TPWKY	This is Exactly Right.
Erin Allmann Updyke	"There are tents outside our hospitals. Every time I see them, I stop, startled. Their drab and dirty flats seem so out of place against the grand facades of world class hospitals. Desperate times, desperate measures. The last time I worked in a tent was West Africa in 2014 during the Ebola outbreak. In those same tents I saw too much pain, loneliness and death. People dying alone. I never thought I'd have to see or experience that ever again. I never wanted to, once was painful enough. There's no way to describe what we're seeing. Our new reality is unreal. The people and places we've known so long and so well have been transformed. Our ERs, our ICUs, everything looks, sounds, and feels different. Just one week and it's a whole different world. The patients I normally see are nowhere to be found. Every single patient I see has COVID-19. Every single patient.
	Working in the ER means walking through a corridor of coughing, each a slightly different pitch and frequency but all caused by the same exact thing. It's not just the volume of patients that's hitting us, it's the severity. Respiratory arrest, respiratory arrest, respiratory arrest. Each takes 6-8 professionals, nurses, respiratory techs, ER docs, anesthesiologists. Each takes an hour or more back to back, all shift long. And it's not just the unrelenting severity. We're being asked to do things we've never done before. Run a code as your goggles fog and you can't decipher the vital signs on the monitor, try to predict which COVID patient will crash if you send them home and which won't, talk to palliative care, talk to family members, long discussions about likely outcomes, listen as family members sob. They can't be here when they ask to withdraw care. We FaceTime so they can say goodbye. We stop the drips, turn off the ventilator, and wait. Your hands upon theirs, you think of their family at home, sobbing. Someone starts saying a prayer, you can't help but cry. This isn't what we do. You standby, you wait. This isn't what we do. You standby, you wait. Time of death 7:19pm.
	I know what my colleagues are feeling. I see it on their faces. We are exhausted. Hours in goggles, gowns, and masks feel like days. But we are only at the beginning. The mental exhaustion is only starting to set in. The things we do, the things we see, this isn't what we do. I worry about my colleagues. Everyday someone calls me crying. How long will they hold? How long will I hold? I remember how this anxiety gnawed at me everyday in Guinea during Ebola. Would today be the day I got infected? Won't know for a week. The days add up, the worry adds up.
	I've never seen my colleagues so afraid, so unsettled. But I've also never seen them all work so well together. I've never seen us more unified, more focused, more sincere. Yes, we worry about PPE. Yes, we worry about lack of medications. Yes, we worry about one another. But I've never seen so much sense of purpose, so much honor to do this job. We didn't sign up for this but we will show up for this every day. I think of this when I finally get home, clothes in a bag, hot shower, look in the mirror, indentations of goggles still deep in my face, blisters on the bridge of my nose. How long will we hold?"
TPWKY	(This Podcast Will Kill You intro theme)
Erin Allmann Updyke	Jesus.
Erin Welsh	Wow, yeah.
Erin Allmann Updyke	So that was 'How Long Will We Doctors Last?' By Craig Spencer, published in the Washington Post on April 3 of this year. Craig Spencer is the Director of Global Health and Emergency Medicine at New York-Presbyterian/Columbia University Medical Center. He also, if you want to read this and more from him, he has another really nice thread on his Twitter account describing what day to day life has been like for an ER doctor during this pandemic.

Erin Welsh	Yeah. It's incredible and so difficult to imagine.
Erin Allmann Updyke	Yeah. It's horrific, Erin.
Erin Welsh	Yeah. Yep. Well, 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	Yeah.
Erin Welsh	So this episode is a continuation of our Anatomy of a Pandemic series which is our series on COVID-19. In each of these episodes, we address different aspects of the pandemic with the help of experts in the field because hey, we're not experts.
Erin Allmann Updyke	We're not experts!
Erin Welsh	Our first six episodes cover things from the virus' biology to clinical disease, from control efforts to mental health coping strategies.
Erin Allmann Updyke	As you might be able to guess from the title of this episode, we're going to talk today about how spillover events happen and why. We'll talk about what we currently know about where SARS-CoV-2 came from and how we can use this pandemic to be better prepared to stop another. We were fortunate enough to speak with Dr. Jonna Mazet, an incredible disease ecologist whose specialty lies in identifying emerging pathogens of public health concern.
Erin Welsh	But before we get to that, we do have a couple pieces of business to go over. First, let's talk firsthand accounts.
Erin Allmann Updyke	Yes!
Erin Welsh	So we are working on more episodes of this series covering things like how the pandemic has impacted the economy or education or marginalized populations as well as update episodes on topics we've already covered. And for these update episodes, we want to hear from you. We wanna hear how this pandemic has affected your life, your job, your family, your friends, etc. If you are willing to share your story with us for inclusion as a possible firsthand account in one of these episodes, please go to our website thispodcastwillkillyou.com and click on COVID-19 FIRSTHAND at the top of the page. And then that'll take you to a form that you can fill out and then we can get back to you with more details.
Erin Allmann Updyke	Real quick, another thing we wanted to say about firsthand accounts, it's kind of like what everyone says in their Twitter bio, retweets are not endorsements. There are so many people that are having so many different experiences and different perspectives during this pandemic. One of our goals with presenting these firsthand accounts is to show just how huge the diversity is in how this pandemic is affecting people. So we hope that by hearing these stories it's a way for us all to increase our understanding and empathy during these horrible, stressful times. We recognize that no single experience is going to be universal. So yeah.
Erin Welsh	Yeah. Exactly. Okay, another piece of business. Alcohol-free episodes!

