

TPWKY

This is Exactly Right.

Erin Welsh

On her second day of life, Kimberly Cowley had congestive heart failure. Considering the vast array of health issues she had been born with, hearing and vision loss, a rare condition known as Tetralogy of Fallot caused by a combination of four heart defects any one of which is a killer, expectations of survival were low. Against all odds, Kimberly survived but the road has been long and often painful.

Born in Hamilton, Canada in 1964, Kimberly spent the first two months of her life in the hospital. Her parents were young and shortly after marriage her mother became sick. She thought it might be a bout of flu. And then once she learned she was pregnant, she thought maybe that was why she felt unwell. It was neither. Her mother later learned that it had been rubella, having come into contact with an infected relative in her first trimester.

In 1964 the rubella vaccine was still five years away from being available. When Kimberly was diagnosed with congestive heart failure that second day in the hospital, her parents realized the problems were much bigger than they had thought. Those first two months were a whirlwind of tests. All Kimberly's parents were told was that they would have to wait until later in life to see how this translated in reality.

Like most children, Kimberly started school at age 5 but in all other ways she was profoundly different from the other kids in her class. Physically she was the size of a small three-year-old and school was an immense challenge. Given no special tools, Kimberly was expected to learn at the same rate as her classmates while missing most of two of her senses. After eight hours of concentrating to hear, see, and keep up she craved silence and to be left alone, meaning after school friends were few and far between. Often lonely, she grew up being bullied and picked on for her differences. Kimberly's parents were at a loss, not knowing what to do or how to cope.

I needed advocates and they just weren't, she said. "My mother had been a bully at school herself and continued that behavior with me. She was unable to relate to my disability. It was hard to get close to my father or brothers too because they didn't try to get close to me."

Things became much worse emotionally for 11-year-old Kimberly when she was scheduled to have heart surgery. Her classmates taunted her, telling her she was going to die. One parent was allowed to go into the operating room with Kimberly while anesthesia was being administered but neither of her parents chose to provide this comfort. She went in alone. When she woke up, she smiled despite the incredible pain knowing she was alive, proving her schoolmates and the unfeeling world around her wrong. Her surgeon called her a willful, stubborn survivor.

These days Kimberly lives quietly. She has worked in the past but seldom full-time. She exercises daily or risks losing her mobility and is a passionate archer. When she ventures out of her home, it's an exercise in extreme concentration. Kimberly uses a long cane to help her get around. Her life is also about tools: her laptop has magnification, her Kindle reader is on the second largest font, and she paints her nails with a magnifying glass clipped to her glasses.

You get used to being stared at, Kimberly said. "The only difference between now and when I was a child is that now I don't care, I just smile. I like who I am and how far I have come. I'm looking forward to the next adventures in my life," she said. "I'm a vaccination crusader. If I can save just one life by telling, teaching, and pushing for vaccination, then I know it's all been worth it."

TPWKY (This Podcast Will Kill You intro theme)

Erin Allmann Updyke Oh Erin, that got me.

Erin Welsh I know. I know. It's...yeah. That firsthand was from Kimberly Cowley and I found it on a website called measlesrubellainitiative.org. And I will post a link to the full account, so that was excerpts, and also according to this website Kimberly is working on a book. So that would be awesome to check out.

Erin Allmann Updyke Yeah, yeah.

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 Today I'm already crying. (laughs) So it's gonna be a great episode.

Erin Welsh (laughs) Just setting the stage, setting the tone for this episode today.

Erin Allmann Updyke Yeah.

Erin Welsh Yes, today we are covering rubella, also known as German measles. Although I don't know how many people still call it that nowadays.

Erin Allmann Updyke In like textbooks I feel like you still hear it.

Erin Welsh Yeah. Well we'll be mostly calling it rubella.

Erin Allmann Updyke Rubella. That's what it's called. (laughs)

Erin Welsh Yeah. (laughs) Well, I guess to start us off it's quarantini time?

Erin Allmann Updyke It's definitely, definitely quarantini time.

Erin Welsh (laughs) What are we drinking this week?

Erin Allmann Updyke We're drinking Ciao Rubella! (laughs)

Erin Welsh Very well done, Erin. And what is in the Ciao Rubella?

Erin Allmann Updyke I don't know.

Erin Welsh (laughs) Okay, I can tell you. Gin, cherry juice, grenadine, a splash of soda water and also a fancy liqueur that's like a raspberry liqueur called Chambord.

Erin Allmann Updyke Chambord.

Erin Welsh: Yeah. I liked the bottle, it was really pretty.

Erin Allmann Updyke: A very ruby rubella drink, I think that's appropriate.

Erin Welsh: Ruby rubella. Yeah, exactly. We will post the full recipe to the Ciao Rubella on our website thispodcastwillkillyou.com as well as all of our social media channels and that is also where you will be able to find the nonalcoholic placeborita.

Erin Allmann Updyke: Oh yeah, we gotchu covered.

Erin Welsh: We gotchu. All right there's some business, I guess we should run down the list of usual suspects before we dive in.

Erin Allmann Updyke: For example, we have incredible merch for sale on our website thispodcastwillkillyou.com, just click on MERCH you can find it. We have incredible offerings by the artist Abigail Ervin-Penner as well as Holly Sullivan. Really, truly, I just got some of the Holly Sullivan framed prints and I am obsessed with them. They're so cute.

Erin Welsh: Oh my gosh. And there are stickers of both which like (laughs) if you're running out of wall space for pictures which I definitely am...

Erin Allmann Updyke: You have water bottle space!

Erin Welsh: (laughs) We also have a Goodreads list if you want to read more on any of the subjects that we talk about in addition to a Bookshop affiliate account and when we post the references to all of these episodes we will also post links when available to the books that we mention on the podcast.

Erin Allmann Updyke: Yep. Is that all of our business?

Erin Welsh: Think that's it.

Erin Allmann Updyke: Okay.

Erin Welsh: Let's dive in!

Erin Allmann Updyke: Let's. This is gonna be a big, fun - not fun - a big episode.

Erin Welsh: It's gonna be a big one, it's gonna be very interesting, there's a lot I feel like to uncover that I had no idea about before diving in.

Erin Allmann Updyke: Oh I can't wait to hear the history but we'll start where we always do with the biology right after this break.

TPWKY: (transition theme)

Erin Allmann Updyke

Obviously we have two major points to talk about today in the biology and that is rubella infection, like in children and adults, and of course congenital rubella syndrome which I think most people listening probably know already the major complication of rubella infection is the effects that it can have on a fetus if someone is infected during pregnancy, especially and specifically early in pregnancy. When we did our EEE episode, eastern equine encephalitis, like back in season three, I said during that episode that rubella was another and one of the only non arthropod-borne alphaviruses in the family Togaviridae. But apparently in 2018 that was changed and rubella was reclassified. So it's not really anymore a togavirus, it's in its whole own family called Matonaviridae in the genus rubavirus.

Erin Welsh

Huh. Okay.

Erin Allmann Updyke

So this is a self-correction cause nobody has corrected me on that yet, I'm shocked.

Erin Welsh

(laughs)

Erin Allmann Updyke

In any case, we are talking today about a virus, it is a single-stranded positive RNA virus. Unlike a lot of RNA viruses that we've talked about it's pretty stable antigenically, so that's a large part of why we have a pretty effective vaccine. Spoilers.

Erin Welsh

(laughs)

Erin Allmann Updyke

So in general, rubella virus is transmitted via aerosols much like measles, which I feel like rubella and measles often go hand in hand in terms of our conversations even though they're really not that similar. But in this case rubella, it's really large particle aerosols so it doesn't linger in the air the way that measles does.

Erin Welsh

Okay, so that explains the lower R0 compared to measles.

