

TPWKY

This is Exactly Right.

Grace

In 1992 in February, I was born in India in a town called Nagpur. It's basically the dead center of India if you're trying to find it. In April of 1993 I was brought over to the States by airplane and was adopted into a family in St. Louis, Missouri and I was raised there until I was 19. And then in 2011 I moved to Springfield, Illinois for college.

So somewhere between 4 and 9 months of age while in India, I had polio. I also had tuberculosis as well while I was there. So we're not sure which one of those came first but very likely one of them weakened my immune system and made it so that when I had the polio vaccine, my body was possibly not able to fight it off because the records do show that I did get the vaccine. The orphanage also has a history of not having the best medical records so there is a chance that maybe I was out getting my diaper changed or getting fed. And, you know, when they came down the row and inoculated every child, that I just wasn't there. So I could've just not gotten it either but no other children in the orphanage got polio which leads us to think that I possibly got it from the vaccine.

Growing up with polio... I don't remember having it as a child, like as a baby per se. But I remember growing up, I remember learning how to walk when I was younger, I had a walker. I went to Shriners Hospitals for Children in St. Louis which is where I got my leg brace made and my mom can tell you exactly what tiles I took my first steps on as a child. And since then I've pretty much just been having preventative care, whether that be different braces, a couple times I've broken my leg because my leg is weaker, or just different surgeries to help correct or prevent certain problems from occurring related to the polio. And the main one as an adult that I've really run into is my official paralysis line is at T9 in my spine and luckily it makes it just so my abdomen is weaker but the actual paralysis is where my hip is and down.

So as an adult I've had issues with chronic UTIs and kidney infections secondary to the polio and I've also had issues with arthritis in my joints. But otherwise not too terrible. At least for me, when you grow up as disabled and it's the only thing that you know, that's your normal so it's not anything like there was an accident and I knew what being able-bodied was vs. being disabled. So I never had that, I guess, annoyant factor there, I just was like, oh this is how I walk, this is how I do things. I just do things a little differently.

TPWKY

(transition theme)

Erin Welsh

So that was an interview that we conducted with a girl named Grace who as you heard came down with polio as a small child. And so we wanted to actually have something unusual which was an actual firsthand account instead of me just reading from a piece of paper, which is the norm.

Erin Allmann Updyke

Right. Which is also great but...(laughs)

Erin Welsh

(laughs)

Erin Allmann Updyke

We like that too.

Erin Welsh

Yeah.

Erin Allmann Updyke

But even better when we can actually hear firsthand from somebody who experiences it.

Erin Welsh

Yeah. So that was really fascinating and also thank you again so much, Grace, for that.

Erin Allmann Updyke Yes, we really appreciate it.

Erin Welsh And if you're just tuning in, this is This Podcast Will Kill You.

Erin Allmann Updyke Welcome.

Erin Welsh I'm Erin Welsh.

Erin Allmann Updyke And I'm Erin Allmann Updyke. It's great to have you here!

Erin Welsh Yeah thanks. And in case you haven't gathered, this week we are doing polio.

Erin Allmann Updyke Mm-hmm.

Erin Welsh And let's jump right in.

Erin Allmann Updyke Yeah, let's do it. Oh wait.

Erin Welsh Oh wait.

Erin Allmann Updyke It's quarantini time!

Erin Welsh Yes! My favorite time.

Erin Allmann Updyke Mine too.

Erin Welsh What are we drinking this week?

Erin Allmann Updyke This week we're drinking the Salk Shot. Right? Yeah.

Erin Welsh The Salk Shot. S-A-L-K. (laughs)

Erin Allmann Updyke I don't pronounce things well.

Erin Welsh Yeah I know. What's in the Salk Shot?

Erin Allmann Updyke It is rum, orange liqueur, and lime juice.

Erin Welsh Rimmed with tajin.

Erin Allmann Updyke Yep and we rim the glass with tajin.

Erin Welsh We're gonna post the full recipe on all the social medias so you can get it there. But I do have to note that this was not a true quarantini for us.

Erin Allmann Updyke (laughs) Something weird happened this week, you guys. First of all we don't drink rum very often.

Erin Welsh: No.

Erin Allmann Updyke: Why did we choose to use rum for this?

Erin Welsh: Okay, so the reason that I was pushing for rum is because FDR, the most famous person with polio, was possibly the United States biggest drinker of all of the presidents.

Erin Allmann Updyke: He was a drinkin' president, that's for sure.

Erin Welsh: He truly was. And he loved to make cocktails and rum was one of his favorite liquors to mix. But also he made the worst cocktails of all time. There are people on record saying the president made the worst martini I have ever tasted, so.

Erin Allmann Updyke: (laughs) So our Salk Shot is not that bad, actually.

Erin Welsh: No.

Erin Allmann Updyke: Except we don't know that for sure because when we tried to make it, it turned out that my bottle of rum was water.

Erin Welsh: Yeah, that was bizarre.

Erin Allmann Updyke: And I don't have a 16 year old living with me so I don't know what's going on.

Erin Welsh: (laughs) So yeah if you make this, actually make it, cause we have no rum, we haven't actually tried it, let us know how it tastes.

Erin Allmann Updyke: I'm very curious. So if you guys could make it and send us a picture and let us know, that would be great.

Erin Welsh: That'd be great.

Erin Allmann Updyke: (laughs)

TPWKY: (transition theme)

Erin Welsh: Erin.

Erin Allmann Updyke: Yes, Erin?

Erin Welsh: I wanna know about the biology of polio.

Erin Allmann Updyke: I wanna tell you all about it. Are you ready for this?

Erin Welsh: I better be.

Erin Allmann Updyke: (laughs) So, poliomyelitis or polio for short is a disease that is caused by the poliovirus. That's the first thing you might've learned.

Erin Welsh

Okay, check.

Erin Allmann Updyke

Check. It's a virus. (laughs) Polio virus is an RNA virus, so if you remember that viruses are basically just genetic material surrounded by protein, polio's genetic material's RNA and it's surrounded by a protein capsid. Polioviruses are related to enteroviruses which are super common viruses that often cause stomach illnesses like vomiting, sort of stomach flu-type illnesses, and also can cause upper respiratory illnesses, and they're also in the same family as the virus that causes the common cold, rhinoviruses.

Erin Welsh

Interesting.

Erin Allmann Updyke

Yeah. Polioviruses are physically capable of infecting other primates but they are really a human-specific virus in general. Poliovirus itself.

Erin Welsh

Okay. So for instance, would you find another primate in the wild that has polio virus or just humans?

Erin Allmann Updyke

Right, no, you wouldn't. You only find humans naturally infected. We can infect animals in the lab that are other primates and also certain lines of mice that we've mutated.

Erin Welsh

Okay.

Erin Allmann Updyke

Anyways, there are three distinct serotypes of the poliovirus, poliovirus 1, 2, and 3.

Erin Welsh

Oh that's easy to remember.

Erin Allmann Updyke

I love it. (laughs) Love it when it's easy. Keep it simple. These three serotypes are antigenically distinct. So antigens, again, are the outside proteins that are on the surface of the virus that our bodies use to find them. So these three serotypes are different enough that infection with one serotype of polio does not confer immunity to the other serotypes.

Erin Welsh

And that's important in terms of exposure and vaccine.

Erin Allmann Updyke

Vaccine development, definitely. Big time, big time. Yeah so the vaccines that are used are trivalent vaccines, so they cover all three serotypes.

Erin Welsh

Oh like 'tri'. Trivalent.