Erin Allmann Updyke	Woo woo!
Erin Welsh	So a little bit ago we posted on our social media about alcohol-free episodes now being available. And so let me tell you what these are. So some educators reached out to us to ask whether there were versions of episodes that didn't contain the quarantini talk and if there weren't, whether they could actually edit those portions out themselves for use in the classroom. And so instead of having a bunch of people doing the same obnoxious work over and over again, editing out the quarantini talk, we thought you know what, it's going to be easier to have them all in one place, available for whoever wants to use it for whatever reason. And so what we did is we edited out all the quarantini talks from our past episodes and put these quote "alcohol-free" episodes in a playlist on a page on our website called Alcohol-Free Episodes which you can find under the EPISODES tab.
Erin Allmann Updyke	Our regular episodes, like the one you're currently listening to even though this is a little irregular for a regular episode, that you get from your normal podcast sources, we will still have quarantinis and placeboritas. So you don't need to worry about losing those. These edited versions of our episodes is just an attempt for us to be more inclusive and accessible because we recognize that a lot of teachers could get in trouble for sharing a podcast with their students that has a good amount of alcohol talk. And also maybe people who are in recovery or just don't want to listen to, might find it difficult to listen to. This isn't about censorship or being sheltered or anything like that and there's definitely no need for some of the harsh words that we've seen on social media about this.
Erin Welsh	(laughs) No, please, guys.
Erin Allmann Updyke	Be kind.
Erin Welsh	Let's just be kind especially during this time, we all need it, right?
Erin Allmann Updyke	Yeah, we do. We do.
Erin Welsh	And as we said, you do not need to worry that we're gonna stop doing quarantini recipes cause we're going to every single episode and we're about to in this one. So nothing is changing about the podcast, we're just providing an additional resource for people who want to use it. And frankly we're flattered that some educators wanna use our podcast in their classroom. Like that's thrilling!
Erin Allmann Updyke	Yes, it really is.
Erin Welsh	So if you do not wish to hear quarantini talk, you can find the edited quarantini-versions under the EPISODES tab of our website. And there's also a disclaimer there at the top of that page that says that there might still be some references to alcohol throughout the episodes that we just haven't found and so if you find one of those and you want us to remove it, please send us the timestamp and the context of the mention. And if you do wish to hear quarantini talk, just keep listening.
Erin Allmann Updyke	Because it's quarantini time!
Erin Welsh	It's quarantini time!
Erin Allmann Updyke	What are we drinking this time?

Erin Welsh	This time we are drinking Quarantini 7.
Erin Allmann Updyke	Such a classic name.
Erin Welsh	It is. One for the ages. Quarantini 7 has rum, orange liqueur, lemon juice, and cinnamon simple syrup. Demerara simple syrup also works pretty well too.
Erin Allmann Updyke	Yeah. Fabulous. As always we'll post the recipe for this quarantini and the nonalcoholic placeborita on all of our social media pages and on our website. (laughs) Wanted to say that very clearly.
Erin Welsh	(laughs) Glad you enunciated that one that time. Okay, now that that's out of the way, let's go over a few things before we dive into the interview with Dr. Mazet. First of all, masks.
Erin Allmann Updyke	Oh gosh.
Erin Welsh	If you've been following the news at all, you may have seen that the CDC has now recommended people wear masks under certain circumstances. So let's talk about that decision. In an earlier episode of this series, we went into masks a little bit and we had repeated the CDC's previous recommendations for masks and why those recommendations were made.
	A quick recap: so previously wearing a mask was not advised for those who were not sick and there were a number of reasons stated for this. One, that may be the most important one, masks are in very short supply and should be reserved for healthcare workers who are battling with this virus on a daily basis. Number two, most masks, especially those that are the most effective, require proper fitting in order to work. Number three, masks can lead to you touching your face more to adjust them or pull them down or to the side and if that mask has viral particles on it, that's an easy way to become infected yourself. Or if you're already infected, you can easily contaminate your hands and then other surfaces that you touch after adjusting your mask. And number four, it can in some cases maybe give people a false sense of security and lead to less hand washing or physical distancing.
Erin Allmann Updyke	So as of April 3rd of this year, the CDC is now recommending that people wear masks in certain situations. So kind of more broadly is now their recommendation. So the question is why is that? What has changed? Quite honestly, great question. According to the CDC website, it's because we know that a good chunk of people, we don't know exactly how many, but a good chunk of people can be infected with the virus, not show any symptoms but still be able to transmit the virus, asymptomatic transmission. Anyone who's listened to this podcast has known that for quite some time. Right? We've talked about that.
Erin Welsh	Yeah.
Erin Allmann Updyke	There's also evidence that people can transmit the virus before they start showing symptoms even if they do eventually become symptomatic and of course if you have a mild infection, you can still transmit the virus.
Erin Welsh	So none of this is new, brand new information discovered in the past week.
Erin Allmann Updyke	No, not at all.