Erin Allmann Updyke

Yes. Exactly, right. So it is a respiratory virus and like every virus on the planet it has to infect a cell in order to replicate. In the case of rubella, it generally first infects the cells of our respiratory tract and then the lymph tissue, which it's very easy to access from our nose and nasal passages. But very, very quickly within 5-7 days after exposure, rubella is able to disseminate throughout our bloodstream, so it causes a viremia meaning you can detect virus in our blood if you took a sample, and it leads to a pretty widespread systemic infection. What that means is that unlike some other viruses and pathogens that we've discussed, rubella has a very wide tropism, meaning it can infect a huge range of our cell types, not just a few types of cells.

Erin Welsh

That's very interesting.

Erin Allmann Updyke

It really is. We don't still know exactly what receptor it uses on our cells to gain entry into our cells but we know that it must be something that's present on like almost every cell type. If that makes sense.

Erin Welsh

So that makes me wonder about other species. So like I know that rubella is human specific-

Erin Allmann Updyke

It is.

Erin Welsh

But if it infects... What is it then about all of these human cells that makes it not able to infect other animals?

Erin Allmann Updyke

Right. Right. It's a really good question. So what is it using in our bodies to be able to infect almost all of our cells but really just humans? I mean, experimentally you can infect other animals so it's not impossible for other animals to become infected, it's just that in general other animals, they're not good reservoirs, they're not like walking around in the world infected with rubella virus.

Erin Welsh

Ooh so I wonder whether it's just the transmission dynamics and like human behavior or maybe it just doesn't cause disease the way that it does... That's so interesting.

Erin Allmann Updyke

It's so interesting, right? Yeah I know. It gets even more interesting quite honestly. But keep that mind, right. Like this is a virus that can infect pretty much any cell type. Additionally we know that like many many viruses, at least part of the pathogenic effect of rubella is by directly killing cells, essentially.

Erin Welsh

Okay.

Erin Allmann Updyke

So when cells get infected with virus and the virus replicates inside those cells, that cell will undergo apoptosis meaning that cell will die. So at least in part, that is responsible for the damage. That means it's not just our immune reaction or our immune response that's causing the symptoms that we see. But we'll put a pin in that because that's not the whole story. And we'll move on to the symptoms, at least in grown humans. I wanna skip ahead, okay?

Erin Welsh

Okay.

Erin Allmann Updyke

In general, in children or adults who get infected, we are talking with rubella about a very, very mild self-limited illness if you have symptoms at all. In general it starts with a rash not a fever. (laughs)

Erin Welsh

Oh! That's the other sub-podcast. (laughs)

Erin Allmann Updyke

Exactly. It started with a fever. *Unless it started with a rash.

Erin Welsh

There you go, perfect.

Erin Allmann Updyke

So in the case of rubella it generally starts with a rash, this rash is very similar actually to the one that we see with measles which I think is a large part of why there's this overlap. It starts on the face, it generally spreads downwards towards the feet encompassing almost your whole body. The rash looks like small red spots maybe with some bumps. But differences between the rubella rash and measles are that it spreads much more quickly, like within 24 hours, it generally lasts only a couple of days, like 2-3 days, and the rash doesn't coalesce or darken the way that measles rashes tend to do.

Erin Welsh

Okay. I also read somewhere it was tingly. Is that the case?

Erin Allmann Updyke

Oh, interesting. I didn't read that.

Erin Welsh

Oh. (laughs)

Erin Allmann Updyke

You can feel it tingling?

Erin Welsh

Just a tingly rash. I mean, granted this description was from the mid 1800s so like, you know.

Erin Allmann Updyke: I wonder is that a description of how the rash feels or is it something about... Like is that how you describe rashes? Like a tingly rash vs a lacy rash, I don't know.

Erin Welsh: (laughs) I assumed it tingles, but... Well because does measles tingle? I can't remember. Or does it like itch or burn?

Erin Allmann Updyke: I don't think so.

Erin Welsh: I didn't think so. So I thought that was one of the designating or differentiating characteristics.

Erin Allmann Updyke: Interesting. Tingly.

Erin Welsh: Yeah.

Erin Allmann Updyke: Tingly. Well I didn't read it, doesn't mean it's not possible. But very differently from measles, that rash is often it, okay, in terms of the symptoms of rubella if you have that at all. Maybe you might also have a small fever, maybe you might also have some swollen lymph nodes but really, that's about it. It's a very mild illness and again, that's if you even have symptoms. The older that you are when you get infected, the more likely that you'll have symptoms beyond the rash but kids are more likely to have the rash for sure, like have any symptoms whatsoever. And if you have symptoms, number one is gonna be the rash.

Erin Welsh: Okay.

Erin Allmann Updyke: In some cases you can have things like arthralgias or joint pain which can last for several weeks but it's really rare and even more rare are severe manifestations like encephalitis, the way that we do see with measles, we're talking though like 1-3 per 6000 cases. So this is a very rare complication. But also other complications that you can get from a wide variety of viral and other infections, things like Guillain-Barre, myocarditis which is when the virus infects your heart, optic neuritis if it affects your eyes, these things are all possible but they're not specific to rubella and they're very, very unlikely with a rubella infection specifically.

Erin Welsh: Gotcha.

Erin Allmann Updyke: But that's not the big story when it comes to rubella.

Erin Welsh: No.

Erin Allmann Updyke: The big story is congenital rubella syndrome or CRS. This is what happens when a person gets infected with rubella and usually this has to be a primary infection, so someone is being exposed and infected for the first time in their life which they are pregnant, specifically during the first trimester which is the first 12 weeks of pregnancy. Now if we remember back to our thalidomide episode when I talked about the embryologic period of development, the first 10 weeks or so, I talked a lot about how anything that has effects on a developing fetus during this period - when it's an embryo not even a fetus - has huge downstream developmental effects. Rubella is one of those infections that can infect a fetus especially at this early, early stage.

Erin Welsh: Mm-hmm.

Erin Allmann Updyke

Essentially what happens is when a pregnant person gets infected with rubella, as we already talked about, that virus spreads really rapidly through our bodies and one of the places that it spreads and can infect is the placenta and the placental tissue. And then it can travel through that placenta and go on to infect pretty much any cell in that developing embryo or fetus. Now what exactly happens inside an infected fetus is still not entirely clear, which I think is fascinating.

Erin Welsh

That's so...yeah. I'm so surprised by that.

Erin Allmann Updyke

Yes. Me too. But we do know some things and they're really interesting. There's kind of three main ways that rubella has effects. We know that in grown humans, one of the main effects of rubella that causes symptoms is direct cell death, right? But in the case of the developing fetus, that doesn't seem to be a main mechanism by which damage is induced. Isn't that weird?

Erin Welsh

I wonder does this have something to do with the fact that we still don't know the receptor? And that like maybe... I don't know.

Erin Allmann Updyke

Maybe.

Erin Welsh

Is it cell death... Okay, so if rubella virus can infect all those different cells that we have, does it cause cell death in all of those cells or is it just a subset?

Erin Allmann Updyke

Great question. Very good question. I don't know. And here's an on top of that, we think that at least part of the reason that a fetus is susceptible when it is and part of why... So this is an interesting, I was gonna say this later but I'm gonna say it now, if a baby is born with congenital rubella syndrome they still harbor rubella virus for months if not years. And so in a fetus and a newborn, rubella is not an acute infection, it's a chronic infection. So it's acting very differently in a fetus than it is in a person.

Erin Welsh

Yes.

Erin Allmann Updyke

So how much does that have to do with the fact that the immune system is still under development? Gosh, who knows, right. Like what are those mechanisms and what is the interaction with a well-developed immune system vs a fetal immune system? It gets complicated. But Erin it's about to get more complicated so I have to keep going.

Erin Welsh

Wait but can I ask two questions before?

Erin Allmann Updyke

You can try.

Erin Welsh

(laughs) So okay. My first question is if it can infect all these different types of cells can it also be transmitted through means other than respiratory, is respiratory just the primary way?

