

Virology with Dr. Shannon Bennett + various Ologists

Ologies Podcast

March 10, 2020

Oh heeeyy, just a quick preamble, a little update. Today is March 18th. This was recorded just about a week ago, not that long ago at all, but already a lot of updates. And I just want to let you know that I reached out to Dr. Shannon Bennett and asked if she had anything else she wanted to let us know, just as a quick update on this, and she said:

Daily, new confirmed cases are growing in number exponentially here in the U.S. and that is in light of one of the lowest per-capita testing rates worldwide by country. That's 26 tests per million people as of March 10th. That means that even though we all recognize that confirmed cases are just the tip of the iceberg of actual infections in the U.S., our iceberg is particularly submerged. In short, it's time to take social distancing seriously and flatten the curve!

This episode will tell you what you need to know about COVID-19, how it spreads, how it affects the human body, and why it's so important right now to isolate. So if you are isolating, social distancing, staying in, staying out of the bars; we can do this, y'all. I myself haven't left the house since Thursday. It's very cozy. Thanks for listening to this. Thanks for staying informed. And here is the broadcast that came out on March 10th. Stay safe. Wash your hands.

Oh heeyyy, it's your friend who washes her hands roughly 5x more often than she did last week, Alie Ward, back with a *spesh ep* of Ologies. This episode is coming out March 10th, and it was not even conceived of until a few days ago. But guess what - we need it, I wanted it, we made it. So pass it on to anyone who needs a distillation of what the hell is going on, and how much we should be freaking out. It's fascinating, it's informative, and I'm *so* glad these ologists were available.

But first, kind of a secret up top. I mentioned last year, as a secret at the end of an episode, that I was shooting a new show for Netflix. And y'all, it finally comes out! This week on March 13th - this Friday - it's called *100 Humans*, and it's bananas. We got 100 people who represent the demographics of the United States, and alongside social psychologists and statisticians we ran them through experiments to see if people are more biased than they are; and if having fun makes you more productive; and if the placebo effect works in New Age spa treatments, and what age group could build furniture the fastest. It's wild! It's out March 13th on Netflix, please do watch it, tweet about it. The hashtag is #100Humans.

Okay, also thank you to everyone who has ever contributed to [Patreon.com/Ologies](https://www.patreon.com/Ologies) and made this show possible. Thanks everyone who's out there wearing *Ologies* merch, and for everyone who boosts the show and keeps it up among the science giants just by rating it, and making sure you're subscribed, and texting links to your friends like a virus, and of course those of you who review it for me to creep and weep - such as this week's from Booboorocksout who says:

Dear Dad Ward, I'm writing because I have some rather big news I wanted to share with you... I GOT INTO GRAD SCHOOL! Sorry to shout at you, but I'm just so very excited! Listening to your wild and wacky podcast inspired me to finally, finally pursue my dream of a PhD. So thanks for that and all the hard work you do to show us that smart people are really just

people like the rest of us: awkward, gross, funny, suffering from imposter syndrome, and all the rest.

Booboorocksout: hell yes to a botany-related episode one day. Go get 'em! Also, listener Kjdemorest, I'm happy to have put a scatological smile on your face.

Okay, virology. We're in it. Let's get into it. I had *planned* to interview the Director of Science at the California Academy of Sciences - this petite, brunette, badass Dr. Shannon Bennett - for a Culicidology episode about muhskeeters and 'skeeter diseases, and malaria, and Dengue fever, and Zika. And I arrived with your Patreon questions in hand, and as her wonderful assistant Andrew was walking me down the hallway (hey Andrew!) he mentioned that Dr. Bennett had just given a talk to all the staff members of the Cal Academy of Sciences about COVID-19, [*record scratch*] as she is a virologist and is *very* up on the topic, and the research, and the outreach.

"Hot damn!" I said. Let's change this entire thing up! We're doing Virology, which comes from the Latin *virus*, which means 'poisonous substance', which comes from the word for a sap of plants, or a slimy liquid - a *potent* juice... which is, after all, what is dripping from our face openings, threatening to kill friend and foe alike. And we're all pretty scared and confused. Now, because this is a really huge and important topic I figured let's make this, kind of, a bit of a salad with more than one Ologist. Let's make it a spesh ep. Let's get a little crazy!

I also reached out to previous guests, including Disasterologist Dr. Samantha Montano. I sprinkled in some wisdom from Disinfectiologist and bleach chemist, Dr. Evan Rumberger, and also touched base with beloved Chiropterologist Dr. Merlin Tuttle about pointing our unwebbed fingers accusationally toward the bat caves. But the backbone of this special episode is Dr. Shannon Bennett, who sat down for a full-length chat about her work and this new, novel virus. She's knowledgeable and passionate and addresses not only the genetics of the virus, but the symptoms, infection rate, prevention, testing, how we should handle the fear and the seeming chaos of a pandemic, and what these virus population curves mean.

If you're freaked out, that's okay, but you will leave this episode feeling armed and empowered, I promise. So, wash your hands, calm your nerves, and feed your brains with this bonanza of corona, with *four* ologists folks! A disaster handler, a hygiene scientist, a bat man, and of course Chief of Science at the California Academy of Sciences, virologist Dr. Shannon Bennett.

[Intro Music]

Aside: Okay, I handed Dr. Bennett a mic, and instantly apologized that she had to touch something I touched, and we were off! [*small car horns honking: be-beep! Be-beep!*]

Alie Ward: I'm gonna give you this... I'm so sorry that I have to hand you it.

