

Anonymous

When I was nine months pregnant, I woke up one morning and felt really off. I was nauseous and could only eat peanut butter toast. Being nine months pregnant, I figured it had something to do with that so I just continued on to work where I was in a rheumatology clinic during my pediatrics residency. After about a half hour in clinic, I felt like I might vomit. So I apologized to the team and I went home. Luckily I made it home before the vomiting started. Once it started, it was pretty continuous and I could not keep down even sips of water. I started having abdominal cramping as well which started to be more worrisome, especially since I was nine months pregnant. I reached out to friends and family who thought it could be signs of labor. So we went in to labor and delivery floor to get checked out. There, they determined I was not in labor. They did some labs which looked good and then sent me home with nausea meds.

At home, I started having fevers and full body aches. I could barely move from bed and my husband kept waking me up to drink sips of electrolyte solution. With the nausea meds, the night was pretty okay. But the next day the diarrhea started which was horrible and unforgiving. That wrapped up quickly however and the whole thing was over in about 36 hours. Two days later I was scheduled for induction. And even then when I went in, I was still dehydrated and the nurses were finding it hard to get an IV. So they had to poke me a few times. We started the induction and my husband started feeling a little nauseous and then he also started vomiting. He gets a nervous stomach, so at first we didn't really think too much about it. But within a few hours he had profuse vomiting, fevers, and diarrhea at the same time. He looked bad enough that the labor and delivery nurses insisted he go to the emergency department and we decided to stop the induction and I went home.

As my husband was evaluated in the emergency department and eventually admitted for fluids, I was at home waiting to hear how he was doing and my water broke. So I went back in and delivered a healthy baby girl the following morning. We had some really phenomenal L&D nurses who helped coordinate my husband coming up to see the baby from the emergency department. And our first family photo was of all of us in hospital attire and all of us in diapers. We found out from my husband's testing that we both had norovirus which I probably picked up at work somewhere but it could have truly been anywhere. I was really scared that our baby would get it, knowing it was so much worse for little ones that had no reserve. But she remained healthy and we all went home in a couple of days. It was a really humbling experience for all of us and I will never underestimate norovirus.

TPWKY

(This Podcast Will Kill You intro theme)

Erin Welsh

Ugh.

Erin Allmann Updyke

Aye aye aye.

Erin Welsh

You know... Yeah.

Erin Allmann Updyke

Yeah. It's not great.

Erin Welsh

Understatement. Understatement, yeah. Thank you for reliving that for us. I know that it was a horrible experience, so we appreciate it.

Erin Allmann Updyke

Thank you.

Erin Welsh

Hi, I'm Erin Welsh.

Erin Allmann Updyke

And I'm Erin Allmann Updyke.

Erin Welsh: And this is This Podcast Will Kill You.

Erin Allmann Updyke: And today we're talking about none other than norovirus.

Erin Welsh: You know Erin, I was getting ready for tonight, like brushing my hair or whatever. And I was like have I ever had norovirus? And for some reason in that moment, after spending a week reading about norovirus and writing about it, that was the first I actually wondered if I had personally experienced it. And I think yes is the answer.

Erin Allmann Updyke: Yes. I feel like I can remember times when you almost certainly had norovirus.

Erin Welsh: Are you thinking of the one when I was in Finland and I had to get off the bus in the winter and barf everywhere? Yeah.

Erin Allmann Updyke: That one was very bad. I remember that.

Erin Welsh: That was really bad.

Erin Allmann Updyke: I feel like there were several other times too when you had really bad GI things and I was like yeah, it's probably norovirus.

Erin Welsh: Oh my gosh.

Erin Allmann Updyke: I can very distinctly remember the most recent, the most memorable time that I almost certainly had norovirus. Don't know what else it would have been. I mean I guess there's many other things it could have been. But it was when my older son was in daycare when he was a baby and all the other kids at daycare had had some barfing thing and then both Brett and I got it and my kid did not. And I was like what is this?

Erin Welsh: I don't get it. So wait-

Erin Allmann Updyke: We'll talk about it though.

Erin Welsh: Okay, yeah. Oh okay. Yeah, I have so many questions already. We can't do this. That would be the earliest yet on record for us. Yeah, we'll get there.

Erin Allmann Updyke: I can't wait.

Erin Welsh: But first-

Erin Allmann Updyke: But first it's quarantini time.

Erin Welsh: It's quarantini time. Erin, what are we drinking this week?

Erin Allmann Updyke: We're drinking The Cruise Shits.

Erin Welsh: I mean I think that for most of us, when you hear norovirus, your first thought is oh that thing that happens on cruise ships.

Erin Allmann Updyke: For me, it's the opposite. Like when I hear cruise ships, the first thing I think of is norovirus.

Erin Welsh Well in any case, I don't know if we can dispel that but we will dispel the fact or the notion that cruise ships are somehow the only place that you can get norovirus.

Erin Allmann Updyke Oh yeah. Definitely not.

Erin Welsh It's far from the truth. I've never been on a cruise and I have gotten norovirus. So end of one counts. But we decided to make this delicious, not delicious-sounding quarantini a martini.

Erin Allmann Updyke Yeah.

Erin Welsh Because martinis pair really well with another great source of norovirus which is oysters.

Erin Allmann Updyke None of this sounds appealing in all honesty.

Erin Welsh No, I know.

Erin Allmann Updyke We're going to make people never eat food again or have fun again. It's going to be a great episode.

Erin Welsh Yeah, it's going to be awesome.

Erin Allmann Updyke But in any case-

Erin Welsh I mean there's really nothing you can do. Yeah.

Erin Allmann Updyke No. We'll post the full recipe for that quarantini and our non alcoholic placeborita on our website thispodcastwillkillyou.com and all of our social media channels.

Erin Welsh We certainly will. On our website thispodcastwillkillyou.com, it is a treasure trove of things; of links that you can click. Links to our bookshop.org affiliate account, our Goodreads list. Links to music by Bloodmobile, links to merch, links to Patreon. And then you can find non link things like our sources for all of our episodes and other stuff. Check it out.

Erin Allmann Updyke Well then.

Erin Welsh Well then. Any other business?

Erin Allmann Updyke No.

Erin Welsh Rate, review, subscribe. Merch.

Erin Allmann Updyke Check it out, it's there.

Erin Welsh We got cool merch. Yeah.

Erin Allmann Updyke Should we just get into the biology of norovirus?

Erin Welsh Let's do it. Let's take a quick break and then get nauseous together.

TPWKY

(transition theme)

Erin Allmann Updyke

Norovirus is an RNA virus, it's in the family Caliciviridae which I don't think that we've ever covered any viruses in that family before except, Erin-

Erin Welsh

RHDV? RHDV. Yeah, rabbit hemorrhagic disease virus.

Erin Allmann Updyke

Yes!

Erin Welsh

That came out fast.

Erin Allmann Updyke

We talked a little bit about that in our myxomatosis episode. But then Erin, you interviewed an expert on rabbit hemorrhagic disease virus. So check out that.

Erin Welsh

Yep. Robyn, she's amazing. Check out that episode. Yes. It's such a fascinating story too. But anyway.

Erin Allmann Updyke

So these are RNA viruses. They're small, they're round, they are a family of viruses that infect a pretty wide range of mostly vertebrate hosts. And the one that we're talking about today, norovirus, there are a bunch of different genotypes and it's a few of them, mostly 1, 2, and 4, that are the ones that cause the most human disease. A norovirus is a human enteric virus which means it's infecting and causing us to get sick in our guts, our GI tract.

Erin Welsh

Oh yeah.

Erin Allmann Updyke

And like many of our GI tract-infecting friends on this podcast, be they viral, bacterial, or otherwise, norovirus is spread through fecal oral contact which means poop gets in your mouth.

