

TPWKY

This is Exactly Right.

Erin Allmann Updyke

"It begins with a rigor followed by heats and chills during the first day. On the second day there's fever with intense malaise, thirst, loss of appetite, white tongue not actually dry, slight cough, heaviness of the head and eyes, and a constant drowsiness. In most cases a humor distills from the nose and eyes, the effusion or suffusion of tears being the most certain sign of sickening for measles. More certain indeed than the exanthem. The child sneezes as if it has taken cold, the eyelids swell, there may be vomiting, more usually there are loose, green stools and there is excessive fretfulness. On the 4th or 5th day, small red maculae like flea bites begin to appear on the forehead and the rest of the face which coalesce as they continue to come out in increasing numbers so as to form Rasimas' clusters. These maculae will be found by the touch to be slightly elevated although they seem level to the eye. On the trunk and limbs to which they gradually extend, they are not elevated.

About the 6th day the maculae begin to roughen and scale from the face downwards and by the 8th day are scarcely discernible anywhere. On the 9th day the whole body is as if dusted with bran. The common people say that the spots had quote, 'turned inwards' by which they mean that if it had been smallpox, they would've remained out longer and have proceeded to separation or maturation. The rash having thus gone in, there is an excess of fever attenuated with labored breathing and cough, the latter being so incessant as to keep the children from sleep day or night."

TPWKY

(This Podcast Will Kill You intro theme)

Erin Welsh

Aw.

Erin Allmann Updyke

Wah-wah.

Erin Welsh

That's awful.

Erin Allmann Updyke

It's not great.

Erin Welsh

(laughs) No but that sounds really miserable.

Erin Allmann Updyke

Yeah so that was from Sindenham's account of London measles epidemic that happened all the way back in 1670.

Erin Welsh

But it could be an account of what's going on today.

Erin Allmann Updyke

It really could, it actually was very similar in a lot of ways to things that I read in my textbooks about describing measles.

Erin Welsh

Including the common people part?

Erin Allmann Updyke

Maybe not that part.

Erin Welsh

The common people.

Erin Allmann Updyke

(laughs)

Erin Welsh

Hi, I'm Erin Welsh.

Erin Allmann Updyke: And I'm Erin Allmann Updyke.

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

Erin Allmann Updyke: And we're obviously talking about measles if you haven't caught the hint yet.

Erin Welsh: A lot of you asked for it and we've been wanting to do it, so here it is.

Erin Allmann Updyke: Yeah, thanks for asking everyone.

Erin Welsh: This one there's a sense of urgency here though which is very real.

Erin Allmann Updyke: Yeah. Why is that, Erin?

Erin Welsh: Well, spoilers, there's measles going on right in the world today.

Erin Allmann Updyke: So much measles today.

Erin Welsh: There's a lot that's happening and I think this is a really interesting one to cover because it deals with a lot of different issues that we have sort of skirted around or skirted past maybe, touched on very briefly here and there in terms of vaccination, in terms of how to view historical epidemics in the light of today.

Erin Allmann Updyke: Yeah.

Erin Welsh: But measles is really one that's gonna bring it all home. So I'm excited.

Erin Allmann Updyke: Me too! It's gonna be fun.

Erin Welsh: Yeah. So speaking of fun, I think it's-

Erin Allmann Updyke: Quarantini time! Absolutely.

Erin Welsh: And what are we drinking today?

Erin Allmann Updyke: Today we're drinking A Rash Decision.

Erin Welsh: (laughs) Thus named because-

Erin Allmann Updyke: Thus named for the characteristic measles rash.

Erin Welsh: And the poor decision-making of some people to not vaccinate their children.

Erin Allmann Updyke: Wah-wah.

Erin Welsh: Yep.

Erin Allmann Updyke: Yeah, we said it. Okay. So what's in this drink that we're drinking?

Erin Welsh Well we've got vodka, we've got grenadine, we've got ginger liqueur or ginger ale.

Erin Allmann Updyke Up to you.

Erin Welsh We've got-

Erin Allmann Updyke Lime juice.

Erin Welsh And lingonberries.

Erin Allmann Updyke Oh yeah, if you're in Finland.

Erin Welsh Otherwise cherries.

Erin Allmann Updyke If you're not in Finland where lingonberries are so abundant. (laughs)

Erin Welsh (laughs) Whatever small red berry to mimic the spots of the meas.

Erin Allmann Updyke Yeah. And as always we'll post the full recipe for this quarantini along with our placeborita, our nonalcoholic version, on our website as well as all of our social medias, @thispodcastwillkillyou on Instagram and Facebook and @TPWKY on Twitter.

Erin Welsh And also someone has started a subreddit called r/TPWKY which is really thrilling.

Erin Allmann Updyke Yes.

Erin Welsh And we have seen the quarantinis posted there, so whoever's doing that, thank you very much.

Erin Allmann Updyke And you should know that Erin Welsh checks it all the time and loves it and is thrilled.

Erin Welsh I'm a lurker, yeah. (laughs) Okay so, measles.

Erin Allmann Updyke Measles. Should we talk about it?

Erin Welsh I think that's why we're here.

Erin Allmann Updyke All right, we're gonna do that right after this break.

TPWKY (transition theme)

Erin Allmann Updyke All right, measles. Before I dive into the biology of measles, I want for everyone to know that we are going to be doing an entire episode focused on vaccines where we'll talk about the history of vaccine development - well, when I say 'we' I mean Erin Welsh, I don't do that. I'll talk about how vaccines actually work in your body to give you immunity and then we'll talk more generally about the status of vaccination across the U.S. and the globe. Today we're talking about one disease, measles, that's often a large part of the conversation about vaccines and we'll talk about why that is but I'm not gonna talk super broadly about vaccines because I do want to give measles the attention that it deserves specifically if that makes sense.

Erin Welsh: Makes sense to me, yeah. So stay tuned, people.

Erin Allmann Updyke: Yeah. But we will talk about vaccines cause vaccines are an important part of the measles story.

Erin Welsh: Yes.

Erin Allmann Updyke: Okay so, measles. First of all it's a virus. It's an RNA virus, which usually I say that means it's scarier than DNA viruses because they mutate and they're hard to target but actually it turns out measles has like very low antigenic diversity so it hasn't changed over its history with humans.

Erin Welsh: We got lucky, everyone.

Erin Allmann Updyke: Yeah, very. (laughs) So that means that the vaccines we developed way back when are still effective against the wild circulating virus today. So that's like the best news I have for you about measles, it's downhill from here.

Erin Welsh: Oh cool. Cool, cool.

Erin Allmann Updyke: Gotta start off on a high, you know? Okay. So when you get infected with measles, the incubation period which again is that period from when you first get infected until you start showing symptoms lasts between 10 and 14 days. Okay?

Erin Welsh: Okay.

Erin Allmann Updyke: However you become infectious up to 5 days before those symptoms start.

Erin Welsh: Ah. You know, those are the deadly ones.

Erin Allmann Updyke: They really are. It's a very, very big deal and we've talked about it before with flu and things like that. But in the case of measles, the fact that you're infectious before you have any symptoms is an even bigger deal because the R_0 of measles, which again is the number of secondary infections that a single infected individual will cause if the entire population is susceptible, for measles that number is between 13 and 18.

Erin Welsh: Yep. It's the highest one that we know, right?

Erin Allmann Updyke: It's the highest one we know.

Erin Welsh: Yeah!