Erin Allmann Updyke

Great question and yes. Yeah so you can culture virus from a whole bunch of different bodily fluids, poop, pee, eye conjunctival fluid, even by scraping off the skin like the virus is in your skin especially when you have a rash, it's actually in the rash and non-rashy skin. So the virus is definitely everywhere, it's in your blood. But it's at highest level in the respiratory tract.

Erin Welsh

Okay, that makes sense.

Erin Allmann Updyke

Yeah.

Erin Welsh: And my other question is in later trimesters or later on in the pregnancy if someone becomes infected, does the fetus have an immunity? Like are there any effects?

Erin Allmann Updyke: Pause that question, I'll answer that, I'll address that.

Erin Welsh: Okay, thank you. (laughs)

Erin Allmann Updyke: (laughs) We will get there, Erin, let's not jump our guns.

Erin Welsh: Sorry I got really excited.

Erin Allmann Updyke: I know you did. So all I told you was what was not the main cause of the effects that we see in a developing fetus. I wanna tell you what we think are, okay? Cause we know some things.

Erin Welsh: (laughs) Okay.

Erin Allmann Updyke: And because it gets even weirder. Infection in the fetus results in decreased cell growth and division. So even if it's not killing cells directly, it's stopping cells from dividing. That's what a fetus does, divide cells. But I mean what that means is that in a developing fetus you have a reduction in cell mass and that can result in not enough cells recruited to shape embryologic parts the way that they should be developed.

Erin Welsh: Okay, so it's almost a side effect of... Like there are so many downstream effects from a rubella infection that's not just, oh, the rubella virus targets those cells in that area.

Erin Allmann Updyke: And there's more.

Erin Welsh: Okay.

Erin Allmann Updyke: Talk about downstream effects. Another cell type, even though we know that rubella can infect a lot of different cells, one of the big problems is when rubella in a developing fetus infects the endothelial cells of the blood vessels. Those are the cells that line blood vessels. We ended up talking about those a lot on this podcast.

Erin Welsh: Interesting.

Erin Allmann Updyke: Infection of those cells causes damage to fetal blood vessels which can downstream cause damage enough that they cause ischemia or tissue death in organs that are supplied by those blood vessels.

Erin Welsh: Okay.

Erin Allmann Updyke: So you can have downstream effects of damage to organs because of damage to these blood vessels in the fetus. Okay.

Erin Welsh: I have a question. okay.

Erin Allmann Updyke: (laughs)

Erin Welsh	Does the timing of infection during the first trimester matter or is it just sort of any time?
Erin Allmann Updyke	Absolutely the timing matters.
Erin Welsh	okay.
Erin Allmann Updyke	<p>So the timing is everything in terms of the effects that you see, in terms of the severity, everything. So there's a lot of details in a lot of the papers that I will post in terms of the exact number of weeks for when you have this effect vs that effect, but in general it goes like this: infection within the first 12 weeks almost always is going to result in infection of the fetus.</p> <p>So infection of a pregnant person during the first 12 weeks of pregnancy for the first time with rubella is going to end up infecting the fetus. In those first 12 weeks, almost all of those infections or a large proportion of those infections are going to result in some kind of fetal malformation or problem down the line. After like 16-18 weeks especially, it's not that infection doesn't occur it just doesn't have those long-term effects or downstream effects. And this is really weird, there's like a period of time in the second trimester where infection itself tends to be lowest. And then in the third trimester the fetus could become infected but the most that you might see would be like some growth restriction.</p>
Erin Welsh	Okay.
Erin Allmann Updyke	But at almost any point in pregnancy a fetus could become infected, it's just that only in that early period of time are you going to see the effects. So let's talk a little bit more specifically about what you see cause then we can talk about even more specifically about the timing.
Erin Welsh	Okay.
Erin Allmann Updyke	So because this is a virus that can affect almost every cell, really almost any part can be affected, almost any organ, really anything. But classically there are kind of three large-scale ways in which congenital rubella syndrome can affect an infant born with it. One is with transient kind of short-lived manifestations that tend to happen if the viral load in that baby is very high at the time of birth. And we'll talk about what those look like. The second is with permanent manifestations so that means something that happened during development that doesn't change, that affected the development of that fetus.
Erin Welsh	Okay.
Erin Allmann Updyke	And then finally there are, and this actually blew my mind because I never learned this previously, there are late onset problems that can happen that are not detectable at the time of birth but become apparent later on. So we'll go through each of those. The transient ones, because this virus is infecting everywhere, they can be really wide-ranging. And infant can be born with jaundice, so that means kind of yellowed skin which usually has to do with anemia or hemolysis so like red blood cells lysing within their body because of infection; hepatitis, so infection of the liver; enlargement of the liver or spleen. A kind of classic description of a baby born with CRS includes a blueberry muffin rash which means purple spots on the skin.
Erin Welsh	Interesting.

Erin Allmann Updyke

Yes and this is actually caused by, this is very interesting, it's caused by erythropoiesis which is the process of making red blood cells in the skin because you have anemia elsewhere and infection of the bone marrow potentially. So basically the baby is not making enough red blood cells so other organs are recruited to help make blood cells and then you end up with this type of rash.

Erin Welsh

Whoa.

Erin Allmann Updyke

You could also have pneumonia, myocarditis, diarrhea, like a lot of different things can happen. These manifestations do tend to clear on their own. However it comes with the caveat of these infants are very sick. And on top of that you don't generally have only these transient manifestations. These babies are oftentimes born with things like growth restriction or other more permanent manifestations. So mortality in babies born with this type of congenital rubella can be as high as 35% in some cases.

Erin Welsh

Oh my gosh.

Erin Allmann Updyke

It's very sad. And I didn't even mention but infection with rubella, especially super early on, can also cause pregnancy loss but I have no idea what the proportion of that is because I was not able to find numbers on like the incidence of that compared to infection that results in these things that we can see in a baby that's born.

Erin Welsh

Mm-hmm.

Erin Allmann Updyke

Okay so now we have these permanent manifestations and that means that something went wrong during development. The most common consequence is deafness. This happens in 2/3 of babies born with congenital rubella and it can be of varying levels, so complete to just mild hearing loss. You also can have neurologic complications including developmental delays, a huge range of heart defects, the heart aside from the ear is the second most common organ involved, I think 1/2 of babies born with congenital rubella have some type of heart defect. And then the third most common is vision defects which can be cataracts, those are the most common, about a 1/4 of babies born with congenital rubella have some degree of cataracts but you can also have retinopathy, glaucoma, a whole number of vision problems. All of these happen either from problems during organogenesis, so the making of organs like your heart, or from tissue destruction and scarring like in the case of hearing loss and some brain damage that can occur.

Erin Welsh

Okay.

Erin Allmann Updyke

Then we have the long-term or delayed manifestations. And this is truly wild. These are things like type 1 diabetes which occurs at anywhere from 50-200 times, depending on the paper you read, the rate of the general population.

Erin Welsh

What?

Erin Allmann Updyke

Right? So babies born with congenital rubella can go on to develop type 1 diabetes. Also thyroid dysfunction and a number of different autoimmune-related thyroid dysfunction, vascular problems. The most severe and most rare complication would be a panencephalitis, so an infection of the entirety of your brain and that is often fatal. But these can occur years down the line.

Erin Welsh

Why?

Erin Allmann Updyke

Why? Why? (laughs) Yeah. But yeah so your question earlier about the specific timing, part of the reason, and I found this very interesting because I was worried you were gonna ask me a lot of real specifics about like, how does cataracts occur? And how does... Okay? So I went down some rabbit holes to try and figure out like what specific things are causing each of these, like the three most common effects that we see which are deafness, heart defects, and cataracts or vision problems. And part of the reason that hearing loss is one of the most common effects is because in contrast to some of the other more serious deficits, the effects that can produce hearing loss can happen later. The organ of corti in your ear is vulnerable to the effects of the virus up to the first 16 weeks, whereas most of the heart defects are uncommon after 8 weeks or so, and then cataracts are uncommon after weeks 9-11, etc.