Erin Welsh

Yep. Good stuff. Great stuff.

Erin Allmann Updyke

But norovirus gets a lot more creative than that. Because norovirus has been shown to be spread through aerosolized vomit.

Erin Welsh

You know, Erin, when I learned about that, I was just in awe-

Erin Allmann Updyke

Yeah.

Erin Welsh

Of both the fact that norovirus can do that but also that we're not all constantly sick with norovirus. It's disgusting.

Erin Allmann Updyke

It gets so much more disgusting, Erin.

Erin Welsh

Excellent. Just keep piling it on. I'm ready.

Erin Allmann Updyke

Literally. Aerosolized vomit, that's a way that it can spread. It also is a frequent offender in contaminated food. And with norovirus, food is often contaminated either at the point of production, think about things like spinach recalls, etc, from when it was packaged, as well as the point of preparation. So that kale salad that you ordered and someone didn't wash their hands that well. We also see water contamination, not just drinking water but also oceans, rivers, you name it. And in general, contaminated environments. And here's where it starts to get even worse.

Erin Welsh

Okay. Starts to get? Got it.

Erin Allmann Updyke

It's just beginning, Erin. Norovirus is an incredibly infectious virus. It often takes less than 100 viral particles to produce an infection which is not a lot of virus. And when people get norovirus, when they're infected with norovirus, they're pooping it out. It's shed in their feces and people can shed it for an incredibly long time even if they never show any symptoms of it. Do you have a question, Erin?

Erin Welsh

Yes. Yes, Erin, I do. I have multiple questions. So number one, how long can people shed? Number two, asymptomatic? Tell me more about that.

Erin Allmann Updyke

Oh my gosh. I was so excited except it was not the exact two questions that I thought you were going to ask.

Erin Welsh

Oh. What did you think I was going to ask?

Erin Allmann Updyke

I was expecting two questions from you right here and I have those two answers.

Erin Welsh

Okay, okay. Let me see what else I could ask. You said that people can shed.

Erin Allmann Updyke

I'll give you a hint.

Erin Welsh

Yeah, tell me.

Erin Allmann Updyke

I said they shed a lot of virus in their poop.

Erin Welsh

How much virus do they shed in their poop?

Erin Allmann Updyke

So glad you asked, Erin. Okay, let me answer these one at a time. How long can people shed norovirus? At a minimum, we're talking 7-10 days but many studies suggest 4-8 weeks, Erin.

Erin Welsh

Excellent news.

Erin Allmann Updyke

Really great news. How much virus per poop? Literally so glad you asked because if you hadn't, I was going to tell you anyways. This is mind blowing, Erin. People shed anywhere from 100,000 to 1 billion viral particles per gram of poop.

Erin Welsh

No! That is not possible.

Erin Allmann Updyke

Per gram. Do you want to know how much a gram of poop is? Because the amount of time that I spent looking this up is not insignificant. A gram of feces is about a quarter teaspoon.

Erin Welsh: No.

Erin Allmann Updyke: We are talking at a minimum 100,000 to a million, up to a billion, some papers say even potentially more but I couldn't do that math, per quarter teaspoon of poop. And as we'll see, norovirus often gives you diarrhea. So it's not like a small amount that you're pooping.

Erin Welsh: No, it's easily in the cups to liters range of things, right?

Erin Allmann Updyke: Yes. Easily.

Erin Welsh: Okay. Like a pinch, a pinch of poop-

Erin Allmann Updyke: A pinch of poop.

Erin Welsh: Contains a billion potentially.

Erin Allmann Updyke: Yep.

Erin Welsh: How are we not all infected all the time? I ask you again.

Erin Allmann Updyke: And then once people poop it out, this virus can also survive in the environment. For how long, you might ask? Another great question. Two weeks on surfaces and up to two months in water.

Erin Welsh: Two months in water.

Erin Allmann Updyke: And yes, I have not one but two citations to back all of these ridiculous numbers up because they're ridiculous.

Erin Welsh: Yeah. Okay. So it really was like the tip of the poop iceberg-

Erin Allmann Updyke: Yes.

Erin Welsh: When you said things are going to get worse. I didn't fully appreciate that.

Erin Allmann Updyke: Yeah. Yep. You're welcome.

Erin Welsh: Excellent.

Erin Allmann Updyke: And Erin, to continue answering your questions, asymptomatic carriers. Yes. Asymptomatic individuals can harbor this virus and continue the cycle of infection even without ever suffering its consequences. And I knew that you would ask how often is this asymptomatic and what's the deal here. I don't have an exact answer as to how often people are asymptomatic. But in various studies that have been done during outbreaks, just where they would check, for example, like random kids' poop in daycare centers and things like that, the range was anywhere from like 11%-40% of people that they examined in these various studies who didn't have diarrhea would end up testing positive for norovirus, depending on the setting that they were studying people. So potentially a pretty high amount of people can harbor norovirus and not necessarily have symptoms from it. And I'll get into a little bit more detail as to why that might be.

Erin Welsh: Yeah. Blood types, etc.

Erin Allmann Updyke: Ooh yeah.

Erin Welsh: I'm curious.

Erin Allmann Updyke: Kind of, kind of. Yeah.

Erin Welsh: Okay. Yeah. Because I was trying to read about it and then I was like ooh, don't spoil yourself. But also wait, what?

Erin Allmann Updyke: Yeah.

Erin Welsh: And then I couldn't understand it and then I was like just leave it to Erin to tell you later. But okay, in these studies, are these like high risk environments or during outbreaks or is it just straight up we're going to go to an elementary school? Which I guess maybe could be considered a high risk environment.

Erin Allmann Updyke: Right, right. Depends on your definition.

Erin Welsh: Yeah.

Erin Allmann Updyke: It was a variety. So there was a bunch of different studies that were cited and a bunch of different review papers and some of them were like during outbreaks where they tested people who maybe were associated but didn't have symptoms. And so you might think that they were more likely to be exposed. But then other studies where they, yeah, just checked random kids' poop in daycare centers to be like how many of these kids are pooping out norovirus? And so that's why there's such a big range.

Erin Welsh: Okay.

Erin Allmann Updyke: Yeah. And like I mean how many of these kids maybe like had norovirus three weeks ago and then so they're still pooping it? I don't have those numbers. But in any case, you definitely can have asymptomatic carriers.

Erin Welsh: Yeah.

Erin Allmann Updyke: If you're going to be symptomatic from norovirus, the incubation period is usually quite short. It can be as short as 12 hours, more often it's between 24 and 48 hours. And there is only one good thing if there is any good thing about this virus.

Erin Welsh: The silver lining. Let's hear it.

Erin Allmann Updyke: Yeah. It's that it's almost always self limited. And so the symptoms are usually pretty short, about 48 to 72 hours, like two or three days.

Erin Welsh: Just three days of literally barfing water that you're trying to ingest.

Erin Allmann Updyke: Yeah. I know. I didn't say it was good news.

Erin Welsh

No, no.

Erin Allmann Updyke

I just said it's the closest that we come.

Erin Welsh

Oh my gosh.

Erin Allmann Updyke

Yeah. Well anyways, I think that we got a really great description of symptoms in our firsthand account. So thank you again so much for being willing to share your story with us. But I will go in once again to a little bit of detail for us on what the symptoms of norovirus look like. Paint a picture if you will.

Erin Welsh

Oh please, yes.

