TPWKY	This is Exactly Right.
Erin Welsh	In the same year, a new kind of sickness came suddenly through the whole region. Even after the first entering of the king into this aisle, which was so sore, so painful and sharp that the like was never heard of to any man's remembrance before that time. For suddenly a deadly and burning sweat invaded their bodies and vexed their blood and with the most ardent heat infested the stomach and the head grievously. By the tormenting and vexation of which sickness men were so sore-handled and so painfully panged that if they were laid in their bed, being not able to suffer the importunate heat, they cast away the sheets and all the clothes lying on the bed. If they were in their apparel and vestures they would put off all their garments, even to their shirts. Others were so dry that they drank the cold water to quench their importunate heat and insatiable thirst. Others that could or at least would abide the heat and stink, for indeed the sweat had a great and strong savor, caused clothes to be laid upon them as much as they could bear to drive out the sweat, if it might be.
	All in manner, as soon as the sweat took them or within a short space after, yielded up their ghost so that of all of them that sickened there was not one amongst a hundred that escaped. In so much that beside the great number which deceased within the city of London, two mayors successively died of the same disease within eight days and six aldermen. And when any person had fully and completely sweat 24 hours, for so long did the strength of this plague hold them, he should be then clearly delivered of his disease yet not so clean rid of it but that he might shortly relapse and fall again into the same evil pit. Yay, again and twice again as many a one indeed did, which after the third time died of the same.
TPWKY	(This Podcast Will Kill You intro theme)
Erin Allmann Updyke	Huh.
Erin Welsh	(laughs)
Erin Allmann Updyke	I was trying to listen for clues and this is gonna be a fun episode, Erin.
Erin Welsh	It is gonna be a very fun episode, I am so excited. So that was a contemporary account of the sweating sickness, I'm not sure actually which epidemic but I found it in a paper by Flood from 2003. Hi, I'm Erin Welsh.
Erin Allmann Updyke	And I'm Erin Allmann Updyke.
Erin Welsh	And this is This Podcast Will Kill You.
Erin Allmann Updyke	And today we're talking about sweating sickness!
Erin Welsh	Sweating sickness. I am so excited because a lot of people have suggested this over the years as we've been doing this podcast and I was like okay yeah, that sounds really interesting. And I was like, yeah, I know about sweating sickness. People sweat and they died and that was it. And then I started to read more about it and I was like what?
Erin Allmann Updyke	I'm excited because I know literally nothing about it. Like when people have suggested it I've been like, okay yeah sure. I have no idea what it is.

Erin Welsh	(laughs) I am very excited. So the way that we did this episode, and I think it's like the way we did the dancing plague episode, is where I research the historical epidemics - and by the way, sweating sickness is a mystery so this is like a mysterious epidemic episode.
Erin Allmann Updyke	Right, it's gonna be like our encephalitis lethargica and our dancing plague episodes, so a little different than tradition.
Erin Welsh	Yeah and so yeah, I did all the research for the history of it as usual but instead of Erin taking on, oh this is the biological cause and the epidemiology of it, I was like hey, research these five things that people think it was.
Erin Allmann Updyke	Right. And so then we'll go through them and look at the biology of these possible explanations and try and figure out what we think.
Erin Welsh	Yeah. Yeah. I mean I think this'll kind of be like an episode of Unsolved Mysteries where you're like, 'Ooh this is so exciting, what's gonna happen? What's gonna happen?' And then ultimately you're not really gonna get a fully satisfying answer.
Erin Allmann Updyke	Do you think that because this has been how many hundreds of years that we have yet to figure out exactly what caused it, you don't think we're gonna solve it on this podcast today?
Erin Welsh	We're not. I mean I feel like with some exhumations of some royal bodies or something and then testing some DNA that is possible, but also that has been tried and no permission has ever been granted. So.
Erin Allmann Updyke	Well. Yeah. All right. We'll do our best.
Erin Welsh	We'll do our best. So Erin, it's a very special time.
Erin Allmann Updyke	Yes. It is. I checked. It is quarantini time!
Erin Welsh	It is quarantini time. This week we are drinking Sweat It Out.
Erin Allmann Updyke	Sweat It Out.
Erin Welsh	And in Sweat It Out is... It's gonna be like a little bit of a spicy and smoky situation.
Erin Allmann Updyke	Of course, to really give you that sheen.
Erin Welsh	Exactly. We want to see those beads of perspiration on your dewy forehead.
Erin Allmann Updyke	(laughs) And upper lip.
Erin Welsh	We have mezcal, lime juice, habanero simple syrup, mango juice, and orange liqueur.
Erin Allmann Updyke	Yum. And we will post the full recipe for that quarantini as well as our nonalcoholic placeborita on all of our social media channels and thispodcastwillkillyou.com.
Erin Welsh	We will.

Erin Allmann Updyke	Do we have any other business to talk about?
Erin Welsh	We do have one small piece of business. We have a correction actually.
Erin Allmann Updyke	Yes we do.
Erin Welsh	So in our last episode which was on rubella, one of the terms that we used was 'differently abled' and a bunch of people have reached out to let us know that that is actually not the preferred term and we apologize for doing that and we will do better in the future.
Erin Allmann Updyke	Yeah. Yeah and thank you. Honestly, thank you for pointing that out and people pointed it out in a way that makes it easy for us to learn and so now we can teach everyone else too!
Erin Welsh	Exactly.
Erin Allmann Updyke	So the preferred term is disabled, not 'differently abled'.
Erin Welsh	Yes. And we appreciate it. So we have any other business to take care of?
Erin Allmann Updyke	We have merch which is amazing, created by incredible artists, available on thispodcastwillkillyou.com under MERCH. We have a Bookshop link as well as a Goodreads list if you're interested in finding or purchasing books that we recommend on this podcast.
Erin Welsh	Ooh and we're getting transcripts.
Erin Allmann Updyke	Yay!
Erin Welsh	Yay!
Erin Allmann Updyke	So you can read more!
Erin Welsh	Yes, yes.
Erin Allmann Updyke	We're very excited, these have been very long awaited and will be available on thispodcastwillkillyou.com, just click on TRANSCRIPTS. We're super excited.
Erin Welsh	Heck yeah.
Erin Allmann Updyke	I think that's enough business.
Erin Welsh	Well should we dive into this episode?
Erin Allmann Updyke	Erin, I can't wait. Like I'm not kidding when I say I know nothing about sweating sickness and I wanna learn all about it.
Erin Welsh	(laughs) Excellent. Well I will dive right in right after this break.
TPWKY	(transition theme)

Erin Welsh	Ready. Sweat. Go.
Erin Allmann Updyke	(laughs) Oh, Erin.
Erin Welsh	(laughs) I feel like planned and rehearsed jokes are probably the best, right?
Erin Allmann Updyke	Definitely, yeah.
Erin Welsh	Absolutely.
Erin Allmann Updyke	I mean I didn't see it coming, so.
Erin Welsh	Spontaneity is overrated. Quick wit? Absolutely not.
Erin Allmann Updyke	Who needs it?
Erin Welsh	(laughs) Okay but for real. The English sweating sickness was basically a series of five epidemics occurring in 1485, 1508, 1517, 1528, and 1551, primarily in England and only England.
Erin Allmann Updyke	Huh.
Erin Welsh	Its entire history takes place within that not quite 70 year timeframe. It caused nowhere near the same level of population devastation that plague epidemics did, and I'm not talking just about the Black Death but I mean the outbreaks of plague that continued across England and the rest of Europe for centuries after. And if it wasn't a plague year, people were still no stranger to deadly illnesses that would burn through a city or a village and wipe out one side of a family tree within a matter of days. Life was precarious, death was always hovering at the edge. Hence like all the rad metal art from that time, all the skeletons.
Erin Allmann Updyke	(laughs)
Erin Welsh	So with these epidemics of plague, typhoid, malaria, influenza, smallpox etc. constantly on rotation, what made sweating sickness so remarkable to people in that time? What was it about sweating sickness that led to such terror and panic that Henry VIII, for example, fled with his members of court to avoid the sickness - somewhat in vain, I might add - and what is it about this mysterious yet very isolated and short-lived illness that still leads people in the 21st century, 500 years later, to talk about it, publish articles about it, highlight it in novels and TV shows? Let's find out.
Erin Allmann Updyke	Yeah.
Erin Welsh	England in 1485 was at a bit of a turning point. The War of the Roses was finally drawing to a close with Richard III losing his life and his army defeated at the decisive Battle of Bosworth Field. Which led to Henry, Earl of Richmond, taking the throne as Henry VII and kicking off a 115-ish rule by the House of Tudor in England.
Erin Allmann Updyke	Okay.
Erin Welsh	And like all of that stuff about the history of the English royal families and succession and blah blah blah I think is really interesting, but that's not what we do on this podcast, I'm not equipped to do it.