Erin Welsh

Okay.

Erin Allmann Updyke

So that's part of the reason why the ear tends to be affected the most out of all babies born with CRS.

Erin Welsh

Gotcha. Interesting.

Erin Allmann Updyke

The good news is there's a vaccine.

Erin Welsh

There's a vaccine!

Erin Allmann Updyke

Ahhh! And Erin, I can't wait to hear about the development and things like that. But it's a live-attenuated vaccine so it's a live strain of rubella virus that's been grown in a lab so that it doesn't cause infection. One dose produces immunity in 95% of people that has been shown to last upwards of 21 years, which is phenomenal.

Erin Welsh

It's a good one.

Erin Allmann Updyke

It's a very good one. So in general, that's the only good news that I have. So, Erin. What's up with this? Can you tell me about it? Like where did this virus come from, why is it only in humans, how did we come up with a vaccine, and why isn't it gone yet? I don't know.

Erin Welsh

Oh my gosh, these are lots of questions and I don't know if I'm gonna be able to answer all of them but I'll do the best that I can. Right after this break.

TPWKY

(transition theme)

Erin Welsh

So Erin, you asked where does this come from.

Erin Allmann Updyke

Yeah.

Erin Welsh

We don't really know!

Erin Allmann Updyke

Ugh. Are you me or something? (laughs)

Erin Welsh

I know, I know. Okay. Here's what I'm gonna do in the history section just to sort of prepare you for the fact that there's gonna be thousands of years of me not talking about the history. I'm gonna start with the evolutionary history and what we do know about it.

Erin Allmann Updyke

Okay.

Erin Welsh: And then basically I have to jump right to almost modern history.

Erin Allmann Updyke: What?

Erin Welsh: Because in terms of ancient history, rubella was unlikely to be distinguished from the other relatively mild or often mild rash-causing illnesses.

Erin Allmann Updyke: Right, yeah.

Erin Welsh: I mean, as you described, the symptoms aren't super specific, so unfortunately that means no mentions of Ancient Egyptian papyri or Hippocrates or whatever.

Erin Allmann Updyke: Well, I'm done listening. Just kidding.

Erin Welsh: (laughs) Okay. But as I mentioned, yeah, there seems to be this big question mark over the origins of the rubella virus. I did read in one paper that looked at the molecular epidemiology of rubella viruses and the different rubella virus genus types across the Asian continent and they say it's thought to have originated there. Like somewhere in Asia.

Erin Allmann Updyke: Oh. Okay.

Erin Welsh: All right? But then I found a paper that was published super recently in Nature in October 2020, so just a couple months ago. It's cool.

Erin Allmann Updyke: (gasps) Just for us.

Erin Welsh: And they reported the first known relatives of the rubella virus which they isolated from several different species of mammals.

Erin Allmann Updyke: What?

Erin Welsh: This is interesting.

Erin Allmann Updyke: Yeah.

Erin Welsh: So ruhugu virus, which is most closely related to rubella, was found in a species of bat called the cyclops leaf-nosed bats which I believe were in Uganda and they appeared otherwise healthy. And it wasn't just like this isolated infection in one bat, it was found in around 50% of the individuals that they sampled.

Erin Allmann Updyke: What?

Erin Welsh: Yes. And they found the other virus which they called rustrela virus in animals in a zoo in Germany that had gotten sick and eventually died from a severe acute neurological disease.

Erin Allmann Updyke: What?

Erin Welsh: The animals were a donkey, a capybara, and a red-necked wallaby.

Erin Allmann Updyke

What?! Erin.

Erin Welsh

(laughs) I know, I know, I know. And so then they were searching for the cause of these deaths, they found rustrela virus in the brain tissue of all three of these animals and then they subsequently sampled other animals around the area to see if they could find the same thing, and they found this virus in about half the yellow-necked field mice that they tested.

Erin Allmann Updyke

So they found these two brand new viruses.

Erin Welsh

Seems to be.

Erin Allmann Updyke

And then they were like, what are these? And they figured out they were closely related to rubella?

Erin Welsh

Really closely related. So if you look at their genomes, they're very similar in terms of coding regions and stuff and the arrangement of those.

Erin Allmann Updyke

What?

Erin Welsh

Yeah.

Erin Allmann Updyke

Like did they come from rubella or did they come from a shared common ancestor? How old are these?

Erin Welsh

So I don't know how old they are, let me pull up the paper to see what sort of the evolutionary implications or timeline or whatever. If I'm reading this correctly, so all three of them came from a shared ancestor but rustrela virus diverged before those too.

Erin Allmann Updyke

(gasps) What?

Erin Welsh

So first rustrela went off the tree, then ruhugu, and then rubella split secondly.

Erin Allmann Updyke

What?

Erin Welsh

Yeah. I don't know about the timeline or anything.

Erin Allmann Updyke

Yeah.

Erin Welsh

Maybe it was in the paper and I just missed it but yeah. Basically so from this paper there were a couple of take-homes. One was that given the ability for these viruses, especially rustrela, to infect a diversity of mammal species and now I'm adding my own little thing about what we know about the rubella virus to infect all different kinds of cell types.

Erin Allmann Updyke

Right.

Erin Welsh

The rubella virus may have initially spilled over from wildlife into humans and that this does raise some concerns for future zoonotic spillover events. Although I do want to give a PSA as we always do to say that bats are not evil and the more funds and effort we put into this type of research and bat conservation, the less likely spillover events are going to occur. Anyway. Okay. But the other really cool implication from this paper is that these new viruses give us the ability to do more comparative studies or to explore different animal models so that we can better understand things about why this virus has such wide-ranging impacts on the body or on the fetus. And yeah, so.

Erin Allmann Updyke

Yeah, that's really fascinating.

Erin Welsh

Yeah. So now we need to launch ourselves quite a bit forward in time to around the 18th century.

Erin Allmann Updyke

Wow, yeah.

Erin Welsh

Yeah. The debate over whether or not these rashy illnesses were different diseases or just different forms of the same disease was still kind of ongoing although there had been some clarity reached regarding at least measles and scarlet fever being separate. And a handful of researchers had started talking about a third separate illness, one that they called rōtheln. I'm gonna be terrible at pronouncing this.

Erin Allmann Updyke

Is it in German?

Erin Welsh

Which is German for 'to redden' according to Google Translate. Throughout much of the 18th century and into the early 19th century, it was in fact mostly German researchers who seemed interested in characterizing this new disease, hence the name by which it would be popularly known in many places outside of Germany: German measles.

Erin Allmann Updyke

Again, not a name that we still use.

Erin Welsh

It is not. But it was much more heavily in use than rōtheln and rubella.

Erin Allmann Updyke

Yeah. Definitely.

Erin Welsh

Throughout the 1800s there was growing acceptance that this disease was a truly separate entity from measles and scarlet fever. But even with all of this discussion and research and a description in the early 1800s that basically covers many of the key features of rubella, people in the medical science community remained a bit hesitant to accept that this was actually a separate disease. But finally the tides seemed to be turning when in 1866, following continued epidemics and other smaller reports of the disease, a British Royal Artillery surgeon published an article describing a current outbreak of the disease known as rōtheln in India. He closed out this article with a paragraph proposing a name change. Quote:

"The name of a disease is always a matter of some importance. It should be short for the sake of convenience and writing and euphonious for ease and pronunciation."

I agree with that part but that's only because I'm terrible at pronouncing anything. To continue.

"It should, if possible, indicate a definite group of pathological conditions. Rōtheln is harsh and foreign to our ears. Rubeola notha and rosalia idiopathica are too long and yet to be proved. I therefore propose rubella as a name for the disease."

Erin Allmann Updyke But also that's just so English-centric that he's like, 'I can't pronounce German!'