Erin Allmann Updyke

For any of us who have, Erin, myself, listeners, ever woken up or just like you're going about your day feeling normal and then suddenly in the middle of what you thought was going to be a normal day, you just start feeling a little bit like trash kind of all over. You just start feeling unwell in your body. And then you start to feel a little bit nauseous. And then shortly thereafter you start just vomiting, just really truly vomiting your brains out. And then after that, you have body aches and maybe a bit of a fever, some chills. You think you can drink some water, you vomit again. And the next time that you vomit, you poop all over yourself on the bathroom floor. And then feel so horrible that you cry about it. And you're still fevering. And this cycle repeats itself a few more times throughout the night. And you wake up the next day, it's still kind of going though maybe when it's going to be diarrhea and when it's going to be vomit.

Erin Welsh

The age old question.

Erin Allmann Updyke

You never quite know. Then you survive on sips of Gatorade. You wake up the next day feeling a little bit improved and you think is it over? You nibble on some crackers and you think at least you'll survive today. You probably had norovirus.

Erin Welsh

Yep.

Erin Allmann Updyke

So that's usually how it goes. It's usually vomiting predominant at the forefront, often with fever, headaches, body aches, and usually moving into diarrhea which usually comes after the vomiting. But these symptoms are all a little bit non-specific and none of them are like an absolute clincher. That's just kind of the most common scenario. And like I said, most of the time this lasts for just a few days and then you get better on your own. If it happens in the setting of an outbreak or a little mini outbreak where it just spreads through your household, then you also notice or might notice this really short incubation period where you get sick and then a day and a half later your husband gets sick and then a day and a half later your friend who came over gets sick, etc. So that is the most common way that we see both outbreaks happen and individual cases.

But that does not mean that norovirus can't be more severe because it absolutely can. So especially in people with comorbidities, be they just age. So kids who are very, very young under the age of 5 are more likely to get very ill because of the diarrhea and vomiting that they have with norovirus. And same thing with our elders, those who are over 75-80, even over 65 if they have other comorbidities. And more and more in recent years, we are also seeing that people with various immune deficiencies have the potential to have a more severe infection. And that didn't always used to be the case, which is interesting and we're not quite sure whether it's changes in the genotype of the virus or what exactly is the reason for that.

But in these populations, then norovirus can cause a severe enough infection that people need to go to the hospital for IV fluids or supportive care and people can end up dying. We will talk in the current event section about how many people die but it's hundreds of thousands of people a year who die from norovirus infection. In the tiniest of babies, so teeny tiny newborn babies, norovirus can also cause something called necrotizing enterocolitis, which sounds bad because it is bad. And this means essentially that the bowels, the guts die and this can be very, very severe for these babies.

Erin Welsh

That's awful.

Erin Allmann Updyke

Yeah. So that's the main story when it comes to norovirus. But usually in this podcast, in these episodes, I like to try and dive into more detail on how do these viruses make us sick. But here's where things get interesting, as if this wasn't interesting enough already.

Erin Welsh

Yeah. Right here is where things are interesting, everyone.

Erin Allmann Updyke

This is the moment, how many minutes in.

Erin Welsh

Make a note.

Erin Allmann Updyke

Time stamp. With norovirus, we don't have an animal model for norovirus. So we don't have a lot of data on like how is it entering our cell? Which cells is it entering? Why does it cause so much vomiting? Why does it then cause diarrhea? Like we don't really have a lot of that level of detail on the pathophysiology of this virus which I wasn't expecting in all honesty. But here's what we do have, Erin, and it gets at your question of asymptomatic carriers.

Erin Welsh

Yeah.

TPWKY

(transition theme)

Erin Allmann Updyke

I don't know if this is when this data first started but I was reading this paper that cited a really, really old study that has since been verified. And now we have some data as to why they found these results. There was this old study that showed... They took a group of people and they challenged them with poop for the norovirus, a bunch of poop.

Erin Welsh

Yeah.

Erin Allmann Updyke

Like 12 of them. And half of them got sick and half of them didn't. And then they rechallenged those same people with more poop. And when they rechallenged them, the ones who got sick the first time got sick again and the ones who didn't get sick the first time didn't get sick the second time either. So the researchers were like what? That's weird. And why is this a repeatable finding? You might think like oh well maybe just someone wasn't exposed to as much or whatever. It turns out that this, who gets sick and who doesn't, might have and likely has something to do with a combination of course of the many different strains of this RNA virus, because there's a lot of different strains, but also our genetics and specifically some of the sugars that attach to our red blood cells.

Erin Welsh

It's so weird. It's so weird.

Erin Allmann Updyke

It's weird. It's not our blood type specifically. So Erin, you mentioned blood type.

Erin Welsh

Yeah.

Erin Allmann Updyke

We have an ABO blood typing system which more accurately should be called an ABOH system but everyone ignores the H. And I'm not going to get into a lot of detail on the blood typing system because it doesn't actually matter that much for norovirus. But these sugars, they're called antigens; these antigens that are attached to our blood cells also get secreted into our saliva and other mucus membranes, including other antigens as well. Like Lewis antigen, there's a few others that people secrete. However some people don't secrete these antigens into their saliva. And these people are called non-secretors. And non-secretors happen to be somewhat protected from norovirus.

Erin Welsh

Why?

Erin Allmann Updyke

Why? It's a great question. So these histo blood group antigens, these are HBGAs, and it's the A and the B and the H, etc; these are the receptors that the virus binds to on our cells. And so the thought is that because non-secretors just don't have as much of this in the environment for the virus to bind to in your mouth or in your gut or wherever you're getting exposed to this virus, then that is why they are at least relatively protected. Because it's not there for the virus to bind to. Does that make sense?

Erin Welsh

Okay. Yeah.

Erin Allmann Updyke

It's not that satisfying of an answer but it's interesting.

Erin Welsh

I mean it makes sense. It's logical. But also I just want to know like what else is this involved in?

Erin Allmann Updyke

Right. Yeah. Do you mean just like the blood types and stuff?

Erin Welsh

I feel like when people realized that blood typing was a thing-

Erin Allmann Updyke

Right.

Erin Welsh

Or that we had these different blood types, that it was going to answer everything.

Erin Allmann Updyke

Right.

Erin Welsh

Or at least that's my perception about it. But then it turns out it doesn't really seem to have all that much effect size in terms of differences.

Erin Allmann Updyke

Yeah, yeah.

Erin Welsh

So it's interesting that like... And again, I know this is not blood types but it's on the fringe of that.

Erin Allmann Updyke

Right. It's related to your blood type.

Erin Welsh

Yeah.

Erin Allmann Updyke

And what is very interesting to me is that it's not necessarily that like someone with this blood type is necessarily a non-secretor, right. Like those two things don't go hand in hand. And at the same time, at least some of the data that I saw suggested that maybe some people with you, Erin, blood type AB, might be relatively protected.

Erin Welsh: Really?

Erin Allmann Updyke: So here I am calling you a norovirus queen when it's me.

Erin Welsh: Yeah. I have had norovirus so-

Erin Allmann Updyke: Well I mean who knows?

Erin Welsh: Yeah.

Erin Allmann Updyke: Maybe it was adenovirus, there's a lot of others. In any case though, that's what we know about the nitty gritty of norovirus. When it comes to diagnosis, a lot of times like we did for ourselves during this episode, Erin, we can clinically diagnose norovirus, especially during outbreaks. There's a really interesting set of criteria that you can use to diagnose norovirus during outbreaks even without having molecular tools. And it holds up even many years after people came up with this criteria, they went back and looked at outbreaks that they had, like PCR data, and they were like wow, these criteria actually do a pretty good job. It's essentially that almost everyone's vomiting, more than half of people are vomiting. The incubation period is 24-48 hours. The total duration of illness is between 12-60 hours. And not total but the mean duration of illness. And that in the people that you were able to get samples from, you didn't find any bacterial pathogen obviously.