Erin Welsh	So these things, asymptomatic transmission, infectious before showing symptoms, we've known about these things or at least highly suspected them for a while. And 'we' meaning like the broader scientific community, not just Erin and Erin. (laughs)
Erin Allmann Updyke	Erin and Erin know all the deets. No we don't!
Erin Welsh	(laughs) We're not experts, so we need to say it again. But why has this recommendation changed now? And we don't know exactly because we're not in the room where these policy changes are being discussed and where these decisions are made.
Erin Allmann Updyke	If anyone who's in those rooms wants to come on the podcast and talk to us about it, we would love to hear from you because this is also a very interesting... Like these are difficult things, coming up with these policies and recommendations. So it would be fascinating to get to talk to somebody who actually does that. We don't do that. That's not our job.
Erin Welsh	No, no we don't do that.
Erin Allmann Updyke	Nope. So let's' talk about what these new recommendations are exactly. On the CDC website as of April 4th, this is what it says: "The CDC recommends wearing cloth face coverings in public settings where other social distancing measures are difficult to maintain, for example grocery stores, pharmacies, especially in areas of significant community-based transmission. It is critical to emphasize that maintaining six feet social distancing remains important to slowing the spread of the virus. CDC is additionally advising the use of simple cloth face coverings to slow the spread of the virus and help people who may have the virus and do not know it from transmitting it to others. The cloth face coverings recommended are not surgical masks or N95 respirators. Those are critical supplies that must continue to be reserved for healthcare workers and other medical first responders as recommended by current CDC guidance." End quote.
	So they're basically saying wear a mask if you absolutely have to go out to help prevent transmitting this virus to other people. But masks are no replacement for staying at home. Also washing your hands and never touching your mask with dirty hands. Does that make sense?
Erin Welsh	And also washing your hands after touching your mask.
Erin Allmann Updyke	Yes. Just washing your hands any time your hands go anywhere near your face, for sure.
Erin Welsh	(laughs)
Erin Allmann Updyke	Okay.
Erin Welsh	But this is an ongoing thing and so there's gonna be more information and we'd love to do a deeper dive into it with someone who is working firsthand on this.
Erin Allmann Updyke	Knows more than we do. Yeah.
Erin Welsh	Yeah. Yeah. All right are we ready to talk about spillover events?
Erin Allmann Updyke	Ugh, I sure am.

Erin Welsh	(laughs) Okay. I think the listeners of this podcast maybe don't need a whole lot of setup for this particular topic because if you've listened to us before, you've heard us talk about spillover events and what they are and disease ecology and what that is. So let's get right to it.
Erin Allmann Updyke	Right after this short break.
TPWKY	(transition theme)
Jonna Mazet	I'm Jonna Mazet, I'm a professor of epidemiology and disease ecology at the University of California Davis in the veterinary school and the University of California San Francisco in the medical school, and I'm the executive director of the UC Davis One Health Institute. There I use One Health in everything I do and that our big team does. And what that means is we're looking at interconnectedness among human, animal, plant, and environmental health and bringing together multidisciplinary teams to work on those really complex problems like this COVID-19 situation.
	I've been the Principal Investigator for the PREDICT Project that's been working in 35 countries all over the world to identify dangerous potentially pathogenic viruses that could spillover from animals into people and build the systems that are needed to be able to respond quickly and be ready for just the scenario that we have. And I've been doing that for ten years, leading that team. And we've detected and discovered 160 novel coronaviruses through PREDICT when just a handful were known. And as importantly, we learned about their hosts and the interfaces and more importantly, I think, we trained about 6800 people in this approach so that the world can be better. I just wish more of them were here.
	Now I'm the director of the One Health workforce next generation which is the logical follow on from PREDICT, meaning that we want this trained workforce to be expanded in the most likely hotspots for spillover so that academics all over the world can be training people to be the workforce, hopefully to prevent anything like this ever happening again. And finally I'm also on the board of the directors of the new Global Virome Project which really grew out of the PREDICT Project, PREDICT provided the proof of concept that we don't need to wait for the next epidemic or tragically pandemic, we can get in front of the curve, in front of the wave, we can understand viruses and know where they are sort of lurking and available to spillover into people. We can know what they are, we can know how to detect them, we can know how to prevent our own risky behaviors that put us in harm's way.
Erin Welsh	Awesome, so many different things that your working on.
Jonna Mazet	Yeah, sorry. (laughs)
Erin Welsh	No, don't apologize. It's amazing. Wow, that's incredible. And it sounds like some of these things sound really fascinating. And you mentioned PREDICT and you mentioned doing surveillance for emerging pathogens, and so can you take us through sort of a step by step of how that's done? Cause there's like logistics involved with working across international borders and then there's the people in the field doing the sampling to then how do you group all of this information together and then disperse it to the people that need it. How does that work?
Jonna Mazet	Yeah there's a lot of minutiae and not sexy work involved there and a lot of it also qualifies for being highlighted on dirty jobs, we swab a lot of butts.
Erin Welsh	(laughs)

Jonna Mazet

And throats and noses. So I can take you through it but the way that we begin is we begin with math. We begin with looking at the best science and pulling it together mathematically to identify hotspots that might be the places most likely for spillover to occur. And once we identify those countries, if they overlap with our funders for the PREDICT Project, USAID or U.S. Agency for International Development where they want and can work, then we can approach the governments in those countries and ask if they'd like to participate. And the PREDICT Project was the first time I'd ever started and international effort where every single government that we talked to said, 'Absolutely yes, this is critically important, we wanna get in front of this.' It's not been, 'We don't have the resources to do this but we'd love to partner.'