Erin Allmann Updyke	(laughs)
Erin Welsh	And so that's all I'm gonna say about that. But the reason that I mention it is because the year 1485 was not just this end of the War of the Roses, we care about it because that's when we first see sweating sickness. The exact date within that year of the earliest cases is a little bit controversial because some early chroniclers claimed that it was brought over at the time of the battle by Henry's French mercenaries. But that's actually unlikely for a number of reasons, among them the fact that there aren't any descriptions of this disease in France during that time and that there were sporadic cases reported elsewhere in England prior to this battle which took place in late August.
Erin Allmann Updyke	August, okay.
Erin Welsh	But where there may have been scattered cases throughout England earlier in the summer of 1485, later it had erupted into a full on outbreak. In early September the mysterious sweating sickness had spread to Oxford, by late September it had reached London, and by October it was in most of the western and southern counties. One contemporary chronicler reported that it had killed 15,000 people in London which is surely an exaggeration because that would have been about 1/3 of London's population at the time.
Erin Allmann Updyke	Oh. Whoa.
Erin Welsh	But that does just further illustrate the impression that it left on the people who were witnessing this illness sweep through. This impression was just of total helplessness and devastation. But what were they seeing?
Erin Allmann Updyke	Yeah.
Erin Welsh	Okay. So I guess maybe before I go through the next few epidemics I should probably describe sweating sickness in a little more detail.
Erin Allmann Updyke	I am like on edge right now.
Erin Welsh	I know, I could tell. I love it.
Erin Allmann Updyke	I'm writing notes literally as you're talking so that I can try and figure out what's going on.
Erin Welsh	(laughs) Okay, okay. This is great because I get to pretend to be you in this episode.
Erin Allmann Updyke	(laughs)
Erin Welsh	It starts with a fever.
Erin Allmann Updyke	With a fever!
Erin Welsh	Yes, I never get to say that! And it actually does, it actually starts with a fever.
Erin Allmann Updyke	Okay, cool.

Erin Welsh	And it comes on quickly. One minute you're doing whatever it is people were doing in England in the 1400s and 1500s, maybe you were rolling out some rye dough or you were tending to your crops, or you're writing a sermon denouncing Martin Luther and his 95 theses or whatever.
Erin Allmann Updyke	Just casual.
Erin Welsh	Just casual stuff. And the next minute you feel this slight fever coming on. And along with that fever an intense sweat.
Erin Allmann Updyke	Okay.
Erin Welsh	This is any old heavy after workout type sweat, this is unprecedented. Not only because of the volume of moisture leaking from your armpits and beading up all over your skin, but also from the vile stench accompanying it.
Erin Allmann Updyke	What?
Erin Welsh	Fetid, corrupt, putrid, loathsome - these are just some of the words that contemporary physicians or scholars used to describe this sweat.
Erin Allmann Updyke	Okay but can I already take a timeout and ask a question?
Erin Welsh	Of course.
Erin Allmann Updyke	This is roles-reversed Erin, now I know how you feel.
Erin Welsh	(laughs)
Erin Allmann Updyke	Okay are people stinking, like is it the sweat that is stinky or is it just that like it's 1485, people don't have great hygiene and so when you sweat you smell yourself and so everyone's sweating and so now they stink. Like is it more stinky than other illness sweat? I'm confused.
Erin Welsh	Well so I can't answer that except for the fact that the horrible smell was noted in all of the descriptions.
Erin Allmann Updyke	Okay.
Erin Welsh	Which would lead me to believe that there is something special about this sweat because how do you avoid smelling yourself? You know?
Erin Allmann Updyke	Yeah.
Erin Welsh	I don't know.
Erin Allmann Updyke	I'm just going through what you asked me to research, Erin, and already I'm like, well, no idea. (laughs)

Erin Welsh	(laughs) I mean, maybe it is possible. So there are some modern scholars that say, well perhaps the excessive sweat was due to anxiety cause the fever wasn't all that high, it wasn't all that burning. Or it didn't seem to be, it seemed like a slight fever and so this excessive sweat would seem strange but it also was incredibly notable, like it's in the name.
Erin Allmann Updyke	It's in the name, yeah.
Erin Welsh	They called it sweating sickness, yeah.
Erin Allmann Updyke	Oh my gosh.
Erin Welsh	So I can't answer you about the smell part but I would have to believe that at a certain point you would have gotten accustomed to how much you and everyone around you stank.
Erin Allmann Updyke	Right and so then this it above and beyond 1485 stink.
Erin Welsh	It seems to be.
Erin Allmann Updyke	Okay.
Erin Welsh	That's the sense I got from this.
Erin Allmann Updyke	All right, okay.
Erin Welsh	Okay. So this sweating which never seems to cease brings on an unquenchable thirst.
Erin Allmann Updyke	Okay.
Erin Welsh	Your heart starts racing, your back and arms and legs ache, you feel stabbing pains in your stomach and bowels, and oh my god does your head hurt. So badly that you're having a hard time keeping a grasp on reality. If you're lucky enough to have been close to home when the symptoms began, you find yourself unable to crawl out of bed. And if you weren't so lucky, you lay on the ground where you stood when you first felt the illness coming on.
Erin Allmann Updyke	Okay.
Erin Welsh	As you lay there sweating rancid sweat, guts roiling, body aching, head absolutely pounding, delirious, your breathing starts to become more and more shallow and a great heaviness seems to settle on your chest. Maybe you pile on more and more blankets or clothes to try to keep the sweat in which might have been prescribed by your quote unquote "doctor". Or you drink as much lukewarm liquid as you can get down. But what you really wanna do, what your body wants you to do, is sleep. And so you close your eyes and give in but just like your insatiable thirst, there never seems to be an amount of sleep that's enough to make you feel rested. If you can endure the first 24 hours of this sweating, aching, burning, breathlessness, you're probably in the clear though relapses leading to death were common. But according to writings from the time, few escaped the illness and most succumbed to death within a few hours. A few hours of symptom onset. If you were well at lunch, you could be dead by dinner. Quote: "But all alike died. Either as soon as the fever began or not long after so that of all the persons infected, barely 1/100 escaped death."
Erin Allmann Updyke	Whoa.

Erin Welsh	The precise cause of death was unclear, still is unclear, but there are some isolated reports of people recovering after being given an enema which suggests along with the list of symptoms that severe dehydration may have played a major role.
Erin Allmann Updyke	Okay, okay, okay.
Erin Welsh	Okay. So now after hearing this description of sweating sickness which I based off of a few contemporary accounts by Thomas Le Forestier and John Keys who lived through the 1485 and 1551 epidemics respectively, I think we can mostly answer my earlier question as to why sweating sickness left such an impression on people at that time, even though epidemics of sweating sickness weren't nearly as widespread as something like the plague. This was a terrifying and rapid disease that would kill you within a few hours.
Erin Allmann Updyke	Everyone's dying from it. I need to know more.
Erin Welsh	Yeah. Okay. Well here we go.
Erin Allmann Updyke	Okay.
Erin Welsh	So what I'm gonna do is I'm gonna talk first a little bit about the characteristics of sweating sickness and then sort of go through each of the epidemics and then I wanna hear from you about the different diseases that you have and we'll try to symptom-match. And then at the same time I have at the end of my notes like an epidemiological breakdown of things like who it affected, where it happened, when it happened, etc.
Erin Allmann Updyke	Yeah.
Erin Welsh	Okay. And the rapid thing, I mean how quickly people died, it doesn't seem to be just the exaggeration or drama of the 1400s and 1500s. Like one of these scholars wrote that, quote: "We saw two priests standing together and speaking together and saw both of them die suddenly. Also in the last day we see the wife of a tailor who suddenly died. Another young man walking by the street fell down suddenly. Immediately some were killed opening their windows, some in playing with children in their street, some in one hour, many in two. It destroyed. As it found them so it took them. Some in sleep, some awake. Some in mirth, some in care. Some fasting and some full. Some busy and some idle."
Erin Allmann Updyke	What? Erin.
Erin Welsh	I know, I know.
Erin Allmann Updyke	And what you're telling me too is like the number one symptom is the fever and sweat. I mean and stench but...
Erin Welsh	Fever, sweat, rapid death. There also seems to be difficulty breathing.
Erin Allmann Updyke	Okay. But how much of that is just because you've been sweating so much and your heart rate is so high that now you're just like tachypneic because your body is on overdrive, which is what it sounds like more than that you're literally having any pulmonary issues.
Erin Welsh	Right. Pulmonary. Right.

