

Erin Allmann Updyke

"On March 23, 1963 at 1AM, Jeryl Lynn Hilleman woke up with a sore throat. Five years old with penetrating blue eyes and an adorable pixie haircut, Jeryl quietly tiptoed into her father's bedroom and stood at the foot of his bed. 'Daddy,' she whispered. Hilleman shook himself awake, rose to his full height of 6'1", bent down, and gently touched the side of his daughter's face. There at the angle of her jaw he felt a lump. Jeryl winced in pain. At the time of his daughter's illness Hilleman was a single father. Four months earlier his wife Thelma had died of breast cancer. Although he wasn't sure what was happening to Jeryl, Hilleman had a pretty good idea.

Near his bed was a book titled 'The Merck Manual', a simply written compendium of medical information. Thumbing through it he soon found what he was looking for. 'Oh my god,' he said. 'You've got the mumps.' Then Hilleman did something that few fathers would have done. He walked down the hallway, knocked on the housekeeper's door, and told her that he'd be gone for a while. Then he went back to his bedroom, picked up his daughter, and put her back to bed. 'I'll be back in about an hour,' he said. 'Where are you going, Daddy?' asked Jeryl. 'To work. But I won't be long.' Hilleman got into his car and drove 15 miles to Merck. He rummaged around his laboratory, opening and closing drawers, until he found cotton swabs and a vial of straw colored nutrient broth.

By the time he got home Jeryl had fallen back to sleep. So he gently touched her shoulder, woke her up, stroked the back of her throat with a cotton swab, and inserted it into the vial of broth. Then he comforted her, drove back to work, put the nutrient broth in a laboratory freezer, and drove home. Most parents thought that mumps was a mild short lived illness but Hilleman knew better. He was scared about what might happen to his daughter. Although he knew that it was too late for Jeryl, Hilleman wanted to find a way to prevent mumps. He decided to use his daughter's virus to do it."

TPWKY

(This Podcast Will Kill You intro theme)

Erin Allmann Updyke

I love it.

Erin Welsh

It's so good. It's so exciting.

Erin Allmann Updyke

It is.

Erin Welsh

It's amazing.

Erin Allmann Updyke

I also just love what a nerd he was that he slept next to the Merck manual, like had it on his bedside table. Maurice!

Erin Welsh

It's amazing. As if you don't do the same thing, Erin. Come on.

Erin Allmann Updyke

I have a stack of medical books on my bedside table right now.

Erin Welsh

See?

Erin Allmann Updyke

Yeah I know, it's embarrassing.

Erin Welsh

Nerds unite. That amazingly written true story is from the book 'Vaccinated: One man's quest to defeat the world's deadliest diseases' by Paul Offit. And it is about Maurice Hilleman.

Erin Allmann Updyke

Yeah.

Erin Welsh: Who played a big part, a huge part, a crucial part, as well as his daughter, in the creation of the mumps vaccine which is the subject of today's episode.

Erin Allmann Updyke: It sure is.

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: We're really excited to be bringing back yet another of the vaccine-preventable diseases.

Erin Welsh: We sure are. I mean this is the last of the MMR that we needed to cover.

Erin Allmann Updyke: Exactly, yeah. The other M, we've got it.

Erin Welsh: The other M. Yeah. Speaking of the other M, what are we drinking this week?

Erin Allmann Updyke: That's what we're drinking! The Other M.

Erin Welsh: The Other M. I feel like most people when they think of MMR it's sort of all blurred together, right. It's measles, mumps, rubella. You barely take a breath between them or even a pause.

Erin Allmann Updyke: Yeah.

Erin Welsh: It's just all one word. But I also kind of think that maybe measles springs to mind first for most people.

Erin Allmann Updyke: I think it depends on the generation. I think that there's a good chunk of people who remember mumps more than anything because of some of its distinctive signs.

Erin Welsh: Sure.

Erin Allmann Updyke: But yeah, measles I think steals the show in that vaccine.

Erin Welsh: Yeah, maybe it's because there have been more recent outbreaks of measles. Although there have been recent outbreaks of mumps.

Erin Allmann Updyke: Have there been?

Erin Welsh: So we are drinking The Other M in any case .

Erin Allmann Updyke: Yep.

Erin Welsh: And in The Other M it's a tasty little concoction with bourbon, sage simple syrup, because my garden has way too much sage, and some orange tossed in there.

Erin Allmann Updyke

Yeah.

Erin Welsh

It's delicious.

Erin Allmann Updyke

I can't wait. It's very early fall. Fantastic.

Erin Welsh

And we will post the full recipe for the quarantini as well as the non alcoholic placeborita on our website [thispodcastwillkillyou.com](http://thispodcastwillkillyou.com) as well as on all of our social media channels.

Erin Allmann Updyke

We sure will. On our website [thispodcastwillkillyou.com](http://thispodcastwillkillyou.com), you all know how many amazing things you can find there. Do we even do this anymore? We've skipped it a few times. Check out our website.

Erin Welsh

I like it.

Erin Allmann Updyke

Yeah.

Erin Welsh

And I don't think there's any more business. So can we dive into the last of the MMR?

Erin Allmann Updyke

I am really excited to do it. Let's take a quick break and then we'll get into it.

TPWKY

(transition theme)

Erin Allmann Updyke

So mumps.

Erin Welsh

Mumps.

Erin Allmann Updyke

Mumps is the disease, that's the name of the disease that's caused by a virus that is named the same thing, the mumps virus. Which I think we've covered a number of viruses whose disease are named the same thing but I don't know why I expected mumps virus to be named something different, like something more virus sounding.

Erin Welsh

That's a good point.

Erin Allmann Updyke

Yeah but it's the mumps virus, it causes mumps.

Erin Welsh

I mean surely it has a virus family and stuff like that.

Erin Allmann Updyke

Oh sure, sure.

Erin Welsh

That sounds a little more professional.

Erin Allmann Updyke

We can do that, of course. It's in the family Paramyxoviridae, there we go. Which is as it turns out the same family as the measles virus as well as parainfluenza, canine distemper, RSV, a whole bunch of other viruses that are pathogenic to humans as well as our dogs. Mumps virus has a single stranded RNA genome, it's an enveloped virus, so outside its little protein capsid it has this lipid and glycoprotein envelope that helps it evade our immune response. And from what I could tell there are at least 12 different genotypes of this virus that do vary geographically but it's unclear whether these genotypes vary that much in virulence, probably not substantially at least as far as we know so far. Serotype wise, if you remember in our leptospirosis episode I talked a little bit about the differences between what is a serotype, etc.

Erin Welsh

Right.

Erin Allmann Updyke

So serotypes are things that vary based on their outside surface proteins and so we can categorize them based on different epidemic outbreaks and things like that, based on different serotypes or serovars. And in the case of mumps it doesn't seem like there are a lot of different serotypes but there are differences in their genes. So there are different genotypes but it's unclear how much these genetic differences really translate to differences in the virus and how it interacts with our immune system and causes disease. If that makes sense.

Erin Welsh

Yeah, okay. So for instance when it comes to different serotypes, you might not have cross protection or as much cross protection from one compared to the other because the surface protein is different and your immune system might not recognize a different serotype that you haven't previously been infected with. Whereas different genotypes, you could be infected with one and then your immune system would recognize another because those surface proteins aren't substantially different?