Erin Allmann Updyke: And what this essentially means is that for every single person who's infected on average 90% of the people they come in contact with who are susceptible will become infected with measles.

Erin Welsh: That's a horrifying statistic.

Erin Allmann Updyke: Exactly. Yeah. I mean is you think about smallpox and how massive of outbreaks smallpox was able to cause, the R_0 of smallpox was between 5 and 7. And people are terrified of things like Ebola or SARS and the R_0 of those are like less than 2 for Ebola or between 2 and 3 for SARS.

Erin Welsh

Yeah.

Erin Allmann Updyke

And yet measles is this thing that infects almost everyone who comes into contact with an infected individual.

Erin Welsh

Do you remember what the R0 is of the virus that's in Contagion?

Erin Allmann Updyke

I don't remember what it actually is, I remember her listing... I don't know if they ever actually said it, cause she just was like, 'We need to figure out what the R0 is.' But I don't remember, yeah. We'll have to look it up.

Erin Welsh

I remember her writing on the board 'measles: 14'.

Erin Allmann Updyke

Yeah. (laughs) I think she wrote polio on there too which was like 6 or 7.

Erin Welsh

Yeah.

Erin Allmann Updyke

Anyways, okay. Let's get worse. Okay so measles is transmitted airborne, not just in respiratory droplets but actually airborne. I told you it gets worse. So what that means is that measles can stay, the virus - infectious measles viral particles - can stay suspended and alive and infectious in the forking air for up to 2 hours after an infected person leaves the room.

Erin Welsh

Wait a second.

Erin Allmann Updyke

Yeah.

Erin Welsh

So it's sort of like, you know how Pigpen in Peanuts, when he's got that cloud of dust around him? So if he were a measles kid it would just be a cloud of measles that would stay in the room 2 hours after he left?

Erin Allmann Updyke

Yeah that's the thing, it stays in the room. And so what happens when there's... Okay, we have had some measles cases here in Champagne and every time there's a new case, public health sends out an alert and they give you a list of all the places that this person was during the time that they were infectious along with the times that they were there. And those times include a 2 hour window after that person left because the room itself remains infectious. Good gracious!

Erin Welsh

Oh my god.

Erin Allmann Updyke

Okay. All right, let me summarize the things we've learned so far. Measles is a virus that if I have it, before I even know I'm sick, for 5 full days I can be walking around breathing, coughing into a room and once I leave that room for 2 hours people can walk into it and become infected by the air which contains my measles. And if those people are susceptible, meaning if they're unvaccinated, 90% of them will become infected. And then for 4-5 days after my symptoms resolve, I'm still infectious.

Erin Welsh

Oh wow.

Erin Allmann Updyke

Yep.

Erin Welsh: I'm just wondering the total amount of time that an individual is infectious.

Erin Allmann Updyke: The total amount of time is probably a good 2 weeks.

Erin Welsh: Okay.

Erin Allmann Updyke: Okay so let's talk about the symptoms. It starts, as the name of our future spinoff podcast would suggest, with a fever. And in this case with measles we're talking about a really high fever, often up to 104.

Erin Welsh: Ooh.

Erin Allmann Updyke: 104 Fahrenheit, 40 Celsius. So the virus invades your bronchioles first. Your bronchioles are the tubes in your lungs where the air goes.

Erin Welsh: Cool.

Erin Allmann Updyke: It infects the epithelial cells which we've talked about a lot in this podcast cause a lot of viruses infect those epithelial cells which are the cells that line your bronchioles. And so that's why the first set of symptoms that you see after fever are respiratory symptoms. A cough, runny nose, you can get conjunctivitis if it moves up into your eye. And then within 2-3 days after symptoms begin, you'll often get something called, I believe it's koplik spots.

Erin Welsh: Oh yeah, I read about the dude.

Erin Allmann Updyke: Oh cool. So these are these small white spots in your mouth and while these spots don't appear in every single case, they are a very common manifestation and there's pretty much nothing else that causes these particular types of spots. So they're what we call, you're gonna learn how to talk like a doctor, pathognomonic for a disease. Pathognomonic, it's a really fun word, it basically means that it's a specific symptom that is very specifically characteristic and indicative of a particular disease. So once you see this symptom, koplik spots, you can say that kid has measles.

Erin Welsh: Can you spell that?

Erin Allmann Updyke: P-A-T-H-O-G-N-O-monic.

Erin Welsh: Huh. Pathognomonic. Interesting.

Erin Allmann Updyke: It's a weird word, yeah. But so other examples, we've actually talked about some other diseases that have pathognomonic findings. Rice water stool is pathognomonic for what disease?

Erin Welsh: So it's like a dead giveaway of cholera.

Erin Allmann Updyke: Exactly. Yeah it's a dead giveaway, like there's no other diseases that you would see this symptom in, essentially. So anyways that's your vocab word for the day.

Erin Welsh: I love it.

Erin Allmann Updyke: So after those koplik spots, in another few days you'll break out in a rash and this is the classic measles rash. It's often called the bucket of paint rash, that's how I learned it in class.

Erin Welsh: Can you explain to me what that means cause you suggested that as a drink name and was like what?

Erin Allmann Updyke: It's like if someone took a bucket of paint and spilled it over your head.

Erin Welsh: Okay.

Erin Allmann Updyke: Because the rash starts up at your hairline and then it slowly works its way down across your face, over your trunk, onto your arm. So it's literally like if you took a bucket of paint like the gatorade buckets after a football game or something and you dumped it on top and now you have gatorade dripping down your face.

Erin Welsh: Oh okay. So it's like the trajectory of where it's gonna pass through.

Erin Allmann Updyke: Exactly, yeah.

Erin Welsh: Not that you look like a bucket of paint has been dropped on you.

Erin Allmann Updyke: Well it also is that the rash becomes confluent and so it does pretty much cover your whole body.

Erin Welsh: Oh, okay.

Erin Allmann Updyke: So it starts out as individual spots but then those spots kind of merge together. So it doesn't actually look like paint cause it's your skin but you know. Doctors.

Erin Welsh: Right. But that does help me visualize what this looks like.

Erin Allmann Updyke: Yeah, oh good. I'm glad. And so that rash is mostly caused actually by your immune system killing cells that are infected with the virus, so not caused by the virus itself necessarily.

Erin Welsh: Okay.

Erin Allmann Updyke: Now in most cases this rash is kind of one of the final symptoms. After a few days of this rash, both the rash and fever will start to subside and you'll recover in most cases. But not everyone will recover. For every 1000 people infected with measles, 1 or 2 will die and at least 1 will develop acute encephalitis which is an infection of your brain that can cause permanent brain damage. You can also get a lot of secondary bacterial infections like pneumonia which is pretty common after a measles infection because of the damage that measles does to your respiratory tract.

Erin Welsh: Right.

Erin Allmann Updyke

But, and this part is a really big deal, measles also causes suppression of your immune system in general. And not just while you're infected but for weeks or months after infection, after you recover if you recover, you're immunocompromised which means you're more susceptible to infection from other pathogens. And, not yet done, it gets even more serious than that because recent data has shown that infection with the measles virus destroys your immunologic memory.

Erin Welsh

What?

Erin Allmann Updyke

Yes! This is the part I was hoping you didn't know because it's so terrifying. So it destroys your immune system's capacity for memory. And our immune system is essentially built on the fact that we have cells that live for a really long time and provide us with defenses against things we've already been exposed to. That's what immunologic memory is. Measles wipes that out. So anything that you had been previously exposed to and should be able to fight off, you can't. It's like you had never been exposed.