So that was really refreshing so we immediately had a collaborate process. But in those initial government meetings, we brought together the ministries of environment, health, and agriculture where the veterinary sector usually lives so that we could apply the One Health approach in those countries to really identify on the ground the best hotspots to target our work and then really get out there and collaboratively look at it from the animal side, the environmental side, as well as the human side.

So we brought those teams together, I can talk to you more if you like about how that went. But once we found those hotspots to investigate, then we needed to train folks to be really safe - biosafety and biosecurity being number one, even including how to pack and ship samples. And before anybody could go out in the field they needed to have ethical clearances for working with people and animals so that we knew that we could conduct the work in the most appropriate way. Then you have to get with the communities because most communities, if you show up in white suits, even my house, if someone showed up in my front yard in a white suit trying to sample the birds in my yard or in some of the communities where we work, their food in the market, that would be horrifying to anyone. So we work with the communities and talk to them about what we're gonna do, have them help us target exactly what kind of high risk interfaces they're seeing in their areas. And they become the really great informational partner and operational partners for us.

Finally then you can do the more sexy stuff, the stuff people like to film on the Discovery Channel of sampling the bats, sampling the nonhuman primates, and getting sort of down into the mud, getting with the rodents and the shrews in people's houses and trying to find the virus safely. Those samples then have to go to the laboratory and we had to strengthen the capabilities for molecular virology in almost every place we worked because we're working in the least resource countries of the world most times. And most of them did not have the technology, they had the will to do this work, especially for wildlife, they didn't have places to do the wildlife virology so we had to help build that up. And our teams at Davis and Columbia University were amazing in coming up with a low cost platform to really discover many, many, you know, more than 1000 viruses.

So once you get that done and you get in the lab and you safely do that, then you have to figure out what you do with that information, and there's two important things. One, it needs to get back to those governments and all of those across the platforms, those different ministries so that they can take action or at least have that information in their repository so they know what to look for when something strange happens. And you have to get that information back into the hands of people like me, people like our team at Equal Health Alliance, the mathematical modeling to really help inform on what should be done from a public health perspective globally and to figure out how to better target surveillance going forward. So it's kind of circular and we do it better iteratively over time.

Erin Welsh

Gotcha. Yeah it sounds like a huge effort in just coordinating everyone's movements and activities and permits and all of that, so.

Jonna Mazet

Yeah, yeah.

Erin Welsh

It's amazing. And so you know, hypothetically let's say that you do or clearly you have found pathogens that have been potential concern for public health safety. And so what happens when you do identify, let's say, a potential spillover event? What happens in that case?

Jonna Mazet

Well I mean there are multiple scenarios. In the PREDICT Project we assisted governments with 45, now 46 unfortunately counting this one, outbreak investigations. Many of which stayed really small, I think a testament to being prepared. Some of which like this one, the project was actually finished ion the countries where we were working at that time were reactivated now thankfully, but those teams reactivated and helped identify the first cases of SARS-CoV-2 coming into their countries using the PREDICT platform as well.

But you know when we do have a very concerning finding, we again have to be very careful. We go to the ministries and these viruses, we consider them sovereign, they're property of their sovereign nation so we always bring it back to the governments first and talk to them about how to release the information to the public. Certainly we write publications and we've gotten into a very interesting ethical dilemma sometimes about whether or not we should talk to the communities at risk or get our paper out. I think most all of us on the team feel like it's the right thing to do to put information out even if it's not published. Now that's becoming more commonplace with pre-prints and with this current again COVID-19 situation, we're seeing that becoming more the norm which I think is fantastic. Public health should be first and foremost on all of our minds, and so that's a positive change that's coming out of this horrible tragedy and I think there will be others.

But yeah, we inform the ministry, I can give you an example. We identified a novel Ebola virus when we were working in Sierra Leone and we found it in bats that were living in people's homes. There aren't that many Ebola viruses in the world so we were immediately concerned about that and we took that to the government and we worked with them to develop an outreach platform, even developed an illustrated guided book that could go out with the narrator's picture book to all of the communities where we were working to start to give them the information but also the tools and the skills to be able to protect themselves in the communities. And then press releases and papers and all of those other things come as well. But first and foremost, it's about letting the governments know so that they can prepare their plan and then working with the communities so they can protect themselves.

Erin Welsh

Gotcha, that makes sense, yeah. So you talked about identifying hotspots where emerging infectious diseases or spillover events are more likely to occur. Can you talk about how you decide what a hotspot is and sort of what makes a hotspot a hotspot, basically?

Jonna Mazet

Okay. Yeah so hotspots for us involve a map with colors and of course the hotter the spot, the redder the place on the map. But what are the underpinnings of that map? So we've done a lot research throughout, well many of us before PREDICT started but throughout the decade of PREDICT to really figure that out and improve those models is kind of what I was saying about bringing that data back into the models. And the things that make a hotspot a hotspot so far are places where there's wildlife, so biodiversity is critical, places where people are interacting with that wildlife, and so we call those high risk interfaces. So we identify those high risk interfaces. Those often come together where human population growth is high, biodiversity is high, and landscape change is high or evolving.