Erin Allmann Updyke

Right, exactly. Yeah.

Erin Welsh

Okay, okay.

Erin Allmann Updyke

Yeah. That was a more succinct summary than my blathering.

Erin Welsh

I feel like I went on and on. But I think that makes a lot of sense and I think that's really interesting from both a public health perspective as well as an evolutionary perspective.

Erin Allmann Updyke

Yeah, yeah, exactly.

Erin Welsh

And vaccines.

Erin Allmann Updyke

And vaccines. So mumps is a human specific virus, it does not infect other animals naturally, just humans. And it's a very contagious disease. The  $R_0$  which we haven't talked about for a long time-

Erin Welsh

Yeah.

Erin Allmann Updyke

So excited to bring it back. The  $R_0$  is a number that is used in epidemiology to estimate the average number of infections that result from a single infection in an entirely susceptible population.

Erin Welsh

I feel like we all know  $R_0$  from COVID now. But keep going.

Erin Allmann Updyke I know but now it's been 2.5 years so people might have forgotten! You know what I mean? But yes, a little refresher. But this is an estimate so it can vary depending on the population and the study that you're doing. So for mumps the average is estimated at around 4.4. So every one case results in 4.5-ish additional cases. But depending on the population, that can vary from 3-10.

Erin Welsh Wow.

Erin Allmann Updyke Yeah. In different studies. So potentially up to one person can infect up to 10 people in some studies.

Erin Welsh Okay. That's very contagious.

Erin Allmann Updyke Very contagious. And transmission is by primarily respiratory droplets as well as close contact in general because respiratory droplets are generally close contact transmission, as well as potentially fomites or surfaces like door knobs or pillows or whatever that become contaminated.

Erin Welsh And that would be contaminated through your saliva?

Erin Allmann Updyke Exactly. It's very much like influenza.

Erin Welsh And how durable is this virus in the environment?

Erin Allmann Updyke Great question. I actually didn't see any data on that, so I do not know.

Erin Welsh Okay.

Erin Allmann Updyke Yeah. Yeah, good question though. But yeah, it can be transmitted that way. So it's very much like influenza and a lot of other crowd diseases that we've covered. And also like a lot of those diseases people become contagious or infectious at least a day or two before their symptoms start. And virus has been isolated from saliva and nasal mucosa up to a week before symptoms start which is terrifying.

Erin Welsh What?

Erin Allmann Updyke Yeah.

Erin Welsh Okay, question.

Erin Allmann Updyke Yeah?

Erin Welsh How long is the incubation period then?

Erin Allmann Updyke Great question. It's very long. It's between 15-24 days, so like 2-3 weeks.

Erin Welsh That is so interesting. Why is it so long?

Erin Allmann Updyke I don't know, Erin. I have a lot of I don't know about mumps. So once we get exposed to the virus, let's say a couple of toddlers at preschool breathing on each other like they do.

Erin Welsh

Yep.

Erin Allmann Updyke

The virus then predominantly infects the cells that line our respiratory tract or at least initially begins to infect those cells, especially the upper respiratory tract, it usually doesn't make its way into our lungs, not causing a lower respiratory infection. And then one of the primary cell types that it infects and begins to replicate within is our parotid glands. Our parotid glands are a pair of salivary glands in your cheeks, kind of like back near the angle of your jaw. And this infection of this glandular epithelium, that's the cells that are lining the glands in your parotid glands, leads to what's called a parotitis. That just means inflammation of these glands. And that is what leads to one of the hallmark symptoms of mumps infection which are super, super swollen cheeks.

But this is not a virus that only infects our parotid glands. It can infect a variety of glandular epithelial cells. It can infect our respiratory epithelium of course, it can infect our central nervous system. And wherever it goes, what it does is essentially replicate a lot and this replication causes a lot of local inflammation, infiltrates of our white blood cells trying to fight off this virus by killing those infected cells, which can then lead to hemorrhage or necrosis of various tissues within these organs and significant swelling and potentially increased pressure in these various glands. So what we see with infection with the mumps virus is both direct damage from the virus replicating in our cells but also a lot of indirect damage from our immune response to such a highly proliferating virus.

Erin Welsh

Okay, questions.

Erin Allmann Updyke

Okay.

Erin Welsh

why does it go where it goes? Especially like the central nervous system and outside of the salivary glands and respiratory tract.

Erin Allmann Updyke

Great questions. So what's very interesting is that one of the papers I read suggested that mumps virus actually has a very high, we've talked on this podcast about tissue tropisms, so particular tissue types that viruses are very good at infecting. And in animal models mumps virus actually has a very strong tissue tropism for nervous tissue. So it invades and replicates really well in nervous tissue in animal models. But in humans we actually don't see very common, it's not the hallmark symptom to have neurologic involvement. As we'll talk about you definitely can but primarily it seems to infect these other epithelial cell layers. Why does it have a particular tropism for these glandular epithelial cells? I don't have an answer for you. And what's very interesting is that it really is these parotid glands specifically that are the hallmark and other salivary glands because our parotids are not our only salivary glands, we have others under our mandible and under our tongue. Those tend to not be infected at least not without also having parotid gland involvement, it's much less common. Does that make sense?

Erin Welsh

Yeah. How fascinating.

Erin Allmann Updyke

Yeah. And I will talk about this isn't restricted to that glandular epithelium, it can infect epithelial cells in a lot of other organs as well. And I think it just is a matter of does it manage to make it all the way to those organs evading our immune response on its way there? And then if it does then it can set up shop and just replicate like it does in our parotids.

Erin Welsh

One more quick question please.

Erin Allmann Updyke

Okay.

Erin Welsh

How does infectivity change throughout the duration of infection?

Erin Allmann Updyke

Yeah. You're most infectious those couple of days before symptoms start and then for the first week-ish after that.

Erin Welsh

Okay.

Erin Allmann Updyke

Yeah. But we know that virus can be detected for up to a week before symptoms and I think for even longer than a week after symptoms begin. But the most highly infectious time seems to be that kind of more narrow time window of just before symptoms start and for a few days, maybe up to a week after.

Erin Welsh

Okay.

Erin Allmann Updyke

Yeah. So let's talk about what those symptoms actually look like, shall we?

Erin Welsh

Yeah.

Erin Allmann Updyke

Just talked about this virus itself, let's talk about what's happening to us. So first of all and this kind of messes up what I just said, Erin, about the parotid glands but 30% of the time this is an asymptomatic infection.

Erin Welsh

Right, yeah.

Erin Allmann Updyke

Yeah. Which I did not know and I feel like it makes it that much more terrifying considering how long the incubation period is, how much you can shed before symptoms even start, how much are asymptomatic carriers contributing to spread? Scary.

Erin Welsh

Yeah.

Erin Allmann Updyke

Okay. But that's 30%, so let's talk about the other 70%, shall we? In that 70-ish percent of people who become symptomatic, the infection usually starts with a little bit of a fever but not like I'm laid out, I'm feverish, I'm so ill. It's just feeling run down, maybe not having much of an appetite, often having a headache, feeling sick. And then over 2-3 days is when that hallmark sign of parotitis begins. The parotid glands can get so big that they actually lift up your ear lobe, kind of up and out and you completely lose that angle of the jaw. If you look at pictures of people with mumps, it's hard for me to describe well but you just really have two ginormous chipmunk cheeks.

