs) And so that was discovered to be the vitamin C that so many people had been looking for which would get him a Nobel Prize actually for that effort. So now that the compound was isolated and described, a pharmaceutical company immediately took out patents to commercially produce the vitamin.

Erin Allmann Updyke: Of course!

Erin Welsh: And make a fortune.

Erin Allmann Updyke: Number one.

Erin Welsh: But eventually access to vitamin C became very cheap and easy and it's also in a lot of fresh fruits and vegetables.

Erin Allmann Updyke: Yeah, did people figure that out pretty quickly? They were like oh, this is in tons of everything that we eat.

Erin Welsh: Oh yeah. Yeah no, mostly it was testing these foods and such for that. They were all found relatively quickly.

Erin Allmann Updyke: Okay.

Erin Welsh: Once vitamin C was discovered though, cases of scurvy really dropped off. And there were a few cases here and there with a fad diet where you just drink green tea, that's it, and honey or something.

Erin Allmann Updyke: Green tea and fen phen, baby.

Erin Welsh: Oh my god. But I'm guessing that scurvy didn't completely disappear. So Erin, tell me where do we stand with scurvy today?

Erin Allmann Updyke: I'd love to.

TPWKY: (transition theme)

Erin Allmann Updyke: There basically are no solid numbers on how many cases of scurvy exist in the world in 2018 or 2017 or 2016 or the 2000s for that matter.

Erin Welsh: Okay so it's eradicated.

Erin Allmann Updyke: (laughs) It's definitely not eradicated. I feel like I've said this on a few episodes already this season, I really tried hard to find numbers on this and I couldn't.

Erin Welsh: (laughs) Everyone if you're playing a drinking game that's related to the podcast, that's one of the rules.

Erin Allmann Updyke: (laughs) Yeah, okay. Anyways. CDC, WHO, FDA, they all failed me. Nobody has numbers.

Erin Welsh: Fighting words.

Erin Allmann Updyke

Yeah, I'm ready to fight with someone about this. And I have a feeling that it's in large part because this is a disease that is so easily treatable and preventable, it's not reportable in any real way, right. It's not something that people are necessarily keeping tabs on at national or international levels. That doesn't mean that it's gone. When you search for epidemiological information on the status of scurvy, what you find are tons, like dozens and dozens of case reports. Case reports are when physicians, after they see a case of something that they don't see very often, they write it up. But I found lots of these. Lots of them. All over the U.S., all over Australia, Europe, this is happening not just in places that we in the U.S. might think sound far away, this even happens in the United States even as recently as the last few years, this year I'm sure there's been cases of scurvy.

But the real question that remains about scurvy isn't even necessarily how many cases there are but why these cases are happening cause we know exactly what the cause is, we know exactly how to prevent and treat it and it's very easy, you don't even need any drugs you just need a bell pepper or a potato or an orange or a piece of broccoli, right. That's all it takes.

Erin Welsh

Right. So what is standing in the way of people having access to that kind of food or supplement in another way?

Erin Allmann Updyke

Exactly. And so that's really what it comes down to is for the most part the people who end up getting scurvy have a lack of access. So scurvy tends to still happen today in modern times in populations like refugee populations that might not have access to any fresh fruits or vegetables and have a very limited diet in terms of what they can access and what they're able to eat because they might be getting food in like bags from organizations that send them to them, right, or things like that. Or they might just have severe malnutrition to begin with. And so scurvy is a very, very common, like you kind of mentioned, it's a very, very common syndrome that comes along with generalized malnutrition.

Erin Welsh

Right.

Erin Allmann Updyke

And part of that is because since vitamin C, you can't store it in your body for very long, it's not one of the first things necessarily that you'll end up dying from but it is something that relatively early on, like within a month or two of having not enough food, you can end up with scurvy or symptoms of scurvy. The other populations that it can happen to are lower income populations that can't afford fresh fruits and vegetables because the thing about vitamin C is that it breaks down relatively easily.

So even if you're eating foods that in theory have vegetables in them, if they are all canned foods or they're all microwaved to oblivion, then you're not actually getting any of the vitamin C that might be in those foods. So even though you're eating a can of chicken tortilla soup that has bell peppers in it, you're not getting any of that vitamin C from those bell peppers. And that's an actual real case that I found in Houston of a woman who was eating only chicken tortilla soup to try and lose weight and she ended up with scurvy, diagnosed in Houston a couple of years ago.

Erin Welsh

Trying to... Wait.

Erin Allmann Updyke

Yeah.

Erin Welsh

Okay.

Erin Allmann Updyke

Yeah. Yeah and so we already hit on two populations.

Erin Welsh: Just one kind of soup?