So in the more pristine areas we often have a little bit lower risk, in the more urban areas we have high risk for amplification and spread but a little bit lower risk for spillover. It's kind of those intermediate areas where things are changing, you're chopping down forests to make farmland, those kinds of areas where we really see the systems of the animals and the people being stressed and the ecosystems being stressed and that makes for a perfect recipe for spillover.

Erin Welsh

Yeah, that makes sense. So on the podcast we've talked a lot about spillover events in general, but could you kind of give us like a step by step and maybe whether there are any patterns that we can see in all spillover events?

Jonna Mazet

Sure. Well I'm sure your listeners are quite better versed now about the human food value chain including all the way from hunting or farming food, especially wildlife or species that aren't used to being farmed or coming into often contact with humans or throughout evolutionary history haven't been living in close contact with humans. So all the way through that wildlife human food value chain we have concerns and certainly we've been raising the flag about our concerns, especially at the market level where you have a lot of wildlife species mixing together that don't normally live together. So again, really big ecosystem disturbance even if the ecosystem is the market because you're housing these animals together. And then all the way through to restaurants. Restaurants that keep live animals, restaurants that buy the animals at those markets. So that's one that people are now aware of that we've been concerned about, warning about, conservation organizations also been warning about for along time.

Other ones are really things that people necessarily aren't thinking about here. There's a huge bat guano industry all the way from going into caves and collecting guano from natural caves, just the humans in there digging is a big ecosystem disturbance. Or setting up actual attractants for bats to collect their guano so that they preferentially roost in palm fronds right at the farm, then you can take that guano and put it right onto the fields for fertilizer. So these are really other important interfaces.

And then the ones that just take us into the wilds. For example, we need elements and minerals for our cellphones to make them faster, thinner, sexier, better and we often need those minerals from rare places for human populations to go, like deep into caves. So all of these things are interfaces that I think you can think of, but they do all have something in common and that is that people are sort of treading heavily into systems or effectively changing the evolutionary patterns that have been at work for hundreds of years. So when we disrupt those patterns we put ourselves at risk, both because we may be out of our element but most especially because we're putting pressure on the systems including the wildlife in those systems. So we may expose ourselves to things that we're susceptible to because we're evolutionarily naïve.

Erin Welsh

Absolutely. And so in talking about land use change and that interface or that barrier between humans and wildlife seems to have kind of decreased, well the barrier has decreased, the land use change has increased over the past say 100, 200 years. And so do we see a corresponding increase in spillover events?

Jonna Mazet

Unfortunately we certainly have. Our projections and those of other great scientists show that we can expect about three recognized emerging infectious diseases each year and I think that our projections will be updated to even show more. Our PREDICT data is showing that spillovers are happening actually quite frequently, even of things as scary as Ebola viruses and that they don't always, in fact don't often take off and cause a recognized outbreak. They might only make one person sick and then for whatever reason that person doesn't infect someone else. Again, as we look at how humans, animals, and the environment interact, sometimes all of the perfect scenarios come together for tragedy and sometimes they don't and just one person gets sick and no physician anywhere would pick that up and think of testing for something new. In that scenario the person either gets better or they unfortunately don't and it ends.

So those spillovers are happening a lot. I think if you look throughout history, initially there wasn't great evidence of germ theory or people didn't believe in it so we don't have a lot of data for hundreds of years ago, and then those pathogens that were noticed and picked up were the ones that we were sharing with domestic animals, which make total sense because we were living in close contact with them, especially the ones that we eat. So we were sharing pathogens with them and we recognize that and we now documented that, we know how to control that. Over time I think we got a little complacent and especially as the human population has grown, you know, 8 billion people on the earth, we're living in more frequent contact with wildlife, pushing out into wild lands and we need to figure it out.

Erin Welsh

Mm-hmm. Yeah. When you think about it that way too, it's hard to know how many close calls we've had in terms of pandemics, how many just was a dead end host kind of a situation. And so going now specifically into SARS-CoV-2 which is of course as you know the virus that causes COVID-19, what do we know at this point as to how it spilled over into humans, what those steps were?

Jonna Mazet

We don't know much at all. Well first of all, my soapbox, if we had been doing this work more broadly earlier and people were beyond sort of the same people that all collaborate, if we had been paying more attention we would have been able to know a lot more. But unfortunately this kind of work will probably not be done or known until after the pandemic at least begins to wane because right now the best minds to do this work have to be focused on the human to human spread. We have to get that under control.

We do believe with quite a bit of confidence that the virus is bat origin and that the evolutionary host is bats. Whether or not it spilled over into an intermediate host is a good question but it didn't need to. We know from our other work and receptor binding work that these SARS-related and SARS-2-related viruses can have quite broad host plasticity or host range and they can infect numerous species. So there's a lot of talk about what that species might have been and it could have been anything that people were exposing themselves to in markets or other things. Or it could have been a bat flying through. So it will take some time to figure that out.