Erin Allmann Updyke

Yeah. Try harder. Just kidding. (laughs) so poliovirus 1 is the most common and something that's kinda cool is that poliovirus 2 has actually been declared eradicated. So there's no wild circulating poliovirus 2.

Erin Welsh

Whoa, that's super cool.

Erin Allmann Updyke

Yeah it's pretty exciting.

Erin Welsh

And do these guys, sorry if I'm jumping the gun, but do these guys differ in their virulence or infectivity?

Erin Allmann Updyke: Great question. I actually couldn't find a lot of good information on that, do you know the answer?

Erin Welsh: Well I know that they do but I don't know which is more virulent or infectious.

Erin Allmann Updyke: Yeah. So I know that poliovirus type 1 is by far the most common.

Erin Welsh: Okay.

Erin Allmann Updyke: And then type 2 I think was the least common, so that's the one that has now been eradicated.

Erin Welsh: Okay and these are geographically distinct, like that is why they have type 1, 2, and 3?

Erin Allmann Updyke: Yes. Yeah, they tend to be in different geographic areas. But poliovirus 1 was overall, like across the globe, most common. Poliovirus is transmitted fecal-oral, just like cholera, so you have to actually ingest poopiness to get infected.

Erin Welsh: Yeah.

Erin Allmann Updyke: There's a small chance that you can transmit it by coughing if you have an infection in your upper gastrointestinal tract but it's pretty not very common. So you can imagine that similar to cholera, the burden was historically and still tends to be heaviest in countries that have poor sanitation. But another important thing about polio that makes it very different from something like cholera is that it's considered a disease of childhood, so it tends to affect children that are under the age of five. And the reason for this, besides the fact that children are constantly shoving poop-covered stuff in their mouths, is that infection with poliovirus provides lifetime immunity. Only to the strain that you're infected with but unlike some other diseases, immunity to polio is very long-lasting.

Erin Welsh: And so when you talk about the infection prevalence being highest is children under the age of five, that is current or recent polio infection prevalences or...?

Erin Allmann Updyke: Historically as well.

Erin Welsh: Historically as well?

Erin Allmann Updyke: Yeah, yeah. So it was always considered a disease of childhood, so people who were... Not that you couldn't get it when you were older but you were probably exposed when you were very young and then once you got infected, you had lifetime immunity.

Erin Welsh: Right.

Erin Allmann Updyke: So you could, in theory, be infected with other serotypes but if you lived in the same geographic region, there's probably in most regions aren't multiple strains circulating.

Erin Welsh: Okay.

Erin Allmann Updyke: So about 75% of people who get infected with poliovirus are totally asymptomatic.

Erin Welsh: 75?

Erin Allmann Updyke 75%.

Erin Welsh All right.

Erin Allmann Updyke I saw estimates as high as 95 but I don't believe them. I believe the WHO and the CDC.

Erin Welsh (laughs) Fair enough.

Erin Allmann Updyke Similar to cholera though, these asymptomatic people can still shed virus in their stool. So they still could be infecting others. The incubation period is around 7-10 days but actually can vary from 4 to as long as 35, which is crazy to me. That's such a huge range.

Erin Welsh Well I read that it has something to do with the amount of time that it takes to make it up to the central nervous system.

Erin Allmann Updyke Well yeah!

Erin Welsh And so for very tall people, your incubation period would be longer.

Erin Allmann Updyke Oh my god are you serious?

Erin Welsh That's what I read somewhere.

Erin Allmann Updyke Oh that's funny.

Erin Welsh Yeah.

Erin Allmann Updyke I guess I didn't think about that because this is only for symptomatic cases, obviously, the incubation period.

Erin Welsh Right.

Erin Allmann Updyke Because incubation period, again, is the time from when you're infected to when you show symptoms. So most people don't really have an incubation period because they don't have symptoms.

Erin Welsh Yeah, 75%.

Erin Allmann Updyke Right.

Erin Welsh Interesting.

Erin Allmann Updyke That is interesting. So also similar to what we saw in cholera, people start shedding virus in their poop a few days before symptoms start and they continue to shed for at least 1-2 weeks, though I saw some estimates that they can shed for up to 4-6 weeks which is a really long time.

Erin Welsh Yeah.

Erin Allmann Updyke So undoubtedly that's something that has made polio more difficult to control is how long you are shedding and this very high rate of asymptomatic cases as well. So 75% of people are asymptomatic and then the other 25% of people who get infected, most of them end up with a relatively mild illness. Fever, headache, sore throat, maybe some nausea, stomachache, vomiting, since this does infect your gastrointestinal tract right, fecal-oral. But you're here, Erin and listeners, to hear about poliomyelitis.

Erin Welsh Oh yes.

Erin Allmann Updyke AKA polio. So poliomyelitis is the disease that happens in less than 1% of people who get infected with the poliovirus, about 1 in 200 cases. This happens when the poliovirus exits your gut and travels to your central nervous system where it attacks your motor neurons.

Erin Welsh Can I just throw something in here right now?

Erin Allmann Updyke Please do.

Erin Welsh The etymology of poliomyelitis.

Erin Allmann Updyke Well I'm gonna-

Erin Welsh Are you gonna say it? Okay sorry!

Erin Allmann Updyke No you go, go, go. Give it to me. (laughs)

Erin Welsh (laughs) Okay. It's from the Greek 'polios' meaning gray and 'muelos' I guess meaning marrow and 'itis' meaning inflammation. And so it refers to the inflammation in the gray matter of the spinal cord which causes the paralysis.

Erin Allmann Updyke Yes. Yeah! Exactly. So myelitis is essentially an infection of the central nervous system. So you can get myelitis from other things as well but poliomyelitis is myelitis caused by the poliovirus. Thanks for that.

Erin Welsh (laughs) Sorry.

Erin Allmann Updyke No! Don't be sorry. So sometimes the paralysis can be reversible but often it is not. And of these paralytic cases, about 5-10% of them are fatal because the paralysis affects the diaphragm or intercostal muscles which are the muscles inbetween your ribs that are responsible for respiration. So you can't breathe.

Erin Welsh And was there a treatment for those cases eventually?

Erin Allmann Updyke Oh I believe you may have heard of it. The iron lung. (laughs) Are you gonna tell us a bit about the iron lung later?

Erin Welsh I'm not, no.

Erin Allmann Updyke Oh dang.

Erin Welsh	I mean, there's so much... Polio has such a rich history that it is, I mean it's a very important part.
Erin Allmann Updyke	It's hard to pick and choose.
Erin Welsh	Right, basically the iron lung was a huge machine that was used to treat the patients whose diaphragm, who could no longer breathe because their muscles had become paralyzed. And so it breathes for them using a pressurized and depressurized rhythm. And there are still people that are in iron lungs today.
Erin Allmann Updyke	Yeah, there's actually a video that's been making the rounds on social media and we'll post it to our social media account as well in case you haven't seen it yet that's about some of the last people that are still living today in an iron lung. Cause that's pretty interesting. So most of the time in paralytic poliomyelitis, it's some part of the spinal cord that's attacked. So you might lost function of a limb or you might lose function entirely in a region inferior to where the motor neurons were damaged but the fatal cases are often because the virus infects the brainstem and when you infect the brainstem, you can infect the cranial nerves which again can affect breathing, swallowing, speaking. So yeah, basically the virus infiltrates and just destroys your motor neurons, so it's really sad.
Erin Welsh	That's horrible.
Erin Allmann Updyke	And if that's not horrible enough-
Erin Welsh	Oh great.
Erin Allmann Updyke	The idea of tiny babies losing function in their limbs and...
Erin Welsh	Oh god.
Erin Allmann Updyke	There's also post-polio syndrome which is a combination of symptoms that include progressive muscle weakness, fatigue, and pain from joint degeneration that can happen in about 25-40% of poliomyelitis cases. And this happens 15-40 years after infection.
Erin Welsh	So just to go back to relate this back to polio infection overall, of the cases that are actually symptomatic of polio there's a very small proportion of them that actually get poliomyelitis and of those it's the 25-40% that you're talking about. Okay.
Erin Allmann Updyke	Exactly. So 25-40% of people who end up with poliomyelitis, that neuron involvement, can go on to have post-polio syndrome. And this happen 15-40 years after infections. So if you imagine you get polio as a baby, 15-40 years later you can end up with these, in some cases, very severe and debilitating muscle symptoms. And there isn't really anything to do to prevent it and there's not much that you can do to cure it. And from what I understand it's not like the poliovirus is still sitting there alive in your nervous system or anything like that. It's not like herpes virus for example, like with chickenpox where it can re emerge as shingles.
Erin Welsh	Right.