Erin Welsh

Also if you've watched Brooklyn 99 there's an episode where Jake and Captain Holt get mumps.

Erin Allmann Updyke

Yeah, I forgot about that!

Erin Welsh

And they named them.

Erin Allmann Updyke

Oh my gosh.

Erin Welsh

They named their big swollen lumps.

Erin Allmann Updyke

That's hilarious. How accurate is it? Well let me go through and you'll tell me.

Erin Welsh

I mean it's been a long time since I've watched it but yeah.

Erin Allmann Updyke

And this swelling can persist for up to an entire week and it is incredibly painful. It's a very, very inflamed organ. It's super tender, 90% of the time it's bilateral so you're miserable on both sides. And usually it starts on one side and then the second side takes a couple extra days to come in.

Erin Welsh

That part is accurate from Brooklyn 99 I'm pretty sure.

Erin Allmann Updyke

Love that. And 95% of people who show symptoms do have this parotitis, so it is very, very classic. The testes are another very common site of mumps infection especially in postpubertal people with testes. 15%-30% of postpubertal people with testes can get an infection that is often an epididymo-orchitis. Oh gosh. It's both epididymitis and orchitis.

Erin Welsh

Okay.

Erin Allmann Updyke

So let me tell you what those two things are, shall we?

Erin Welsh

Yeah, yeah.

Erin Allmann Updyke

So these symptoms often start several days to a week after the parotitis. It is possible to get it without that parotid gland swelling but it's much less common. And it's two different things that can happen. First it's an orchitis which is inflammation of the testes themselves, the sperm-producing little oval structures in the scrotum. With that inflammation, think of it just like your parotid glands, it's swelling, it's warmth, it's tenderness, extreme tenderness because of all this inflammation. Then on top of that you can also get an epididymitis which is inflammation of the epididymis which is the tube that carries sperm away from the testes themselves and kind of stores the sperm as well. And with that you usually also see more general constitutional symptoms like a worsened fever, headache, vomiting, just overall looking a lot sicker. So that's very miserable.

In terms of the long term effects of this epididymo-orchitis, it seems still controversial from what I could tell whether there is a long term association with infertility or subfertility or reduced sperm production. There are some studies that do suggest a small decrease in testicular size and/or abnormalities in spermatograms, whether that be sperm count, sperm morphology, or sperm motility. But this is only in a percentage of people and it doesn't seem like we have great data on how common this is or what the real effects of this are, like why is this causing more long term effects. Ovaries can also be affected but it tends to be much less common. About 5% of postpubertal or reproductive age people with ovaries get oophoritis, so again just inflammation, same situation happening but in the ovaries. You have a question, your face is saying why and I don't know why.

Erin Welsh

Yeah, why is it less common is really what I was going to ask.

Erin Allmann Updyke

I wonder if it has anything to do with differences in body temperature or something, like the testes and the salivary glands are in a very different place in your body, in your abdomen. But I don't know because they can also replicate in your kidneys just fine. So maybe it's just that it's a more indirect route to try and get there for the virus. I don't have an answer for you. Do we just diagnose it less? I don't know. I don't know. I don't have an answer.

Erin Welsh	Interesting.
Erin Allmann Updyke	<p>Now all of those symptoms are horrible, they're painful, they may or may not cause residual symptoms in the case of an orchitis or an epididymitis but they do tend to be self limiting in all those cases. The problem with mumps virus is that it can also infect the central nervous system and it can result in a meningitis or an encephalitis. It is rare, most estimates, I saw suggested that about 5%-10% of cases of mumps will cause a meningitis, although one World Health Organization article suggested up to 15%. And less than half a percent, 0.5% cause encephalitis which is the worst.</p>
Erin Welsh	5%-10% still seems pretty dang high.
Erin Allmann Updyke	<p>It is, absolutely. And apparently up to half of the time with a meningitis, it can happen even without that parotid gland swelling and infection. So you might not have had that as a preceding symptom to know that this meningitis is likely related to the mumps. If that makes sense. And if that's not enough, that it can happen without even the parotid gland swelling, it can also happen in any order. So you can see meningitis that starts before salivary gland involvement or after salivary gland involvement.</p>
Erin Welsh	Okay.
Erin Allmann Updyke	<p>Now mumps meningitis is a more severe infection. You can see things like high, high fevers, headaches, vomiting, all the scary kind of meningeal signs when you have inflammation of these meninges lining your nervous system like stiff neck, like lethargy. But in general very low mortality from mumps meningitis and very little long term issues and problems that arise as a result of this meningitis which is really in contrast to other causes of meningitis.</p>
Erin Welsh	Okay.
Erin Allmann Updyke	However-
Erin Welsh	There's always a however.
Erin Allmann Updyke	<p>There's always a however. There can be a progression to encephalitis which is inflammation happening in the brain itself, in the parenchyma of the brain and that does lead to the potential for severe and lasting damage including seizures, behavioral changes, hearing loss. Asterisk, hearing loss is actually a well known complication of mumps that happens in about 4% of cases overall, so not only in these encephalitis cases. But unlike hearing loss as a consequence of other forms of meningitis, it's often unilateral rather than bilateral, one ear not both, and it's often transient which is good but it can be permanent which is not good.</p>
Erin Allmann Updyke	<p>And despite how rare this encephalitis is in a mumps infection, mumps was the leading cause of viral encephalitis in the United States and many other countries until the vaccine was widely available. So this is not a benign disease even though the vast majority of people who get it will have a very sort of self limited disease course. So yeah, that's kind of the worst of the things that can happen. Like I kind of alluded to, mumps can infect a lot of other organs. It can cause a pancreatitis which is inflammation in your pancreas, it can cause kidney infections, it can infect your heart. Really it can go anywhere but the ones I talked about are the most common places that we see mumps infection happening. Overall the fatality rate is very low, about 1-3 per 10,000 infections and almost exclusively in cases of encephalitis.</p>
Erin Welsh	I have a question.

Erin Allmann Updyke

Okay.

Erin Welsh

So clearly it can cross the blood-brain barrier and cause problems in your central nervous system.

Erin Allmann Updyke

Correct?

Erin Welsh

Can it cross the placenta?

Erin Allmann Updyke

Great question. I believe so. Mumps, it's not very strong associations but there is some suggestion that mumps can be associated with spontaneous abortion, early pregnancy loss, even in a few case reports that I saw neonatal infection leading to neonatal death when someone was infected very much at the end of their pregnancy, like a few days before delivery. So yeah.

Erin Welsh

Okay.

Erin Allmann Updyke

But part of the problem about kind of all of these questions is that most of what we know about the pathogenesis of mumps comes from animal models and this is a human specific virus. So all these animal models are imperfect and I think it's probably a part of why we don't know maybe as much about the specific pathogenesis as we do about other viruses.

Erin Welsh

Right, okay. That makes sense.

Erin Allmann Updyke

But we do have a vaccine.

Erin Welsh

We do.

Erin Allmann Updyke

It's the second M in the MMR vaccine, measles, mumps, and rubella. The vaccine for mumps is a live attenuated vaccine which means it's a live virus that has been grown in laboratory culture to not be virulent, so it doesn't cause symptomatic disease. And it's available in MMR but also on its own, just mumps. And there's actually a lot of different vaccine strains that exist out there and some of them do seem to be more effective than others which is very interesting, especially in the context of the fact that we don't know that genotypes are all that different. You know what I mean?