Erin Welsh

Oh my god. Okay, first question. Okay I have two questions.

Erin Allmann Updyke

Okay.

Erin Welsh

The first one is that you said that it destroys the capacity. So does that mean that if you get infected let's say with something again then you will not develop protective antibodies to that, you could continue to get reinfected with that?

Erin Allmann Updyke

So that's a really good question. I don't know if it... It transiently suppresses your immune system overall and then it wipes out all of your memory cells. But I believe after the period of immune suppression, so like after a few weeks or months, you would be able to then mount an immune response but it's just that it would be like mounting an immune response all over again, like you had never been exposed.

Erin Welsh

But once you had been re-exposed to whatever it was, then subsequently if you were exposed you can still build memory.

Erin Allmann Updyke

Yes.

Erin Welsh

It basically clears out your hard drive.

Erin Allmann Updyke

Yep, starts you back at zero.

Erin Welsh

And then you add stuff again. Okay.

Erin Allmann Updyke

Yeah.

Erin Welsh

Second question.

Erin Allmann Updyke

Yeah.

Erin Welsh

How?

Erin Allmann Updyke: Great question. There is a paper on that but it was getting very in depth technically on the like 'this is how these immune blah-blah-blahs' and I couldn't deal with it. So I'll link to that paper. (laughs)

Erin Welsh: Okay. (laughs)

Erin Allmann Updyke: Yeah and the other thing is that I don't think that it's entirely clear, this is a pretty recent paper, we didn't realize just... We knew about the short term suppression of your immune system.

Erin Welsh: Right.

Erin Allmann Updyke: We didn't know until very recently and the way we actually found this out is looking at long term data trends of mortality rates. So I don't think that it's entirely clear, there's mouse models that show that it's possible for measles to wipe out those cells but it's not 100% clear how the heck measles is so powerful and destroys your immune system so much.

Erin Welsh: That's amazing!

Erin Allmann Updyke: Oh my gosh. So measles infection is not just... It can kill you by killing you outright, it's also associated with short term increases in opportunistic infection, and long term - I'm talking years - increased mortality rates due to non-measles disease. This is something that makes a lot of sense in light of vaccination because what we know is that vaccination with the measles vaccine not only protects you from measles but at a population level it decreases mortality from non-measles diseases for years after vaccination. And the reason that that is what's happening with vaccination is because of how strong the effect of infection with measles is on your immune system. It just destroys it.

Erin Welsh: I think that the long and short of it is that being vaccinated against measles and getting measles naturally and then gaining immunity to it are not the same thing in any respect whatsoever.

Erin Allmann Updyke: No. Exactly.

Erin Welsh: Being naturally infected will lead you to have adverse health outcomes, probably ones that you won't even realize. Vaccinated protects you.

Erin Allmann Updyke: Exactly. They're not even comparable, cause that's something that I think a lot of people, you know it's like, 'Oh well why can't I just let my kid get the chickenpox instead of giving him the chickenpox vaccine?' Or whatever. And in this case especially with measles that is not the case, vaccination protects you not just from measles but it protects your immune system. And infection with measles wipes your immune system out. So it's amazing.

Erin Welsh: That's so remarkable, I had no idea.

Erin Allmann Updyke: I'm glad. It was really fun to get to tell you.

Erin Welsh: (laughs)

Erin Allmann Updyke: Yeah so that's measles, that's the virus, that's how it makes you sick. So that's all I've got, Erin.

Erin Welsh: Okay.

Erin Allmann Updyke: So how'd we get here? How did we learn how to fight this sucker?

Erin Welsh: It's a good story.

Erin Allmann Updyke: Cool. Shall we take a quick break?

Erin Welsh: Let's do it. But for real cause I'm gonna get a quarantini.

TPWKY: (transition theme)

Erin Welsh: The measles virus probably came from something like bovine rinderpest.

Erin Allmann Updyke: Oh!

Erin Welsh: Future episode someday. Or canine distemper virus. But archeological evidence isn't really clear on that so we don't really know exactly where it came from. Okay but what do we know? Well we know that the measles virus would have needed a pretty large population density with a sufficient influx of susceptible people in order for it to be sustained.

Erin Allmann Updyke: Makes sense.

Erin Welsh: It's a crowd disease.

Erin Allmann Updyke: Yeah.

Erin Welsh: But saying pretty large population density isn't exactly me being precise so let's-

Erin Allmann Updyke: (laughs) Let's get some precision here, Erin.

Erin Welsh: I mean that's my middle name. (laughs) Not at all. Okay. But there's some pretty cool math here actually. All right so some researchers calculated that the virus has to move to a new host at least 26 times a year if it's going to survive in a population.

Erin Allmann Updyke: Interesting. That makes sense if it's a 2 week disease.

Erin Welsh: Yeah. Yeah. At a bare minimum, there needs to be 26 susceptible people in a population every year for measles to persist.

Erin Allmann Updyke: Okay.

Erin Welsh: But there are a lot of buts. But then those people would have to be in close or frequent enough contact for transmission and then once infected and hopefully recovered you are immune so new susceptibles had to come in from somewhere, either being born, whatever. Basically while in theory you only need 26 new hosts but in practice you need a whole lot more. So the more reasonable estimate was calculated to actually be a population, this includes both susceptibles and immune, of 250,000 people.

Erin Allmann Updyke: Okay. Wow! That's a huge jump up.

Erin Welsh: And so that's for maintenance to keep the virus around.

Erin Allmann Updyke

Okay, right.

Erin Welsh

Because otherwise of course the virus could get into a population and sweep through it, no problem, of any size.

Erin Allmann Updyke

Right.

Erin Welsh

But this is for the cyclic outbreaks to happen.

Erin Allmann Updyke

Yeah.

Erin Welsh

But yeah that is a pretty big size. So then when and where did people start to even form settlements that big?

Erin Allmann Updyke

Yeah.

Erin Welsh

The authors of this measles book that I read which by the way has a million cool maps and figures, it's so full of information, holy cow.

Erin Allmann Updyke

Yeah, so many.

Erin Welsh

They did so much work on it. Anyway so they started looking through archeological records to make a list of possible places where A) there would be enough people, and B) there would also be agriculture and exposure to domesticated animals because that's probably where the virus came from. And so then they came up with a list and dates for these so-called urban nuclear areas, most of which were in the Fertile Crescent but some were also in Central and South America and West Africa. But the most likely place where measles was first established was in Sumeria in the Tigris and Euphrates river valley around 3000 BCE.

Erin Allmann Updyke

Wow.

Erin Welsh

So it's old.

Erin Allmann Updyke

That's a long time ago.

Erin Welsh

5000 years. Yeah, okay.

Erin Allmann Updyke

Cool. Done.

Erin Welsh

There you go, established. (laughs) And that's the history-

Erin Allmann Updyke

We've done measles.

Erin Welsh

Okay but still we're there, measles, Sumeria, 3000 BCE.

Erin Allmann Updyke

Okay.

Erin Welsh: But it wasn't there for long or at least it wasn't only there for very long. Measles did what diseases do: spread. The virus spread north to Southern Europe, the rest of the Middle East, and east to India, China, and Japan where early writings indicate it was there by 300 or 800 AD.

Erin Allmann Updyke: Wow.

Erin Welsh: As for Africa, measles didn't seem to establish there the way it did in Europe and Asia possibly because of lower population density, I don't know, possibly because of physical or landscape barriers making pathogenic exchange not super frequent. Or possibly it was there and we just don't know about it because there aren't as many written records.