Erin Allmann Updyke	There's no cough, there's no sputum, there's no...oh my gosh, Erin.
Erin Welsh	(laughs) I mean yeah, there doesn't seem to be a cough, there was no rash.
Erin Allmann Updyke	There's no rash.
Erin Welsh	Yeah.
Erin Allmann Updyke	What?
Erin Welsh	I know. I know, okay. Okay. The people living in England during the time of the sweat were no stranger to a quick and unexpected death but this was shocking even to them.
Erin Allmann Updyke	Yeah!
Erin Welsh	And another reason that may have stood out was not just how rapidly it seemed to descend on a village or town but also how quickly it left. So within let's say like 5 days, you might see the same number of burials you would normally see in several months. It's just this big blip on the radar. Whereas outbreaks of plague and influenza and smallpox and other infectious diseases would show up in more of like this rolling wave fashion.
Erin Allmann Updyke	Right.
Erin Welsh	A slow build, sustained intensity, and then a gradual decline. And sweating sickness was like a rogue wave just like boom! Right in the middle.
Erin Allmann Updyke	Right. What?!
Erin Welsh	(laughs) This characteristic of sweating sickness is also super useful for present day analysis or investigation into the disease because it allows researchers to identify likely outbreaks of sweating sickness using parish registers which recorded baptisms, marriages, and burials among other things.
Erin Allmann Updyke	Okay.
Erin Welsh	And so even if a parish register didn't know that it was specifically the sweat that was responsible for a burst of death, you can use information from nearby registers to note likely outbreaks and to estimate the impact that an epidemic of sweating sickness had on a particular village or a town and to also study geographical variation in outbreaks. So not only was the sweating sickness deadly and lightning fast, it also appeared to be brand new and unknown outside of England, at least at the time of the 1485 epidemic. And so like we heard in the firsthand account: "A new kind of sickness came through the whole region which was so sore, so painful and sharp, that the like was never heard of to any man's remembrance before that time." (laughs)
Erin Allmann Updyke	I'm really having a hard time with this.

Erin Welsh	I know, I love it. (laughs) And this newness also played into the explanations put forth by scholars who lived during that time. So remember germ theory is hundreds of years away at this point and so superstition or meteorological or celestial explanations really took kind of front and center.
Erin Allmann Updyke	Honestly, I'm not surprised. Like I'm leaning that way right now. (laughs)
Erin Welsh	I know. I know. (laughs) Maybe it was punishment for supporting Henry VII or maybe it was the way that the planets were aligned or maybe it was just bad air.
Erin Allmann Updyke	Bad air.
Erin Welsh	What did seem clear was that there seemed to be no way to predict or control when it emerged and when it disappeared. Which only it did a handful of times, never to be seen again. Or was it?
Erin Allmann Updyke	I don't know, Erin. You tell me.
Erin Welsh	(laughs) Okay so now I'm gonna go through the sweating sickness epidemics briefly, just finish up the timeline and then I wanna hear from you.
Erin Allmann Updyke	Okay.
Erin Welsh	All right so the 1485 epidemic of sweating sickness arrived in mid to late summer and disappeared within a few months and it wasn't until 1508 that the sweat showed up again. And there isn't a whole lot of information about this particular outbreak, maybe because it seemed to be less extensive than the previous one. But one important thing to note is that it began like the previous in summer, so June 1508, and burned out by October that same year.
Erin Allmann Updyke	Okay.
Erin Welsh	And again this epidemic seemed to be restricted to England and I mean just England, not even Wales or Scotland.
Erin Allmann Updyke	What? Okay.
Erin Welsh	Yeah. And next we have 1517. Again beginning near the end of June and stopping by the end of October at which point it was overshadowed by an outbreak of the plague that was apparently much more devastating, which is why we probably don't know a whole lot about that one. And like the previous two epidemics, this one was again constrained to England and primarily in London, although nearby areas were affected. So like Oxford and Cambridge were said to have become ghost towns during this outbreak and 400 students at Oxford reportedly died within a week.
Erin Allmann Updyke	What!
Erin Welsh	It was a lot. That's a lot.
Erin Allmann Updyke	400 students. So were talking young people.
Erin Welsh	Yup, yup.

Erin Allmann Updyke	Okay. That's an important piece of information.
Erin Welsh	It is. And the fourth epidemic, which occurred in 1528, broke with the established pattern of epidemics in that this one also seemed to cross the English channel to continental Europe the following year. And this outbreak also seemed to be particularly devastating, with some reports of up to 40,000 people in London becoming infected although only 2000 dying. And this 1528 epidemic is the one that Henry VIII fled from with many members of his court, although several of them died, some only after like an hour or two of symptoms appearing.
Erin Allmann Updyke	What?
Erin Welsh	And just to further illustrate how quickly this came on and how rapidly devastating it could be, at the Archbishop of Canterbury's house, 18 members of the household died of the sweat in just four hours.
Erin Allmann Updyke	What...
Erin Welsh	(laughs)
Erin Allmann Updyke	I'm losing it, Erin.
Erin Welsh	I know, I know. It's very strange.
Erin Allmann Updyke	18 people died within four... Okay this doesn't even sound like an infectious disease.
Erin Welsh	Well, okay. Interesting that you should say that. Put a pin in it. Okay.
Erin Allmann Updyke	(laughs) Yeah.
Erin Welsh	Also Anne Boleyn became infected but recovered.
Erin Allmann Updyke	Okay. Cause I remember you saying this was in The Tudors and I was like, 'Oh should I watch that season?' But then I didn't cause I didn't want to learn about it but also it was in the first season, wasn't it?
Erin Welsh	Yeah, I didn't manage to watch the entire episode but it's Season 1 Episode 7.
Erin Allmann Updyke	Okay I definitely have seen it but it was long enough ago that I don't remember anything except like a vague, running down the halls being sweaty or something.
Erin Welsh	Yeah, I don't know. I'm not sure how representative it was. I also started reading Wolf Hall which also apparently portrays sweating sickness epidemics cause it takes place during the same time, covers the same people, etc etc. but also that book is a lot bigger than I thought it was, so...
Erin Allmann Updyke	(laughs)