Erin Allmann Updyke

The best explanation that I've seen is that when polio attacks your motor neurons, it might not destroy all of your motor neurons. So you're left with a subset of functioning neurons and then these neuronal cell bodies because your neurons are basically a cell body with fibers sticking out of it, then the cell bodies that are left will sprout new fibers to reinnervate the muscles that have previously lost function. But then over time these cell bodies are essentially working way harder than a cell body would otherwise have to work and so over time they may weaken of end up dying themselves.

Erin Welsh

Right, so it's like rapid aging of your motor neurons?

Erin Allmann Updyke

Exactly, yeah. And so that's why you have this very late onset and it's a very progressive weakening of your muscles. From what I understand, it's not 100% sure that that's the explanation but that's the best that people have been able to come up with. Yeah. Things like the severity of the initial infection, the age at which you are infected, and the thing I found really interesting is how well you recovered, all affect whether or not you end up getting post-polio syndrome. The better your recovery, the more likely you end up with post-polio syndrome.

Erin Welsh

Interesting.

Erin Allmann Updyke

Yeah. And I think that's one of the things that helps support this hypothesis that if you recovered really well, then your neurons regenerated a lot and then they're really working overtime. Isn't that interesting?

Erin Welsh

Yeah.

Erin Allmann Updyke

I thought that was very, very cool. I mean not cool. It's a very interesting side effect of an infection with a virus like this.

Erin Welsh

Mm-hmm. Particularly when it's no longer in your system. Circulating.

Erin Allmann Updyke

Right, yeah. Yeah, so I think that's everything about the biology. Any questions?

Erin Welsh

Not yet.

Erin Allmann Updyke

Good.

Erin Welsh

But we'll see.

TPWKY

(transition theme)

Erin Welsh

So I guess then that means that it's time for me, right? The history?

Erin Allmann Updyke

Yes!

Erin Welsh

Okay. It seems like I always start off the history part by saying, 'Oh, well the first recorded instance of whatever disease was in Egypt,' and today's gonna be no different.

Erin Allmann Updyke

(laughs)

Erin Welsh: Yeah. Yeah, there are illustrations dating from Egypt in 1400 BC that should people with withered limbs and a dropped foot which is particularly characteristic of polio.

Erin Allmann Updyke: Wow!

Erin Welsh: So it's been around for millennia but it's interesting because it really didn't start to reemerge or be noted in literature or in historical accounts of the day until the 17th century and then it was more just like case by case or describing a disease overall, it wasn't really in reference to epidemics.

Erin Allmann Updyke: Huh. Interesting.

Erin Welsh: So descriptions matching clinical signs of polio show up in the 17th century. This is in contrast with many of the other diseases that we've talked about so far, all of which have kind of popped up in epidemic form at some point or another or multiple times, or at least like leprosy have left enough of an impact that they're written about throughout history. One of the thoughts as to why polio wasn't an epidemic disease has to do with sanitation. Yeah. Prior to wide scale water treatment and sanitation measures, children were probably exposed to polio at a very young age, experienced a minor infection or the vast majority of them did, and then also recovered and had lifetime immunity.

Erin Allmann Updyke: Right.

Erin Welsh: Obviously there was a proportion of these individuals who became partially paralyzed as a result of infection.

Erin Allmann Updyke: Or died.

Erin Welsh: Or died.

Erin Allmann Updyke: Right.

Erin Welsh: But studies done in the 20th century prior to the introduction of the vaccine show that the case fatality rate and case paralysis rate was highest in the very young, so like under a year, and then it dropped in young children like under the age of five, and then it rose in adolescents and adults. So like a check mark.

Erin Allmann Updyke: Okay. Right.

Erin Welsh: Which is really interesting.

Erin Allmann Updyke: Yeah.

Erin Welsh: And this seems to suggest that the older you are when you first encounter polio, the more devastating it could be.

Erin Allmann Updyke: And the more likely you are to get post-polio syndrome, so that makes sense.

Erin Welsh: Exactly.

Erin Allmann Updyke I actually know why that is. Because as a child your nerves are really good at regenerating and so the older you get, the less good they are at regenerating.

Erin Welsh That makes sense.

Erin Allmann Updyke Except that when you're a tiny baby infant, you have no immune system and so you can't fight anything off. And so tiny babies are gonna die, little kids are gonna be okay for the most part, and then as you get older you're not gonna be able to recover. (snaps) Got that medical degree for something. (laughs)

Erin Welsh Yay! (laughs)

Erin Allmann Updyke Working on it, don't have it.

Erin Welsh That's really interesting. It's only a matter of years. (laughs) Yeah so these epidemics were probably able to occur in the 20th century as sanitation measures increased and the population of already exposed people decreased so that polio could tear through an unexposed community.

Erin Allmann Updyke Interesting. That is so fascinating.

Erin Welsh It's kind of like a disease of sanitation.

Erin Allmann Updyke Right.

Erin Welsh Unlike a disease that we see, like with cholera where the lower the sanitation measures... And it kind of goes, it's a mix.

Erin Allmann Updyke It's a middle ground, right?

Erin Welsh Yeah, it's a middle ground.

Erin Allmann Updyke Because you have to have good sanitation so that you're clean... If you have really, really great sanitation then you're not gonna have fecal-oral contact very often. But then if you have a little bit of sanitation so that not everyone is exposed, then you have more susceptible individuals that are older and then you can have these epidemics. That is so interesting! Wow!

Erin Welsh Yeah. Yeah, it's the sporadic nature of the sanitation that really would lead to these epidemics.

Erin Allmann Updyke Oh wow that is so interesting.

Erin Welsh Well in any case, the polio story really begins full force in the late 19th and early 20th centuries when polio began appearing in epidemic form in Scandinavian countries, in the U.S. and then on to Europe.

Erin Allmann Updyke Of course people only care about it when it's in the western hemisphere.

Erin Welsh Oh yeah, no. So let me make one thing clear: the only reason that there's a polio vaccine and that it is almost eradicated is because this struck wealthy children in the United States. And then it was like people actually cared about it.

Erin Allmann Updyke

Right.

Erin Welsh

It's a darn shame that they don't care as much about diseases that are not on their doorstep.

Erin Allmann Updyke

Right, like visual leishmaniasis. Visceral leishmaniasis is what I just said.

Erin Welsh

Visual.

Erin Allmann Updyke

Yep, that's not what I said. (laughs)

Erin Welsh

It also of course had global distribution but these were the countries where all of a sudden it was appearing in a more epidemic form.