Erin Allmann Updyke: Okay.

Erin Welsh: I don't know. Distinguishing between measles and smallpox in historical texts is really quite tricky.

Erin Allmann Updyke: That makes sense.

Erin Welsh: Yeah I mean physicians didn't often, or at least at various points didn't make a distinction between the two. But that would change in the Middle Ages when measles really came into its own.

Erin Allmann Updyke: It's like, 'I need to distinguish myself. None of this confusing me-'

Erin Welsh: I'm my own person!'

Erin Allmann Updyke: (laughs) I'm my own person. Measles going through its teenage years.

Erin Welsh: Yeah I mean that side-swept bangs and the heavy eyeliner on the top and bottom.

Erin Allmann Updyke: Oh god. I can't, this is hitting too close to home. (laughs)

Erin Welsh: Yeah I know, right, right. (laughs) Okay. All right so by the Middle Ages which let's say the 5th-15th century, measles was fully established throughout the Old World. I mean it was there. If the population center was big enough, it was there. Although I wonder, I wrote this as a little side note to myself, I wonder how the Black Death, the bubonic plague in the 14th century, how that disrupted the measles epidemic pattern.

Erin Allmann Updyke: Oh it probably just, it screws everything up as we saw, as we've seen.

Erin Welsh: I just wanna know. I didn't look it up though. Okay anyway. So during the Middle Ages is when physicians started to recognize and describe measles as a disease although the term 'mesles' was used to refer to the lesions from leprosy and so it's not fully clear when it switched from being used interchangeably to being reserved just for measles alone.

Erin Allmann Updyke: Okay.

Erin Welsh: But the earliest reference that we can say for sure is talking about measles is from the physician Rhazes which was latinized from - I'm gonna try to pronounce this.

Erin Allmann Updyke	Do it.
Erin Welsh	Abū Bakr Muhammad Zakariyyā Rāzī. So he was from close to where Tehran is today. Not only was he one of the first people to suggest that a fever might be your body's natural defense against disease in the year 900.
Erin Allmann Updyke	Oh, wow.
Erin Welsh	He also wrote a whole treatise on how measles and smallpox were different things and how to tell them apart also in 900.
Erin Allmann Updyke	Cool!
Erin Welsh	Yeah, super cool.
Erin Allmann Updyke	Wow! That's awesome.
Erin Welsh	All right so now all of that was just me laying the groundwork for getting to the real part of the story which is 1500s onward.
Erin Allmann Updyke	Okay.
Erin Welsh	So by 1500, which is the end of the Middle Ages, measles was established in pretty much all parts of the Old World. But how much of it was actually impacting populations? As we've talked about, if you want to trace historical patterns of disease, you have to rely on some pretty iffy records. One of these which is absolutely fascinating I came across is the London Bills of Mortality which I think was started to keep track of plague outbreaks but now they're a goldmine not just for statistics and looking backwards in time but also for ridiculous names for diseases. For instance in 1665, which was a plague year, 397 people died of quote, "rising of the lights" which had to do with lungs, possibly croup. (laughs)
Erin Allmann Updyke	Okay.
Erin Welsh	86 people died of "King's evil" which is tuberculosis, scrofula.
Erin Allmann Updyke	Oh. Cause they got it from the king.
Erin Welsh	Well this was the whole royal touch era.
Erin Allmann Updyke	Right, the kind didn't cure them, so.
Erin Welsh	Yeah, yeah. And 5 died of "distracted".
Erin Allmann Updyke	Distracted driving, it happens early!
Erin Welsh	That horse and buggy. When were buggies invented?
Erin Allmann Updyke	I don't know.

Erin Welsh

Okay anyway but you should look into it, it's fascinating. And you'll also see some recognizable ones one there. You know, scurvy, leprosy, smallpox, and so on. And even though these records are incomplete and not super reliable, they can help to paint a picture of some of the disease trends especially year to year. In London there were measles deaths every year from 1676 to the mid 1800s.

Erin Allmann Updyke

Wow.

Erin Welsh

Which shows that the disease was fully endemic.

Erin Allmann Updyke

Yeah.

Erin Welsh

But if you look at the yearly trends you can also see that there were some years with a lot of cases and some with just a few. And the interval between these outbreaks got shorter and shorter as time went on and the deaths due to measles also grew, probably because population was growing, probably because crowded conditions, nutrition, etc etc. And measles was also not just variable year to year but also throughout the years, so it was a very seasonal disease. You knew that it was springtime in Europe when measles was on the rise and then smallpox would follow in its footsteps in the fall. And some researchers have suggested that the measles epidemic in the spring weakened the population and led to a super intense smallpox epidemic in the fall.

Erin Allmann Updyke

Oh my god, are you serious?

Erin Welsh

Yeah, yeah.

Erin Allmann Updyke

Oh dude.

Erin Welsh

Yeah. It's really...yeah.

Erin Allmann Updyke

Oh my gosh.

Erin Welsh

I love it.

Erin Allmann Updyke

Flabbergasted.

Erin Welsh

Good word.

Erin Allmann Updyke

Thanks.

Erin Welsh

So this seasonality of measles was viewed as evidence that the origin was miasma, bad air.

Erin Allmann Updyke

Of course.

Erin Welsh

But a few people said no, no, it's infected clothing or other agents or the air and you know. But measles would show to be contagious conclusively by someone with probably only the best intentions, the Scottish physician Francis Home had heard about Turkish physicians inoculating against smallpox and thought, 'I bet I can do that with measles.' First he tried to get some pus-like material from the rash and bumps of his volunteers but I guess there wasn't really pus?

Erin Allmann Updyke: It's a pretty flat rash, it's not really a pus-y situation.

Erin Welsh: Yeah. So then he's like I'll just go for the blood, the blood's fine. So he sliced open the most measley section of measles-

Erin Allmann Updyke: (laughs) The most measley. That's awful.

Erin Welsh: Yeah. And then he put some cotton balls in there to soak up the blood.

Erin Allmann Updyke: No.

Erin Welsh: And then he sliced open the arms of 12 children and put those blood-soaked cotton balls into those slices.

Erin Allmann Updyke: Oh my god! This guy. What on earth?

Erin Welsh: Well 10 of the 12 came down with measles.

Erin Allmann Updyke: Shocking.

Erin Welsh: But he was like oh no it's much milder, it's super mild. I don't know for sure whether it was milder but they didn't die and he viewed his experiment as a success.

Erin Allmann Updyke: I'm sure he did.

Erin Welsh: It was debated amongst his peers. Okay. But let's go back to some of these measles outbreaks though because you know say 'an outbreak happened there and an epidemic happened here' but what numbers really am I talking about? For instance, the Great Glasgow Epidemic of 1808 led to 787 measles deaths, most of which were children, out of a population of around 100,000 people.

Erin Allmann Updyke: Oh my gosh.

Erin Welsh: Which compared to some of the other diseases that we've talked about looks like a relatively small mortality rate. But measles did still kill.

Erin Allmann Updyke: Yeah.

Erin Welsh: When he was 73 years old, Louis XIV lost his son, his grandson, and his great-grandson all within 11 months of each other to measles.

Erin Allmann Updyke: Whoa.

Erin Welsh: So his sole surviving great-grandson would succeed him at the age of 5.

Erin Allmann Updyke: Whoa.