Erin Welsh	Didn't quite make it all the way through. Anyway. And so again with this 1528 epidemic, the disease emerged in June and disappeared in September. But the following year, 1529, is when we see a similar disease appear in continental Europe. Beginning in July in Germany and Austria, and then spreading to the Netherlands, Poland, Prussia, Denmark, Sweden, Norway, Finland, Lithuania, Russia, and elsewhere. So like all over.
Erin Allmann Updyke	Okay.
Erin Welsh	And by September it was gone. And there's been some discussion as to whether or not this disease on continental Europe was the same as the English sweating sickness but it seems like they were because the descriptions of symptoms are similar. And maybe the biggest clue is that it was referred to as the 'English sweat' or 'sudor anglicus' or 'the English bath' or other names that clearly place its origin in England.
Erin Allmann Updyke	Did they talk about how bad they stunk?
Erin Welsh	Yeah. So perfect, thank you for asking that. I have a quote: "In 1529 a terrible disease spread in the lowlands at Cologne, Antwerp, Frankfurt, reaching as far as Strasbourg so that in these places a great many people died and they call this disease the English sweat because it came from England. And whoever was affected by this disease went from life to death in 24 hours. For when one was afflicted with the disease it came with a great poisonous sweating and one sweated to death forthwith so that countless people died of the disease everywhere. Some people sat down to table in good health and were carried away dead."
Erin Allmann Updyke	What? Erin!
Erin Welsh	(laughs) I know. Are you going to devote the rest of your life to study the English sweating sickness?
Erin Allmann Updyke	Yeah that's it, that's my career, okay. Forget family medicine, it's sweating sickness. All the time.
Erin Welsh	I feel like it's inevitable. (laughs) And so after this 1528 and 1529 epidemic which seems to be the only one that spread to continental Europe, the sweating sickness made only one more appearance in 1551, again in England.
Erin Allmann Updyke	And that's a long time later.
Erin Welsh	Yeah, yeah. We'll talk about the intervals. So Keys describes this last epidemic as beginning in April 1551 and spreading over the country over the next few months before dying out in September. London's death toll peaked at over 700 people in a week in the middle of July and some towns reportedly lost half of their population. After 1551, sweating sickness seems to have just like dropped off the face of the earth entirely. Isolated cases of a similar disease may have shown up in parts of Germany, France, Northern Spain, Northern Italy, and Holland over the next couple hundred years but no large epidemics. And these isolated cases aren't often mentioned in histories of sweating sickness. What is commonly mentioned, however, is Picardy sweat, I'm hoping I'm saying that right., another infectious disease of unknown cause that first emerged in 1718 in Northern France and later spread to Germany, Austria, Belgium, Switzerland, and Italy. And the last extensive outbreak of this disease occurred in 1906 in France. So there seems to be two forms of the Picardy sweat. One very mild, resembling nephropathia epidemica.
Erin Allmann Updyke	Is that one of the Hantaviruses?

Erin Welsh	Uh huh.
Erin Allmann Updyke	Okay, yeah.
Erin Welsh	And another more severe version that more closely resembled the sweating sickness but was still much more mild. There were also some fairly substantial differences between the two diseases in terms of their symptoms. So for instance the Picardy sweat was often accompanied by a rash and subsequent peeling of the skin as well as nosebleeds, neither of which seem to be symptoms of sweating sickness.
Erin Allmann Updyke	But is it just cause everyone died so quickly that they didn't show any other symptoms? That's something I'm wondering.
Erin Welsh	I mean, yeah. That's possible. I don't know how quickly the rash came on but definitely the more severe version of the Picardy sweat does seem to be extremely rapid onset.
Erin Allmann Updyke	Okay.
Erin Welsh	But the mortality rate of the Picardy sweat ranged from like 0 to 20%, while the sweating sickness was much, much more fatal. Like estimates put it at 30-50%.
Erin Allmann Updyke	Okay.
Erin Welsh	So the two diseases probably weren't the same but I think that they were probably, or a lot of people think that they were probably linked. Like may have been caused by the same vector or reservoir or may have similar ecological origins, I should say.
Erin Allmann Updyke	Right or like a similar type of pathogen or something like that maybe.
Erin Welsh	Yeah, yeah. So.
Erin Allmann Updyke	I have a lot of ideas, Erin.
Erin Welsh	Yeah. I mean I don't know... So now at this point it's like, is it time to go through what might have caused?
Erin Allmann Updyke	Can we? I'd love to. I really would love to.
Erin Welsh	Okay. So what are the things I even told you to research? Cause I don't remember.
Erin Allmann Updyke	Okay. There's several. It's actually fun cause some of these things we've already covered and some of them we're going to cover. So you told me to research ergot, relapsing fever, hantavirus or a type of hantavirus, and anthrax and then also peripherally influenza. But I feel like we can say it's not influenza.
Erin Welsh	Yeah. And the reason, so I will say that like I told you these before I really started doing extensive research and I pulled those diseases from Wikipedia being like, 'These are what scholars have put forth as possible explanations.'

Erin Allmann Updyke	Right, that's what Wikipedia says. Right. Yeah. So let's go through them. And I have a favorite already.
Erin Welsh	Ooh, what's your favorite?
Erin Allmann Updyke	Well we'll go over it last. Okay let's just take a quick break, I feel like we need to breathe. (laughs)
Erin Welsh	Okay. Yeah, yeah, yeah. For sure. And sweat.
Erin Allmann Updyke	And sweat.
TPWKY	(transition theme)
Erin Allmann Updyke	Okay, yeah. I have a favorite already, Erin, but the thing is it's not perfect. I guess that's the point of a medical mystery is like nothing really fits perfectly.
Erin Welsh	Yeah.
Erin Allmann Updyke	But based on the ones that you told me to look up because Wikipedia said, we can very quickly eliminate several of them and we can talk about why. And then we can go through the one that I think seems like the best option.
Erin Welsh	Okay, perfect.
Erin Allmann Updyke	Okay. So influenza, if you haven't listened to our very first episode of this entire podcast, you can learn all about influenza on that episode, but basically this does not sound anything like influenza. (laughs)
Erin Welsh	It does not. And so that was one of the earliest explanations put forth and I think that it was very popular and retained popularity for a while because the 1918 influenza had a similar pattern in that is attacked who seemed to be like the youngest and healthiest with a male predominance. Yeah.
Erin Allmann Updyke	Right, right. And certainly it's not out of the question that you would have a brand new strain of influenza and it could be much more deadly like the 1918 pandemic. But otherwise, symptoms-wise, this sudden onset of fever and fever being the one and only major symptom, that just doesn't really fit with what we see with influenza even if it's a different strain. Like influenza is usually a slightly more gradual onset, you're definitely gonna have some kind of respiratory symptoms a lot of times because it is a respiratory pathogen, and usually when we see the more severe forms it's because it's causing a viral pneumonia rather than just sweating and then dying.
Erin Welsh	Right.
Erin Allmann Updyke	So I think we can pretty confidently say it's very unlikely that this was an influenza, especially an influenza strain that remained localized to only England and then didn't spread to anywhere else.
Erin Welsh	Right. What does that tell us about transmission route?

Erin Allmann Updyke	Yeah, probably wasn't respiratory is my guess.
Erin Welsh	(laughs)
Erin Allmann Updyke	Okay another one I think we can pretty quickly eliminate is actually gonna be ergot.
Erin Welsh	Yes, for sure.
Erin Allmann Updyke	So ergot we talked a lot about in the dancing plague episode. (laughs) This whole episode is actually just like 'see previous episodes'.
Erin Welsh	I know, I know, I know. (laughs)
Erin Allmann Updyke	But we will go through it. So ergot, a fungus, produces a number of different alkaloids including ergotamine, which if you ingest ergotamine or any of these other alkaloids, that's when you get these types of symptoms. What I like about this as an explanation is that ergot is not an infectious disease, right. It's like you're ingesting this alkaloid produced by this fungus and so the onset can be really rapid and from what you're saying, the onset of this is so rapid that it's hard to believe this is an infectious disease because it's so very rapid like that.
Erin Welsh	Well yes. And it also affected members of a household in clusters.
Erin Allmann Updyke	Okay. Right. So I could see that as well.
Erin Welsh	Right. But there are a lot of things against ergot, too.
Erin Allmann Updyke	Yeah like for example the symptoms are nothing like... (laughs)
Erin Welsh	Correct, so that would be the number one thing.
Erin Allmann Updyke	Yeah so the signs and symptoms of ergot generally have to do with like it causes vasoconstriction. So depending on where that vasoconstriction is, you're either gonna have tissue death and limbs falling off or you have a convulsive form where it's affecting your central nervous system, so you have nausea, vomiting, diarrhea, convulsions, all kinds of weird sensations. But nothing like this super high fever, sweating, that's just not something that you really see. Certainly hallucinations and delirium like you were talking about, but because of the ergotamine not because of the fever and sweat.
Erin Welsh	Yeah. I think maybe not ergot but a foodborne type of thing was also...
Erin Allmann Updyke	Right. Yeah.
Erin Welsh	Like I know botulism was briefly proposed at some point but that again doesn't fit.
Erin Allmann Updyke	It doesn't fit, yeah. Symptoms-wise it doesn't fit. I agree that cluster-wise and household and onset-wise, some kind of preformed toxin or a foodborne something. I could see that fitting with some of the epidemiological characteristics but there aren't a ton of those. I mean there are some that cause fever but really, actually no, there are not a ton that really cause this kind of fever that you would see because fever is indicative of inflammation which is something that we see more with infection rather than... I don't know.