Erin Welsh (laughs) So let's call it this thing that I am going to make up entirely: rubella.

Erin Allmann Updyke Yeah.

Erin Welsh Yes. But the name did catch on, people were like, 'Yeah, sure, let's do it.' Although the term German measles would still around for much longer in many places to kind of an annoying degree cause it caused a whole lot of confusion, it's not from Germany and it's also not a type of measles.

Erin Allmann Updyke Right. Yeah.

Erin Welsh And at times it also caused anti-German sentiment. For instance in WWI, although it lagged behind other diseases such as influenza and typhus, rubella did do some damage. U.S. Army hospitals admitted more than 17,000 soldiers for rubella and rubella was the cause of over 211,000 days lost from duty.

Erin Allmann Updyke Wow.

Erin Welsh And the high prevalence of this disease led to lots of German measles jokes about Germany and in WWII the disease was nicknamed 'the liberty itch' or 'victory measles'.

Erin Allmann Updyke What?

Erin Welsh Like freedom fries and victory measles.

Erin Allmann Updyke Yeah, oh my god.

Erin Welsh (laughs) Okay. For the next big development in rubella history we have to jump ahead again, this time to the early 20th century, around 1941.

Erin Allmann Updyke Wow. So far.

Erin Welsh Yeah. Let's do a bit of context building here, my favorite thing to do, in terms of infectious disease and medicine. So it's kind of hard to imagine just how much the field of medicine had changed in 100 years from 1841 to 1941.

Erin Allmann Updyke I want a compilation of every time that you've said that on the podcast. (laughs)

Erin Welsh I know! I know. And I'm like, I feel self-conscious saying it because I'm like, god surely people are sick of hearing the same thing.

Erin Allmann Updyke I love it though.

Erin Welsh It helps me get into the mindset of like why 1941 was an important year or why that year... Why things happened when they happened.

Erin Allmann Updyke Yeah! Yeah.

Erin Welsh

Yeah. Anyway. So germ theory had a lot to do with advancing knowledge regarding some of the most common or prevalent diseases in that time, but medical technology allowing for close observation and measurement of things previously only able to be described qualitatively turned the art of medicine into a science. Definitely have said that before.

Erin Allmann Updyke

Oh yeah.

Erin Welsh

And a great deal of this change can be described by a single word: specialization. The growing body of knowledge regarding human anatomy and disease processes and treatments made it possible for different, highly specialized fields to develop.

Erin Allmann Updyke

Okay.

Erin Welsh

Now onto the infectious disease context. Germ theory had been around for decades but the pace of discovery in terms of uncovering new pathogens or new treatments or vaccines was still incredibly high. Around 1941 we had a smallpox vaccine, a cholera vaccine, a typhoid vaccine and others. And we were more easily able to tell, oh this disease is likely caused by a bacterium vs a virus vs a parasite. Antibiotics were on the cusp of widespread use, just a couple years away, and as a result of our increased understanding of how different diseases were transmitted and improved sanitation infrastructure, the world was facing lower rates of death due to infectious disease than ever before. But of course there was still an incredibly long way to go. Things like tuberculosis and polio still sickened or killed many people and it also made them terrified. So a potential vaccine or treatment for these feared diseases held a lot of promise and hope for people. But I think it's important to remember that not all diseases were as equally feared, or like the need for a vaccine for every disease was not as self-evident as it maybe is today.

Erin Allmann Updyke

Yeah. Yeah! Which is very interesting, especially in the context of rubella.

Erin Welsh

Exactly. So it was like, you know, when you have tuberculosis or polio outside your door, you don't have room or even reason to be scared of something as mild and routine like rubella, which is what it seemed at the time.

Erin Allmann Updyke

Right. Yeah.

Erin Welsh

And so epidemics of rubella were tracked and control attempts were made and research on the causative agent still continued, it didn't really take front and center the way other things did. But that would change starting in 1941.

Erin Allmann Updyke

Ooh.

Erin Welsh

Australian pediatric ophthalmologist Norman McAlister Gregg-

Erin Allmann Updyke

There's your specialization.

Erin Welsh

Yep. (laughs) He'd been practicing for close to 20 years when in 1940 and 1941 he started to notice an unusual amount of parents bringing in their babies with the same concerns. Unusual cataracts or eye infections or other rare eye disorders. And he had been in the field for a while and so he recognized that the rate of these conditions that he was seeing was uncommonly high and he wondered whether there was some sort of link that was connecting them. And maybe it was unusual for the time but he was the type of doctor that listened to their patients' concerns and to their hypotheses as to why their kid was sick and what had caused it. He exhibited patience and empathy, at least from what I've read about him.

Erin Allmann Updyke

Wow.

Erin Welsh

And one day Gregg, which is his last name but it's really just funny for me to be like, Gregg.

Erin Allmann Updyke

Gregg!

Erin Welsh

I see there are two Gs here but like, Gregg!

Erin Allmann Updyke

Gregg.

Erin Welsh

So one day Gregg overheard a couple mothers of his patients, so children with rare cataracts, talking in the waiting room about what they thought had caused their child's poor eyesight. One of the mothers wondered out loud whether it could have been the rubella infection that she had early in her pregnancy and the other mother also mentioned that she too had gotten sick with rubella while pregnant. And instead of immediately dismissing this as another superstition, which there were plenty of superstitions, as no doubt many other physicians would have done, he considered it a plausible idea despite the fact that at that point the idea of an infectious disease infecting a fetus had not really been considered, much less explored.

Erin Allmann Updyke

That's fascinating, Erin.

Erin Welsh

And so he asked around to other colleagues whether they had seen similar cataracts in babies or young children and if they said yes, he reached out to the parents of those children to ask whether the mother had experienced a rubella infection during pregnancy.

Erin Allmann Updyke

Wow.

Erin Welsh

And what he was finding was that a substantial proportion of those women said yes. A proportion that was at least great enough for him to expand his efforts and conduct an actual official planned study into this phenomenon.

Erin Allmann Updyke

Wow.

Erin Welsh

And through this additional research, he found that a rubella infection during pregnancy, especially early on in pregnancy, was associated with a suite of eye problems but that it wasn't limited to just the eyes, there also seemed to be cardiac involvement in some of the children. In 1941 he compiled his findings into a report that presented at the October meeting of the Ophthalmological Society of Australia. Some Australian newspapers also happened to pick up this story and Gregg found himself the recipient of tons of phone calls from people who had been infected with rubella during pregnancy and their child had either sight or hearing or heart or developmental issues. And so public and scientific interest in this possible link between rubella infection during pregnancy and congenital defects grew and the bigger picture of congenital rubella syndrome took shape. Although that term wouldn't be really used until the 1960s.

Erin Allmann Updyke

Okay.

Erin Welsh

Rubella has been likely infecting humans for thousands of years and so I think it's natural to ask the question, why did it take until 1941 for people to make the connection between a rubella infection during pregnancy and congenital abnormalities?

Erin Allmann Updyke

Yeah.

Erin Welsh

What was so special about that year or about Dr. Gregg? I set up some of the historical context earlier, especially the role that specialization in medicine likely played, but there's more to the story. First, Norman Gregg was notable in that he listened to the mothers in his office and pursued a lead that others may have dismissed due to the fact that A) nothing like it had been observed before, and B) it was originally put forth by women, most of whom weren't medically trained in any way or even maybe had received formal education. In his writings and interviews, Gregg acknowledged the contribution of these mothers whose strong interest in their child made them observant and willing to recount any information that might be relevant. In addition, Gregg was not just a pediatric ophthalmologist whose specialization meant he saw a ton of patients from a wide geographic area, he was also a university researcher, meaning he could undertake an epidemiological study and do some stats to see whether his research questions were answered and if so, what those answers were.

Erin Allmann Updyke

Yeah.