Erin Welsh

When we do, which I assume hopefully we will get at least clearer picture of how that spillover event occurred, how can we use that information in the future? What does that tell us?

Jonna Mazet	So always in retrospect we can learn more about how to control our risk. That said, I wanna live in a world where we're not doing it retrospectively. I think we can learn more now and we were learning again as I mentioned with the PREDICT Project, we knew that these markets where animals were sort of housed and really high density kind of crushed together, stacked on top of each other, and multiple species were mixing that might have been occurring in the market that at least amplified if not started this pandemic. We know that's dangerous, we knew it before, hopefully we will see solid policy change. There's some great movement towards that and some concerning events, reopening markets and things that point to us really having a hard time changing our behavior. Humans are the issue here. We have to get more comfortable with change and that's evolutionary to us, we're not comfortable with that. So that's gonna be tough.
	So we can learn from this one. We can also, because we have lots of samples and lots of people interested we can learn as we're responding to this one about our transmission risk and those intermediate hosts, we just have to do the work. And there's so much more attention now, I think the time is here. We can have a lot of positivity and hope that this horrible, horrible tragedy will help us to do things differently to keep anything like this from happening again. But also to allow us to strengthen our governmental and public health systems so that we're much more nimble and ready and able to respond to anything that comes our way.
Erin Welsh	Mm-hmm. Yeah. So going back again quickly just to spillover events in general, can you talk about what it means for a pathogen to jump species? And also I feel like I hear mostly or read mostly or for some reason just associate mostly viruses as jumping species more than bacteria. Is that a known characteristic or is it just that we hear more about the viruses?
Jonna Mazet	Well, Erin, I mean I think the reason you're hearing about it now is because we're paying attention to viruses. Frankly, I would say other than a few really important viruses like influenza and HIV, we haven't been - in our medical history - been very much attention to viruses. Frankly we know a lot, lot more about bacteria because we've been paying attention to them, they're easier to work with without molecular tools. And now we have the tools so we have no excuses, we need to do this for viruses and know as much about them as we've known about bacteria.
Erin Welsh	Mm-hmm. Gotcha. So I wanna talk now a bit about what happens when prevention, so identifying these pathogens before they spillover or right at a spillover event, when that has to shift to control efforts. So what are the first steps taken for disease ecologists that are studying this outbreak in particular and how is the One Health approach being used to study and slow down the current pandemic?
Jonna Mazet	Well we have to get together and make sure that we're again working in that sort of One Health approach where we're collaboratively bringing the disciplines together. Everybody has their area of expertise and can work on their own specific part but we need to communicate and collaborate to really get a handle on things. So in really good One Health responses we see the governments and entities, regulatory entities that are in charge pulling together those platforms for communication, collaboration and assignments of everybody's different role and then coming back together.

In Uganda for example, they have a zoonotic disease task force that over the years of the PREDICT Project we saw it going from just being sort of ad hoc and stood up often way too late when an outbreak started to being a constant permanent committee that was ready and available and would be activated within hours of a first case being identified. And you could see that the environmental team would go out and start sampling in the environment, understanding the environmental exposures, figuring out how to clean those up and protect people. You saw the animal side trying to find the host, making sure additional spillovers don't happen or things don't get amplified in animal hosts while the really important work for human to human spread, contact tracing, control, go into place. Unfortunately at least here in our country that didn't happen this time. And I'm disappointed about that but the only thing we can do now is say we have the opportunity to fix that for the future.

Erin Welsh

Mm-hmm. Yeah, absolutely. I wanted to talk a bit about conservation and how wildlife conservation fits into this and what role we see wildlife conservation playing in spillover events or preventing them and then also maybe a little bit of the conflict in terms of how wildlife conservation is sort of a public greater good thing when people are struggling to feed their families. I don't know if you wanted to chat a little bit about that.

Jonna Mazet

Absolutely. So especially in this one I think there's a moment here that we shouldn't lose from a wildlife conservation perspective. People are aware that wildlife in markets now presents a risk and it's really the heavily trafficked wildlife that presents the biggest challenge from a conservation perspective. And even for the most heavily trafficked wildlife, pangolins, we're seeing that they're likely susceptible hosts or at least could be infected with closely related if not this SARS-2 coronavirus.

So first and foremost, wildlife that is moving around the planet, sometimes legally, sometimes not legally into our value chains for medicines, foods, and things. Those are targets of surveillance and control and for wildlife that's trafficked or hunted, captured, transferred illegally, we can really do a greater good for the wildlife while also doing an amazing risk reduction effort for humans. So I think that the time is now to look at that and frankly a lot of that trafficked wildlife is moved by the same bad actors that move drugs and traffic humans and we wanna see that stopped. Certainly there are places where we look at the trade-offs of protein availability and nutrition and what's available to people, so certainly we can think about better ways to get protein into diets than eating wildlife.

But really, frankly, in my last decade of work in going to these markets, most of the wildlife is more expensive, we have papers on this, most of the wildlife was more expensive than chickens and even pork which is sometimes a very highly valued meat. And it's really tradition and sort of you know, everybody at Thanksgiving has the thing they like the best. Some people wanna make sure there's turkey or macaroni and cheese and families all over the world have those preferences and traditional dishes that make events special. And that is a lot of what we see in the legal wildlife trade. And so again it's human behavior and what we'll tolerate and what we'll change to protect ourselves as well as the planet.