Erin Welsh

Yeah.

Erin Allmann Updyke

And what's very interesting and I'll kind of talk more about what has happened as a result of this, some cases of aseptic meningitis, so meningitis that you can't grow anything from in culture have happened as a result of vaccination with specific strains of the vaccine, of the mumps vaccine. But this vaccine isn't really in use very commonly anymore because of that. And importantly all of the cases of aseptic meningitis that happened from this vaccine strain of the virus did not result in any kind of long term consequences or any deaths as far as everything that I read.

Erin Welsh

Okay.

Erin Allmann Updyke

But important to note.

Erin Welsh: Okay. I have a question about the disease itself, mumps.

Erin Allmann Updyke: Okay.

Erin Welsh: So you mentioned that in infants the disease can be very severe. Do we see any other patterns when it comes to age? For instance in terms of whether someone has certain symptoms or more likely to have a more severe course of infection, stuff like that.

Erin Allmann Updyke: Yeah, great question. It actually tends to be more severe, like a lot of childhood illnesses, if you get it later in life. So as an adolescent or an adult especially with testes because we really don't see that testicular infection prior to puberty very commonly at all.

Erin Welsh: Right, okay.

Erin Allmann Updyke: Yeah.

Erin Welsh: So then that leads me to a question about the vaccines which is waning immunity.

Erin Allmann Updyke: Yeah.

Erin Welsh: How does the vaccine durability change across these different vaccine strains?

Erin Allmann Updyke: That's a great question, Erin. The whole waning immunity thing is a really important part of vaccination. So in general childhood infection with mumps induces a very persistent long lasting immunity that as far as we know is pretty much lifelong. But again infection can also cause meningitis encephalitis and death. So we vaccinate to avoid those consequences. Vaccination with mumps specifically does seem to have a waning immunity although it's not for everyone. On average some studies have found that vaccination can lead to 27 years or more of immunity to mumps which is a really long time.

Erin Welsh: Yeah.

Erin Allmann Updyke: But up to 25% of people might lose that protection within just 7 or 8 years.

Erin Welsh: Okay.

Erin Allmann Updyke: So the 27 years is an average but that average has a really wide spread. And the question of why that is is something that we still don't really know.

Erin Welsh: Okay.

Erin Allmann Updyke: And I'll talk a lot more in the current events section about what the consequences of that have been in terms of outbreaks that we've seen in adolescents and young adults especially that likely this waning immunity plays a big role.

Erin Welsh: Yeah, of course.

Erin Allmann Updyke: So that's the biology of mumps.

Erin Welsh: What a weird little virus.

Erin Allmann Updyke: Isn't it? It's interesting though.

Erin Welsh: It's really interesting.

Erin Allmann Updyke: Yeah. So tell me Erin, where did this weird little guy come from?

Erin Welsh: I won't answer that question but I'll get into more about mumps and the history of this disease right after this break.

TPWKY: (transition theme)

Erin Welsh: Mumps is a classic. It's a classic TPWKY topic. Historically it's been a classic childhood illness and now thankfully it's a classic vaccine-preventable disease.

Erin Allmann Updyke: Such a classic.

Erin Welsh: It's a classic. And most of what I'm going to talk about today is the story of the mumps vaccine as well as the man behind this and many other vaccines, Maurice Hilleman.

Erin Allmann Updyke: If you're a listener, you know his name.

Erin Welsh: You certainly do. But before I get there I want to briefly take you through the early history and prehistory of mumps or at least as far as we know. Where the mumps virus came from seems like somewhat of a difficult question to answer. It's possible that it spilled over from pigs to humans during the Agricultural Revolution when humans first began to domesticate pigs. And that's based on the fact that there's a very similar virus found in pigs and they seem to be related. Or another option is that it spilled over from humans to pigs. Maybe. And more recently a virus very similar to the human mumps virus has been found in certain bat species, leading some researchers to hypothesize that perhaps the mumps virus spilled over from bats into humans and maybe also pigs. This is kind of my long way of saying that we don't know.

Erin Allmann Updyke: We don't know.

Erin Welsh: We don't know where mumps virus came from and when it first started infecting humans.

Erin Allmann Updyke: Okay.

Erin Welsh: And maybe that information is out there and I just didn't search for it well but I couldn't find anything more specific than that. But we do have a better sense for when mumps was first written about and that is of course from the Hippocratic texts around the 5th century BCE. Retrospective diagnosis of any disease can be difficult and a little bit hand wavy but as you described, a typical infection with mumps is pretty distinctive thanks to those chipmunk swellings around your jaw.

Erin Allmann Updyke: Yeah.

Erin Welsh: And so this quote from the Hippocratic text describing an outbreak of an illness on the island of Thasos seems pretty clearly mumps. Tell me if you agree.

Erin Allmann Updyke: Okay.

Erin Welsh	Quote: "Swelling appeared about the ears in many on either side and in the greatest number on both sides. In some instances earlier and in others later inflammations with pain seized sometimes one of the testicles and sometimes both."
Erin Allmann Updyke	Yep, sounds like mumps.
Erin Welsh	Sounds like mumps, yeah. And in later centuries historians and physicians recorded outbreaks of a disease that sounds pretty similar to mumps. And as early as 1755 people suspected that it was contagious.
Erin Allmann Updyke	I love those stories when people knew that it was contagious before they knew what the heck a virus or a bacteria or anything was.
Erin Welsh	What was the actual contagious agent.
Erin Allmann Updyke	Unit, yeah.
Erin Welsh	Yeah, yeah. And by the way, I just have to throw in here the etymology of mumps.
Erin Allmann Updyke	Ooh please.
Erin Welsh	So the English word for the disease, mumps, it's different in other languages, the origin of that is a bit of a mystery. It could refer to lumps around your face.
Erin Allmann Updyke	Okay.
Erin Welsh	Could refer to the English word 'mump' meaning to be sulky. Or it's even been suggested that it comes from the difficulty in speaking experienced by people who have those salivary gland swellings.
Erin Allmann Updyke	Mum-mum-mum-mum-mum. Mumbling?
Erin Welsh	Yeah. I don't know. But one of the things I thought was really hilarious especially when you were talking about why doesn't the mumps virus have a more scientific sounding name.
Erin Allmann Updyke	Yeah.
Erin Welsh	So one of the earliest articles about mumps, like scientific articles from 1790 is titled quote "An account of a distemper: by the common people in England vulgarly called the mumps." And the author in the text immediately said I beg leave to call it not mumps but angina maxillaris. He was like we can't call it mumps, that's too improper. So the mumps is the vulgar name for it I guess. Who knows?
Erin Allmann Updyke	Hilarious.

Erin Welsh

But anyway by the late 1700s interest in mumps had increased with the result that people began to take a closer look at the more severe manifestations of infection, like the nervous system involvement that you talked about. They also began to recognize its cyclic pattern. So every few years, I don't know, 3-7 years or so, an epidemic would occur as the number of susceptible individuals in a given area increased. Which is something that we commonly see for crowd diseases, especially prototypical early childhood diseases. People also started to note its global distribution which truly seemed to be global. And they also observed how it spread rapidly under certain conditions. Things like prisons, boarding schools, ships, and of course soldiers at war. The estimate for some military populations was as high as 6000 cases per 100,000 individuals.