Erin Welsh: So I don't claim to know anything about French history but a quick Wikipedia skin tells me that Louis XV, which is the 5 year old who didn't die of measles, was one of the longest reigning monarchs and also the one who's excessive spending helped to lead to the collapse of the government and the French Revolution and thus his grandson being beheaded. So measles-

Erin Allmann Updyke: So pretty much we have measles to thank for the French Revolution.

Erin Welsh: I just wanted someone to write an alternate history book or TV show of what would've happened if measles didn't wipe out so much of the French royal line.

Erin Allmann Updyke: Wow. Also I didn't know that Louis XIV lived to be so old. 73, that's old back then.

Erin Welsh: Yeah, yeah. Well he lived I think a few years beyond that as well, that's just when he lost everyone.

Erin Allmann Updyke: That's sucks by the way for them.

Erin Welsh: Yeah, yeah. But in general measles was viewed in Europe as a moderately deadly disease that killed mostly children. But let's remember a couple of things about that. First there are many other diseases going on at the same time that had horrific mortality rates like plague, smallpox, tuberculosis, etc that may have overshadowed measles deaths. And second, these are populations that have some history of exposure to measles. But what happens when measles gets into a population that has never experienced it before?

Erin Allmann Updyke: Can you tell us?

Erin Welsh: I think I'm about to.

Erin Allmann Updyke: Excellent.

Erin Welsh: All right. So let's go to the New World for another round of Columbian exchange.

Erin Allmann Updyke: Oh no.

Erin Welsh: Guess how many people die? So you know so quaint measles mortality rates of like 3-5%? 7%?

Erin Allmann Updyke: Right. Or even lower these days.

Erin Welsh: Oh yeah, way lower. Well those are gonna seem ridiculous to what I will tell you about the New World.

Erin Allmann Updyke: Oh no.

Erin Welsh: So Caribbean islands and Central American regions were the first hit by measles and other diseases brought over from Europe. And Cuba for instance may have lost up to 2/3 of its entire population due to measles in 1529. 2/3!

Erin Allmann Updyke: Oh. That's like plague status.

Erin Welsh: Yeah.

Erin Allmann Updyke

Jesus. I had no idea.

Erin Welsh

I didn't either. Measles was the leading cause of death in many of these places competing with smallpox, typhus, mumps, influenza, etc etc.

Erin Allmann Updyke

Wow.

Erin Welsh

Yeah. I mean the history of measles in the New World reads pretty much like you would expect it to, just a horrific tragedy. The conquistador Francisco Pizarro brings it to Nicaragua and then to Peru as he's on his mission to destroy the Incan Empire. And then from there it just sort of spreads all throughout South America completely unimpeded by anyone or anything. And it also moved north all within the span of a century or so for when Columbus landed. But it's not like it swept through, killing an enormous chunk of various populations and then disappearing. It became endemic in many of these regions with more major epidemics happening at irregular intervals, killing thousands regularly. So mortality rates, they ranged from 60% at the beginning, then 50, then 25, then 16, sort of slowing down or creeping down a bit over time as the immune population built up.

Erin Allmann Updyke

Right.

Erin Welsh

And obviously it's hard to separate out the effects of measles and smallpox and all these other diseases that were going on at the same time but measles took a much larger toll than I knew it did.

Erin Allmann Updyke

Yeah.

Erin Welsh

Yeah. So measles and smallpox are considered to be the two big killers of Native American populations of the New World with only smallpox outranking measles in the number of deaths caused.

Erin Allmann Updyke

Wow.

Erin Welsh

And measles was also an epidemic disease in European settlements in North and Central America primarily affecting children but also every now and then getting its grip on a larger proportion of the population. And it seemed for some reason like measles was more severe in the colonies than it was back in Europe and out good friend, Cotton Mather, you remember him?

Erin Allmann Updyke

Why does that name sound familiar?

Erin Welsh

Smallpox.

Erin Allmann Updyke

Oh, I have such a hard time Erin with the names and the dates and things.

Erin Welsh

Cotton Mather, we lost our minds over it.

Erin Allmann Updyke

I believe you.

Erin Welsh

Pretty sure it was smallpox. Anyway. Well poor Cotton lost his wife, three children, and his maid to measles in the span of 2 weeks.

Erin Allmann Updyke

2? Ooh.

Erin Welsh

Mm-hmm. He has a bunch of... I found an article that had his diary entries during this time and it is really heartbreaking. Yeah. So he noticed this big difference, he was like, 'Why is it so deadly here? Back in Europe this is seen as a routine illness.'

Erin Allmann Updyke

Right.

Erin Welsh

And probably it had to do with the lower population density, maybe a larger susceptible population was built up, but yeah. Also I wanted to shout out a listener, her name's Meredith, who sent us an email who had some fun Cotton Mather tidbits.

Erin Allmann Updyke

Oh!

Erin Welsh

Such as the fact that he may have been an instigator of the Salem Witch Trials and his father's first name in Increase. (laughs) Just fantastic.

Erin Allmann Updyke

(laughs) Oh I remember that.

Erin Welsh

Okay. Over the years from 1840 to the early 1900s, the world's population grew tremendously. So almost doubled. And during this time we see a lot of measles epidemics of two kinds. So the typical cyclic measles outbreaks in endemic countries and the epidemic devastation in naïve populations. Broadly urbanization increased as did transportation and as did our understanding of how measles spreads. Okay so there's this dude named Peter Ludwig Panum who is the measles guy.

Erin Allmann Updyke

Okay.

Erin Welsh

He really set the groundwork for what we understand about measles or at least what we did going into 20th century, how measles moves through a population. And so he developed all this information when he was tracking an epidemic in the Faroe Islands in 1846. So in 1846 in the Faroe Islands there were 7782 people living there.

Erin Allmann Updyke

Okay.

Erin Welsh

Of those, 6000 became infected by measles, so that's 77% became infected.

Erin Allmann Updyke

Whoa. Okay.

Erin Welsh

Because the population was isolated they had never had measles. This dude Panum went to the Faroe Islands to watch the spread of the disease, making observations such as incubation period, classic symptoms, the time when someone is most infectious, so on. And he also noticed that all age groups seemed to be impacted which wasn't normally the case so he was like, 'Oh this could be because the population has never experienced it before' and so on. So it was a pretty big conclusion to draw back then and it made a big impact in terms of understanding future outbreaks and how they differed among different populations.

So the final big impact of his report on this epidemic was his complete dismissal of miasma as the way it spread. He was like, 'No, measles is clearly contagious and the only way to prevent someone from getting infected is to isolate the infectious person. It's the only way.' As for mortality rates due to measles, they did drop over time but again looking just at death due to measles infection during the epidemic is only going to show you the tip of the iceberg because of all of these things that we talked about, immunocompromised, this immune system forgetfulness. Not really forgetfulness.

Erin Allmann Updyke

Decimation really.

Erin Welsh

Yeah. So major cities like London and Glasgow would see a few thousand cases of measles every year with a few hundred deaths. Iceland experienced some intense epidemics for instance. To quote an Icelandic surgeon during the 1846 epidemic: "It would be easier to count the people who escaped the disease than to count those who were affected by it for it spared very few."

Erin Allmann Updyke

Wow.

Erin Welsh

So similar was Hawaii who lost 1/5 of its population over the decade between 1850 and 1860.

Erin Allmann Updyke

Whoa!