Erin Welsh	Right. Well and I think there's also the matter... I mean I definitely have withheld some key points.
Erin Allmann Updyke	Oh great, thanks a lot, Erin!
Erin Welsh	(laughs) I think that we can back and forth this. So like when we're talking about how sweating sickness seemed to be spread, it doesn't really fit food-borne pathogen. It does seem to have traveled along roads. So like if it took 15 days to travel between one village and another, that is often the interval that was seen, the interval between outbreaks in particular villages or towns. And that bit of information I think is really interesting because it points towards human to human transmission. But the pattern geographically of epidemics is that rural areas seem to be hit hard and cities maybe not as hard as you might expect if it were something like a crowd disease or transmitted person to person. So what it seems to be is that there was another source of infection but that human to human was also possible.
Erin Allmann Updyke	Okay. So another one that you had me research that I don't think that it is, even though i do think there are a number of things that I understand why this is a common proposition, is hantavirus. Ooh, see! Your face tells me that you think hantavirus is the best fit.
Erin Welsh	I do.
Erin Allmann Updyke	Yeah. I mean you're withholding a lot of information so maybe that information is gonna tell me that I agree. But I actually - this is a spoiler - but I think relapsing fever fits really well.
Erin Welsh	Okay, interesting.
Erin Allmann Updyke	And there's a few reasons why I think that could be the case even though there are some symptoms that don't really fit relapsing fever. But okay, so let's go through hantavirus then. Or do you wanna go through anthrax? Cause I don't think it's anthrax.
Erin Welsh	I don't think it's anthrax either.
Erin Allmann Updyke	Okay so do we wanna talk about why or should we just wait until we do anthrax as an episode?
Erin Welsh	I think we should talk about why, just briefly.
Erin Allmann Updyke	Okay. So anthrax is a disease caused by a bacterium, kind of, called Bacillus anthracis. This is a Gram-positive, aerobic, spore-forming bacterium. So that is important because what it means is that when this bacteria senses a change in their environment, such that it becomes unfavorable like a low nutrient environment, they form this spore which is very environmentally hearty, much like clostridium species do like we talked about in botulism. And so it can survive in the soil for years. So anthrax is kind of global in distribution. Like this bacteria lives and this spore can persist in the soil for decades, potentially.
	But what happens is if you get exposed to the spores in a couple of different ways, either through your skin like a break in your skin, or through your gastrointestinal tract, or the worst form is if you inhale the spores. What happens is those spores get engulfed by our macrophages, which are white blood cells, and then within our white blood cells as they travel to our lymph nodes, they can reactivate into the live bacteria and these bacteria produce a number of different exotoxins that cause a lot of problems.

	So I mean, really none of the symptoms of cutaneous - which is skin - or gastrointestinal or inhalational anthrax, none of those symptom-wise really fit with the description of the illness that you gave for sweating sickness. Certainly one thing that does fit is that this is something that, these spores could be transmitted on an animal for example, it's very common for people that work with animals or livestock to become infected either with inhalational or gastrointestinal anthrax. So kind of the travel and that kind of distribution, maybe if you had anthrax in one area and then it moved with livestock or something to another area, maybe you could see that.
	And also inhalational anthrax is very deadly and very rapid. You start with a pretty nonspecific fever, feeling cruddy, having muscle aches. Especially cause we're talking about inhalational here, you usually have a cough, right? This is something that's causing inflammation in your lungs so you might have abdominal pain but also chest pain. And then over a couple of days you get a further fever but also more shortness of breath, a lot of trouble breathing, this occurs over a couple of days. And then at that point, especially if this crosses your blood-brain barrier and causes meningitis, then very rapidly your progress to shock, hypothermia, and death within like a number of hours, like 24 hours or something. But that's after a few days of feeling cruddy and having a fever and that kinda thing. So that doesn't really fit. And then the cutaneous and gastrointestinal-wise absolutely doesn't fit, so.
Erin Welsh	Well and also the fact that anthrax was known and was around, it didn't disappear whereas this really does seem to be this incredibly unique disease that then disappeared.
Erin Allmann Updyke	Yeah. Yeah. That's interesting. But that's why... Okay, I'm gonna make an argument still for relapsing fever.
Erin Welsh	Oh no, that's totally fine. (laughs) I'm curious because this is the thing is that like maybe I feel like I'm leaning more towards hantavirus A) because of the papers I read, but B) because I already know more about hantavirus. I don't know really anything about relapsing fever except its transmission route.
Erin Allmann Updyke	Right. Well and I mean I dove into all of these but I don't think I dove as deeply as I would have if we were doing a full-length episode on it, so I also feel like I don't know everything there is to know about relapsing fever and I definitely feel like I know more about hantavirus. But yeah, I mean, okay. Let's talk about hantavirus.
Erin Welsh	Yeah.
Erin Allmann Updyke	So if you want even more deep dive on hantavirus, it's all the way back in Season 2, we did a whole episode on it. But there's a whole bunch of different hantaviruses. They all are RNA viruses, they're commonly found in rodents and moles and shrews. Erin, hantavirus was the episode when I learned that moles and shrews are not rodents.
Erin Welsh	(laughs) I think I just relearned that when you said that.

Erin Allmann Updyke	(laughs) The most deadly of hantaviruses is the Sin Nombre virus which causes Hantavirus Pulmonary Syndrome, which has the highest case fatality rate of like 40-50%. But there are a number of other hantaviruses that we know of including Seoul virus, Hantaan virus, Puumala virus, and Dobrava virus, which tend to cause a disease that we call Hemorrhagic Fever with Renal Syndrome. So if we're talking about Hantavirus Pulmonary Syndrome, you definitely get fever, you definitely get muscle aches, headache is certainly one of those symptoms, abdominal pain, diarrhea maybe. And importantly you don't have those upper respiratory symptoms, which is interesting because even though this is a pulmonary illness, at the first part of this disease you don't really have any kind of pulmonary, like lung symptoms.
	But this is a longer disease. The first phase usually lasts 3-5 days but even up to two weeks. And then after that first phase where you're just kind of feeling cruddy, then you start to have these heart and lung symptoms and within 24-48 hours of that is when you could die. But even still you have a longer period of feeling not good and having a fever and having all these other symptoms before you die. I don't know, Erin.
Erin Welsh	Okay. I feel like we have pretty successfully ruled out a few of them.
Erin Allmann Updyke	Yes.
Erin Welsh	Okay. And we are now left with what we think and what has been commonly reported as the two leading proposed explanations.
Erin Allmann Updyke	Yeah. Okay.
Erin Welsh	What if you briefly laid out just the very basic characteristics of hantavirus, the Hantavirus Pulmonary Syndrome, and relapsing fever. Just like how they're transmitted, table form type stuff. And then I'll go through the epidemiological characteristics of sweating sickness and we'll kind of talk about each point for each of them.
Erin Allmann Updyke	Okay. That sounds fun.
Erin Welsh	Okay.
Erin Allmann Updyke	Okay so focusing on Hantavirus Pulmonary Syndrome. So Hantavirus Pulmonary Syndrome has a case fatality rate about 30-50%.
Erin Welsh	Sounds familiar.
Erin Allmann Updyke	It does sound familiar. Relapsing fever, first of all importantly there are two different forms of relapsing fever. There is louse-borne relapsing fever and there's tick-borne relapsing fever, and they're very different in terms of their epidemiological characteristics. And I think this sounds much more like louse-borne relapsing fever which is more common in groups, it's more common in epidemics, and has a case fatality rate of between 10-40%.
Erin Welsh	Okay.
Erin Allmann Updyke	Okay? Okay. So hantavirus transmission. Hantavirus is transmitted by aerosolized mouse poop, essentially. It's transmitted by aerosols but not person to person.
Erin Welsh	However there is an asterisk next to that 'not transmitted person to person' because there have been instances reported in Argentina that suggest person to person transmission.