Erin Allmann Updyke

Right.

Erin Welsh

In the past when we've talked about epidemics or pandemics, the numbers are staggeringly huge, except in the case of leprosy, with like 25% of people being infected or dying as a result of infection. By comparison, polio caused minor outbreaks initially. Its first epidemic appearances in the U.S. in the 1890s through the 1910s resulted in a few hundred to a few thousand cases of which about 10% died and 40-50% were paralyzed.

Erin Allmann Updyke

Wow.

Erin Welsh

So sidenote, yeah, these percentages correspond to reported cases.

Erin Allmann Updyke

Okay.

Erin Welsh

The actual number of polio cases was probably a lot higher and the percentages of fatal or paralytic cases was probably a lot lower.

Erin Allmann Updyke

Right. Oh, because the number of cases were a lot higher. Right, of course.

Erin Welsh

Still though, we're talking about a few thousand cases in a country of a couple hundred million people. How then did polio mobilize an entire country towards finding a way to stop it?

Erin Allmann Updyke

Cause they were white babies.

Erin Welsh

That's true.

Erin Allmann Updyke

(laughs)

Erin Welsh

Well, yeah, the answer lies in who was most impacted. And that was young, otherwise healthy children. In the early 20th century no one yet knew how polio was transmitted. All they knew was that one summer day your kid would go out to play, come home in the evening feverish and complaining of body aches, and be paralyzed or dead within days.

Erin Allmann Updyke

Yeah.

Erin Welsh

And it really struck fear into the hearts of people across the United States.

Erin Allmann Updyke I mean it would be terrifying, there's no denying that.

Erin Welsh Of course! The fear was palpable. Summer was synonymous with polio season.

Erin Allmann Updyke Everyone's poopin' in the pool.

Erin Welsh (laughs) Well, swimming pools were shut down. So you had better poop before it was shut down.

Erin Allmann Updyke (laughs)

Erin Welsh Children under the age of 16 were barred from public places such as movie theaters in an attempt to limit disease transmission. Do not gather in groups, children. That's kind of the idea. The number of polio cases in a town was reported daily on the radio and in newspapers the way baseball or football scores were reported.

Erin Allmann Updyke Wow.

Erin Welsh Mm-hmm.

Erin Allmann Updyke Interesting.

Erin Welsh It was a nation obsessed.

Erin Allmann Updyke Yeah.

Erin Welsh And as the years went on, it was clear that polio was on the rise. From the small beginnings of a few hundred cases at the turn of the century, 1916 for instance saw 27,000 fatal cases-

Erin Allmann Updyke Oh my god!

Erin Welsh -in the eastern United States, the vast majority of which of course were children.

Erin Allmann Updyke Wow! Okay that's a big number, I feel like.

Erin Welsh It's a big number!

Erin Allmann Updyke Yeah.

Erin Welsh And remember how - I just had to throw this in here - remember how cats were killed during outbreaks of plague?

Erin Allmann Updyke Oh no.

Erin Welsh It happened with polio too!

Erin Allmann Updyke Wait, literally how?

Erin Welsh: I don't know. (laughs)

Erin Allmann Updyke: Cats don't have the receptor that poliovirus needs to infect cells.

Erin Welsh: Right but they did not know that polio was even a virus back then.

Erin Allmann Updyke: I know but how were cats... What were cats dying of is what I'm asking.

Erin Welsh: No, no, no, no, no. No I'm sorry. They were dying of humans.

Erin Allmann Updyke: Oh. People were killing cats?

Erin Welsh: Yeah.

Erin Allmann Updyke: Because they thought they were getting... Oh my god!

Erin Welsh: 72,000 stray cats in 1916 were rounded up and killed in New York City.

Erin Allmann Updyke: Because people are stupid?

Erin Welsh: I would say lacking the knowledge.

Erin Allmann Updyke: Okay, ignorant.

Erin Welsh: And acting out of fear.

Erin Allmann Updyke: Aw.

Erin Welsh: Yes.

Erin Allmann Updyke: Poor kitty cats.

Erin Welsh: I mean the number of theories as to what caused polio or how to treat it abounded.

Erin Allmann Updyke: Oh god.

Erin Welsh: So George Washington Carver, the peanut man, his idea was to treat polio with peanut oil. (laughs)

Erin Allmann Updyke: That's like today, shove a walnut up your butthole to cure your cancer. That's not real.

Erin Welsh: It's a very Gwyneth Paltrow type of treatment.

Erin Allmann Updyke: Yeah. (whispering) 'Just have some lemon juice with some paprika and cayenne pepper. It'll solve your problems.'

Erin Welsh: (laughs) Is that how she talks?

Erin Allmann Updyke

I don't know, that's my GOOP impression. (laughs)

Erin Welsh

I loved it.

Erin Allmann Updyke

Yeah.

Erin Welsh

Okay, what was I saying? Oh yeah. So one unique thing that stuck out to scientists from this epidemic was that the disease seemed to strike harder in relatively wealthy regions which enjoyed reliably - more or less - clean water and sanitation systems. And this was completely unlike what had been seen in the past and was a large part of why the movement to help polio gained so much momentum. Perhaps the most famous polio victim was FDR, like I already said, Franklin Delano Roosevelt, who was the 32nd president of the United States.

In the summer of 1921 the then 39-year-old spent several days at the family home on an island off the coast of Maine where he filled his time with extensive physical activity. He was like sailing and running and racing his kids and swimming in the freezing waters. And then one evening a strange feeling came over him. He felt chilled, feverish, with numbness and deep muscle aches. He began to have trouble walking and the paralysis spread up to his chest and down even to his fingers, like he had trouble writing.

Erin Allmann Updyke

Wow.

Erin Welsh

The diagnosis of polio did not come for several days, in part because he was of an unusual age to be afflicted.

Erin Allmann Updyke

Yeah, that's quite old.

Erin Welsh

But he grew up probably completely isolated.

Erin Allmann Updyke

Yeah.

Erin Welsh

Yeah. By the time that he was actually diagnosed with polio he had lost much of the function of his legs, which he would never fully regain. Newspapers of course ate this story up and he was ridiculed by his political rivals as being physically unfit for office of any kind. And he responded by initiating a massive campaign which lasted throughout his life to hide his disability from public view. He had intricate leg braces designed and was very careful not to be photographed in a wheelchair. But the truth was that he would never again be able to stand on his own unaided.

Erin Allmann Updyke

Wow.

Erin Welsh

FDR coming down with polio was honestly probably the best thing that could've happened for polio.

Erin Allmann Updyke

To polio. Or rather to the children who suffer from polio, right.

Erin Welsh

Right. Do you know whose face is on the dime?

Erin Allmann Updyke

Is it FDR?

Erin Welsh

It is.

Erin Allmann Updyke

That was a guess.

Erin Welsh

Do you know why it's there?

Erin Allmann Updyke

Cause he's a ten centin' good guy. That was a bad, nope, I don't know.

Erin Welsh

(laughs) Rewind! Just kidding. I'll tell you.

Erin Allmann Updyke

Please.

Erin Welsh

Okay. From the time of his infection to his death, FDR campaigned and helped raise funds for polio organizations. His first endeavor was to purchase Warm Springs which was a retreat in Georgia whose natural mineral hot springs were advertised as having curative benefits. So he spent so much time at Warm Springs rebuilding the area, rehabilitating different cabins and stuff, and also providing a lot of treatment free of charge for polio patients. So it did do some good. And there was also, he created something called the Warm Springs Foundation which was used to raise money for polio patients.

Erin Allmann Updyke

Cool.