Erin Welsh

Uh-huh. But also even in places where measles was supposedly endemic like in the U.S., measles could still cause a huge problem. During the American Civil War, over the course of that, over 204,000 troops were killed on the battlefields due to, you know, fighting. But over twice that number died of disease. Not measles alone but just disease. Camp measles was one of them. So camp measles seemed to be more severe than regular measles.

Erin Allmann Updyke

Weird.

Erin Welsh

Yeah and had much deadlier complications. So you probably wouldn't die directly from measles but you'd probably die from how it had weakened you and sort of in more foreshadowing of this whole thing, some surgeons during the war said that they thought the bulk of all serious illnesses, 9/10 cases during the Civil War were traceable to measles.

Erin Allmann Updyke

Wow.

Erin Welsh

All right. If you've ever learned the term 'virgin soil epidemic' in biology or public health class, ever heard that term?

Erin Allmann Updyke

No.

Erin Welsh

Virgin soil epidemic?

Erin Allmann Updyke

No I haven't.

Erin Welsh

It's basically like naïve population epidemic.

Erin Allmann Updyke

Oh, okay. All right.

Erin Welsh

Yeah. But okay, if you've heard either of those terms it was probably in association with the Fiji measles epidemic of 1875 which destroyed close to 1/4 of the entire population of that country. Let's track the sequence of events. In September 1874, the most prominent chief of Fiji King Cakobau signs over Fiji to be under British rule. Obviously this was a big deal politically and many discussions had to follow so that people could figure out how things were going to fallout, basically how things were going to work after Fiji became part of the British Empire. So King Cakobau along with a couple of his sons went to Australia to chat with the Governor of Sydney. While there-

Erin Allmann Updyke

Uh oh.

Erin Welsh

Cakobau picked up measles but he recovered before getting back on the ship. But his sons didn't. So their illnesses weren't detected til they were well on their way back to Fiji and the doctor on the ship was like, 'Okay, you guys are sick, you're going in an isolation room.' But when the HMS Dido arrived at the Fijian capital on January 12, 1875, no yellow quarantine flag was flown and no notice of measles was made.

Erin Allmann Updyke

Oh no.

Erin Welsh

Over the next 10 days after the ship got back, about 69 high up, political people from all over Fiji and other nearby islands came to Cakobau's house and other political gatherings were taking place to discuss what it meant that the Kingdom of Fiji was no longer. So everyone after this goes their separate ways back to wherever they had come from, bringing measles back as a souvenir unexpectedly.

Erin Allmann Updyke

Whoa. The worst souvenir.

Erin Welsh

Within a couple of weeks, nearly all of those 69 chief would be dead and the epidemic would be unstoppable. Cases exploded, it just tore through.

Erin Allmann Updyke

Oh my god.

Erin Welsh

I mean it was enormously high mortality which was probably exacerbated by the breakdown of infrastructure and any medical tension as there just weren't people around to do it. It was also a really bad year weather-wise with lots of hurricanes which meant ruined crops and starvation or at the very least poor nutrition which makes measles more deadly.

Erin Allmann Updyke

Oh no.

Erin Welsh

Vitamin A deficiency: really bad.

Erin Allmann Updyke

Very bad.

Erin Welsh

So for two months the epidemic raged and the rest of the outside world had no idea because all of the harbors were closed to isolate the islands to not allow any more cases in or any more cases out.

Erin Allmann Updyke

Oh my god.

Erin Welsh

So at the end of those two months, the world was like how many people died? How many? In a population of around 150,000 people estimated, 40,000. 40,000 died of measles. Virtually no one was spared and a 1/4 of the population died.

Erin Allmann Updyke

Oh my god.

Erin Welsh

Mm-hmm. I had no idea how absolutely devastating measles has been.

Erin Allmann Updyke

Me neither.

Erin Welsh

Yeah.

Erin Allmann Updyke

Oh I'm so glad we're doing this episode.

Erin Welsh

Me too. On that note of the Fiji epidemic, I came across this incredible paper by Dr. David Morens about this epidemic and also re-examining in light of today and today's political climate and today's educational system, it was just a really eloquent, wonderful read and we will definitely link to that. Moving on. In the first half of the 20th century, measles was endemic nearly everywhere, at least in all places with a population large enough to sustain it and it had its fun during both world wars.

Erin Allmann Updyke

Of course.

Erin Welsh

But fortunately the reign of measles was coming to an end or at least that's the illusion. Okay. Although the mortality rate due to measles had dropped quite a bit in the 20th century, it was still killing children so it was still a big priority for vaccine development. Enter John Enders. So he's the reason I suggested the quarantini name Ender's Fame.

Erin Allmann Updyke

Which would've been so good. Just slightly too obscure.

Erin Welsh

Yeah it's quite obscure. (laughs) Maybe we can make a t-shirt, how about that?

Erin Allmann Updyke

Oh my god, Ender's Fame.

Erin Welsh

Ender's Fame with the design of the Ender's Game book.

Erin Allmann Updyke

Yeah, 100%.

Erin Welsh

But I've mentioned him at least once before on the podcast I think in the context of polio.

Erin Allmann Updyke

Okay.

Erin Welsh

Cause he's a super famous virologist who among other things isolated the poliovirus which allowed people to make a vaccine, Salk and Sabin, and won Enders the Nobel Prize in 1954.

Erin Allmann Updyke

Okay that does sounds vaguely familiar.

Erin Welsh

Okay but in that same year, so in 1954, he and another scientist named T. C. Peebles isolated the measles virus from an 11 year old boy and having this virus that they could finally isolate, they could then measure it to see how much virus was present in a particular culture which made standardization really possible. So anyway, vaccine was just around the corner.

Erin Allmann Updyke

Cool.

Erin Welsh: So within 6 years they had a vaccine they could test.

Erin Allmann Updyke: Wow!

Erin Welsh: Which they did on-

Erin Allmann Updyke: Uh oh.

Erin Welsh: 1500 developmentally delayed children in New York City.

Erin Allmann Updyke: Oh dear.

Erin Welsh: And 4000 children in Nigeria.

Erin Allmann Updyke: Oh god, it's like we just never manage to get it right, do we? Oh dear.

Erin Welsh: From what I can tell, those vaccine trials worked fortunately.

Erin Allmann Updyke: Oh thank god but it's not that much solace.

Erin Welsh: I know, I know. And mass vaccination campaigns started shortly after in 1963. So in the first two years of the campaign, over 10 million doses were given to kids in the U.S. but that wasn't enough and the vaccination effort wasn't equal in all places. So for instance, rural and inner city areas had lower rates of vaccination so new initiatives were planned. The target was to get at least 90-95% of the population vaccinated cause that was the only way to actually break the cycle of outbreaks.

Erin Allmann Updyke: Yeah.

Erin Welsh: The year before the vaccine was introduced, there were over 481,000 cases of measles in the U.S. Within four years, that number had dropped by more than half and by 1968 there were only 22,200 cases in the U.S. That's amazing!

Erin Allmann Updyke: Bananas.

Erin Welsh: But then tragedy struck because all the campaign funds for measles were diverted for the rubella vaccine and vaccination rates for measles dropped and as a result they tripled a few years later. The cases tripled.

Erin Allmann Updyke: Huh. Interesting.

Erin Welsh: But anyway.

Erin Allmann Updyke: I bet I know how they fixed that problem though.

Erin Welsh: MMR?

Erin Allmann Updyke: Yeah. They just put it together. They really just put it in the same vaccine. (laughs)

Erin Welsh Well when I read that sentence I was like but wait a second, weren't they in the same vaccine? (laughs) Yeah. I want to quickly shout out some of the measurable, positive impacts of the measles vaccine in the first 18 years of its implementation. Okay. So cases averted between 1963 and 1981: and estimated 48.4 million cases.