Erin Welsh: Right, right, right. Yeah.

Erin Allmann Updyke: But so those are the outbreak criteria that people can use. And the bummer is we still don't have any specific treatment for norovirus. And so when people do get very ill from norovirus, all we really have is supportive care and we still don't have any vaccine. But there's a lot of work being done.

Erin Welsh: Yeah.

Erin Allmann Updyke: So prevention is really the key to norovirus.

Erin Welsh: I mean hand sanitizer doesn't work, let's talk about that.

Erin Allmann Updyke: No but washing your hands does! Listen to our tagline.

Erin Welsh: Yeah. One of the outbreaks that I read about was on the Pacific Crest Trail in 2022 I think. And I think that last year is when the CDC was like oh we connected the dots, it was norovirus. But basically on the trail, people who were doing a through hike were getting super sick after staying in this cabin or whatever.

Erin Allmann Updyke: Yeah. I feel like I saw someone on TikTok who probably had gotten that. Anyways, sorry.

Erin Welsh: Oh like on the PCT?

Erin Allmann Updyke: Yeah.

Erin Welsh: Yeah, yeah. And like it completely makes sense to me even though I never would have thought of it before. When you're hiking and camping, especially if you're like doing backpacking, you don't get to thoroughly wash under running water 20 seconds, 25 seconds, whatever it is.

Erin Allmann Updyke: Nope.

Erin Welsh: It's just... Yep. And so there was-

Erin Allmann Updyke: I mean unless you are lucky enough to have a stream where you can... But then you're washing in stream water.

Erin Welsh: Exactly. Then you're washing in stream water. And yeah. What a horrible place too to also have non stop vomiting and diarrhea, just like on a backcountry trail.

Erin Allmann Updyke: Potentially quite dangerous.

Erin Welsh: Yeah.

Erin Allmann Updyke: So Erin-

Erin Welsh: Yeah.

Erin Allmann Updyke: Can you tell me where did this virus come from? How is it here with us? All about it.

Erin Welsh: Let's do that. Let's get into it right after this break.

TPWKY: (transition theme)

Erin Welsh: The first part of our story begins in 1929 with a report written by John Zahorsky, a pediatrician in St. Louis. In this report titled 'Hyperemesis hiemis or the Winter Vomiting Disease'-

Erin Allmann Updyke: Ah, the winter vomiting disease.

Erin Welsh: The winter vomiting disease. In this report, Zahorsky describes how he's observed and treated epidemics of gastrointestinal illness over the past 30 years, over his entire career, and they all tended to happen in the winter months. And this report seemingly struck a nerve with other pediatricians who were like yeah, mass outbreaks of vomiting in the winter, a lot of kids, yep, that sounds familiar, been there, done that. And they also had been wondering like what on earth could this be caused by? Is it one disease or not? The most popular working theory at the time was that it was milk.

Erin Allmann Updyke: Milk?

Erin Welsh: Milk.

Erin Allmann Updyke: Like cow's milk.

Erin Welsh: Like cow's milk. Yeah. And specifically that milk having been delivered on the doorstep would freeze in the winter months and then it would pop, the liquid would expand and freezing and it would pop off the bottle top, exposing the milk to some sort of contamination.

Erin Allmann Updyke

How interesting. Because then it would only happen in places that get cold enough to freeze. It's not happening here.

Erin Welsh

Yeah. Okay.

Erin Allmann Updyke

Cool.

Erin Welsh

It's not happening in the future because of global warming. But the milk hypothesis was not right. Zahorsky, in a later report describing a multi thousand strong outbreak in St. Louis in 1940, he agreed that milk, yeah, it's probably likely to blame and that it was probably something to do with an overabundance of bacteria despite pasteurization in the winter months. This was a hunch.

Erin Allmann Updyke

Okay.

Erin Welsh

Like there was no evidence to back this up.

Erin Allmann Updyke

Cool.

Erin Welsh

And his idea, this idea of his was not borne out in subsequent outbreaks where investigators could find no single food item or exposure linking everyone together. And that particular characteristic of these outbreaks is sort of the randomness of it or the not so much randomness but just like how did everyone get sick and the timeline of things, that called into question whether or not this was a distinct clinical entity or just coincidence. So I came across a paper from 1943 titled 'Is there an Epidemic Vomiting Disease of Winter?' Question mark.

Erin Allmann Updyke

Just like is that even a thing?

Erin Welsh

Does it exist? And I think their conclusion was like maybe.

Erin Allmann Updyke

Interesting.

Erin Welsh

More research. Yeah. And then there was another paper that I read that detailed an outbreak in Charleston, South Carolina in 1941 and 1942. And at the end of it, the author of this paper writes, quote: "This account adds very little to the knowledge of the vomiting disease." End quote.

Erin Allmann Updyke

We did all of this work and we know nothing more than we did before. Honestly I can empathize a lot with that feeling.

Erin Welsh

I can. But I also cannot imagine a paper today-

Erin Allmann Updyke

Getting published?

Erin Welsh

That does not overstate. And then this has the potential to greatly influence our knowledge of X, Y, and Z.

Erin Allmann Updyke

Oh that's really funny.

Erin Welsh: But I loved it. But yeah, and then the paper does go on to say that hopefully though this will get people more interested in winter vomiting disease.

Erin Allmann Updyke: Yeah.

Erin Welsh: And it did. There continued to be sporadic reports about winter vomiting from all over the globe trying to make sense of an acute gastroenteritis that seemed to strike members of a family at random, where there seemed to be no central point of contamination, and where no one had found consistently an infectious agent responsible for the infection. But for the most part, epidemic winter vomiting was kind of like a background player on the foodborne illness outbreak scene for decades. And it just didn't draw nearly as much attention or resources as bacterial contaminants like salmonella or E. coli, which were much more easily detectable, which also made them the biggest targets for food safety measures.

Erin Allmann Updyke: Okay.

Erin Welsh: And this lack of appreciation continued even after the causative agent of winter vomiting disease or acute infectious nonbacterial gastroenteritis, which is also such a mouthful... I mean let's go back to winter vomiting disease. I guess norovirus is fine. But so the causative agent of this was discovered in 1972 and still people didn't really care that much about it at the time.

Erin Allmann Updyke: Interesting.

Erin Welsh: And so when it was discovered, it was given the name the Norwalk agent. Later it was called norovirus but at the time the Norwalk agent. Do you want to know how it got the name Norwalk agent? Okay. In October of 1968, at an elementary school in Norwalk, Ohio, it was right around Halloween time, 50%, 116 of 232 of the students and teachers at this elementary school came down with acute gastrointestinal illness. 50%.

Erin Allmann Updyke: 50%?

Erin Welsh: Yeah.

Erin Allmann Updyke: All like within a day or like what time frame?

Erin Welsh: The bulk was within 48 hours but I think it was like not over a very long period of time.

Erin Allmann Updyke: Right, right. Oh my gosh.

Erin Welsh: It was not a slow burn. Yeah. Flash flood I guess.

Erin Allmann Updyke: Just imagine the smells.

Erin Welsh: Yeah. Oh my god.

Erin Allmann Updyke: Yeah. Elementary school. Not everyone can hold that.

Erin Welsh: There's not enough sawdust to cover the vomit.

Erin Allmann Updyke: Oh the elementary sawdust. Yeah, yeah, yeah.

Erin Welsh: The smell, I can still picture it and smell it. Exactly.

Erin Allmann Updyke: Oh yeah.

Erin Welsh: But then of course because it's norovirus, the illness didn't stop there. It spread to other family members and then friends and other contacts in the community. And so public health investigators were like oh god, what is happening? Let's test everything we can. We're testing water, we're testing food, we're testing poop for bacterial agents. And they also surveyed the students and the teachers for any sort of commonality. And they came up empty. To the researchers, this strongly suggested a viral origin.