Erin Welsh

And the other notable thing, not necessarily about Gregg but about the time period, was that WWII was underway and the assembly and movement of troops led to widespread rubella epidemics not just in Australia but across the globe as well. And those rubella epidemics in the military of course spilled over into the broader public and so the increase in the frequency of those unusual cataracts he was seeing was likely the result of those rubella epidemics.

Erin Allmann Updyke

Yep, that's makes sense. Whoa Erin.

Erin Welsh

(laughs) I know. It's interesting. I just like to put myself in the shoes of like, why? Why then? Why this person? It's cool to think about.

Erin Allmann Updyke

Yeah. Yeah, the whole epidemics thing about rubella is very interesting too because it's definitely like majority a disease of childhood but in all populations before vaccines, there was going to be some proportion of people of childbearing age who are still susceptible. So then what causes an outbreak in kids vs in adults vs in people who are pregnant? Like it's just so interesting to think about all of the different factors that would have had to combine to lead to these, not just rubella, but congenital rubella outbreaks. Like ugh, it's very interesting.

Erin Welsh

Right. Especially at a time when... You know, the other really key thing is that rubella, at least then, people knew it was a virus but they didn't know which virus. And diagnosis based on clinical presentation was iffy a lot of the time, it was usually a process of elimination. Have you gotten measles before? Have you gotten scarlet fever before? Yes? Okay probably this is rubella.

Erin Allmann Updyke

Well and on top of that there's such a high rate especially in adults of no symptoms whatsoever, like a completely asymptomatic infection, so-

Erin Welsh

It's like over 50% right?

Erin Allmann Updyke

Yeah it's about 50% in kids that'll be asymptomatic and in adults it can be as high as like 6 or 7 to 1, so a really high rate. So the fact that he was able to find statistical significance in his samples of like asking people, 'Hey, did you get rubella when you were pregnant?' or whatever. That's like, oh man.

Erin Welsh

Yeah. It's amazing to think about.

Erin Allmann Updyke

It really is.

Erin Welsh

But what did the rest of the world think of Gregg's hypothesis? (laughs)

Erin Allmann Updyke

Gregg! I don't know.

Erin Welsh

Well, while researchers and clinicians in Australia were pretty quick to accept Dr. Gregg's findings as fact and start informing people about the dangers of rubella infection during pregnancy, the rest of the world wasn't so keen or so quick to believe him or his research.

Erin Allmann Updyke

Ugh.

Erin Welsh

Which does have some merit, Gregg's data had only included children with congenital defects, the methodology behind how he collected the data was unclear, and there was still some doubt that rubella could be reliably distinguished from measles and scarlet fever. And his critics argued that Gregg's findings were suggestive of a link but not conclusive.

Erin Allmann Updyke

Okay.

Erin Welsh

But I think it's also interesting that scientifically the idea that compounds or pathogens could cross the placenta was not new, it was something that embryologists and pathologists had known for probably at least a few decades. But most clinicians at the time probably didn't receive training or specific education in embryology the way they do now. And still nothing like this had ever really been observed before in humans in terms of a virus and so this got some people thinking that viruses represented this whole new realm to be feared in terms of negative effects during pregnancy.

Erin Allmann Updyke

Huh.

Erin Welsh

So, anyway. But despite this initial doubt, the link became more accepted as clinicians did their own tracking of patients or patient case histories in places like North America and Europe. And data supporting the link just seemed to grow and grow and grow and the boundaries of congenital rubella syndrome also seemed to grow as well or expand as well. And from there it trickled out into the public. For some people who had had a child with congenital rubella syndrome, it was a relief to know why that had happened, to have some sort of an answer, because it relieved some of the anxiety or worry they may have carried in terms of deciding whether to have another child, or it may have relieved some of the guilt that they may have carried with them.

With the dangers of rubella uncovered and yet no vaccine for its prevention, doctors considered what to do to minimize the risk of infection in pregnant people. Stop epidemics in their tracks, inform the public of the risks of this virus which had previously been thought to be minimal. Prophylaxis really seemed like the only way to actually ensure the safety to pregnant people. Others recommended that people should try to become infected while young to gain lifelong immunity, like rubella parties, those were actually a thing. Although others strongly recommended against that considering there could be severe consequences of infection, like why invite a pathogen when there could be something that you don't know happens?

Erin Allmann Updyke

Right.

Erin Welsh

But until there was a vaccine, there was also a recognition that rubella and thus congenital rubella syndrome was not entirely unavoidable and some of the advice like 'keep away from small kids' was completely impractical for some mothers who maybe already had a couple of school-aged kids at home.

Erin Allmann Updyke

Small kids, yeah.

Erin Welsh

That was like, yeah what are they supposed to do, live in a hotel for nine months?

Erin Allmann Updyke

That's like... Well this is a little bit off topic but after a C-section you're not supposed to lift over 20 pounds, so if you have a toddler it's like, well, you can't touch him. (laughs)

Erin Welsh

Yeah.

Erin Allmann Updyke

Oh dear.

Erin Welsh

Yeah. And so recognizing this, in the popular media the headlines shifted towards a concern that the continued epidemics of rubella would lead to what was framed as an enormous social problem wherein institutions or long-term care facilities would be overwhelmed and families would be hugely stressed. During this time the prevailing view in the U.S. was that children with CRS were seen as tragedies and the parents and families of those children as the victims of those tragedies. Now of course our society has evolved a bit in empathy, but this framing wasn't just because of a lack of empathy back then. It was also because during that time period, we lacked the knowledge and resources to adequately care for people who were differently abled. Often the solution was institutionalization, which was a huge financial strain, and public schools weren't equipped also to provide additional resources that's going to make education possible for children with congenital rubella syndrome.

Erin Allmann Updyke

Yeah and especially when you think about deafness and hearing loss, that often wasn't able to be diagnosed until much later in life which is still the case in some parts of the world which is hugely detrimental to learning ability. Whereas now if you're able to identify it early on, you can already get things in place to be able to help that child with what they need. So that's huge for sure.

Erin Welsh

Yep. And all of these things also were compounded by the social stigma and shame that was associated with having a child with congenital defects. Why didn't you take better care of yourself during pregnancy? Like all of these accusational questions of pointing fingers and assigning blame to people who...

Erin Allmann Updyke

Blame the mothers. It's classic.

Erin Welsh

To mothers primarily, yes. And the emotional turmoil would have affected everyone in the family and of course what parent doesn't want the best for their child, for their child to be healthy and to have no limits on what they can do and achieve. The media attention on congenital rubella syndrome reached new heights in the early 1960s when an enormous rubella epidemic was underway in the U.S. But although it was quite a sizable epidemic, this was not the first rubella epidemic in decades. In 1958 for example, there was another rubella epidemic across the U.S. but it didn't make nearly as many headlines. So let's consider why this early 1960s rubella epidemic might have caused such alarm.

Erin Allmann Updyke

I can take some guesses.

Erin Welsh

Yes. If you've listened to the podcast before, there are two possible reasons you can guess right away. Number one was polio. Jonas Salk's polio vaccine had been developed and deployed a little over ten years before and so the specter of polio and the paralysis that it could cause was still pretty fresh in the minds of many people. And secondly, even more recently, Erin?

Erin Allmann Updyke

Thalidomide.

Erin Welsh

That's right. Thalidomide. And if you haven't listened to our polio or thalidomide episodes, go check those out for more historical context on that situation. But thalidomide had this enormous impact on the U.S. even though the U.S. largely escaped - not entirely as we talked about in the episode - but people read the news articles and testimonials of parents and saw the pictures of children born with limb malformations.

Erin Allmann Updyke

Yeah, that makes sense.

Erin Welsh

And essentially it put this image to their fears of what could happen with a rubella epidemic especially since unlike polio there was no vaccine and unlike thalidomide it was not safely off the shelves.

Erin Allmann Updyke

Right. Yeah, yeah.