Erin Allmann Updyke

Wow.

Erin Welsh

That's pretty high.

Erin Allmann Updyke

It is. And it's interesting that they're grown ups. There's that many people who are still susceptible in that population for that outbreak to happen.

Erin Welsh

Yeah.

Erin Allmann Updyke

That's interesting.

Erin Welsh

Yeah it is. Yeah, how did they they escape it?

Erin Allmann Updyke

Yeah, yeah.

Erin Welsh

I mean they just missed the window.

Erin Allmann Updyke

They just missed the window. Oof.

Erin Welsh

And unfortunately hit it later on.

Erin Allmann Updyke

Yeah.

Erin Welsh

So during the US Civil War about 11,200 cases of mumps were reported during the first year and over 13,400 in the second.

Erin Allmann Updyke

Wow.

Erin Welsh

So again these are people who escaped it as children.

Erin Allmann Updyke

As children, yeah.

Erin Welsh

Mumps also ran rampant during WWII with the Surgeon General of the US Public Health Service stating in 1940 that it was quote "one of the most disabling of the acute infections among armed forces recruits, exceeded only by the venereal diseases." Endquote.

Erin Allmann Updyke

Wow. Wow.

Erin Welsh

Yeah. I had no idea how prevalent this was.

Erin Allmann Updyke

No.

Erin Welsh

And I feel like a lot of us who were born after the mumps vaccine already existed maybe just didn't realize how widespread it was, it was just sort of an inevitability almost of childhood.

Erin Allmann Updyke

I feel like mumps has been one of the most brushed under the rug. Like a vaccine came out and then our collective consciousness forgot how bad it was because I didn't know how bad it was.

Erin Welsh

I feel like the same thing. Maybe measles was like that too until measles started increasing and people were reminded of just how horrible this disease could be.

Erin Allmann Updyke

Maybe, yeah.

Erin Welsh

Yeah. But I agree, it does sort of seem like an afterthought. And it certainly didn't used to be just an afterthought.

Erin Allmann Updyke

Right.

Erin Welsh

It used to be a hugely important disease and that made it a public health priority to find out how it was transmitted and what caused it. What was the pathogenic agent in 1930 for C. D. Johnson and E. W. Goodpasture demonstrated that mumps was caused by a filterable transmissible agent aka a virus in saliva.

Erin Allmann Updyke

Love it.

Erin Welsh

And they did this by transmitting the disease from humans infected with mumps to rhesus monkeys. And a little more than 10 years after that the virus was first cultivated by K. Habel and a few years after that in 1948 G. Henley and his colleagues investigated the relatively high rate of asymptomatic infections.

Erin Allmann Updyke

Interesting.

Erin Welsh

Apparently there was an experimental killed virus vaccine that came out in the early 1950s but I don't know if it stayed experimental or if it was ever distributed widely. And I'm kind of guessing that it wasn't because mumps was still infecting millions of people every year.

Erin Allmann Updyke

Yeah.

Erin Welsh

And in order for mumps to become this afterthought like we talked about, simply one of the Ms in MMR in many places around the world which it kind of is today although things are changing, that transition would take a more effective vaccine. And for that we needed of course Maurice Hilleman.

Erin Allmann Updyke

Let's hear it for Maurice!

Erin Welsh

Let's hear it for Maurice. From the start of the 20th century to the end of it, Americans lived 30 years longer on average and that's thanks to an improvement in many different technologies and infrastructure from seatbelts to access to clean drinking water and improved sanitation, antibiotics, workplace safety regulations, improved nutrition, and many other things. But the most impactful of all medical advances was certainly vaccines. And the person responsible for developing a great number of these life saving vaccines was one Maurice Hilleman. Like you said Erin, if you've listened to the podcast before, Maurice Hilleman's name probably sounds familiar to you especially if you listened to our vaccines episodes where we mentioned some of the incredible work that he did in vaccine research. But we didn't talk about him in too much detail and since this mumps episode marks the last of the diseases covered by the MMR vaccine that we've done on the podcast, I thought I'd take just a little bit more time to talk about Maurice.

Erin Allmann Updyke

I can't wait.

Erin Welsh

Maurice Hilleman was born at his family's home on the banks of the Tongue and Yellowstone rivers near Miles City, Montana on August 30, 1919. It's like eastern plains Montana, just out there.

Erin Allmann Updyke

Okay.

Erin Welsh

His birth was marked not only by global tragedy, he was born at the end of the influenza pandemic that had killed tens of millions of people around the world, but also by personal tragedy, his twin sister died at birth and his mother followed shortly after from eclampsia.

Erin Allmann Updyke

Ugh.

Erin Welsh

Yeah. Maurice later said quote, "I always felt that I cheated death."

Erin Allmann Updyke

Wow.

Erin Welsh

He spent his childhood living with his aunt and uncle but working during the day at the family farm, the Riverview Garden and Nursery, and getting into trouble and adventures when he wasn't working. Nearly drowning in the Yellowstone River while floating on a makeshift boat, getting diphtheria, nearly getting hit by a freight train while riding his bike across a train bridge. Yeah, a rough and tumble childhood. His childhood heroes were Charles Darwin, he got caught reading 'On The Origin of Species' in church.

Erin Allmann Updyke

Oh my god.

Erin Welsh

And also Howard Taylor Ricketts who I talked a lot about during our Rocky Mountain spotted fever.

Erin Allmann Updyke

Yeah, Ricketts of rickettsia.

Erin Welsh

Ricketts of rickettsia. He worked in Montana trying to understand how Rocky Mountain spotted fever was transmitted and the role that the tick played, etc, etc, and find the causative agent. As Maurice got to the end of high school, he struggled with what to do next. The thought of going to seminary school to become a preacher which was a very common path at that time for people in his town, that didn't really appeal to him. And so he applied and got a full scholarship from Montana State University. He graduated in 1941 first in his class with a degree in chemistry and microbiology. His plans were to go to medical school but he couldn't afford it so he turned his sights to grad school.

He applied to microbiology programs all over the country and his top pick was University of Chicago. He got into all of them but he chose Chicago where he quickly made impressive progress on his dissertation discovering that chlamydia was not caused by a virus as was the prevailing thought at the time but rather a small intracellular bacterium. After finishing that up, the expectation from everyone at the university was that he would stay in academia teaching and doing research. But that didn't really sound great to him, didn't sound as good as a job at a pharmaceutical company. Because he wanted to take what he had learned in graduate school and apply it to industry, be able to scale up vaccine production, be able to quality control stuff instead of just one project after the next after the next.

Erin Allmann Updyke

Yeah.

Erin Welsh

But the University of Chicago didn't want him to go into industry and so they set up various obstacles to make it more difficult including a French exam. And Maurice hadn't studied French. So he spent six months learning the language, passed the test, and finally was permitted to work at the pharmaceutical company E. R. Squibb in New Jersey.

Erin Allmann Updyke

Wait I'm sorry. They wouldn't give him his degree or something until he jumped through these hoops?

Erin Welsh

I don't know if it was like not giving him his degree or just, I can't remember what what the book said but yeah.

Erin Allmann Updyke

Oh my gosh.