Erin Allmann Updyke: Makes sense.

Erin Welsh: But how do you prove that back then?

Erin Allmann Updyke: Not filtering something, something, right? No, not that?

Erin Welsh: Well my answer here was two words, human volunteers.

Erin Allmann Updyke: Ooh yes. There was a surprising to me number of papers that talked about all of the human volunteer studies that they did with norovirus.

Erin Welsh: Yeah.

Erin Allmann Updyke: Where they were like and then these 12 people, we fed them poop and then we fed them poop again and then again.

Erin Welsh: Right.

Erin Allmann Updyke: And I was like who are these people?

Erin Welsh: Who are these people? How can you be saying this so casually? Like oral administration of stool filtrates is the technical words.

Erin Allmann Updyke: Yes! Yeah. That's just poop in mouth, dude.

Erin Welsh: Poop in mouth. Horrible. Okay. And so in this specific instance, they took poop, like actual poop or rectal swabs from people in the Norwalk and other outbreaks.

Erin Allmann Updyke: Yeah.

Erin Welsh: And they added some special ingredients like veal infusion broth-

Erin Allmann Updyke: What?

Erin Welsh: Bovine serum albumin, and then they shook it all up and then filtered so that at the end result was this nice little cocktail of filtered poop. The filtrate, the liquid that came through was then treated with antibiotics and then yeah, fed to the volunteers. Which in this study was a mix of, you asked who are these people?

Erin Allmann Updyke: Yeah.

Erin Welsh: A mix of male prisoners.

Erin Allmann Updyke: So quote unquote "volunteers".

Erin Welsh: A mix of men in prison. Volunteers.

Erin Allmann Updyke: Yep.

Erin Welsh: And then they also said, so we had, I think I don't remember the exact phrasing but it was like these 50 male prisoners and then quote "normal volunteers".

Erin Allmann Updyke: Oh dear. Okay.

Erin Welsh: Excellent, yeah. Informed consent was obtained. They clarified that.

Erin Allmann Updyke: Sure. Wink.

Erin Welsh: Pretty much everyone who was fed samples from Norwalk got sick within 48 hours.

Erin Allmann Updyke: Wow.

Erin Welsh: A few remained asymptomatic.

Erin Allmann Updyke: Interesting.

Erin Welsh: And one person in the study vomited approximately 20 times within a 24 hour period and needed like fluid administration. Just 20 times. I just...

Erin Allmann Updyke: 20. Ugh.

Erin Welsh: Yeah. And I'm not sure if it was this paper or a different paper because this, like we talked about, this administration of fecal whatever was done multiple times. But in one of those studies, the researchers wanted to test for immunity and so they tested the volunteers again, they exposed them again to more poopy samples.

Erin Allmann Updyke: Yep.

Erin Welsh: I mean can you imagine like vomiting 20 times in an hour and then getting better. And then a few, I don't know how long it was afterwards, being like so do you want to go through that again?

Erin Allmann Updyke: Do that again.

Erin Welsh: We don't know the likelihood.

Erin Allmann Updyke: Yeah.

Erin Welsh: But yeah. But fortunately there was enough immunity that the person or the people who were tested again a second time didn't get sick.

Erin Allmann Updyke: Okay.

Erin Welsh: At least in that instance. With the help of these volunteers, researchers were able to demonstrate that yes, winter vomiting disease was a viral infection. And it also helped to lay out some of the infection characteristics like incubation period, like how many times you can hope to vomit or poop your pants in a 24 hour period, stuff like that.

Erin Allmann Updyke: Right.

Erin Welsh: And because these samples were from Norwalk are the ones that got people the most consistently I'll, hence Norwalk agent or Norwalk virus.

Erin Allmann Updyke: The name. Okay.

Erin Welsh: Yep. A few years later, researchers Kapikian and colleagues visualized the virus for the first time. And that was fantastic news because it meant that if you suspected an outbreak of Norwalk virus or norovirus, you didn't have to spin down poop and then get a bunch of volunteers to feed it to them to prove that you had a virus on your hands or this virus on your hands. You could just like look for it in the samples.

Erin Allmann Updyke: Right. Actually find the virus.

Erin Welsh: The virus. Unsurprisingly, being able to test for Norwalk-like viruses or noroviruses as they were soon to be called, led to the virus being detected in more and more outbreaks of acute gastroenteritis. But it still remained a really underappreciated cause of AGE, acute gastroenteritis because I don't want to keep saying that, until the late 1990s, perhaps because of the long standing belief that viruses were rarely responsible for AGE and that most cases were down to E. coli or salmonella. But also because norovirus infections tended to be self limiting.

Erin Allmann Updyke: Right.

Erin Welsh: And so not everyone sought treatment for them. And so a lot of cases went under reported or undetected.

Erin Allmann Updyke: Right. You don't appreciate the full scale or scope of it.

Erin Welsh: Exactly, yeah.

Erin Allmann Updyke: Okay.

Erin Welsh: Yeah, yeah. And there could be entire outbreaks that you just completely miss too, right. But this also meant that the food safety measures targeted primarily foodborne bacteria and weren't necessarily effective against norovirus which is a different beast entirely.

Erin Allmann Updyke: Right.

Erin Welsh: Things like I think chlorination or refrigeration, some of these things, I mean like we talked about hand sanitizer. Norovirus is like okay, like I'm not bothered at all. And we can kind of see this in action. So between 1993-1997, more than 2500 foodborne outbreaks were reported to the CDC in the US and 68% were labeled as unknown etiology. Like great question, we don't know. And less than 1% were attributed to noroviruses.

Erin Allmann Updyke: That just means that they didn't look for norovirus in 68% and they would have found noro or another virus in most of those.

Erin Welsh: Exactly.

Erin Allmann Updyke: Yeah.

Erin Welsh: Yeah. And then though the advent of reverse transcription PCR in the 1990s made detection of noroviruses even easier, you didn't even have to look under a scope. And they began to draw more and more of the spotlight. And so today they're estimated to cause about 50% of all foodborne acute gastroenteritis cases in the US. Which is a lot.

Erin Allmann Updyke: The numbers are wild, Erin. Just wait.

Erin Welsh: They are truly. And to borrow from the title of a 2005 paper, 'Are Noroviruses Emerging?' Probably. They're making up a bigger piece of the foodborne illness pie, partly because of better detection, partly because of food safety measures leading to a drop in bacterial foodborne outbreaks, and partly because our behaviors are changing around the globe. Global travel, the cruise ship industry which I know makes up only part of the norovirus story and also probably we have such that link because the reporting is mandated. Whereas I think it's not like at home.

Erin Allmann Updyke: With norovirus?

Erin Welsh: Yeah.

Erin Allmann Updyke: No. Especially not like single cases.

Erin Welsh: Right.

Erin Allmann Updyke: Norovirus is not a reportable illness.

Erin Welsh: Right. But if there's an outbreak on a cruise ship, that's definitely reportable.

Erin Allmann Updyke: Right.

Erin Welsh: And so I think it just sort of like underlines the link between norovirus and cruise ships is that it's just like yeah, important to identify what it is. Yeah. But then there's also things like irrigating crops with sewage contaminated water, the globalization of food distribution, contamination of fresh and seawater leading to higher accumulation by shellfish, and as norovirus continues to grow, as we enable it to grow and spread, it's also evolving. We've already seen genetic changes in globally circulating strains which may impact transmission efficiency. Norovirus isn't going anywhere anytime soon unless there's a vaccine on the brink of introduction and you're about to tell me about that, Erin. Maybe? Fingers crossed. No?