Erin Welsh

Mm-hmm. Absolutely. It's hard because I think this is again where something like a One Health approach or a more interdisciplinary approach is really crucial in trying to get messages not only from the people studying these pathogens to the people who may be exposed to these pathogens but also vice versa. What are the things that they're concerned about, what are the trade-offs that they view, and how do we come to a compromise while also making everyone healthy?

Jonna Mazet

Yeah, absolutely.

Erin Welsh	So so far in this pandemic, what do you think we have learned from a One Health or maybe a disease ecology perspective that you think could help us prepare for or hopefully stop the next one?
Jonna Mazet	Well certainly we need to be ready earlier. So what we did with the PREDICT Project provided a proof of concept that we need to go even further and we need to have a One Health approach to be able to prepare. That's why I joined the Global Virome Project and we really want to understand the hosts, the interfaces, the geographical locations, not just identify the viruses early but understand what will make them a jumper and how to target therapeutics and diagnostics. And that takes more than just finding the virus once.
	Really we've been working on risk ranking for all of the new viruses that we've found and others have found and a tool that we call 'Spillover' that will help us rank those viruses. We've used experts from around the world, the best in the field, to help us rank about 40 different factors epidemiologically, ecologically, virologically, to help us collect that information and rank new viruses as they're found. The key thing to that is having enough detections to understand if they're single host viruses or if they're easily moving between species and if they're easily moving between species, that certainly moves them way up high on our risk ranking.
Erin Welsh	How do you determine whether something easily moves between species? Is that something like that's the genomic question or is it an experimental question?
Jonna Mazet	We can do it multiple ways. So certainly we can do it genomically looking at both the viruses ability to bind to receptors and then the host's receptors' ability to receive that virus, that's happening with coronaviruses, we've been doing that for quite a few years and working with some of the best folks out there like at North Carolina University to do that work. But you can also do it in a low tech way and frankly if you go out and sample the wildlife and you find the viruses, then they're getting into those wildlife. So you don't necessarily for every single virus need to do heavy duty laboratory investigations because that's very expensive and time consuming. You can start by identifying those viruses and if you're doing heavy sampling, you can say, 'Okay this one is only ever being found in this one species, it's much less likely to jump. Let's look at its spike protein and in the host the ACE2 receptors to see what makes that one different than all of these coronaviruses that seem to be able to jump and we find in dozens of hosts.'
Erin Welsh	Mm-hmm. You know I think the PREDICT Project with its One Health approach is such a perfect example of how you can have expertise in one field and bring so many different people together with all so many different expertises together to still work on one common goal. And so you mentioned mathematicians, field ecologists, veterinarians, physicians. What are some other examples of people... Cause I know that people, after this, are going to want to get involved and maybe this is something that speaks to them. So what can they do?
Jonna Mazet	Yeah. I mean, a big one that we need more of, we have some great social scientists working with us both in the behavior realm and in economics on the PREDICT Project and the Global Virome Project. Those areas of expertise are underrepresented in health work and frankly because they're underrepresented in health work and academia, we undertrained people to help us with this and we're going to feel that especially from the behavior change perspective. We really need those medical and cultural anthropologists that are willing and able to innovate in behavior change if we're gonna get in front of these things.
Erin Welsh	Mm-hmm. Awesome. So what do you think are some of the biggest barriers or challenges in identifying these spillover events in the future? And maybe even though we've learned so much from this, what do you think in the future is going to make it more difficult to prevent something like this from happening again?

Jonna Mazet	Well for me the future is bright and I have a lot of hope that this tragedy will allow us to not have to live with the barriers anymore. I think the barriers have always been there and we can break them down now. The barriers are really human nature barriers, we deal with what we were worried about because it just happened instead of looking forward. It's hard to prioritize resources to things that only might happen instead of definitely will happen and when the resources are limited, of course we're gonna take care of what's affecting our population right now. But in some of the better resource countries like our own, we need to contribute to and take care of what we know will come even if we don't know when.
	So I think those barriers are lowered right now, we have to take advantage of that lowering to really stop chasing the last epidemic and start preparing for the next one. And we can prepare sort of agnostically to the pathogen to be ready to bring in the right people so if the next one happens to be a paramyxovirus like measles, in that family, we can have all the contingency plans and bring in the best labs that work on those everyday for that emergency early phase response so that while our government gets ready and makes its test kits and everything, we aren't just waiting, we're testing and we're using that very willing and able workforce that can be pre approved on a contingency basis. So I really think those barriers are down right now but we need to take advantage of this opportunity that's presented itself out of chaos and tragedy.
TPWKY	(transition theme)
Erin Welsh	That was awesome, thank you so much Dr. Mazet. I just had the greatest time talking with you.
Erin Allmann Updyke	Ugh. I'm just so jealous, Erin.
Erin Welsh	(laughs)
Erin Allmann Updyke	I'm at home with a baby currently who doesn't like to nap for long enough for me to get to do these interviews. (laughs)
Erin Welsh	Listen, your presence was missed and...
Erin Allmann Updyke	Yep. Some day I'd like to meet you, Dr. Mazet. Anyways. What did we learn from that interview?
Erin Welsh	We learned a lot of things. A lot of things. Let's talk about the five just as we have for other episodes in the series.
Erin Allmann Updyke	Okay.
Erin Welsh	So the first thing that we learned isn't that new and we've said it before, but I think it bears repeating. Spillover events have been on the rise for a very long time and there is no slowing down in sight. Researchers estimate that we'll see three recognized emerging infectious diseases every year. Three! Those are just the ones that we recognize. And so that means that there are a good deal of spillover events or emerging infectious diseases that we may not even realize are there simply because the person got better or they died and no one else got infected and we didn't know what to look for or even that we should be looking for something. So the more we look, the more likely we are to catch something early and stop a potential pandemic in its tracks.
Erin Allmann Updyke	Dang. Three a year.