Erin Allmann Updyke Whoa.

Erin Welsh And almost 5000 lives saved.

Erin Allmann Updyke Is this in the U.S. alone?

Erin Welsh Mm-hmm. Yeah.

Erin Allmann Updyke Wow.

Erin Welsh And the net benefits achieved in terms of monetary things: roughly 4.5 billion dollars saved.

Erin Allmann Updyke Yeah.

Erin Welsh Yeah.

Erin Allmann Updyke Wow.

Erin Welsh International vaccination campaigns were started by the WHO in 1974 and they were operated on basically a shoestring budget.

Erin Allmann Updyke Shocking.

Erin Welsh But they did get the job... Well they didn't get the job done necessarily but they did really a lot of good work and vaccination rates were high in some areas, geographically variable due to logistical and other reasons. But all in all measles cases and complications and deaths went down and many researchers said that there was no reason to believe that eradication is impossible. Which brings us appropriately to the current status of measles and the dumpster fire/poop parade/catastrophe-

Erin Allmann Updyke (laughs) Did you say poop parade?

Erin Welsh (laughs) Yeah. That's going on today. So tell me what is happening with measles today.

Erin Allmann Updyke Okay. All right. We'll take a quick break.

TPWKY (transition theme)

Erin Allmann Updyke So measles was eliminated from the U.S. in the year 2000. What Erin? There's hundreds of cases going on right now and it's 2019! You're right.

Erin Welsh (laughs) You took the words right from my mouth.

Erin Allmann Updyke

So elimination means that for more than 12 months there can't be any continuous disease transmission. Elimination does not mean eradication, it does not mean that there are zero cases. It just means there's not sustained transmission.

Erin Welsh

Okay.

Erin Allmann Updyke

So most of the cases of measles that we see in the U.S. begin as imported cases, so someone traveling who's unvaccinated comes back to the U.S. or something like that, most of the time. However that wouldn't be an issue if the entire population was immune but that's not the case because we have outbreaks. So basically every time that you see more than 3 cases in any one place that are linked in the U.S. it's considered an outbreak. 3 cases makes an outbreak. I'm fairly sure that at some point in the last 19 years they considered a single case an outbreak but I could be wrong about that. So let's talk about how many cases we've seen in the U.S. The first 10 years after elimination were going pretty great. Since 2010, not so much. We've had several years of much, much higher than normal cases. In 2011 there were 220 cases, in 2013 187, in 2014 we hit an over 20 year high with 667 confirmed cases across 23 different outbreaks.

Erin Welsh

Are you serious?

Erin Allmann Updyke

Yeah, 2014. A huge amount of those outbreaks or a huge amount of those cases I think like 380 cases were in one outbreak alone.

Erin Welsh

Where was that outbreak?

Erin Allmann Updyke

2014 there was 383 cases primarily among unvaccinated Amish communities in Ohio. And then we get to 2015, probably the most infamous outbreak in recent days in the U.S. because that's the Disneyland outbreak.

Erin Welsh

Oh yeah.

Erin Allmann Updyke

So in 2015 there were 188 cases that year in total, 147 of them happened from the Disneyland outbreak.

Erin Welsh

Oh my gosh, there's your 14. There's your R0 of 14.

Erin Allmann Updyke

Right, exactly. We had 86 cases in 2016, 120 in 2017, 372 last year. But so far as of February 14th, 2019 we have already had 127 confirmed cases and actually I can tell you we can up that to 129 because two more cases have been reported in Champaign, Illinois that aren't yet up to date on the CDC website. So the CDC website as of February 14th says there have been 5 outbreaks so far but now we know there have been 6 because there are 4 confirmed cases in Champaign which makes an outbreak.

Erin Welsh

So that means that we are on track to have a banner year for measles in the U.S.

Erin Allmann Updyke

Yep, yep. Definitely, definitely. So the thing is that we can say that these outbreaks are happening because of declining vaccination rates. So if you look at the U.S. as a whole, the MMR vaccine rates are actually steady at about 91%. However that's not true across the entire country, there are pockets of the country where vaccination rates are much lower and where vaccination rates are declining. Additionally over the past I think three years there have been declines in the number of the percentage of new kindergarteners entering with vaccine exemptions, personal vaccine exemptions. So that means you have more kids going into the public school system who are not vaccinated.

Erin Welsh	Right.
Erin Allmann Updyke	So yeah.
Erin Welsh	So obviously people who are becoming infected with measles are those whose parents choose to not have them vaccinated, who choose not to be vaccinated, and those who cannot be vaccinated or those who don't have access.
Erin Allmann Updyke	Yeah.
Erin Welsh	Of the ones who for health reasons cannot be vaccinated, do we have any sort of measurable idea of how much they are being impacted by these outbreaks? What proportion they constitute? Because presumably these people are immunocompromised or might be in a way where they cannot be vaccinated against measles, they get measles it makes everything worse. Yeah.
Erin Allmann Updyke	Yeah, no that's a really good question. I don't know. I can tell you for sure that the vast, vast majority of cases in measles outbreaks happen to unvaccinated individuals so it's not like you got vaccinated and the vaccine just didn't work very well, it's actually a very effective vaccine. It's not 100% effective but it is pretty effective. So there are not stats that I can find on why those individuals are not vaccinated, whether it's because of immunocompromise or personal exemption, religious exemption, or lack of access.
Erin Welsh	Okay.
Erin Allmann Updyke	So let's zoom out a little bit and we'll talk about the world and I'll also address a little bit more about this idea of why some people can't get vaccinated, cause it's an important part of the story.
Erin Welsh	Right.
Erin Allmann Updyke	Worldwide measles is still a huge, huge problem. It's a little difficult to get really great numbers just like it is for most diseases. It's estimated that only about 10% of measles cases are actually reported.
Erin Welsh	Wow, that's very low.
Erin Allmann Updyke	It's very low, it's surprisingly low. But the Measles and Rubella Initiative which is a collaboration between the CDC, the WHO, the United Nations, UNICEF, and the American Red Cross, they have this big initiative where their goal is to eliminate measles from 5 out of the 6 WHO regions by 2020. It's one year away by the way.
Erin Welsh	Oh, okay.
Erin Allmann Updyke	Yeah, they're not gonna hit their goals and they know it but they're trying. But they estimate that while in 2017 there were 173,000 cases reported worldwide, it's estimated that 7 million people were infected with measles in 2016 for example.
Erin Welsh	I'm sorry, 7 million?

Erin Allmann Updyke

7 million.

Erin Welsh

But only the ones that were reported were at 170,000. Is that what you said?

Erin Allmann Updyke

Yeah, that was in 2017 so it was a little bit higher in 2016.

Erin Welsh

Oh my god.

Erin Allmann Updyke

And so it's estimated that 90,000 children a year die from measles. Again these are estimated numbers, not actual numbers of deaths that we know are confirmed. But that's like 246 children a day. It's major.

Erin Welsh

90,000 preventable deaths.

Erin Allmann Updyke

Yeah, we're talking about 90,000 human lives that are lost to a disease that we have the ability to prevent. It's horrifying.

Erin Welsh

That we have the ability to eradicate.

Erin Allmann Updyke

Yeah. Yeah, we do cause we didn't mention this but like smallpox, which we did eradicate, measles is a disease of only humans, there's no animal reservoirs to worry about. So if we can eradicate it from the human population we eradicate it, period.