Erin Allmann Updyke: It's not going anywhere anytime soon.

Erin Welsh: Cool. Great. Awesome. Well until there is a vaccine or something that we can do, our best bet is in controlling the virus, preventing exposure, cleaning contaminated surfaces. And that takes a better understanding of what exactly it is doing and how it is being spread. Let's talk about vomit.

Erin Allmann Updyke: Okay.

Erin Welsh: Yeah. Okay. If you have emetophobia, I think that's how you say it, it's extreme fear of vomiting.

Erin Allmann Updyke: I think that's how you say it.

Erin Welsh: Now might be the time to fast forward if you have made it this far somehow. Because I felt so nauseous in writing this and reading about this, like I had to stop several times and be like I gotta take a breather, this is making me feel actually ill. But as a physiological response, vomiting or emesis is an ancient one, like deep time ancient. So, so many animals vomit. Reptiles, fish, amphibians, birds, primates. So many mammals. It's incredibly widespread in the animal kingdom with some surprising exceptions. Like rodents and lagomorphs, which either never evolved the response in the first place or lost it somewhere along their evolutionary journey. And this, you talked about how we don't have a good animal model for norovirus, it might be in part because like this has been challenge because rodents, like our go to is lab rats, lab mice-

Erin Allmann Updyke: Our normal species, yeah.

Erin Welsh: They don't vomit. So that's been a challenge overall in understanding the physiological mechanisms of vomiting and how that pathway is formed and how different stimuli affect different things and so on. With the neural responses and linking.

Erin Allmann Updyke: Right.

Erin Welsh: Is nausea different from vomiting? Are they on the same pathway or different pathways? All of this stuff, which is really fascinating, has been difficult to do. Also horses don't vomit.

Erin Allmann Updyke: What?

Erin Welsh: Yeah. And probably more animals that I missed. But those are the ones that I came across.

Erin Allmann Updyke: I don't think I've ever wondered if animals vomit because I've always just assumed... I bought my niece a book called 'Does It Fart?'

Erin Welsh: Yeah.

Erin Allmann Updyke: When she was younger. That someone wrote, that's a hilarious book examining who farts in the animal kingdom because not all animals fart. But I just assumed that all animals vomit. We need a sequel.

Erin Welsh: Yeah, we do. I feel like my Google skills are pretty good. I'm pretty good at searching for things. I found it difficult to find a review on vomit.

Erin Allmann Updyke

Well then.

Erin Welsh

Well then.

Erin Allmann Updyke

That's another book idea for you, Erin. There we go. I don't know if I could make it through. You get a little too nauseous?

Erin Welsh

It might, yeah.

Erin Allmann Updyke

How interesting.

Erin Welsh

Yeah. But it's also surprising that it's not more widespread, right. Because vomiting is a super helpful defensive response. Like let's say we eat something poisonous, something that bypasses our other defensive barriers, like taste and smell. Our vomiting response can protect us from being harmed by those ingested toxins. Morning sickness, which is like nausea and vomiting in the early months of pregnancy, that's thought to be beneficial because it helps to avoid certain foods that might contain more pathogens. Nausea and vomiting evolved in a very different setting than most of us find ourselves today. Compared to the past, we're not doing too bad when it comes to foodborne illness and safe food practices.

But we still have these super sensitive responses that may at times feel very unwelcome. Like sea sickness or motion sickness, reactions to certain medications or anesthesia, there are occasions where that vomit pathway is activated where it might not be protecting us from foodborne toxins. But it still happens because evolutionarily it was so beneficial. And of course too much of a good thing can be a bad thing, like vomiting that goes on for long periods or happens too frequently during pregnancy, that can be harmful to both the pregnant person and the fetus. So like seems to be beneficial up to a point. Motion sickness still seems to be a bit of a mystery in terms of why that response would evolve. Like does it provide any evolutionary advantage? Unclear. We're going to maybe do an episode about it. And of course, if... I think it's on our list, Erin.

Erin Allmann Updyke

I feel anxious.

Erin Welsh

And of course if you're barfing a lot after a bout of food poisoning or a GI infection, you're at risk of dehydration and just like full body system collapse. And sometimes this vomit response can be co-opted by our little pathogen friends so that they can get to know everyone in your close circle or on your cruise ship. Researchers have for a long time recognized how important vomiting is in the transmission of norovirus but it was only relatively recently that they were able to directly measure just how important. And they did it using Vomiting Larry.

Erin Allmann Updyke

Vomiting Larry. I need to know so much more.

Erin Welsh

It's a capital V, capital L.

Erin Allmann Updyke

Of course it is.

Erin Welsh

Yes. Proper noun. So let me introduce you to Vomiting Larry. So Vomiting Larry was created by the UK's Health and Safety Laboratory. Picture a CPR mannequin. You know like from the one episode of The Office? Or Erin, you've seen them I'm sure all over the place.

Erin Allmann Updyke

I love that that's the reference. Yep.

Erin Welsh: Yeah. That's what comes to my head. You can call him Airway Larry, that's actually his real brand name. Airway Larry is great for teaching things like intubation, ventilation, CPR, etc, because he has teeth, he has a tongue, he has a larynx, he has trachea, vocal cords, just the full shebang of upper torso gear.

Erin Allmann Updyke: Yeah.

Erin Welsh: And what you want to do is now remove Airway Larry's head from the plastic organs he came with, like lungs and stomach, and then you want to attach Larry to a pressurized set of tubes. Basically like a mannequin head, mouth fully agape, sitting on top of a long clear plastic tube.

Erin Allmann Updyke: Okay.

Erin Welsh: Which you can fill with fluid to then be forcefully ejected through Vomiting Larry's mouth.

Erin Allmann Updyke: Okay.

Erin Welsh: It's incredible to see in action.

Erin Allmann Updyke: There's videos I assume, we can find.

Erin Welsh: Of course there are videos.

Erin Allmann Updyke: Okay, good.

Erin Welsh: And so what researchers did is that they filled Larry's tube, his stomach, his food pathway, with fluorescent fluid and let her rip. And when they flip on the black light UV bulbs, they can see just how far his projectile vomit made it. And so you can do this with differing amounts of vomit. You can do this with different force. You can do this with different I would assume consistency of vomit.

Erin Allmann Updyke: Consistencies. Or different trajectories, like towards the toilet vs I didn't make it.

Erin Welsh: Versus just pure projectile, like came on suddenly.

Erin Allmann Updyke: Right. Yeah.

Erin Welsh: Yeah.

Erin Allmann Updyke: Like my kid all over the couch.

Erin Welsh: Excellent.

Erin Allmann Updyke: Yep.

Erin Welsh: Yeah, exactly.

Erin Allmann Updyke: Yep.

Erin Welsh: Oh no, my god. Okay so but they did this with 1 liter of barf, of fluorescent barf, which is a lot.

Erin Allmann Updyke: Okay. That's a lot.

Erin Welsh: It's like kind of a worst case scenario.

Erin Allmann Updyke: Yeah.

Erin Welsh: But in norovirus, sometimes it maybe feels worst case. So 1 liter. Most of the 1 liter that was ejected through Larry's mouth hung around in an area of around 1.2 x 1.6 meters, so like 4 x 5 feet.

Erin Allmann Updyke: Okay.

Erin Welsh: Which is still a lot. But there were splashes that made it over 3 meters in front of Larry, over 9 feet, like splashes, and 7 feet to the sides.

Erin Allmann Updyke: Gross.

Erin Welsh: Absolutely horrific but probably not surprising to anyone that has experienced or witnessed projectile vomiting before. But what that means is that you have a tremendously huge area that you need to disinfect, an estimated 84 square feet or 7.8 meters squared. Yeah. I watched a YouTube video of Vomiting Larry and another vomiting machine which is like a mini one, it's very cute.