Erin Allmann Updyke	Yes, there is some possibility of at least one specific strain. But most hantaviruses have not ever been shown to be able to be transmitted person to person. Now what about relapsing fever? This is fun. First of all, relapsing fever is caused by Borrelia species. So these are spirochete bacteria not too distantly related to Lyme disease but different species, and there's a number of different species of Borrelia that can cause relapsing fever which I think is important. And while tick-borne relapsing fever is transmitted from the bite of a tick, much like many other tick-borne diseases, louse-borne relapsing fever is transmitted from the hemolymph which is the blood of a louse. That means that if a louse is living on you and biting you and so you're itchy and then you scratch, you like shmoosh that louse and then you scrape it open and you scrape their blood into your skin. That's how you become infected. And I'm pretty sure that there have been some suggestion that there might be, for louse-borne relapsing fever, that there could be person to person transmission based on epidemiological characteristics.
Erin Welsh	Okay, cool. Interesting.
Erin Allmann Updyke	Sorry I got so excited that I couldn't finish that word.
Erin Welsh	(laughs)
Erin Allmann Updyke	Some other characteristics. So, incubation period I think I probably important because like you said, if this was moving kind of like village to village or area to area in about the time it takes for someone to travel, then you're probably not looking at something that has a super long incubation period. So for hantavirus it's actually quite a long incubation period, it's usually like 2-3 weeks incubation period after exposure to symptoms. Relapsing fever, there's a pretty big range in general, it's about 7 days but it can be as low as 4 or as high as like 18.
Erin Welsh	Okay.
Erin Allmann Updyke	And then duration of illness, and this is the part where honestly none of these fit really well. Because with hantavirus, especially Hantavirus Pulmonary Syndrome, you have a first phase of kind of fever, malaise, not feeling great, headache, and that usually lasts 3-5 days but even up to like 12 days where you're just feeling bad. And then when you get to the second phase where you have shock and pulmonary edema, so like fluid in your lungs, that usually happens really quickly within 24-48 hours. And then you might die. But in general, you're feeling cruddy for at least 3-5 days before that.
Erin Welsh	Yeah.
Erin Allmann Updyke	Okay. Now with relapsing fever, I mean you said that sometimes people relapse, Erin.
Erin Welsh	(laughs)
Erin Allmann Updyke	So relapsing fever does start very abruptly with a very abrupt onset of a really, really high fever along with shaking, chills, headache, and delirium.
Erin Welsh	Interesting.
Erin Allmann Updyke	And you often also have very severe joint pain, muscle aches, nausea and vomiting, and extreme weakness, like you can't even get up and walk because you're so weak and you feel extremely lethargic.

Erin Welsh	Oh! Okay.
Erin Allmann Updyke	Like you said, all you wanna do is sleep.
Erin Welsh	Yeah.
Erin Allmann Updyke	And then you can also get like a very profound anorexia, feeling so bad like you just don't want to eat, you might have weight loss. But - and this is where it just falls apart, Erin - the first fever, this really high onset fever, your skin is usually hot and dry.
Erin Welsh	(sighs)
Erin Allmann Updyke	It's like a very classic description, it's a hot and dry, which the reason that this is outlined in all of these clinical descriptions is because a lot of other diseases that cause a fever, especially a relapsing fever like malaria, you usually are sweating quite a lot in association with the fever.
Erin Welsh	Right.
Erin Allmann Updyke	But with this one, your skin is described as hot and dry.
Erin Welsh	Yeah. That does not sound like sweating sickness. (laughs)
Erin Allmann Updyke	(laughs) But it also doesn't, I mean hanta doesn't sound like that either.
Erin Welsh	So I have a question about relapsing fevers.
Erin Allmann Updyke	Okay.
Erin Welsh	How diverse is this group or how many different bacterial species cause relapsing fever and how much variety in symptoms is there among those species?
Erin Allmann Updyke	Very good question. So I saw, and I didn't write down every single species but louse-borne relapsing fever is mostly one species and that's Borrelia recurrentis.
Erin Welsh	Okay.
Erin Allmann Updyke	But there are at least 3 or 4 other species of Borrelia that cause tick-borne relapsing fever and there's a number of different tick species that also can transmit. So hard ticks and soft ticks, which is fun.
Erin Welsh	Okay. It is fun.
Erin Allmann Updyke	Yeah, I know, we never talk about soft ticks. So tick-borne and louse-borne relapsing fever look a little bit different. So the length of illness is different, the mortality rate is different, tick-borne relapsing fever is not as deadly as louse-borne relapsing fever. Louse-borne usually lasts a little bit longer, like 5.5 days of symptoms rather than 3 days, and then the interval between relapses is also longer for louse-borne relapsing fever and you generally have fewer relapses, you have like maybe one, maybe two relapses. But with tick-borne relapsing fever you often have like 3 or more relapses of symptoms.

Erin Welsh	Okay.
Erin Allmann Updyke	Okay. Now you do foten have a rash, it's not uncommon, but - and this is why I mentioned that in the French epidemic, where people did have a rash - the rash can look a lot of different ways, like there's a lot of different kind of presentations of a rash but it usually happens after the first set of symptoms while you're otherwise asymptomatic. So if people survived long enough to get to that point, maybe they would've had a rash.
Erin Welsh	Okay. Okay.
Erin Allmann Updyke	But this is getting off of the epi characteristics a little bit but I wanna get into the pathophysiology of how relapsing fever works because this is part of what makes me think that maybe it was like a certain subtype of Borrelia that caused these particular epidemics. Because what I think is really interesting is like, what causes this relapsing disease, right?
Erin Welsh	Yeah.
Erin Allmann Updyke	The reason that you have a relapsing fever and symptoms in tick-borne or louse-borne relapsing fever is that the bacteria that cause this vary their surface antigens.
Erin Welsh	Ooh.
Erin Allmann Updyke	So they change out those proteins that are on their surface that our body is responding to in order to kill them and they do so during cycles of disease, they change them so well that... So you get infected, right? The bacteria enter your bloodstream either by you scratching them in or by a tick spitting them into your bloodstream, they replicate, our body reacts which is why you have all these symptoms, fever, feeling crappy. And then our immune system tries to kill them off but the bacteria go, 'Okay, well you figured out this antigen, so we'll just change our outer proteins.' And then our body's like, 'Oh! We did it! These bacteria are gone.' And they don't recognize these anymore so then they can start to replicate all over again, you have a huge amount of bacteria in your blood again, and it's like a whole new infection.
Erin Welsh	That is unbelievably cool.
Erin Allmann Updyke	Right?
Erin Welsh	I am very... That is fascinating.
Erin Allmann Updyke	It is so fascinating.
Erin Welsh	Wow.
Erin Allmann Updyke	And so I wonder could it be that there was a particular antigenic subtype that was present in England at this time that happened to cause a slightly different presentation of this disease? I don't know. I just don't know, Erin.
Erin Welsh	I know, I know, I know. Okay so I have a few more questions about the epi characteristics of relapsing fever and hantavirus or Hantavirus Pulmonary Syndrome. So first of all, is there any general pattern in who, whether it's age group or whatever that is most susceptible or seems to have the most outcomes with either of these?