Erin Welsh

And the other huge thing that he did was to create the National Foundation for Infantile Paralysis in 1938. Infantile paralysis is what a lot of people called polio back then.

Erin Allmann Updyke

Okay.

Erin Welsh

And this was an attempt to depoliticize the fundraising of money for polio victims and research. Fundraising had been going on but it was mostly in the name of the Warm Springs Foundation and the biggest fundraising events were on Roosevelt's birthday, which didn't exactly encourage donations from the Republicans, who was the opposing political party.

Erin Allmann Updyke

(laughs)

Erin Welsh

The first action of the National Foundation for Infantile Paralysis - it's a mouthful - was to ask people to mail dimes directly to the White House in a stunt they called the March of Dimes.

Erin Allmann Updyke

To mail dimes.

Erin Welsh

Mail dimes.

Erin Allmann Updyke

That's funny.

Erin Welsh

And it was surprisingly enormously successful.

Erin Allmann Updyke

Wow!

Erin Welsh

People sent so many dimes that counting them individually was impossible. The dimes had to be shoveled onto a scale to be weighed.

Erin Allmann Updyke

Oh my gosh. Wow.



Erin Welsh: Yeah. In total over 2.7 million dimes were sent to the White House.

Erin Allmann Updyke: Do you know how many dollars that is?

Erin Welsh: 270,000.00

Erin Allmann Updyke: Thanks. (laughs)

Erin Welsh: (laughs) And so because of the enormous success of this stunt, the National Foundation for Infantile Paralysis eventually became the March of Dimes, which still exists today. And to honor Roosevelt's contribution to the cause, his face was put on the dime in 1946 after his death.

Erin Allmann Updyke: Wow. That's really interesting, I never knew that story.

Erin Welsh: Yeah. The impressive amount of money raised by the March of Dimes was used for two primary reasons: treatment and care for those afflicted by polio, and scientific research to develop a vaccine for its prevention.

Erin Allmann Updyke: Cool!

Erin Welsh: Yeah, it was a really well-funded organization for a while. The early 20th century was riddled with amazing medical advancements that resulted in the reduction or elimination of many diseases through the development of vaccines or antibiotics. Polio then must have seemed like some kind of cruel joke because early research on a polio vaccine was wildly unsuccessful.

Erin Allmann Updyke: Really?

Erin Welsh: Yeah and early trials in the 1930s led to several children, dozens I think, becoming paralyzed or dying.

Erin Allmann Updyke: With the vaccine trials? Ugh. That sucks.

Erin Welsh: Yeah. As a result, scientists began to steer their research more towards treatments and away from vaccines.

Erin Allmann Updyke: Uh oh.

Erin Welsh: A couple of hurdles stood in the way of a successful polio vaccine. With the smallpox and yellow fever vaccines which had already been successfully developed and deployed, there was only one strain of virus for the vaccine so creating the vaccine was pretty straightforward. With polio, researchers didn't know at the time how many strains there were and it wasn't until 1951 that the final number was in, which as you mentioned, was three. That meant that an effective vaccine would have to contain all three types of the virus.

Erin Allmann Updyke: The other issue was how to grow enough virus to make vaccines. Previous research had indicated that the virus could only be grown in nervous tissue which was all but impossible to grow inside a lab at the time. Then a man named John Enders tested this conventional belief by inoculating other tissue - skin, muscle, kidney - with the polio virus. And it grew.

Right, because it actually infects your gut and it can actually, I didn't mention this, but it can infect your spleen and your liver. It can actually infect a whole bunch of your tissues. But obviously they wouldn't have know that then because the only symptoms you really see or associate with poliomyelitis are the nervous symptoms.

Erin Welsh

Well he did know that, like he did know, he said well it infects your gut so it's got to be able to exist in other tissues. Okay.

Erin Allmann Updyke

Ah, got it. Smart guy, Enders.

Erin Welsh

Well this incredible breakthrough would be the only polio-related development to win a Nobel Prize. It revolutionized cell culture in the lab.

Erin Allmann Updyke

That's really cool.

Erin Welsh

This finding, along with the discovery of the three strains, meant that the groundwork was laid for vaccine development. The March of Dimes began to essentially funnel money into the development of a vaccine. An enormous number of scientists were involved in this process, so let's meet the two men whose names you've probably heard linked to polio before: Jonas Salk and Albert Sabin. These two were similar in many ways. Both men were of Eastern European descent, both were Jewish, and both faced substantial obstacles because of this. However Sabin was older, more established and respected in the scientific community, more concerned with earning the respect and praise of his peers, his fellow researchers. Salk on the other hand was young, relatively young, a novice when it came to polio research, and seemed to be more interesting in the celebrity spotlight over the scientific one and was dismissive of others' contributions to the development of the vaccine, according to some of his lab members. He would put his name in front of theirs.

Erin Allmann Updyke

Oh that's not cool, bor.

Erin Welsh

I know. I really wanted there to be a hero in this story, they both kinda seem to have their own personal issues.

Erin Allmann Updyke

I can be your hero.

Erin Welsh

Baby. (laughs)

Erin Allmann Updyke

(laughs) That song is good.

Erin Welsh

These two would feature as the major players in one of the most contentious scientific rivalries of the 20th century.

Erin Allmann Updyke

Can I just say I wish that I was involved in a scientific rivalry.

Erin Welsh

I mean, do you want to be?

Erin Allmann Updyke

Yeah it kinda sounds exciting, doesn't it?

Erin Welsh

Okay so what issue do you want to take up in arms?

Erin Allmann Updyke

I don't feel strongly enough about anything.

Erin Welsh: Okay.

Erin Allmann Updyke: Maybe later.

Erin Welsh: Okay.

Erin Allmann Updyke: Just a thought.

Erin Welsh: Get back to me on that.

Erin Allmann Updyke: I will.

Erin Welsh: So the feud between Salk and Sabin simmered quietly with Sabin passive-aggressively disparaging the work of Salk but the two kept a polite front until 1953. The previous year, 1952, had seen the highest number of polio cases in the U.S. so far with more than 57,000 cases overall, 21,000 of them paralytic, and 3000 fatal.

Erin Allmann Updyke: Oh my gosh.

Erin Welsh: Yeah. So the urgency and pressure to create a vaccine was never higher. And when Jonas Salk announced in 1953 that he had come up with a vaccine that he had successfully tested on polio-afflicted and mentally disabled children, I might add-

Erin Allmann Updyke: Oh, god. Always.

Erin Welsh: Always. The U.S. celebrated. Salk became a celebrity overnight, appearing on TV to tell his story but to also caution viewers that more testing needed to be done. In response, Sabin publicly declared himself to be, quote "anti-Salk" saying that the killed virus vaccine that Salk had developed was not enough to ensure lasting immunity and implied that it was downright dangerous. He emphasized that the only way to eliminate polio was through a live virus vaccine, which coincidentally was what he was working on at the time.

Erin Allmann Updyke: (laughs) Of course.

Erin Welsh: Sabin's hesitation did have some legitimacy. Salk's vaccine was in no way perfect. Despite Sabin and others' protestations, this vaccine was the closest thing yet to a prevention for polio and plans were drawn up for a country-wide experiment.

Erin Allmann Updyke: Can you remind me what year this is?

Erin Welsh: So this is in 1953 when he announced that, 'Hey I have a vaccine that is close to being ready.'

Erin Allmann Updyke: Okay. Okay. But it was still under trials at this point. Okay.

Erin Welsh: It was still under trials. And so in 1954 the testing to validate this vaccine was going to happen and it was going to be the biggest public health experiment in U.S. history to date.