Erin Allmann Updyke: Okay.

Erin Welsh: I don't know if this one has a name but it's created at North Carolina State University. And in one of the Vomiting Larry videos, a researcher let Larry spew his fluorescent liquid all over the arena and then cleaned it up the best that they could under normal lighting.

Erin Allmann Updyke: Oh love this.

Erin Welsh: And then when they were like okay, all done, this looks clean, I think I got it all up. Flip on the blacklight and there's still spatter everywhere.

Erin Allmann Updyke: Schmears everyone.

Erin Welsh: And so I know that vomit doesn't contain quite as much norovirus particles as poop-

Erin Allmann Updyke: The poop.

Erin Welsh: But still, it's there and if it's going to live on that surface for a while, it is rough. But even more was that this researcher looked down at themselves and was like oh it's on my gloves. Okay. It's on my cuffs, it's on my face. Because you can imagine if you're cleaning up and let's say that your hair falls into your face, you just... Yeah. And it's not like this person wasn't trying, like they really were trying to clean up every bit possible. It's just that vomit really goes everywhere. And norovirus is so, so dang infectious.

Erin Allmann Updyke: Ugh.

Erin Welsh

And then of course you mentioned the aerosolized particles. So part of how we know more about this is creatures like Vomiting Larry and the NC State one. One study detected per cubic meter of air between 1400-2400 genomes of human norovirus in healthcare facilities experiencing an outbreak. Like actual transmissible amounts in the air, just there. Erin, I am both in awe and still terrified of norovirus and I would really love for you to tell me that there's some good news on the horizon for this bug.

Erin Allmann Updyke

Okay.

Erin Welsh

I do have to mention that I have a list of vomit trivia that I didn't know how to squeeze into the rest of the narrative. So if you would like to hear any of those, I can share them with you or we can just chat later.

Erin Allmann Updyke

I think I'd like to at least hear some of this vomit trivia. Because what?

Erin Welsh

Okay, it's just a few.

Erin Allmann Updyke

Okay.

Erin Welsh

Number one, you know the so-called like vomitorium? The vomitoria from Ancient Rome where people would allegedly go to vomit after eating a bunch of really rich food.

Erin Allmann Updyke

Yeah, yeah. They gorge themselves and then bulimia.

Erin Welsh

Yeah.

Erin Allmann Updyke

Yeah.

Erin Welsh

Yeah. Apparently there's no actual, unsurprisingly, evidence for this.

Erin Allmann Updyke

Interesting.

Erin Welsh

Vomitoria is a real term that used to be used but it was what the entrances and exits of like theaters or public arenas were called because people would just like spew forth to get good seats or when they're all leaving in a rush.

Erin Allmann Updyke

Oh that's really funny.

Erin Welsh

Isn't that great?

Erin Allmann Updyke

Oh that's good trivia.

Erin Welsh

These are all over the place.

Erin Allmann Updyke

I love it.

Erin Welsh

In 1992, George H. W. Bush barfed on the Japanese Prime Minister during a visit. And there was a new slang word created basically meaning to pull a Bush. So like if you vomited, it was you're pulling a Bush.

Erin Allmann Updyke

Oh that's really funny.

Erin Welsh

I liked that one. According to the Guinness World Records, the oldest vomit is 160 million years old and is from an ichthyosaur.

Erin Allmann Updyke

Petrified vomit?

Erin Welsh

Petrified vomit, yeah.

Erin Allmann Updyke

Fun.

Erin Welsh

Did you know-

Erin Allmann Updyke

No.

Erin Welsh

That there is a diterpenoid substance, like a secondary metabolite, produced by certain types of corals in subtropical waters? And this compound, scientists named it pukalide. Do you know what pukalide does?

Erin Allmann Updyke

No.

Erin Welsh

It induces vomiting in fish that consume it. And so it's a great defensive mechanism for these corals because fish will come up, eat a small amount of it, and then just vomit a lot.

Erin Allmann Updyke

Barf.

Erin Welsh

Which I really like. Yeah.

Erin Allmann Updyke

You really like that, Erin.

Erin Welsh

I do like that. And speaking of vomit as a defense mechanism I guess, vultures are well known for their defensive vomiting. This is a quote that I pulled from a paper, an older paper-

Erin Allmann Updyke

Sorry, I did not know this about vultures. Thank you.

Erin Welsh

I think I've just been deep in the vomit literature so it feels like familiar knowledge.

Erin Allmann Updyke

Like as everyone knows-

Erin Welsh

As everyone knows, of course, those old vultures and their vomit.

Erin Allmann Updyke

Okay.

Erin Welsh

Okay, this is a quote that I pulled: "When wounded or entrapped, the turkey vulture has two means of defense. It ejects at the enemy the putrid contents of its gullet and if this is not enough, the bird can play possum, apparently dying." Doesn't actually die, it just pretends to die.

Erin Allmann Updyke Right, right, right.

Erin Welsh Yeah.

Erin Allmann Updyke I know what playing possum means. That I do know. I've just been deep in the possum literature, so I wasn't sure.

Erin Welsh Oh wow.

Erin Allmann Updyke Okay.

Erin Welsh That's fun.

Erin Allmann Updyke One last one.

Erin Welsh Give it to me.

Erin Allmann Updyke Okay.

Erin Welsh This one makes me nauseous, this is why I was like really feeling sick. It's so fascinating though. It turns out that our perception of odors can be greatly influenced by verbal cues. So what do I mean by that? There was a study from 2001 where researchers exposed participants to various smells that aren't super specific. Do you what I mean? Like they can be found in multiple different things or sources.

Erin Allmann Updyke Okay.

Erin Welsh And on the first exposure they said okay, the source was one thing and on the second exposure they exposed the participants to the same exact scent but they said it came from a different source.

Erin Allmann Updyke Okay.

Erin Welsh Then they asked whether the participants believed that the two scents were the same or different.

Erin Allmann Updyke Okay.

Erin Welsh One of these scents was a 1:1 combination of isovaleric and butyric acids. On the first exposure of IB acid, and this is the compounds, participants were told that they were smelling Parmesan cheese. On the second exposure, they were told that they were smelling vomit. 83% of them thought that they were smelling two different things.

Erin Allmann Updyke Wow.

Erin Welsh Which as a Parmesan cheese eater, I find really disturbing. But like also how amazing that your perception of smell or like your response to it can be so influenced by words.

Erin Allmann Updyke That is really interesting.

Erin Welsh: Yeah. There were some other ones like patchouli, they said this is either a musty basement or incense.

Erin Allmann Updyke: Well I mean that's six and one half dozen of the other to me. Oh that's really funny.

Erin Welsh: Oh my gosh. But yeah, those are all of my vomit trivia that I gathered.

Erin Allmann Updyke: I really loved it. I really hope that we have a trivia night sometime soon so that I can really pull those out because...

Erin Welsh: The vulture one, it's golden.

Erin Allmann Updyke: Yeah. Well I can move us a little bit forward from vomit, if you like.

Erin Welsh: Please do, I'm ready to leave this behind.

Erin Allmann Updyke: We'll take a quick break and then I'll tell us what's up with norovirus in the world today.

TPWKY: (transition theme)

Erin Allmann Updyke: Norovirus is a very big deal worldwide. And even though most of the time, as we talked about, it is self limited, it is also the today leading cause of epidemic gastroenteritis worldwide across every single age group. What this means, and you mentioned this a little bit, Erin, is 50% of outbreaks are estimated, at least 50% of outbreaks are estimated to be caused by gastroenteritis. Which means any time that there's a cluster of people who get sick from a single source, 50% of the time that's noro. And 90% of nonbacterial gastroenteritis outbreaks. So anything that's not bacterial gastroenteritis, it is norovirus.