Erin Allmann Updyke	I don't think so, at least nothing that stands out in the research that I did. It's not like young people only die form this or old people only die from this.
Erin Welsh	Okay. And then what about like any seasonal or temporal aspect?
Erin Allmann Updyke	So with tick-borne relapsing fever, it certainly is something that's going to be more common when people are outside and when ticks are outside which is going to be in the summer months. Louse-borne tends to be a more epidemic disease, it doesn't tend to be sporadic the way that tick-borne relapsing fever does. But these are human body lice and so there doesn't tend to be a specific seasonal variation necessarily because human body lice live on us all of the time. With hantavirus I think I remember it being something where it just depend son when you're in contact with mice.
Erin Welsh	Well for Hantavirus Pulmonary Syndrome it was summer.
Erin Allmann Updyke	Summer, that makes sense because that's when you're in contact with mice.
Erin Welsh	Okay, one final question.
Erin Allmann Updyke	Okay.
Erin Welsh	Immunity. Do you gain immunity after infection?
Erin Allmann Updyke	Ooh!
Erin Welsh	And are there asymptomatic infections?
Erin Allmann Updyke	Really good question, Erin. I'm gonna guess with relapsing fever no, you don't gain immunity because already they're changing up their antigen so much that that's why you're having relapses to begin with. For hantavirus there is a vaccine that's available at least in some parts of the world, so I would think that there's immunity for at least some portion of time not sure how long that immunity would last.
Erin Welsh	Okay. Okay. So I feel like now that we know a bit more about the two leading potential causes, let's go over the epi characteristics of sweating sickness.
Erin Allmann Updyke	Okay.
Erin Welsh	Okay, let's take a quick break first.
TPWKY	(transition theme)
Erin Welsh	All right so I've grouped the epi characteristics into five basic sections.
Erin Allmann Updyke	Okay.
Erin Welsh	So, you know, what was sweating sickness? So like symptoms, case fatality rate, etc. Number two, how it seemed to spread. Number three, where it occurred. Number 4, who is affected. And number 5, when it happened.

Erin Allmann Updyke	Okay.
Erin Welsh	Okay so starting with what it was. It was rapid onset fatal disease characterized by excessive foul-smelling sweating, fever, body aches and pains, stomach pains, headache and delirium, heart palpitations, and breathing that was shallow and labored. Death often occurred within the first few hours of the first symptoms showing up and case fatality rates vary among epidemics and affected regions. So like sometimes it seemed to be really low, sometimes it was really high. But overall it does seem that it was a very high mortality rate and most estimates put it at like 30-50%.
Erin Allmann Updyke	Okay.
Erin Welsh	The only epidemic where mortality could actually be somewhat reliably calculated was the 1551 one, that's because by that point but not for the previous epidemics, parish registers actually began to be in use. And so we get an estimate from some guy's amazing analysis of parish registers that around 15,000 deaths were due to sweating sickness in the 1551 epidemic in England.
Erin Allmann Updyke	Okay. Okay.
Erin Welsh	But let's compare that to 30,000 deaths from the plague in 1563, in a plague epidemic year, and 180,000 deaths from influenza epidemics in 1557, 1558, and 1559. So although it was deadly, it didn't cause nearly the same loss of life as some of these other diseases.
Erin Allmann Updyke	Right. Yeah.
Erin Welsh	Okay. All right number two: how it spread. And we talked a little bit about this but this is very challenging to nail down. So basically it does seem that human to human transmission was possible but that may not be the only route through which a pathogen was transmitted.
Erin Allmann Updyke	See this is why I lean louse-borne because lice move from person to person and thereby move the disease.
Erin Welsh	Right.
Erin Allmann Updyke	So it's not directly person to person but it is person to person in that sense, right. It doesn't need an animal reservoir, it's a human disease.
Erin Welsh	It doesn't, right. But I think what makes me lean away from louse are a number of things, like one is the seasonality which was very pronounced, like it was summer months.
Erin Allmann Updyke	That's true.
Erin Welsh	It emerged suddenly, it disappeared suddenly. So that to me implies some sort of like ecological characteristic of this disease. And the second thing is, and I didn't really go that into it yet and I will right now, I'll skip ahead to number four, is who it affected. So who sweating sickness mostly affected.
Erin Allmann Updyke	Okay.

Erin Welsh	And so like I said, it seemed to primarily impact England only, even respecting political boundaries. And I don't really know what to make of that, like maybe contemporary writers were just being a bit dramatic in wanting to play up the role of England as a victim. Or maybe it was real, in which case I wonder if there was some sort of cultural or behavioral difference that prevented its spread. So like maybe one type of grain was more commonly grown and stored in England thus providing more food for rodents or maybe it was stored in a particular way or certain place that would have changed how rodents and humans or arthropod vectors and humans interacted with one another. And while some of the names for the disease highlight how sweating sickness seemed to be an English thing - so like Sudor Anglicus, the English Sweat - others seemed to draw attention to the type or class of person that was commonly affected. So stoop-gallant, stoop-knave, and Know Thy Master, which basically seemed to affect wealthy, well-to-do, healthy young men primarily. So between the ages of 15 and 40.
Erin Allmann Updyke	And that would lean kind of away from a louse-borne just because lice usually it's in more crowded conditions, more lower socioeconomic status when you don't have access to be able to clean yourself and get rid of lice.
Erin Welsh	Right. And I talked a bit about the urban to rural difference as well where it did seem to hit hard rural areas but it also was in urban areas as well. I don't know. But not to the same degree as it was maybe in rural areas. Okay and so then the final thing is when it happened, and by this I mean two things. So one is the very sporadic nature of the epidemics. So the years separating them are 23, 9, 11, and again 23.
Erin Allmann Updyke	That's weird.
Erin Welsh	It's very strange. You could say, so some people suggest that it's an 11 year or 10 year gap and that there are just two missing epidemics, whether they're missing to our knowledge or missing to our knowledge or missing to whether they actually happened or not, it's not known. But there's also this very strong seasonal pattern to infection.
Erin Allmann Updyke	Right, yeah.
Erin Welsh	And if we're going along with the hantavirus thing, some current or modern scholars suggest that there were wet years that preceded these epidemics or very wet summers, which is what happened in the 1993 Four Corners Sin Nombre outbreak that led to a much higher-
Erin Allmann Updyke	Mouse population.
Erin Welsh	Right, exactly. But I think that like, I don't know. If we're talking about louse-borne relapsing fever and we're talking about Hantavirus Pulmonary Syndrome, those are two very different routes of transmission.
Erin Allmann Updyke	Yes.
Erin Welsh	And so I think that's one and also exposure pattern.
Erin Allmann Updyke	Yes.
Erin Welsh	So in putting together these pieces, you have the strong seasonality which puts it more in the column of Hantavirus Pulmonary Syndrome, which is when you would have very distinct times of year during which you would be in contact with rodents.

Erin Allmann Updyke	And certain years where you're certainly going to have a higher risk of transmission because of ecological factors, definitely.
Erin Welsh	Right, exactly. And you also have this urban to rural variation in infection that does not seem to be mediated by other routes of transmission, I guess.
Erin Allmann Updyke	Yeah.
Erin Welsh	The symptoms are a whole other thing.
Erin Allmann Updyke	Yeah. And that's where for me it falls apart. Like for me the symptoms really do not sound like-
Erin Welsh	Like HPS?
Erin Allmann Updyke	I mean...
Erin Welsh	Well, but here's that thing that... I mean obviously I have a little pet theory.
Erin Allmann Updyke	Yeah.
Erin Welsh	It's not my theory at all, I found it in papers. But before the 1993 Four Corners outbreak of Sin Nombre virus, we didn't know about Hantavirus Pulmonary Syndrome.
Erin Allmann Updyke	Right.
Erin Welsh	We didn't know that that's how it can manifest in your body. And then in the descriptions of sweating sickness they talk about how you were well at lunch or you sat down to dinner and then you were carried off.
Erin Allmann Updyke	Right. And I do wonder cause you also have to take into account that this was like the late 1400s and early 1500s, their definition of someone who is well might not be the same as our definition of someone who's well, so they might actually be kind of miserable but like that's normal for them. (laughs)
Erin Welsh	Exactly. Yes. Right, right.
Erin Allmann Updyke	So then maybe it does seem as though you were fine and now you're dead, when really they've been feeling cruddy for a couple of days but they just thought that they didn't get enough sleep or they're always kinda feeling cruddy. Whatever it is. So in that case you do have very rapid death once you hit that particular phase of Hantavirus Pulmonary Syndrome.
Erin Welsh	Yep.
Erin Allmann Updyke	And even with the other hantaviruses that are a lot less deadly that now circulate in Europe and other parts of the world, when you do die from those, you die pretty rapidly, right?
Erin Welsh	Right.
Erin Allmann Updyke	It's either like you recover over a very long period of time or you die pretty dang quick. So yeah I guess that does... There are things that fit, it's just...