Erin Allmann Updyke: Whoa.

Erin Welsh: So over the course of 1954, over 1.3 million children would take part-

Erin Allmann Updyke: 1.3 million?!

Erin Welsh: Million.

Erin Allmann Updyke: Wow.

Erin Welsh: With some of them receiving the vaccine and others receiving a placebo and others just being observed without receiving any sort of injection. In April 1955 the results of the trial were in. The vaccine was quote: "safe, effective, and potent."

Erin Allmann Updyke: Thank goodness because like 1.3 million children? Just like...

Erin Welsh: Oh boy.

Erin Allmann Updyke: I mean they do trials before they go to trials but still.

Erin Welsh: I mean back then it was a little more iffy.

Erin Allmann Updyke: I'm sure it was, yeah. I'm sure it was. Well they did the trials just on kids who had no choice in the matter. Yeah.

Erin Welsh: Exactly. It was estimated that this vaccine conferred protection to 60-90% of those vaccinated. Bells were rung, there was actual rejoicing in the streets.

Erin Allmann Updyke: Wow!

Erin Welsh: Seriously. Children around the world could now be protected against polio.

Erin Allmann Updyke: Cool.

Erin Welsh: It was a huge, huge development.

Erin Allmann Updyke: Yeah that's a major deal.

Erin Welsh: And Salk was a god of science in the eyes of the public, especially after going on TV to answer the question, quote, "Who owns the patent on this vaccine?" with quote, "Well, the people I would say. There is no patent. Can you patent the sun?"

Erin Allmann Updyke: (laughs) Changed my mind, I don't want a rivalry, I wanna be a god of science.

Erin Welsh: (laughs) So yeah, I mean, that was a nice sentiment.

Erin Allmann Updyke: Yeah!

Erin Welsh: Right? So with no patent on the vaccine, drug companies were free to make and sell the vaccine. You would think that the road was free and clear for all kids to be free from the fear of polio. Not so fast.

Erin Allmann Updyke

Course, never.

Erin Welsh

One problem was with administering it. The U.S. government, headed at the time by Dwight Eisenhower, didn't want to administer the vaccine at public schools fearing that it would seem too much like socialized medicine.

Erin Allmann Updyke

Oh god.

Erin Welsh

Mm-hmm. So they consciously chose not to plan on how to get the vaccine to kids, how to ensure that there was enough vaccine being produced, and instead just leaving it up to the drug companies and to the parents.

Erin Allmann Updyke

Oh my lordy lordy.

Erin Welsh

Some of whom, the parents, could not afford to pay for the vaccine.

Erin Allmann Updyke

Right.

Erin Welsh

But you know this was during the time of the Cold War and so any sort of whiff of socialism was really, like-

Erin Allmann Updyke

It was communism.

Erin Welsh

Exactly.

Erin Allmann Updyke

Oh dear, America. (laughs)

Erin Welsh

Another problem was that some drug companies had better safety checks than others. One drug company, Cutter Laboratories in San Francisco didn't check its product well enough and it failed to disclose some of their findings which showed that there were live virus particles in the vaccine.

Erin Allmann Updyke

Great, cool.

Erin Welsh

Over 200 people contracted polio from that vaccine with most severely paralyzed and 11 dying.

Erin Allmann Updyke

This is a really great way of like how to convince people to not do vaccines is by doing it this way.

Erin Welsh

Oh, it as a fiasco for sure.

Erin Allmann Updyke

Yeah.

Erin Welsh

And it really also soured public opinion of the Salk vaccine which was helped along by Sabin, whose live virus vaccine was finally ready to test. Just in time. Since the U.S. was not at all keen on the idea of another wide scale vaccine trial, Sabin brought his vaccine to the Soviet Union where in 1959 the Russians tested - never wanting to be outdone by the U.S. - 10 million children.

Erin Allmann Updyke (laughs)

Erin Welsh Successfully, thank goodness.

Erin Allmann Updyke That was funny.

Erin Welsh The Sabin live virus vaccine eventually displaced the Salk killed virus vaccine across the globe. It certainly had its advantages. The Sabin vaccine, which was a live virus, a weakened virus I should say, it was cheaper. Since it was an oral vaccine whereas the Salk vaccine is injected, you did not need a trained medical professional to administer it, it was thought to be more effective and protect you for longer, and it also apparently had a broader protection.

Recently, also this is a really cool thing, recently vaccinated individuals would shed attenuated viral particles for several days which could then be picked up by unvaccinated individuals resulting in passive vaccination.

Erin Allmann Updyke I love that.

Erin Welsh It's very cool.

Erin Allmann Updyke That's very awesome.

Erin Welsh That was a huge bonus to that one.

Erin Allmann Updyke It was a major bonus. You don't have to necessarily vaccinate everyone. Great if you can but if you can't, they're probably going to indirectly vaccinate their family members because this is transmitted fecal-oral and you're shedding this attenuated weakened virus in your poop.

Erin Welsh Yep.

Erin Allmann Updyke Gotta love it.

Erin Welsh I mean it's genius.

Erin Allmann Updyke Yeah.

Erin Welsh But there was one glaring fault of the Sabin vaccine.

Erin Allmann Updyke I'd say there might be two but they're very related.

Erin Welsh Because it was a live virus vaccine, some of those given the vaccine would develop paralytic polio, 3 in 100 million doses. Which is a really small number but still very problematic. In several countries where wild polio had been completely wiped out, there were still a few dozen cases each year as all a direct result of the Sabin vaccine.

Erin Allmann Updyke You know, I actually saw numbers that were much higher than that.

Erin Welsh I'm sure that they are.

Erin Allmann Updyke 1 in 750,000 doses administered will result in vaccine-associated paralytic poliomyelitis.

Erin Welsh: Oh wow. 750,000. Wow.

Erin Allmann Updyke: Yeah. And that's if you're fully immunocompetent.

Erin Welsh: Oh right but if you have any sort of-

Erin Allmann Updyke: If you are immunocompromised like in our interview with Grace, she talked about having TB. If you're immunocompromised you are 3000-6000 times more likely to end up getting vaccine-associated paralytic poliomyelitis than a person who's immunocompetent.

Erin Welsh: Holy moly.

Erin Allmann Updyke: I know! So it's not an insignificant fear.

Erin Welsh: No. Well and seeing this in I think the early 80s, Salk's son who was a doctor wrote an article calling for a switch back to the safer killed virus vaccine. In response Sabin said, direct quote: "He doesn't know what he's talking about, his work is completely out of focus, distorted, erroneous information, just a chip off the old block." Real piece of work, Sabin was. (laughs)

Erin Allmann Updyke: This is the problem with-

Erin Welsh: Toxic masculinity egos?

Erin Allmann Updyke: Well, toxic masculinity but also scientific rivalries. (laughs)

Erin Welsh: Oh my gosh. I know.

Erin Allmann Updyke: I mean you gotta be able to see both sides, man.

Erin Welsh: Ugh, yeah.

Erin Allmann Updyke: There are pros and cons to both of these vaccines. I'll talk more about it too when we talk about the state of polio today.

Erin Welsh: Of course. Yeah, yeah. So the craziest thing though is that Salk wrote that, Jonas Salk's son wrote that in the early 80s and no one listened to it.

Erin Allmann Updyke: No, no one listened to it. (laughs)

Erin Welsh: The live virus vaccine would continue to be used for another 20 years in the U.S. until the CDC finally called for a return to the Salk vaccine in 2000, which is what is used today.

Erin Allmann Updyke: Do you know what you were vaccinated with? Cause I called my mom to ask.