Erin Welsh

I know it's academia.

Erin Allmann Updyke

Yeah.

Erin Welsh

Yeah. And at Squibb he worked on the mass production of influenza vaccines. After about four years there he headed to the Walter Reed Army Medical Research Institute to try to develop new influenza vaccines. And that's something that would serve him very well when he led the charge to produce a vaccine for the 1957 pandemic strain of influenza.

Erin Allmann Updyke

Whoa.

Erin Welsh

The 1957 flu pandemic doesn't get a whole lot of attention I feel because maybe it wasn't as severe as the 1918 one. But what it did was demonstrate the potential for another influenza strain to sweep through populations, especially those that had no previous immunity to a similar strain. And Maurice was not only one of the first in the US to recognize the potential for pandemic spread but also he was able to get people to take it seriously, pushing for vaccine development when others were like you know what, it's not here, we're going to be fine, we don't need to worry about it.

Erin Allmann Updyke

Wow.

Erin Welsh

And he was like no, we absolutely need to worry about it. And part of the reason why the 1957 flu pandemic didn't turn out to be as deadly as the 1918 one was likely due to the vaccine that Maurice produced and pushed.

Erin Allmann Updyke

Wow.

Erin Welsh

After the 1957 pandemic Maurice broadened his scope beyond influenza. He left Walter Reed to become the Director of Virus and Cell Biology at Merck Research Laboratories and in his new position he had one simple easy goal, to prevent every viral and bacterial disease that commonly hurt or killed children.

Erin Allmann Updyke

Oh my goodness.

Erin Welsh

I know. Super easy, right?

Erin Allmann Updyke

Super simple.

Erin Welsh

No problem.

Erin Allmann Updyke

Doesn't have big goals or anything.

Erin Welsh

No. But honestly he got pretty close

Erin Allmann Updyke

Wow.

Erin Welsh

He created and tested more than 30 vaccines over the next 30 years of his career. And one of those vaccines was of course for the subject of this episode, mumps.

Erin Allmann Updyke

Mumps.

Erin Welsh

As you heard in the firsthand account, the mumps vaccine got its start when Jeryl Lynn Hilleman, whose father was Maurice Hilleman, came down with the infection in March 1963. Maurice took that Throat sample that he had gotten from Jeryl and brought it into the lab where he set to work on trying to make a mumps vaccine. Not for Jeryl of course like was mentioned since it wouldn't do her any good at that point but for the rest of the world. During the 1960s about a million people in the US got infected with mumps every year. And so when you were talking about these numbers Erin of oh well 5%-10% of people get meningitis and then a smaller percentage of point get encephalitis, those seem like small numbers. But when you have millions of cases every single year, those are thousands of lives.

Erin Allmann Updyke

Exactly. That's the thing about mumps. 95%-100% of people will get mumps in their lifetime if they are unvaccinated if the entire population is susceptible.

Erin Welsh

Yeah.

Erin Allmann Updyke

So this is not a disease that only affects some people, it literally affects everyone in unvaccinated populations. And that's what it did until we had a vaccine.

Erin Welsh

Yeah. Those percentage points can make the risk of diseases like this seem low but when you have a number of susceptible people, first of all the actual number of people impacted can be high, second of all no matter how low the risk is, if you can avoid it, why risk it?

Erin Allmann Updyke

I know.

Erin Welsh

Yeah. I think like we've talked about many of us today don't maybe think about mumps all that often, especially those born after the vaccine was available. And I think our distance from that time period when mumps was a persistent childhood threat, basically an inevitability, means that we don't recognize how fortunate we are to not have to think about mumps. We're like oh, we never think about mumps, it's brushed under the rug. How amazing is that?

Erin Allmann Updyke

Right?

Erin Welsh

That's a wonderful thing.

Erin Allmann Updyke

Yeah.

Erin Welsh

And so Maurice was not just thinking oh hey, no one's made a mumps vaccine yet, guess I'll give it a go, this seems like a solvable problem, something fun. He knew that if he could successfully create a vaccine, he could save millions of people around the world from this potentially harmful infection.

Erin Allmann Updyke

Yeah.

Erin Welsh

And so he took Jeryl's sample to the lab and he inoculated it into an incubating hen's egg and then passed the virus into more eggs and then grew the virus in chick cells that he had cultured. Again he transferred the virus from one flask of chick cells to the next, seeing the virus get better and better at infecting the chick cells with every passage. And Maurice took this to mean that the virus was losing its ability to infect humans as it was getting better at infecting these chicken cells.

Erin Allmann Updyke

Right.

Erin Welsh

But perhaps even though it couldn't cause disease in humans, maybe it could induce an immune response, enough for protection. This serial passage process that Maurice used had been used and has been used by many researchers for decades to make vaccines. It's how Louis Pasteur made the rabies vaccine for instance. But how can you know for certain that the virus you've created using this process or any process really is actually A) effective at preventing infection while B) not giving you the disease itself and C) being safe?

Erin Allmann Updyke

Yeah.

Erin Welsh

You have to test it out. And this is where we come to the part of the story that is not surprising but still disappointing, frustrating, appalling, choose your adjective. But it's important to talk about. And that is the testing of vaccines and other medical studies in children with developmental disabilities. This was not an uncommon practice in the 1930s, 1940s, 1950s, and into the 1960s, including with Maurice Hilleman's mumps vaccine. Paul Offit in his book 'Vaccinated' writes that from our perspective today we may think of the scientists heading those studies as amoral, viewing those children as expendable opportunities to conduct their studies. But he argues that these doctors really saw the children as more vulnerable, more in need of protection, especially those living in crowded and underfunded state run facilities where infectious diseases often ran unchecked.

And part of his reasoning to back that up is that many of these researchers, including Maurice Hilleman, including Jonas Salk, also tested the early versions of their vaccines on their own children. So why would they inject their kids with something they thought could be unsafe? I'm not sure that I agree with that take entirely. I think it's likely that some researchers did feel that way, that they had good intentions with their studies and who they chose to test out those untested products on. But others may not have felt that way, may have truly looked at these children as less than or as dispensable. And maybe others didn't really think that much at all about the ethics of this beyond seeing these children as an opportunity.

Administration of the vaccine and follow up was easy because they were all in one place, infection rates were high so you could get a good sense of how well these vaccines protected, and many of the children were wards of the state so you didn't have to deal with the parents. And my point here is not try to decipher what these researchers thought about what they did, whether their intentions were good or bad or how they reconciled it with their ethics. And I'm also not going to go into the history of how we got from there to where we are today with much stricter guidelines on how these studies are conducted, who gets chosen or who gets asked to participate in the study, informed consent and so on. I'm also not saying it was a different time, everyone did it and no one thought much of it. And I'm also not saying progress could only have happened at the expense of these nonconsenting individuals which is certainly not the case.

Erin Allmann Updyke

Right.

Erin Welsh

So enough about what I am not trying to do, what I do want to do, what I want to get across is just that this happened. This is a crucial part of the history of the mumps vaccines, of polio vaccines, of hepatitis B virus, and so many other things. When talking about the history of a disease or medication or medical technology, we need to address the cost of progress and acknowledge who actually paid for it which in many cases has been nonconsenting individuals. Where did the earliest data come from that showed that the mumps vaccine was safe and effective? It came from children whose consent was not or could not be given and that should be a part of the story we tell when talking about the history of mumps.