Erin Welsh: I wanna know what the other 10% is.

Erin Allmann Updyke: Other viruses most likely. And then sometimes toxins.

Erin Welsh: Okay, okay.

Erin Allmann Updyke: Yeah. And it causes countless, I don't have an exact number of the number of outbreaks, but so many outbreaks every year in hospitals, in schools, in military facilities, at fancy resorts, and on cruise ships. Literally everywhere. But norovirus is not just limited to outbreaks. Norovirus is a cause of regular old gastroenteritis as well. And it's estimated that overall norovirus causes close to 20% of all cases of acute gastroenteritis worldwide. Like every time that someone gets sick and starts vomiting and having diarrhea, 20% of the time it's probably norovirus. So what does that number look like? At least 685 million cases every year.

Erin Welsh: Wow.

Erin Allmann Updyke: So we're talking over half a billion cases every year.

Erin Welsh: Oh my god. Okay.

Erin Allmann Updyke

And while this is most of the time self limited, we know that this infection can also cause more serious illness. So it's estimated that norovirus results in 200,000 deaths worldwide, 50,000 of which are in children under age five every year. And these deaths are primarily in low and middle income countries that don't have access to as much supportive care. If you want data from just the US, it's estimated that norovirus causes 21 million cases every year of acute gastroenteritis just in this country. And that's about 60% of all cases where we know what the cause was, like where we're able to identify the cause. This results in 71,000 hospitalizations and over 400,000 ER visits.

Erin Welsh

Whoa.

Erin Allmann Updyke

Like this is not minor because all of that also has an economic burden. And globally the total economic burden of norovirus is estimated at \$60 billion every year due to both healthcare costs and economic losses.

Erin Welsh

I have a question about-

Erin Allmann Updyke

Okay.

Erin Welsh

I'm sorry, vomiting again. But like at what point, what are the signs to be like now you should go to urgent care, ER, whatever?

Erin Allmann Updyke

Yeah, that's a really good question. Certainly if you're not peeing. If you go the day and you're vomiting and you haven't peed all day.

Erin Welsh

Okay.

Erin Allmann Updyke

That's not normal.

Erin Welsh

Okay.

Erin Allmann Updyke

So if you have like a reduction in or if you're looking at your kid's diaper, for example, and they have like one or two wet diapers in a day, that's not normal. So that's very worrisome. So we think about urine output. But also just if every time that you try and take a sip of water, you're barfing it back up, then you're not retaining any of that liquid. So then that's a reason that you would want to seek care. Or similarly if every time you take a sip of water, you're just pooping your brains out, because it could go either direction especially with norovirus. Those are the main... It's not like an exact number because it's also going to be different for every person depending on how hydrated were you before you got sick? How tiny are you? How young are you? How old are you? Yeah.

Erin Welsh

Okay.

Erin Allmann Updyke

So what do we do about it? I have a little niche fun fact since we're doing fun facts in this episode. Trivia.

Erin Welsh

Fun.

Erin Allmann Updyke

One of the things I found that is so interesting and cool about norovirus when it comes to the current research is that there exists a thing called NoroNet and this is a data sharing network that is this international, quite informal network of people that you can join, you can submit your information to try and join NoroNet. I don't know what the vetting process is like but it exists. And it's been around since the mid 90s. And it's just this international network of people who study norovirus and share all of the deets that they find about it. So it's mostly genomic data from all over the world. There's like 25 countries that are represented on every single continent. And this data sharing network has led to some really important advancements in knowledge with regards to things like the changes in genotype that we're seeing, with some genotypes being more prevalent now than they were before. Or maybe is the virus becoming more virulent? Like things like that.

And all of this is really important for the biggest area of research in norovirus, vaccine development. There's a lot of interest in the development of a vaccine but we don't have one yet. That's the short answer. And what I think, there's a few things that make it really hard. One is that, and you kind of mentioned this, Erin, we do have data that people can develop immunity to norovirus. But what we don't really know is how long this lasts. We also don't know how robust that immunity is when we're talking about so many different genotypes and an RNA virus that does mutate fairly rapidly. And because most people don't get that sick from norovirus, from an economic perspective it's hard to maybe think of the incentives for vaccine developers which is a huge downside when you have capitalism, etc.

Erin Welsh

Right.

Erin Allmann Updyke

But what I found really interesting is that there was a cost analysis, that they did this simulation model that said that even if a vaccine were only about 50% effective, so that's like our best flu shot, for example, and only lasted for about 12 months. So think, you'd have to get a norovirus vaccine every year like you do the flu shot and you'd only have about partial protection. It was estimated that even a vaccine that met those criteria would save \$1000-\$2000 in healthcare costs per case averted of norovirus. And again, there's 685 million cases.

Erin Welsh

Right.

Erin Allmann Updyke

So if you could have adequate vaccine uptake, you could have some pretty significant cost savings. But how do you get good vaccine uptake? How many people get their flu shots, COVID shots, etc? But that being said, there are a lot of people who are working on vaccines and the World Health Organization has a great website actually that you can see a list of a whole bunch of different vaccines of various types, so using different vaccine platforms, a lot of which are in phase two or three clinical trials as of this recording in 2024. So that's pretty exciting stuff.

Erin Welsh

Yeah.

Erin Allmann Updyke

Someday, someday.

Erin Welsh

Someday.

Erin Allmann Updyke

We could maybe prevent norovirus with more than just washing your hands and bleaching the world.

Erin Welsh

But until then, wash your hands and bleach the world.

Erin Allmann Updyke

Yeah. You filthy animals! It's not the end of the episode though.

Erin Welsh

No.

Erin Allmann Updyke

Because we gotta tell you about our sources.

Erin Welsh

Okay. I will go. I have got... Erin, I have so many sources for this. If you want to read about Vomiting Larry, I got a couple of papers. One is from Makison-Booth in 2014 titled 'Vomiting Larry: A Simulated Vomiting System for Assessing Environmental Contamination'. And then in terms of sort of some of the history of norovirus or like the future of norovirus, there's a paper by Widdowson from 2005, 'Are Noroviruses Emerging?'. And then if you want to read some of the early work on norovirus, there's a paper from 1942 by Warren titled 'The Vomiting Disease'. And there's a whole lot more that I'll post.

Erin Allmann Updyke

I did the opposite, Erin. I found a couple of really great review papers. So my list is surprisingly short for this episode. But there was a great review paper from 2015 simply titled 'Norovirus' from Clinical Microbiology Reviews. And another one from Nature Reviews Microbiology from 2016 called 'Human Norovirus Transmission and Evolution in a Changing World'. And there were a few other ones looking the epidemiology of norovirus. You can find the list of our sources from this episode and every single one of our episodes on our website thispodcastwillkillyou.com under the EPISODES tab.

Erin Welsh

Thank you again so much to the provider of our firsthand account for sharing your awful norovirus story. Thank you and sorry.

Erin Allmann Updyke

Yeah, thank you. Thank you also to Bloodmobile for providing the music for this episode and all of our episodes.

Erin Welsh

Thank you to Tom Breyfogle and Lianna Squillace for our fantastic audio mixing.

Erin Allmann Updyke

And thank you to Exactly Right network.

Erin Welsh

And thank you to you, listeners. I really hope that this was enlightening and not just nauseating.

Erin Allmann Updyke

And thank you as always to our incredible patrons. Thank you so much for your support. It really means the world to us.

Erin Welsh

It does. Well we've said it before but we really, really mean at this time. Wash your hands.

Erin Allmann Updyke

You filthy animals!