Erin Welsh

It's a great target for eradication.

Erin Allmann Updyke

Yeah. But so let's talk about the vaccine. So in terms of measles, the first thing I can tell you is that the MMR vaccine is safe, it's very safe, the rates of adverse events are extremely, extremely low and the vast majority of those adverse events are things like fever and excessive crying. Compared to death and encephalitis, which is not that uncommon for infection with measles along with wiping out your entire immune system, the MMR vaccine is worlds and worlds safer.

Erin Welsh

Right.

Erin Allmann Updyke

It's also very effective. It's not 100% effective but one dose of the MMR vaccine is about 93% effective against measles and two doses, which is what's recommended in the U.S. and the World Health Organization would like to have everyone vaccinated with two doses, it's 97% effective. So that means that 97% of people will have immunity to measles after two vaccinations. So because of that, because it's not 100% effective and because of just how contagious measles is, ideally you have to have very, very high vaccination coverage, 95% to interrupt transmission.

Erin Welsh

Yeah.

Erin Allmann Updyke

And that is a huge challenge and that's kind of the challenge behind why we haven't seen as much decrease in... We've seen a huge decrease in measles, don't get me wrong, but they have a hard road in front of them for a number of reasons. Number one. So the MMR vaccine which again is measles, mumps, and rubella, so it covers three different diseases, but this is a live attenuated vaccine. So what that means is that it's an actual virus, it's three actual viruses. They're a modified strain of the virus that can replicate just like a real virus would but they do not cause disease. They basically grow these viruses in cell culture until they lose their virulence or their potency. So in some ways that makes for a better vaccine because your body responds to it in a way that's more akin to a real infection.

But one of the challenges with a live virus vaccine is that number one, it has to be kept cold because it's a live virus. So when you're trying to go all over the globe you might not always have access to a refrigerator, so that's challenge number one. Number two, you have to give this vaccine via injection which means you need trained healthcare workers to actually administer that vaccine and you have to jab a needle into a tiny baby human and usually they don't like that, so that's stressful both for the caregiver and for the infant. Number three, when the baby is born, when a baby is born, they get antibodies from their mom and their immune system itself is super immature, it's basically nonexistent, babies are like just kinda useless. So you can't give a tiny baby human a live virus vaccine because A) those maternal antibodies that are floating around in their blood will just destroy that virus, assuming that the mother has been either exposed or vaccinated to that virus. And B) the baby wouldn't be able to mount a proper immune response anyways.

So you can't give the MMR vaccine to babies until ideally they're at least 12-15 months old. But in some cases when there's outbreaks going on, they'll give the MMR vaccine to babies as young as 6 months but then they're gonna need a third vaccine because we don't actually think it's that effective at 6 months, it's kind of one of those 'better than nothings' if there's an outbreak going on.

Erin Welsh

Yeah which is tricky that you need that double dose and to time it right. So if you're part of the WHO mounting this campaign for vaccination, you can't just go to a place and vaccinate, you have to be at a place and vaccinate for long periods of time.

Erin Allmann Updyke

Yep. And also because it's attenuated vaccine and not a killed vaccine, people like you said who are immunocompromised can't get this vaccine because in those populations, it can cause more serious adverse effects. So what that means is that you are always going to have some percentage of the population who cannot get vaccinated because of an immunocompromise. And you're always gonna have a certain percentage of the population that's under 12 months so they can't get vaccinated either. So in order to hit that 95% you kind of have to vaccinate everyone who's capable of getting vaccinated.

Erin Welsh

Right.

Erin Allmann Updyke

And like you said, the fifth point is that you have to give two of these. I mean giving one is protecting 93% of the population so that's pretty good but 97 is better.

Erin Welsh

Oh yeah.

Erin Allmann Updyke Right? So yeah, it's really challenging and so I wanna give credit where credit is due. The Measles and Rubella Initiative has given vaccination to over 2 billion children since they started in 2001 and worldwide global vaccination rates are increasing actually across the globe if you just take a very broad view of it. That's not true everywhere, there's a lot of places where vaccination rates are declining. There are a couple of really big measles outbreaks going on right now outside the U.S. as well. So in the Philippines there have been in the last 2 months, from January to February of 2019, over 11,000 confirmed cases.

Erin Welsh Oh my god.

Erin Allmann Updyke And 189 deaths.

Erin Welsh What?

Erin Allmann Updyke And in Madagascar right now there's an outbreak that's been going on since September that the last number I saw from the WHO said over 68,000 cases and they're estimating 900 deaths. There's at least-

Erin Welsh 68,000 cases.

Erin Allmann Updyke 68,000. Six-eight-zero-zero-zero.

Erin Welsh In Madagascar where a plague epidemic has just ravaged the entire population.

Erin Allmann Updyke Yes. Yep. And I should say too that in recent analyses from the CDC, the vast majority of children in the U.S. who are unvaccinated are also uninsured or underinsured. So we have a big problem with access in this country as well, I think it's sometimes easy to just blame it on the Disneyland outbreak, 'Oh it's these rich people who are choosing not to vaccinate'. But it's not just that in this country or in any country, it's also an access issue and an education issue and a miseducation issue.

Erin Welsh Yeah. It's a double whammy. We have gotten and would probably continue to get a load of questions from people living in certain foci of outbreaks right now, so Seattle, Vancouver, New York, yeah.

Erin Allmann Updyke And then now we have one here where I am!

Erin Welsh People who are vaccinated, people whose kids are vaccinated, whether there's any concern that they need to have for their own personal safety or the safety of their children.

Erin Allmann Updyke Basically if you got two MMR vaccines, you are 97% sure that you're immune. Yeah and babies like I said in places where there is an active outbreak going on, you can get the vaccine for those children as young as 6 months. What a fun episode, guys!

Erin Welsh All right. It's very relevant and much more deadly.

Erin Allmann Updyke I know! I really didn't know that it, you know... Cause the number you always see now is like 1-2 per 1000, that's what it tends to be in current times, so.

Erin Welsh It killed 1/4 of the population of Fiji.

Erin Allmann Updyke

Good god. Sources.

Erin Welsh

Sources? Okay so I mostly relied on a book called 'Measles: An Historical Geography of a Major Human Viral Disease' by Andrew Cliff, Peter Haggett, and Matthew Smallman-Raynor. I mentioned this earlier but an article by David Morens called 'Measles in Fiji 1875: thoughts on the history of emerging infectious diseases'. And also the Cambridge World History of Human Disease edited by Kenneth Kiple.

Erin Allmann Updyke

Excellent. I had several good articles, this one on nonmedical exemptions is by, main author is Jacqueline Olive. And then the also Science article. On all of the articles and books we will always post along with links whenever we can on our website thispodcastwillkillyou.com, you can find all of our sources from every single episode there. And somebody on Twitter also was making like a, what do you call it, like citation-friendly source list too on some bibliography website that I didn't know existed. So I'll find that and post a link to it somewhere too.

Erin Welsh

Great, yeah. Thank you all for listening.

Erin Allmann Updyke

Thanks for requesting this, this was a really interesting one for us to get to research and I think it's very timely and relevant unfortunately.

Erin Welsh

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

Erin Allmann Updyke

We love it. And that's all of our thank yous.

Erin Welsh

Okay. Well in that case, wash your hands.

Erin Allmann Updyke

You filthy animals. And get vaccinated, goodness.

Erin Welsh

Please.