Okay, so what happened? The first mumps vaccine test was actually a pretty small study. 16 children at the Trendler School in Pennsylvania which was a home for developmentally delayed children. And these 16 children were injected with Maurice's experimental mumps vaccine in June of 1965. The results were clear, fortunately the vaccine was both safe and produced antibodies against mumps. And so a second trial was carried out this time on 60 children with developmental delays living at other schools, again demonstrating that the vaccine induced the production of antibodies against the mumps virus.

But one thing still had to be answered. Did this vaccine actually prevent disease? We saw antibodies but were those antibodies enough to prevent infection from actually happening? And to answer that they had to scale up. And for this Maurice and his colleagues thankfully turned away from using these state run schools and instead for several months Maurice and his colleagues went around to preschools and elementary schools in the Philadelphia area and handed out flyers to parents telling them about this new vaccine and that there would be info sessions held at local churches. At these sessions researchers on the project would describe the vaccine, how it was made, a bit about how it worked, and then they would open it up to questions. If a parent was interested in allowing their kid to get the vaccine, they filled out a 3x5 inch card that said 'I allow my child to get a mumps vaccine.' It had a signature at the bottom.

Erin Allmann Updyke

All right.

Erin Welsh

This 3x5 little index card was a far cry from the informed consent forms that you see today with info about the safety of the vaccine, the timeline of the project, a list of the ingredients, what the study would entail in terms of tests or follow ups, all the things that were known. But I found it really funny to read that it did include the home and work phone numbers of Robert Weibel who was one of the lead investigators on the project.

Erin Allmann Updyke

Wow.

Erin Welsh

It was like call anytime you have any questions, any concerns.

Erin Allmann Updyke

That's good.

Erin Welsh

In total about 400 children were enlisted in the study with 200 getting the mumps vaccine and 200 getting a placebo.

Erin Allmann Updyke

Love it.

Erin Welsh

Several months after the study began, a mumps epidemic swept through Philadelphia. And when the dust settled, 63 children in the study had gotten mumps, two had been given the vaccine, and the remaining 61 had not.

Erin Allmann Updyke

Wow!

Erin Welsh

Pretty good. Pretty clear.

Erin Allmann Updyke

Yeah.

Erin Welsh

Yeah. And on March 30, 1967, a couple of years after this study and four years after Jeryl Lynn came down with mumps, the Jeryl Lynn mumps vaccine was licensed for use in the US and cases of the disease dropped rapidly. And since that time this vaccine has prevented millions, countless millions of cases of mumps around the world. I want to read this quote from a reporter that has been widely circulated about the mumps vaccine because I think it's hilarious.

Erin Allmann Updyke

Okay.

Erin Welsh

Quote: "Jeryl recovered from mumps virus but mumps virus never recovered from infecting Jeryl." Isn't that cute?

Erin Allmann Updyke

I love it.

Erin Welsh

I love that. Within a few years the mumps vaccine was combined with the measles vaccine also made by Hilleman and the rubella vaccine made by Stanley Plotkin to be the one shot MMR vaccine we know today. And this was simply just to reduce the number of injections that a child had to get.

Erin Allmann Updyke

Stings, yeah. There are more and more combo vaccines coming out because there are more and more vaccines.

Erin Welsh

More and more vaccines. It's awesome. This combo shot of course was the same that would later be falsely attacked by Andrew Wakefield who did his best along with many other people to undermine the efforts of Maurice Hilleman and others to keep children safe. If you want to hear more about the history of the anti-vaccine movement and just how completely wrong and unethical Andrew Wakefield was, is, check out our vaccines part two episode. And I'll also recommend the books 'Vaccines Did Not Cause Rachel's Autism' by Peter Hotez, our fave, and also 'Deadly Choices' by Paul Offit. And there are many other great books and other resources out there. But please be careful where you find your information. Books aren't peer reviewed and anyone can write a book and claim anything they want to in it. And even though they aren't peer reviewed, there are reviews of nonfiction scientific books that can often be found in academic journals. So it's a bit more homework but I will recommend plugging a book title into Google Scholar, seeing if a review pops up, read the review to see whether it's good or not.

Erin Allmann Updyke

I love that.

Erin Welsh

Yeah, recommend. Anyway back to mumps and Maurice. Over the course of his career, Maurice Hilleman and his team created tens of vaccines including 8 of the 14 routinely used in us vaccination schedules, measles, mumps, hepatitis A, hepatitis B, chickenpox, Neisseria, meningitidis, Streptococcus pneumoniae, and Haemophilus influenzae. His vaccines have saved the lives of I don't even know if we have a number, countless people around the world and continue to prevent death and illness in millions annually. His name and work really should be more widely known at least as well known as someone like Louis Pasteur or Jonas Salk or Alexander Fleming and that's part of the reason why I wanted to spend a little time talking about his life and what led up to the creation of the mumps vaccine.

Unfortunately several of the diseases for which Maurice developed these vaccines have been making a comeback over the last few decades due to a lack of access to vaccines, vaccine hesitancy or anti-vaccine sentiment, and waning immunity. And mumps is no exception. I so, so wish it were the case that the last chapter in the book of mumps was 'here's this life saving vaccine, everyone used it and mumps went away forever.' But sadly that's not the case. So Erin, tell me where we actually stand, what the most up to date chapter is on mumps today and what college campuses have to do with it.

Erin Allmann Updyke

I can't wait. We'll take a quick break and then I'll let you know.

TPWKY

(transition theme)

Erin Allmann Updyke

Turns out Erin, college campuses have a lot to do with it if we're being honest.

Erin Welsh

I thought so.

Erin Allmann Updyke  
Yeah. While we've had a vaccine for mumps since like you said the 1960s, mumps is not quite as common of a vaccine included in national immunization programs worldwide as things like measles, rubella, even polio. About 50%-60% of countries depending on which paper I read include mumps in their national vaccine schedules. But in places where it has been very highly uptaken I guess the effect was dramatic. Finland actually eliminated mumps entirely in the country for a while and only had imported cases here and there.

Erin Welsh  
It's so awesome. But also your verb tenses are worrying.

Erin Allmann Updyke  
I know, yeah. They're valid. The US had a decline of like 99%, we were down in 2001 to less than 0.1 case per 100,000 people.

Erin Welsh  
Wow!

Erin Allmann Updyke  
From a million cases per year to less than 0.1 per 100,000 people.

Erin Welsh  
That's so great and I hate where this is going. Okay.

Erin Allmann Updyke  
Yeah. Since those numbers which really I would say probably peaked in the early 2000s in terms of overall effectiveness and decline of mumps cases, probably peak early 2000s, 2001, etc. Since then we have seen increasing numbers and an increase in sporadic outbreaks in the US, in Europe which is highly vaccinated, and across the globe. The reasons for this are very multifactorial and what's interesting about these outbreaks especially in the US is that they tend to actually be among vaccinated individuals and not unvaccinated individuals as we saw with measles outbreaks several years ago.