Erin Welsh	Three a year!
Erin Allmann Updyke	My gracious. All right, number two. There is a usual sequence of events that emerging infectious disease researchers follow when they collect and present their data. Normally it goes like this: collect data, present the data to governments of the countries where you're working, and then begin the lengthy process of publishing the data in peer reviewed articles. And ethical dilemma can arise about whether the data you've collected should be shared with the communities at risk before being published. And the reason for that dilemma is not because you're worried about being scooped but because the peer review process is an important way of double checking your work with people who don't have any horse in the race. By and large though, there seems to be consensus that getting that information to the communities at risk as soon as possible is the right thing to do even if the data aren't published yet. And this is something that we've seen a lot in this current pandemic and will hopefully cause us to reexamine the way we get public health information out there in the future.
Erin Welsh	Number three. We know how spillover events happen and we can estimate where they're most likely to occur. Spillover events are caused by humans invading wild spaces and wild animal habitats, changing the natural environment. When people do this we stress the systems and the wildlife and that leads to us exposing ourselves to things to which we are immunologically naïve. Something we've never, our bodies have never seen before. And so the places that tend to be hotspots for spillover events are high in biodiversity and have increasing or evolving landscape change. And this is because in those places, the barriers between humans and wildlife are lowered. And the wildlife trade in particular poses a pretty huge threat not only to the conservation of some of the most trafficked animals, but also to public health because that's where a lot of these spillover events happen. And conservation efforts would go a long way to reducing the likelihood of spillover events but policies also need to be sensitive and keep in mind cultural traditions and the basic needs of people living in these hotspots.
Erin Allmann Updyke	Number four. How many times can we say this? We need to stop chasing the last pandemic and spend more resources on stopping the next one. What what!
Erin Welsh	(laughs)
Erin Allmann Updyke	By doing that we can enable an entire willing and skilled workforce that can give us a leg up on preventing another devastating pandemic. We've said before that when these emerging infections occur, we're not starting from scratch. But let's make sure we can do all we can to start as far away from scratch as possible. Invest in global health!
Erin Welsh	Yeah. Okay, number five. We gotta work together. We gotta work together! So working together, this is what the One Health approach is all about. And so by recognizing that the health of humans, animals, plants, and the environment is interconnected, it makes it so that a lot of disciplines have to work together to understand the drivers of disease. And people who work in One Health have done a great job of collaborating across disciplines that are very different but there is also a need for more social scientists in healthcare and especially health research fields. Because we can do all of this super cool ecology or microbiology or mapping research but if we want this research to make an impact on people, we need to communicate these things to communities and get them involved.
Erin Allmann Updyke	Yes! Absolutely.
Erin Welsh	(laughs) Okay.

Erin Allmann Updyke	What a fun episode.
Erin Welsh	It was so great. I mean honestly I was very nervous, I felt like completely starstruck and it was really fun to talk with her, so. And also thank you so much to Brooke for putting us in touch with Dr. Mazet. It was very appreciated.
Erin Allmann Updyke	Fantastic guest to have. And also a huge thank you to my very good friend Duyen Spigelman for all of your help with our firsthand account form. Reminder: if you'd like to share your firsthand account with us, please go to our website thispodcastwillkillyou.com and click on COVID FIRSTHAND.
Erin Welsh	Let's do sources real quick.
Erin Allmann Updyke	Yeah, let's.
Erin Welsh	Okay. Once again that firsthand account was by Dr. Craig Spencer and the article appeared in the Washington Post. We will also post a link to the new recommendations on the CDC website regarding the use of cloth face coverings.
Erin Allmann Updyke	Excellent. Thank you to Bloodmobile for providing the music for this and all of our episodes.
Erin Welsh	Did you know that you can find Bloodmobile's music if you click on our website and then you click on MUSIC, you can find it? You can indeed.
Erin Allmann Updyke	You sure can, you sure can. Mm-hmm. (laughs)
Erin Welsh	And thank you to you listeners for listening. We know that these are very trying times and so-
Erin Allmann Updyke	We hope that you find, I don't know, those of you that find comfort in more information which is obviously the kind of people that we are. Hopefully you're getting something out of these episodes and we hope you're staying safe and well, mentally and physically.
Erin Welsh	Yeah, we do. And if there's an aspect of this pandemic that you want us to cover in more depth or more detail, we're open to hearing suggestions.
Erin Allmann Updyke	Mm-hmm. Yeah.
Erin Welsh	Well, until next time, wash your hands.
Erin Allmann Updyke	You filthy animals!