Erin Welsh

The thalidomide scandal of a few years before turned this rubella epidemic from what would have been a largely private matter to a public one. The rubella epidemic that began in 1963 and continued through 1965 was enormous. Approximately 12.5 million people became infected with rubella.

Erin Allmann Updyke

Whoa!

Erin Welsh: Mm-hmm. And an estimated 20,000 babies were born with congenital rubella syndrome with around, there are tons of different numbers quoted but one I saw is 11,000 miscarriages and therapeutic abortions.

Erin Allmann Updyke: Wow.

Erin Welsh: Which brings me to the next big step in the history of rubella. It was the combination of both the thalidomide scandal and this rubella epidemic of the early 1960s that led to more open discussion of abortion and ultimately widespread abortion law reform in the U.S.

Erin Allmann Updyke: Really?!

Erin Welsh: Yes.

Erin Allmann Updyke: No way! I had no idea!

Erin Welsh: I know, I know. Me either. I stumbled across it when I was looking for books on rubella.

Erin Allmann Updyke: Wow!

Erin Welsh: Uh huh. So as we talked about in our birth control episode, birth control isn't new, abortions aren't new, they're not a 20th century invention.

Erin Allmann Updyke: Not at all.

Erin Welsh: Although I think we tend to think of Roe vs Wade as being the moment where abortion came into the open and it had only been practiced in back alleys and in people's basements up to that point. That's not quite accurate. During the depression, for instance, safe abortion clinics practiced openly. But with the conservative moral backlash really only beginning in the 1940s and 1950s which was also a very politically conservative time. Abortions didn't stop, of course, but they just became more unsafe and more secretive and there were more moral implications to it.

Erin Allmann Updyke: Right, yeah.

Erin Welsh: In the early 1960s you could still seek an abortion in some states through applying for one and having a hospital abortion review committee look over your case.

Erin Allmann Updyke: Ew.

Erin Welsh: It was basically a panel of generally male doctors.

Erin Allmann Updyke: Yeah a bunch of dudes deciding whether or not you get to... Oh my goodness.

Erin Welsh: And then often at least in some instances you would have to undergo several physical or gynecological exams with members of that abortion review committee.

Erin Allmann Updyke: Absolutely not.

Erin Welsh

Isn't that... Yeah, yeah. It's appalling. And throughout the 1940s and 1950s, abortion was painted as an incredibly dangerous thing to do, it was often resulting in death and those seeking or performing abortions were criminals or immoral or deficient or evil in some way. Thalidomide, and I highly recommend people read about Sherri Finkbine sometime cause that also plays a huge role in the history of abortion and abortion law reform, but thalidomide and the rubella epidemic of the early 1960s turned this discussion of abortion into one of a right to be informed and make an informed choice, to choose what a woman felt was right for herself and right for her family. It began to be considered as necessary or right and its illegality was considered more immoral than its legality.

Erin Allmann Updyke

Interesting.

Erin Welsh

And it is true that the image of people seeking abortions changed during this time, it became more of a middle class problem and so that did definitely put a spin on, like it had to be a white, middle class person seeking an abortion.

Erin Allmann Updyke

Right. Educated, white...mm-hmm.

Erin Welsh

Mm-hmm.

Erin Allmann Updyke

Yeah, they're the only ones who can seek abortions morally.

Erin Welsh

Uh huh, yeah. Early legal battles in abortion often sued physicians and hospitals that provided false information or refused to provide any at all which prevented the patient or the person seeking abortion from making their own decisions about their body or about their family or their own life. For instance, a woman would go to her doctor and say, 'I don't feel well, something's wrong with me' and he would be in his brain thinking 'Oh, that looks like rubella but it might not be, I don't wanna worry her unnecessarily.' And so then he might note it on her chart but not ever tell her.

Erin Allmann Updyke

What?

Erin Welsh

Mm-hmm. So that would happen or it'd be a doctor saying, 'Actually I'm not sure if it was rubella.' These early legal battles were all about information and access to information and a patient's right to access that information.

Erin Allmann Updyke

Right, yeah.

Erin Welsh

Some of these lawsuits came to be known as wrongful birth or wrongful life suits and they ended up revolutionizing abortion law in the U.S. But there is one quick note that I wanna make about rubella, abortion, and people of color during this period. Often whether or not an abortion committee granted someone the approval to seek a therapeutic abortion depended on a recorded positive diagnosis of rubella. But as we discussed in our Rocky Mountain spotted fever episode, skin rash diagnoses in people of color is notoriously difficult and lacking in guidance in the medical literature.

Erin Allmann Updyke

Mm-hmm.

Erin Welsh

But there is a medical student named Malone Mukwende who is working on a book that is going to address this and the problem of not having accurate pictures or information in medical literature. It's like, it's 2020, I can't believe that it's... It's incredible, I'm so, yeah. It's awesome.

Erin Allmann Updyke: I can't wait for that book.

Erin Welsh: So anyway but this added one more layer of discrimination and bias against people of color in the medical realm, you know, just as per usual.

Erin Allmann Updyke: As per usual.

Erin Welsh: Anyway. In addition to propelling abortion law reform forward, the rubella epidemic in the U.S. in the 1960s also propelled scientific research forward. The virus that caused rubella was identified in 1962 and the first test for rubella, like whether someone was newly infected or had been previously infected, was developed in 1965 by Stanley Plotkin.

Erin Allmann Updyke: Plotkin! I read some of his papers. (laughs)

Erin Welsh: Yeah! (laughs) But the biggest goal was a vaccine which was seen as the best solution scientifically and culturally in light of abortion. Since rubella epidemics tended to occur every 4-6 years, 1970 was sort of this looming deadline when the next big epidemic was expected to happen. Fortunately a live-attenuated vaccine was developed in 1966 by scientists at the NIH who agreed to share it widely on the condition that it not be patented.

Erin Allmann Updyke: Awesome.

Erin Welsh: And I know Erin you were like, 'I can't wait to hear about the story of the vaccine' but like that's basically all I have for the development.

Erin Allmann Updyke: Yeah but that's what I wanted to know. Like what was the-

Erin Welsh: The impetus for that? Yeah.

Erin Allmann Updyke: Exactly. Because in the context of such a mild generally illness, I was really interested in what were the factors driving the vaccine development, so. You answered those burning questions.

Erin Welsh: (laughs) And so once this vaccine was available, there was a massive vaccination campaign in the U.S. in the late 1960s and despite Nixon's ridiculous budget cuts and basically having to depend on an army of volunteers, it would prove to be one of the most successful vaccination campaigns in history.

Erin Allmann Updyke: That's awesome.

Erin Welsh: Hopefully to be upset by the COVID vaccine.

Erin Allmann Updyke: Finger crossed!

Erin Welsh: Fingers crossed. So here's a quote: "By the spring of 1972, 75% of all schoolchildren and more than half of all children between 1-4 years old had been immunized against rubella.

Erin Allmann Updyke: From 1966 you said it was developed?

Erin Welsh: 69 is when this campaign started.

Erin Allmann Updyke Wow, so in three years. That's pretty phenomenal.

Erin Welsh Yeah. It's huge! A few years later the rubella vaccine would be combined with the measles and mumps vaccine and by, I don't know, the 1980s, for many people rubella simply came to mean just the R in MMR.

Erin Allmann Updyke Yep.

Erin Welsh That's it.

Erin Allmann Updyke Absolutely. Which is fascinating.

Erin Welsh How fast we forget these things.

Erin Allmann Updyke Yeah. Oh yeah.

Erin Welsh Over the next few decades, massive vaccination campaigns decreased the global prevalence of rubella and congenital rubella syndrome dramatically and it was eliminated in the U.S. in 2004. However lapsed vaccination rates - I can hear that intake of breath, Erin.

Erin Allmann Updyke Yeah.

Erin Welsh Anticipating the bad news to come.

Erin Allmann Updyke The 'however', yeah.