Erin Welsh: I have no idea.

Erin Allmann Updyke: At that point in time the recommendations were kind of 'do whichever one you and your doctor think is best' so I called my mom to ask. I was like, do you remember? I got the oral one.

Erin Welsh: Oh wow.

Erin Allmann Updyke: Yeah. I'm okay.

Erin Welsh: Yeah. So polio, like smallpox, is another of the diseases that the World Health Organization targeted for eradication. In 1988 the goal for eradication was announced to be the year 2000. But clearly there are still cases around. So Erin, where do we stand today?

TPWKY: (transition theme)

Erin Allmann Updyke: Polio today. The good news is that polio is very close to being eradicated.

Erin Welsh: That is good news.

Erin Allmann Updyke: So you mentioned it was 1988 that the World Health Organization decided that that was gonna be their new goal. In 1985 the Pan American Health Organization, which is an organization we never talk about on this show but it's an organization like the World Health Organization but it's just for the Americas, North and South America and Central America. They made it their goal in 1985 to eradicate polio from the western hemisphere by 1990. And they came super close. So in 1991, that was when the last case of wild poliovirus transmission was recorded in Peru and in 1994 the Americas region of the World Health Organization's region, so the Americas, were classified as polio-free.

Erin Welsh: Wow.

Erin Allmann Updyke: Yeah in 1994, it's been a long time.

Erin Welsh: Yeah.

Erin Allmann Updyke: It was four years late, later than they wanted but hey. It snot so bad.

Erin Welsh: I mean better late than never.

Erin Allmann Updyke: Better late than never. And again in 1988 is when the WHO made it its goal to eradicate polio. They definitely haven't done it, it's 2017, polio still exists.

Erin Welsh: How many cases have there been like this year or last year?

Erin Allmann Updyke: Great question, great question. So they have made major progress. In 1988 when they made it their goal there were 350,000 cases estimated of poliomyelitis, that is neuron involvement.

Erin Welsh: Oh wow. Wow.

Erin Allmann Updyke: In 2016, 37.

Erin Welsh: Wow!

Erin Allmann Updyke: Yeah! The WHO estimates that 16 million people have been saved from paralysis. 16 million.

Erin Welsh: Wow.



Erin Allmann Updyke: I know.

Erin Welsh: I know every episode we're always like, 'Oh, that WHO, they're so amazing!' But you know, it's true.

Erin Allmann Updyke: They're not a perfect organization by any means but they really try hard.

Erin Welsh: They've done great things.

Erin Allmann Updyke: So, 1994 the Americas were declared polio-free. In 2000 the Western Pacific Region which is Western Asia, Pacific Islands, and Australia were declared polio-free. In 2002, the European region. And in 2014, and this one's very exciting, the Southeast Asia region was declared polio-free.

Erin Welsh: Wow.

Erin Allmann Updyke: So India was one of the places that was very, very difficult to implement polio eradication campaign because it's a massive country, it's so densely populated, there are so many parts that are remote and underdeveloped and underserved, but they did it.

Erin Welsh: That's incredible.

Erin Allmann Updyke: 2011 was the last case of wild polio in India.

Erin Welsh: That's so cool.

Erin Allmann Updyke: Yeah.

Erin Welsh: So just to bring it back to smallpox and the eradication campaign there, smallpox, the vaccination record is a scar on your arm and so it's very visible. Whereas with polio you need multiple courses for one, and two it's not visible and so the records have to be really well kept. It just is overwhelmingly a lot more difficult.

Erin Allmann Updyke: It's a very, very difficult and logistically challenging campaign to undertake. And we talked already about how the oral polio vaccine, OPV, was and still is kind of the vaccine of choice for the eradication campaign. It's super cheap, I think I saw it costs 14 cents per administration and it can be administered by anybody, so literally anyone can be trained as a volunteer, you just squeeze a dropperful. Something I thought was really cool is that included in the oral polio vaccine is vitamin A because vitamin A deficiency is a major cause of mortality in children under five in a lot of countries. So the WHO estimates that they, by including vitamin A in the oral polio vaccine, they estimate that 1.5 million childhood deaths have been prevented.

Erin Welsh: Holy cow!

Erin Allmann Updyke: Right?

Erin Welsh: That's amazing!

Erin Allmann Updyke: I know! Fangirling over here.

Erin Welsh: I know. (laughs)

Erin Allmann Updyke: And so we talked about one of the biggest risk factors of using the oral polio vaccine is that this vaccine-associated paralytic polio. There's another aspect of it. We've talked about the benefits but there's another thing that actually makes this a dangerous vaccine to use and that's the exact flip side of the fact that you get this passive immunization of your household members. This exact same property is what allows for outbreaks of what is called circulating vaccine-derived poliovirus. This has happened in Pakistan, Nigeria, and Laos, Democratic Republic of Laos. This, what is CVDPV - that's too many acronyms.

Erin Welsh: Whoa.

Erin Allmann Updyke: The vaccine-derived poliovirus that is circulating can evolve to become more virulent and more like its wild type progenitor. Which is fascinating-

Erin Welsh: And scary.

Erin Allmann Updyke: And scary and insane. And so this type of paralysis that's associated with the vaccine-derived poliovirus is clinically indistinguishable from that that you would get from a wild poliovirus. You can tell by laboratory analysis, so we know when outbreaks are going on which is causing it. So they are trying to move away from the use of OPV now that the risk of these side effects are essentially outweighing the risk of infection by wild type poliovirus in the majority of countries. We also are seeing a push towards using a mono or bivalent OPV instead of a trivalent OPV.

Erin Welsh: Are they safer or what's the...?

Erin Allmann Updyke: Well, in the case of poliovirus 2, there basically is no wild circulating PV2 but we do see outbreaks of vaccine-derived PV2 happening.

Erin Welsh: From the oral vaccine.

Erin Allmann Updyke: From the oral vaccine, right.

Erin Welsh: So if they moved away... So it would either be moving towards a killed virus vaccine, the injected vaccine, or it would be moving towards a bivalent or monovalent oral vaccine.

Erin Allmann Updyke: Yeah. And so what they're actually doing is both. So the WHO is phasing out the use of the oral polio vaccine, they're using mono or bivalent where wild poliovirus 1 or 3 are circulating very commonly, but then they're phasing it out and they're trying to bring in the injected vaccine. But again this is much more difficult and expensive to administer in a lot of countries.

Erin Welsh: Did you find anywhere that actually indicated that the Salk killed virus vaccine conferred shorter than lifetime immunity to Sabin?

Erin Allmann Updyke: Great question. I haven't found anything that indicates that it confers a shorter immunity. What happens is that the IPV, the injected or the inactivated poliovirus vaccine, does not confer mucosal immunity. So the immunity that you get by taking the oral vaccine directly affects your cells in your gut.

Erin Welsh: Because that is the transmission...

Erin Allmann Updyke

Exactly. That is the route of administration and that is the normal route of transmission.

Erin Welsh

Okay.

Erin Allmann Updyke

So from what I could gather, and I haven't read every paper on this so this is me conjecturing based on my knowledge, the antibodies that your gut uses are IgA in general which are different than the antibodies that circulate in your blood. So the antibodies that you make when you get injected with the inactivated poliovirus vaccine are not the same ones that your body would make... You make both types but you'll make more of the kind if you get the oral polio vaccine. So what can happen is that you can potentially still get infected, you're less likely to end up with paralytic paralysis so you're protected but you can still transmit and pass the poliovirus to other people if you don't have the oral polio vaccine. If that makes sense.