So it's likely that this idea of waning immunity that we talked about in the biology section likely plays a really big role when it comes to mumps, that it plays less of a role as we see with other infections. So think more like pertussis which is another one we've already covered, waning immunity leading to segments of populations that are now newly immune and therefore you can have an outbreak. This has happened on college campuses because nothing's wrong with college campuses but it's just a place where this huge group of people all got vaccinated at around the same time, some proportion of them had waning immunity at around the same time, and they're in close quarters sharing saliva and etc. Now you have an outbreak. Ripe for an outbreak. So in the US we had outbreaks in 2006, 2016, 2017, and 2019 that were all pretty big. Most of those had case numbers of over 6000 in these outbreaks.

Erin Welsh  
That's a lot.

Erin Allmann Updyke  
It's a lot. And in 2019 the outbreak was over 3000.

Erin Welsh  
Wow.

Erin Allmann Updyke  
Not all of this was college campuses but a number of these outbreaks were associated with college campuses. Do you remember Erin, 2016 Illinois?

Erin Welsh  
I was living in Panama that whole year.

Erin Allmann Updyke  
Oh well it was at University of Illinois. And they were recommending MMR boosters for everyone.

Erin Welsh  
I think I do remember that vaguely.

Erin Allmann Updyke

Yeah.

Erin Welsh

I remember the emails at least.

Erin Allmann Updyke

Worldwide it's hard to get great numbers. There have been outbreaks like this that number in the thousands in the UK, in other countries in Europe, in Australia. It's hard to get a number globally but one paper that I read estimated global annual average of more than 500,000 cases between 2005-2010.

Erin Welsh

Okay.

Erin Allmann Updyke

So it's not like this is a virus that we have even come close to eliminating by any means.

Erin Welsh

And it's human specific, so in theory...

Erin Allmann Updyke

In theory. In theory, Erin. Part of the issue I think has been in addition to perhaps issues of vaccine access which always come up, a number of countries had initially implemented national vaccine campaigns and then made them more like a voluntary and not as part of the national vaccine program. And part of this had to do with these cases of aseptic meningitis. And so I want to get into this a little bit more especially because there has been polio in the news recently and this kind of relates to what we have seen with polio as well. So let me get into this idea that viruses can cause infection.

If you have listened to our polio episode, We talked a lot about the fact that there are two different polio vaccines. In the US we used to use an oral polio vaccine, across the globe we used to use this exclusively, an oral polio vaccine. And this is a live attenuated vaccine. Highly effective. It was an oral vaccine so easy to administer and it replicated in our guts which is how polio is transmitted, it's fecal-oral. So this oral vaccine conferred really good protection and it was also possible for people to shed this live virus through their feces which meant you could have passive immunization of say household contacts through this fecal-oral route of a non virulent strain of this virus.

Erin Welsh

It's awesome.

Erin Allmann Updyke

It's awesome. However this nonvirulent strain can mutate potentially to become more virulent and actually cause disease. And so over time as we massively decreased the number of polio cases, the risk-benefit analysis of using this live attenuated vaccine shifted into the other direction. And so we no longer use the oral polio vaccine in the US and in a lot of other countries that have eliminated or greatly reduced polio, we now use an inactivated injected polio virus vaccine. That's what we use in most of the world. Now when it comes to mumps this exact series of events has not been shown to happen, we don't have things like passive immunization and that sort of thing. We haven't seen outbreaks from the viral strain the way that we have in cases of polio.

However there have been case reports of aseptic meningitis, so inflammation occurring in the meninges, importantly not encephalitis, not inflammation in the brain itself, but aseptic meningitis from some strains of the vaccine. And so understandably this caused a lot of concern and led to the withdrawal of some of these vaccine strains and in some cases stopping vaccination for mumps entirely or making it voluntary rather than part of a national immunization campaign. Which has implications not only for vaccine uptake and acceptance but also a lot of times for funding, countries don't fund it if it's not part of the national campaign.

Erin Welsh

Yeah.

Erin Allmann Updyke

One country where this happened, where these cases happened because of the particular vaccine strain that was used and then the national vaccine program stopped was in Japan. And Japan now has one of the highest rates of mumps among high income countries with over a million cases reported annually as of 2015.

Erin Welsh

Whoa.

Erin Allmann Updyke

So that's a huge issue. Yeah, yeah.

Erin Welsh

Whoa.

Erin Allmann Updyke

I know. So I feel like what this comes down to, it's several different things. One, there are other strains of this vaccine like the one that we use here in the US that are not associated with aseptic meningitis, I want to emphasize that the vast majority of strains that are used for this have not been associated with this and are very, very safe and well studied vaccines. The strains that have caused this generally are not used and the cases all were, while scary, self limiting. But I do feel like this kind of touches on something that I think is important when it comes to a disease like mumps and a vaccine like the mumps vaccine that was developed many years ago.

I think that this is a good example of why we can't be complacent both in terms of we can't assume that the disease is gone just because we have a vaccine for it, right, we don't know how long immunity is going to last when we come up with a vaccine. So it's quite possible that this could reemerge at a later date, so we shouldn't be complacent in that way. But we also shouldn't be complacent in terms of the vaccine itself. We have a vaccine, it's very effective, though the immunity might not last as long as we'd like, and it can prevent morbidity and mortality. But can we make it better? Can we make it more safe? Can we make it more effective? Especially as we are doing such a good job of reducing the population disease incidence overall. Can we make a more effective vaccine with less potential for side effects? So I think that that is kind of the place I'm most excited to see mumps research go in the future is towards maybe new vaccine research.

Erin Welsh

Yeah.

Erin Allmann Updyke

But I don't have an update on where we're at with that.

Erin Welsh

No but I agree, that was really well put about complacency.

Erin Allmann Updyke

Yeah.

Erin Welsh

We can still look forward, we don't have to be like okay, clap our hands, we're done.

Erin Allmann Updyke

Yeah. We can't forget where we came from and why it was so important to begin with and why it's still so important to get this vaccine.

Erin Welsh

Yeah. It's the full picture.

Erin Allmann Updyke

The full picture. So that, Erin, is the mumps.

Erin Welsh: The mumps. Should we do sources?

Erin Allmann Updyke: We should, we should do some sources.

Erin Welsh: Okay. I have several but I'm only going to shout out two, one is the 'Cambridge World History of Human Disease', the mumps chapter. And the other is of course 'Vaccinated' by Paul Offit which was also the source for our firsthand account. Recommend, great read.

Erin Allmann Updyke: I had one particular favorite paper for the biology section and that was titled 'Mumps'. Gotta love it.

Erin Welsh: Easy.

Erin Allmann Updyke: Yeah. From The Lancet in 2008. I had a couple of others for more details on the pathogenesis. And then a number of papers on the epidemiology of mumps especially in the era post vaccines. So you can find the list of our sources from this episode and all of our episodes on our website, did we tell you about it? Thispodcastwillkillyou.com.

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

Erin Allmann Updyke: Thank you to the Exactly right network.

Erin Welsh: And thank you to you, listeners. We hope you liked this one. We hope you thought it was interesting, yeah.

Erin Allmann Updyke: I liked it.

Erin Welsh: Did you learn more about mumps than you ever thought you would?

Erin Allmann Updyke: More than you wanted to but you're so happy you did?

Erin Welsh: I hope so.

Erin Allmann Updyke: And a special thank you as always to our patrons. Thank you so, so, so much for your support.

Erin Welsh: Yeah, absolutely. Okay well until next time, wash your hands.

Erin Allmann Updyke: You filthy animals.