Erin Welsh Yep. Lapsed vaccination rates and lack of access to vaccinations in other places has led to rubella and congenital rubella syndrome continuing to be a huge problem in many places. Which is where I end my story and pass the mic to you, Erin.

Erin Allmann Updyke Oh great! Love to pick it up on happy notes like that!

Erin Welsh (laughs) You're welcome.

Erin Allmann Updyke We'll take a quick break first and then dive in.

TPWKY (transition theme)

Erin Allmann Updyke So this'll be relatively quick and kind of mostly good news, Erin.

Erin Welsh That's good. That's good.

Erin Allmann Updyke Not great news but decent.

Erin Welsh Good not great. Excellent.

Erin Allmann Updyke Not great. So let me just hit you with numbers straight off the bat. All right. And were just gonna talk about really the last 20 years from like 2000 to 2020.

Erin Welsh: Okay.

Erin Allmann Updyke: Cool? So as of early 2019, 168 out of 194 countries that the World Health Organization monitors had introduced rubella vaccination as part of their childhood vaccination series. 168 out of 194. So that's a lot.

Erin Welsh: Wow, yeah.

Erin Allmann Updyke: Global coverage was estimated, so that means the total number of kids who get vaccinated, was estimated at 69% which was up from in 2000, 21%.

Erin Welsh: Wow. Wow.

Erin Allmann Updyke: Yeah, so that's pretty great.

Erin Welsh: Yeah.

Erin Allmann Updyke: Because of that - this is gonna get interesting - the total reported cases of rubella, not congenital rubella syndrome but rubella, declined by 97%.

Erin Welsh: In the last 20 years?

Erin Allmann Updyke: In the last 20 years, from over 670,000 cases reported in 2000 to just over 26,000 cases reported in 2018. And here's what's really important about that. Reporting has gotten worlds better for rubella in that time period.

Erin Welsh: Yeah. So it's likely that it's even more than a 97% decrease.

Erin Allmann Updyke: Right. So we've had a huge increase in the number of countries that report. In 2000 only 53% of countries reported their rubella numbers and in 2018 91% of countries were reporting something. Granted, this is all gonna be an underestimate, blah blah, we always say that, that's always true. But still that's major.

Erin Welsh: Yeah.

Erin Allmann Updyke: Right like 40% more countries are reported and we have a 97% decline in rubella cases.

Erin Welsh: Whoa. That's amazing!

Erin Allmann Updyke: It's incredible and that's because of vaccines!

Erin Welsh: Because of vaccines.

Erin Allmann Updyke: For congenital rubella syndrome the story is not quite as beautifully perfect but it's still very reassuring. In 2000 there were 156 cases reported. Do you think there were only 156 cases, Erin?

Erin Welsh: No.

Erin Allmann Updyke: Definitely not. In 2018 there were only 449 cases reported, so that's an increase. But again here the percent of countries reporting increased from 39% to 71%.

Erin Welsh: Wow.

Erin Allmann Updyke: So that means that 71% of countries are doing some kind of surveillance to look for congenital rubella and identify it and then reporting those numbers to the World Health Organization.

Erin Welsh: That's excellent.

Erin Allmann Updyke: It's very excellent. So in our measles episode, when was that? Season 2?

Erin Welsh: Yeah, I think so.

Erin Allmann Updyke: A while ago. Anyways, way back when. We talked a lot, I'm pretty sure if I remember correctly, about the Global Vaccine Action Plan and the Measles & Rubella Initiative which are these groups of plans that the World Health Organization kind of helps coordinate and administer across all the regions. Where most regions, not every region, but most regions had a goal to eliminate measles and rubella by the year 2020.

Erin Welsh: Oh, this year.

Erin Allmann Updyke: So yeah, here we are, we're recording at the end of 2020, this episode will be out in early 2021, we have not achieved those targets. We don't have the data from 2020 yet but as of the 2019 Global Vaccine Action Plan reports, I will post a link to the full reports which has every region, the five different regions which is the African region, the American region, the Eastern Mediterranean region, the European region, and the Southeast Asian region, and the Western Pacific region, so those are all the regions. Each of them have their own reports, each of them had slightly different goals, each of them are at slightly different places on meeting those goals. No one has met their goals completely but every region has made major progress for the most part on getting towards those goals.

Erin Welsh: That's good.

Erin Allmann Updyke: And the Americas were declared free of endemic rubella in 2015 and as far as I can tell, they have maintained the status. But like you said, Erin, because of low vaccine rates in certain places the report actually combines measles and rubella and so some countries in the Americas have had endemic transmission but I think so far it's just of measles and not rubella. But that just kind of means that rubella could be not that far behind.

Erin Welsh: Right, sure. All it takes is just one.

Erin Allmann Updyke: Exactly, right. But still that's pretty major progress.

Erin Welsh: Absolutely.

Erin Allmann Updyke: And I feel like this year especially, any progress is something that we should celebrate.

Erin Welsh: (laughs) Yes. Yes.

Erin Allmann Updyke: We need some victories.

Erin Welsh: Agreed.

Erin Allmann Updyke: So yeah, that's pretty much the status of rubella. It's just sort of these vaccination campaigns and trying to make sure that every kid has access to a rubella vaccine.

Erin Welsh: Mm-hmm.

Erin Allmann Updyke: Ta-da!

Erin Welsh: This is a more uplifting ending than many of our episodes.

Erin Allmann Updyke: I think so too!

Erin Welsh: Yeah. Yeah. Good. I'm glad. Okay, I guess is it time for sources?

Erin Allmann Updyke: Yeah, I think so.

Erin Welsh: I read a book called 'Dangerous Pregnancies: Mothers, Disabilities, and Abortion in Modern America' and this is by someone named Leslie Reagan who is at the University of Illinois.

Erin Allmann Updyke: Really?!

Erin Welsh: Yeah!

Erin Allmann Updyke: Interesting.

Erin Welsh: Yeah, yeah. It was a very interesting read, I really enjoyed it. It did totally open my mind to like, oh my gosh, I had no idea about the link between this. Fascinating. And then I want to shout out the Nature paper I mentioned by Bennett et al from 2020 called 'Relatives of rubella virus in diverse mammals'. And then finally just a couple older paper I pulled the history from. One by Cooper from 1985 called 'The history and medical consequences of rubella' and by Forbes from 196, 'Rubella: historical aspects'. And there were a few more that I'll post as well.

Erin Allmann Updyke: I found a very phenomenal book chapter in Remington and Cline's 'Infectious Diseases of the Fetus and Newborn Infant' written by none other than Reef and Plotkin.

Erin Welsh: Oh, Plotkin!

Erin Allmann Updyke: That was very thorough. And then a number of other papers as well which we'll link to on our website thispodcastwillkillyou.com. Just click on our EPISODES tab and you can find the sources for every single episode we've ever done.

Erin Welsh: Every single one. 64.

Erin Allmann Updyke: What?! (laughs) Wow.

Erin Welsh: Well, thank you to Bloodmobile for providing the music for this episode and all of our episodes.

Erin Allmann Updyke

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Erin Welsh

Heck yeah, heck yes. They make this stuff happen. They make it possible. And you know who else makes it possible is you, listeners.

Erin Allmann Updyke

You do.

Erin Welsh

Thank you, thank you, thank you from the bottoms of our hearts.

Erin Allmann Updyke

Seriously.

Erin Welsh

From the bottom of our hearts? From the bottoms of our hearts.

Erin Allmann Updyke

Well so the bottom is the ventricles which are the parts that-

Erin Welsh

From the ventricles of our hearts.

Erin Allmann Updyke

The ventricles of our hearts, specifically the left ventricle.

Erin Welsh

(laughs) You heard it here first, listeners. Thank you from the left ventricle of our hearts.

Erin Allmann Updyke

That's the powerful one.

Erin Welsh

Oh my gosh, well, okay. Let's end this thing. Until next time, wash your hands.

Erin Allmann Updyke

You filthy animals.