So in a country like for example in Norway, they have only ever used the IPV, they've never used the OPV. But they have really great sanitation so they're not having this problem where if everyone is vaccinated with the IPV then every individual is protected and what you're not necessarily stopping is the transmission to other people that have not been vaccinated. Does that make sense?

Erin Welsh

Yes.

Erin Allmann Updyke

And so yeah, so that's one of the biggest differences that I found between the two of them. Both of them are effective but in slightly different ways and like we said already, administration of say one dose of the IPV and one dose of the OPV, like administration of both of them is actually very great. So it doesn't have to be all OPV or all IPV, there can be some combination. But in areas where there is absolutely no circulating wild polio, you're better off with the IPV because the side effects are far less and the risk of a future outbreak is lower as well.

Erin Welsh

Mm-hmm. Cool.

Erin Allmann Updyke

So economic modeling way back in the 80s predicted that polio eradication would save 40-50 billion U.S. dollars between 1988 and 2035.

Erin Welsh

Which is why the global campaign started?

Erin Allmann Updyke

I would assume so, yes, because everything's about money. But what's interesting is that it's predicted to cost 7 billion dollars between 2013 and 2019 to keep this eradication effort going.

Erin Welsh

Right because of the surveillance.

Erin Allmann Updyke

Surveillance is super expensive, we're gonna have to switch to the inactivated virus vaccine which is more expensive, there's just a ton of costs involved in it. So I've heard a lot of critiques and we're talked about before how this eradication effort really was spearheaded and started because it was white children in wealthy countries who were being affected. Not only, obviously, but they were being affected.

Erin Welsh

Because they were affected is how it became worked on.

Erin Allmann Updyke

Exactly. So there are critiques that say, you know, this eradication effort itself is... There's a lot of money going to it that could be spent on other diseases.

Erin Welsh

Such as?

Erin Allmann Updyke

Well, I mean, you could think of it as diseases that we think of as even more neglected than polio like neglected tropical diseases, intestinal helminths, leishmaniasis, chagas, do a plug for that one. But there's, I don't know the economics of this to be honest all that well, and so this is my personal, Erin Allmann Updyke's opinion, it doesn't have to be the opinion of This Podcast Will Kill You unless you agree.

Erin Welsh

Okay. (laughs)

Erin Allmann Updyke

(laughs) I feel like number one, polio still sucks. It's still a terrible virus and so in my mind any kid who doesn't have to get it in any country, that's a worthwhile endeavor. That's the first thing I feel like. And the second thing is that what's really cool about this polio eradication effort is that it has taken so many individuals being mobilized and the development and implementation of infrastructure that now exists in so many countries that once you have a system of infrastructure like that up and running for vaccination for polio, there's not that many steps away from being able to vaccinate for MMR, DTaP, hepatitis A, all of these other things.

Erin Welsh

MMR is measles, mumps, rubella. DTaP is diphtheria, tetanus-

Erin Allmann Updyke

And acellular pertussis. (laughs) Sorry.

Erin Welsh

(laughs) That's okay.

Erin Allmann Updyke

Obviously it's been easier to do polio because it's an oral vaccine but still you're having this switchover and you're still doing... There is so much surveillance that happens for polio, you can also train people to do surveillance for things like cholera and influenza, but what I think is even more exciting is you can train people then to identify outbreaks of new viruses like Marburg or Nipah, which I hope we'll talk about someday. So what's exciting to me is that getting this initial setup is often one of the biggest barriers to controlling any disease, so if nothing else this global eradication campaign has put a lot of boots on the ground in helping to develop the infrastructure that we would need to be able to do even more great public health work in the future.

Erin Welsh

Right, yeah. I agree. Yeah, I feel like if you are an economically-minded person, which is going to be the people who actually make these decisions unfortunately, that the infrastructure is already set up, a lot of the cost is already invested, and that it wouldn't be that much additional effort to do some of these other global campaigns.

Erin Allmann Updyke

Right. Granted, the money just needs to keep coming which is the second other biggest hurdle that every disease and public health campaign has to deal with but, you know. Polio is a mostly happy ending. We've really, really decreased... Did we even say the three countries that it still exists in?

Erin Welsh

I don't think so.

Erin Allmann Updyke

It's Afghanistan, Pakistan, and Nigeria.

Erin Welsh

I think you might have said it, but...

Erin Allmann Updyke

I don't remember if I did.

Erin Welsh Polio is almost gone and that's great.

Erin Allmann Updyke Right.

Erin Welsh I mean you and I didn't have to endure closed swimming pools.

Erin Allmann Updyke Well, only for poop but not for polio poop. (laughs)

Erin Welsh Oh okay. (laughs) And yeah, so...

Erin Allmann Updyke So I don't even think we need to ask the question of how scared you need to be for this episode. It's not a big threat of bioterrorism.

Erin Welsh No.

Erin Allmann Updyke You know, recognize that it still happens but-

Erin Welsh But you have probably been vaccinated.

Erin Allmann Updyke You've definitely been vaccinated. If you've ever gone to school, you've been vaccinated. (laughs)

Erin Welsh Well, sources time?

Erin Allmann Updyke Yep. Let's do it.

Erin Welsh Okay. I read a couple of books to get my information. The first is called 'Polio: An American Story', it is by David Oshinsky and it is a really great look at polio in the United States, sort of the drive to create this vaccine, and concentrates a lot on FDR, Sabin, Salk. Basically what I talked about today.

Erin Allmann Updyke Cool.

Erin Welsh Another great one which had a better overview of the history and it's a general book is called 'Viruses, Plagues, and History' by Michael Oldstone. And finally I wanna put in a plug for a book called 'Small Steps: The Year I Got Polio' and it's by a woman named Peg Kehret, I think is how you say her name, and I did not read this but it was recommended to us by Grace and it's supposed to be a great firsthand account, like a memoir of this girl's experience with polio when she contracted it at the age of 13, I believe.

Erin Allmann Updyke Oh that sounds really interesting.

Erin Welsh Yeah, so that's all I got.

Erin Allmann Updyke	I wanna give a shout-out to the Polio Global Eradication Initiative which is funded by not only the WHO even though we talked about them most today, it's also funded by UNICEF, Rotary International, the CDC, and the Bill and Melinda Gates Foundation as well as of course all the governments in the countries that they operate. And finally this review called 'Impact of inactivated poliovirus vaccine on mucosal immunity: implications for the polio eradication endgame' by Edward Parker et al in Expert Review of Vaccines published in 2015. You know my citations are always so much more boring than yours to read.
Erin Welsh	Oh my gosh I just fell asleep, I'm sorry.
Erin Allmann Updyke	I know, I almost did too. Sorry, no offense Eddie Parker.
Erin Welsh	(laughs) I'm sure that they're chock full of good information.
Erin Allmann Updyke	It is actually a very interesting article to read but you gotta like the articles things, I guess. The books are more accessible.
TPWKY	(transition theme)
Erin Welsh	I wanna give a huge shout-out to Grace who was so awesome in letting us interview her and sharing her story with us and also to Bloodmobile as per usual, who provided all the music for this episode.
Erin Allmann Updyke	Yeah, thank you so much. Thank you Grace so much for talking with us, it was amazing and awesome and I hope all of you listeners enjoyed it.
Erin Welsh	Rate, review, and subscribe.
Erin Allmann Updyke	Please, please, please.
Erin Welsh	Follow us on social media.
Erin Allmann Updyke	Yep.
Erin Welsh	And wash your hands.
Erin Allmann Updyke	Ya filthy animals. (laughs)