Erin Welsh	I don't know. I mean like I said at the beginning of this, this is like an episode of Unsolved Mysteries, I hope you didn't go into it expecting a solid answer.
Erin Allmann Updyke	It is! And it's also so bizarre that it would be only in England even if it was a hantavirus because whatever mice populations or whatever that would be high in England, like why wouldn't they also be high in Scotland and Wales? I don't think that the ecology is, I don't know the ecology all that well but I would assume that there are a lot of similar rodent species in those areas.
Erin Welsh	Right. Well yeah, definitely. And I think people have looked in the writings of the time and found no evidence or nothing to suggest that there were massive either population booms or massive die-offs of rodents, like anything unusual about rodent populations. But that's where I was wondering whether grain was stored in a different way or in a different location in the house in England.
Erin Allmann Updyke	Uh huh, yeah.
Erin Welsh	I mean there's also like... There could be a wet summer in certain parts of England and it could've missed Wales or Scotland entirely. And also how much of that is just a little bit of like, 'Oh the English are being punished for our support of Henry VII' or something.
Erin Allmann Updyke	Yeah.
Erin Welsh	So going over it, what do we know? What can we say about this?
Erin Allmann Updyke	Yeah.
Erin Welsh	Do we think it was an infectious, contagious, transmissible pathogen?
Erin Allmann Updyke	Maybe?
Erin Welsh	I think yes based on how it seemed to travel along roads or along common routes.
Erin Allmann Updyke	So it seems more like an infectious and like there's some component of person to person spread.
Erin Welsh	There's some component of person to person but it's not driven by that and there's a strong ecological component as well.
Erin Allmann Updyke	Right! Which is so weird.
Erin Welsh	Yeah. So that points towards either arthropod or rodent, the two most likely.
Erin Allmann Updyke	Right. Ugh, my god Erin.
Erin Welsh	In all likelihood this is something that we don't have anymore, like why did it disappear? No idea.

Erin Allmann Updyke	Which is even more fascinating. Like if this was a virus, whether a hantavirus or some other virus or a bacteria that caused these specific outbreaks across an entire country and then disappeared, where did it go?
Erin Welsh	Yeah. Well unless it didn't, unless it really was the Picardy sweat.
Erin Allmann Updyke	But what's that?
Erin Welsh	They don't know.
Erin Allmann Updyke	Right! So then where did it go? It caused on outbreak?
Erin Welsh	No it caused outbreaks starting from 1718 all the way through 1906 was the last outbreak. The last diagnosed case was in 1918.
Erin Allmann Updyke	That's even weirder, Erin.
Erin Welsh	What is the case though is that most people seem to believe that Picardy sweat and sweating sickness were different diseases.
Erin Allmann Updyke	Okay.
Erin Welsh	Like sweating sickness didn't turn into Picardy sweat, but that they were probably caused by the same thing whether that was a rodent reservoir or some sort of arthropod-transmitted virus or like relapsing fever where there is no rodent reservoir.
Erin Allmann Updyke	Fascinating.
Erin Welsh	Yeah.
Erin Allmann Updyke	And there's still no consensus, is that correct?
Erin Welsh	There's still no consensus. If you look at the evolution of thought as to what caused sweating sickness, it started out influenza and relapsing fever and then it kind of morphed into some sort of arbovirus, so virus transmitted by an arthropod, but that was kind of discarded even by the authors themselves cause they're like, we don't see any bites or rashes. That would have been noted, they feel like it would have been noted. And then following the 1993 Four Corners Sin Nombre outbreak that is when Hantavirus Pulmonary Syndrome became the leading cause.
Erin Allmann Updyke	Interesting.
Erin Welsh	Yeah.
Erin Allmann Updyke	Even though there's still no pulmonary symptoms.
Erin Welsh	I mean I guess what they view as pulmonary symptoms are the shallow breathing, difficulty shallow breathing, and the heaviness on the chest.
Erin Allmann Updyke	Interesting.

Erin Welsh	Yeah. But I think that it's interesting to think about why do we care about this still? Like why are we still talking about it?
Erin Allmann Updyke	Well I feel like, do we have to explain the answer to that question when we're living through a pandemic of a brand new virus. (laughs)
Erin Welsh	Yeah exactly, exactly. But I think this is such a bizarre and terrifying and fascinating illness, sweating sickness. And these diseases that we think could be related to it that exist today, they're still around. Does that mean that there's the potential for something like this to happen again? Who knows?
Erin Allmann Updyke	Absolutely.
Erin Welsh	I mean yeah, I think it all boils down to the fact that understanding the nature and the cause of epidemics, whether they're present or especially those in the past, can help us just prevent future ones from happening, so.
Erin Allmann Updyke	Right. And trying to understand too like I think we went through the ecological characteristics of this disease as well as the temporal characteristics and the epidemiological. Like understanding all these different facets can really help you to narrow in on what you think might be the cause.
Erin Welsh	Right. You can't just compare symptoms.
Erin Allmann Updyke	Right.
Erin Welsh	You have to consider the context.
Erin Allmann Updyke	Yeah.
Erin Welsh	So yeah, I mean, I don't know. Sweating sickness. It was a deadly, mysterious, probably infectious, contagious disease with an ecological component.
Erin Allmann Updyke	Fascinating, Erin. I learned so much. I mean I also learned nothing but I learned so much. (laughs)
Erin Welsh	(laughs) I know, I know. It's interesting. If anyone has any other thoughts on what it could have been or wants to vote for their favorite.
Erin Allmann Updyke	Yeah I really, really felt like I wanted for it to be relapsing fever but I agree ecologically it just doesn't quite fit. And even symptoms-wise, it doesn't quite fit, you know? None of these symptoms-wise really quite fit perfectly.
Erin Welsh	Mm-hmm.
Erin Allmann Updyke	Cause obviously if they did, then we'd have an answer. But some kind of hantavirus... I mean I could see it. I understand that argument.
Erin Welsh	Yeah. We may never know.

Erin Allmann Updyke	We may never know but I think I can live with that.
Erin Welsh	Yeah.
Erin Allmann Updyke	Yeah.
Erin Welsh	Okay well, there you have it everyone.
Erin Allmann Updyke	There you go. (laughs)
Erin Welsh	We could both be okay with it being hantavirus.
Erin Allmann Updyke	Some kind.
Erin Welsh	Well.
Erin Allmann Updyke	All right then. I bet you have a ton of sources. (laughs)
Erin Welsh	I do have a lot of sources. (laughs) Okay so I'll call out a few of them. One by Eric Bridson from 2001 and that was the first one to propose Hantavirus Pulmonary Syndrome as the cause of the English Sweat. Then there was another incredible paper from 1997 by Alan Dyer called 'The English Sweating Sickness of 1551: An Epidemic Anatomized'. And then there were some other pretty good ones. So I read one by Flood from 2003, 'Safer on the Battlefield than in the City', and by Taviner et al from 1998, 'The English Sweating Sickness: A Viral Pulmonary Disease'.
Erin Allmann Updyke	Awesome. If you'd like to do a deeper dive on any of the illnesses that we talked about on this podcast I will have sources from previous episodes as well as a few more for diseases that we haven't touched on yet. And you can find the sources from every single one of our episodes on thispodcastwillkillyou.com under the EPISODES tab.
Erin Welsh	That's right. Well, 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 of which we are proud to be a part.
Erin Welsh	Yes, thank you. And thank you to you, listeners, for listening. We hope that you don't hate this unsatisfying episode. (laughs)
Erin Allmann Updyke	I hope that you had fun, I had fun.
Erin Welsh	Yeah, I had a lot of fun. And if you have any ideas as to what it could be...
Erin Allmann Updyke	Yeah, let us know. Or if you have other medical mysteries you'd like for us to not be able to solve...
Erin Welsh	Ooh, yes.
Erin Allmann Updyke	(laughs)
Erin Welsh	Okay, well. Until next time, wash your hands.

Erin Allmann Updyke	You filthy animals.