Erin Allmann Updyke: One soup. Chicken tortilla soup.

Erin Welsh: Did she say why she chose that particular soup? What brand was it?

Erin Allmann Updyke: And I quote: "Chicken tortilla soup." I'm sorry, that's all I got for ya.

Erin Welsh: (laughs) Oh boy. Eat your vegetables.

Erin Allmann Updyke: Yeah, I mean that's sort of the long and short of it. yeah so it can happen in low income populations, it can happen in displaced populations, it can happen also in populations maybe with mental illnesses who aren't eating, maybe who aren't eating at all or who aren't eating fresh fruits and vegetables, maybe they're only eating toast or they're only drinking something or whatever.

Erin Welsh: Right.

Erin Allmann Updyke: Yeah so there are definitely still populations both in this country, in every country, it definitely is still an issue, it still happens. The only numbers that I saw, some article claimed that the overall rates of scurvy or of vitamin C deficiency rather, not of scurvy necessarily, could be anywhere from 2% or 7% in countries like the U.S. to up to 45% in other countries. And the other population that it can happen to is children, whether because they're very picky eaters or because they also don't have access to foods that are fresh.

Erin Welsh: I also read something, speaking of populations, 'bachelor's scurvy' was a term that was used frequently and this was to refer to older men who lived alone, or 'widower's scurvy'.

Erin Allmann Updyke: Yes.

Erin Welsh: Who lived alone and this was largely in the early 1900s and just did not eat any fresh food, they just ate...yeah.

Erin Allmann Updyke: Yeah, older populations are especially at risk for sure because they might not be eating much at all, as you age it might be like your metabolism slows down, you're just not hungry, you're tired, or if you aren't working you might not have a lot of money, etc. So you're eating things that...yeah. I hadn't heard the term 'bachelor's scurvy'. (laughs)

Erin Welsh: Yeah.

Erin Allmann Updyke: But yeah, that's a population that would definitely be at risk for scurvy. And one thing that I found interesting is that clearly scurvy still happens, right?

Erin Welsh: Yeah.

Erin Allmann Updyke: Scurvy still happens everywhere, all it takes is just not eating fruits and vegetables. So it's not hard to get scurvy if you think about someone only eating toast and rice or something like that.

Erin Welsh: Chicken tortilla soup.

Erin Allmann Updyke Chicken tortilla soup, whatever. But yeah so that's scurvy in the world today.

Erin Welsh Wow, okay.

Erin Allmann Updyke Yeah.

Erin Welsh Very interesting.

Erin Allmann Updyke Yeah, I had fun doing this.

Erin Welsh I loved this. I thought it was a really fun departure, I loved seeing germ theory from the other side.

Erin Allmann Updyke Yeah, we've never seen that.

Erin Welsh Yeah.

Erin Allmann Updyke How fun.

Erin Welsh And I'm sorry there weren't more pirates.

Erin Allmann Updyke You know, I made them enough. I just kept shoving the pirates in there.

Erin Welsh I mean the thing is is that pirates were just a part of all of the sailors. If you want to read about sailors and pirates, let's talk about sources.

Erin Allmann Updyke Let's.

Erin Welsh Okay.

Erin Allmann Updyke Great transition by the way.

Erin Welsh (laughs) So I read a book by Kenneth Carpenter which I mentioned earlier called 'The History of Scurvy and Vitamin C'. It is extensively well researched, it is great, it's a really thorough book. Also 'A History of Scurvy and Vitamin C' by Howard Sauberlich and the book 'Vitamin C in Health and Disease', the Cambridge World History of Human Disease, and then a couple of articles which we'll post.

Erin Allmann Updyke Yes, we will post all of the articles that we used on our website [thispodcastwillkillyou.com](http://thispodcastwillkillyou.com), you can find those under our EPISODES tab. Each episode we have all of our book lists and our article lists. If you are for some reason especially interested in any of the case reports, shoot us an email at [thispodcastwillkillyou@gmail.com](mailto:thispodcastwillkillyou@gmail.com) and I'd be happy to send you those. You also can find us on Twitter @TPWKY and @thispodcastwillkillyou on Instagram where we post lots of pictures and cool stuff that we find about each episode. Thank you to-

Erin Welsh Bloodmobile for providing the music for this episode and all of our episodes.

Erin Allmann Updyke We love it.

Erin Welsh And thank you for listening!

Erin Allmann Updyke

Yeah, we really like making this podcast and it makes us happy that we're not the only ones who listen to ourselves talking.

Erin Welsh

Yeah.

Erin Allmann Updyke

(laughs)

Erin Welsh

Until next time, wash your hands.

Erin Allmann Updyke

And eat a bell pepper. (laughs)

Erin Welsh

(laughs)