Dr. Shannon Bennett: Don't worry, it's okay. [*Alie laughs nervously*] We'll just wash later. We're impermeable, right? It's only if we take this and touch our eyes, nose and mouth before washing. So, we're all set.

Alie: That's a good point, I gotta stop touching my face!

Dr. B: On average we touch our faces 15 times an hour. 90 times a day we touch our face. We don't even know it!

Alie: [*groans*] Are you serious!

Dr. B: Yep, and I think it's part of our grooming heritage, you know, as primates we groom, and we're always grooming, and we just don't even know it.

Alie: And we can't touch other people's faces, right? [*giggling*]

Dr. B: Well that... socially we *usually* don't do that either. [*laughs*]

Alie: Okay, good to know. And you are a molecular epidemiologist, a virologist... You've got a lot of ologies under your belt! Microbiology too?

Dr. B: I call myself a microbiologist because I study viruses in the context of the rest of the microbial world they live in. So, virologist *and* microbiologist - why not? - and molecular epidemiologist.

Alie: And you've got a busy week. You've had a busy couple of weeks, haven't you?

Dr. B: It's been very exciting.

Alie: Ooohhhh my goodness! You've spent a lot of your time looking at mosquitoes, and malaria, and Dengue fever, and you yourself, I understand, have not just been a doctor, but also a patient in this, right?

Dr. B: Yes. I think you really have to know your study organisms intimately, [*Alie laughs nervously*] so what better way to do that than to be a host yourself? It was not done on purpose, though. Part of the experience that led to my origin story as an ologist.

Alie: When did you start looking at things under microscopes? When did you start wondering about how things jump from animals to humans? When did it all happen?

Dr. B: Right. So, I liked biology, I liked being outdoors but 'outdoors' and 'biology' - that's a huge scope of things you could focus on. I had no focus until very late in my undergraduate program.

I had an opportunity to go to West Africa as a volunteer for the summer, and I worked with communities to talk about primary health care challenges, but using theater. I was *really* interested in theater as a teaching tool. In the daytime I taught grade five math and in the evenings I taught a theater program.

Aside: Y'all, this ologist's journey started because she was a *theater nerd!* Oohh, my heart!

Dr. B: Like every good citizen I went to my public health professional and got all the vaccines and anti-malarial medicines that I needed. And six weeks later I head to Africa, and within two weeks I caught malaria. [*Alie groans*] And everybody said, "This malaria's resistant to all those anti-malarias you Westerners are prescribing!"

This mosquito borne parasite... It's not a virus. Malaria is caused by a parasite, a eukaryote related to us at the cellular level. It had evolved resistance and continues to evolve resistance rapidly. So that was my first lesson: things change! So I was wrestling with malaria and the fever-chill cycle that is a hallmark of that pathogen and I picked up amoebic dysentery.

Alie: Ooohh man!

Dr. B: Yeah. So, amoebic dysentery is also caused by a eukaryotic single-celled animal: *entamoeba histolytica*. So, *histolytica* comes from the fact that it melts your tissues in your colon and intestines and it creates bloody ulcers. So, the first hallmark is you and you see bloody stool. I saw a lot of blood in my stool, I got a little concerned... Sure enough, I had amoebic dysentery, while still wrestling with fever-chills from malaria.

Alie: Oh my god!

Dr. B: So they shipped me off to a leper colony. Leprosy is caused by a bacterium.

Alie: So they literally sent you to a leper colony?!

Dr. B: Only place to get nursing care!

Alie: I thought that was perhaps an exaggeration, but no...

Dr. B: It's true. I was hospitalized in a leper colony. They had nursing care there. And leprosy, even though there's a lot of social stigma around leprosy, it's actually not very infectious. It's transmitted through families so it can *look* infectious - just like coronavirus right now is being transmitted through families. But it turns out that leprosy is a combination of long, intimate exposure *and* genetic predisposition, so it's not very infectious. It was perfectly fine for me to be hospitalized in a leper colony. It was a very casual, pleasant experience, but I saw lots of evidence of people with leprosy or recovering from leprosy and it typically causes your lower extremities to atrophy and drop off eventually. So that was interesting... [clip from 1987's *Planes, Trains & Automobiles*, John Candy as Del Griffith: "That's the understatement of the year!"]

I had *also* picked up a skin infection while I was there. We have microbes on our skin - a whole complement of them - and one of them is a staphylococcus bacterium. Basically, I had an open wound, I think it was a mosquito bite I had scratched or maybe a cut on my leg, and it got infected with *staph*, and I was getting spikey fevers from *staph*... striations down my leg... and it was all very exciting.

So I had a triple whammy of two eukaryotes and a bacterium, and then I was surrounded by a bacterial infection. I had a lot of time to languish in the hospital, and think about my plight, and understand that things were out there all the time. They're either in human communities or non-human communities. They're evolving, they're changing. I came out of it with a new, deep appreciation and admiration for the incredible, diverse world of microorganisms, whether they're viruses, bacteria, or eukaryotes; and what it was to be a host, and what it was to be a parasite, and conquer all these barriers.

Alie: Right, like a "worthy adversary" type of respect.

Dr. B: They call it an arms race, and truly that's maybe not quite fair because they have us beat in terms of being able to evolve more rapidly and they have more on the line.

Aside: Dr. Bennett says that viruses are under a lot of pressure to be really good at being effective parasites, whereas we have to defend ourselves against *all kinds* of things - not just these viruses! So we're outsmarted mostly. Oh, and speaking of smarts, she went on to get her Bachelor's of Science in Biology from McGill University and her PhD in Zoology from the University of British Columbia. But that was after she recovered from her hands-on experience with pathogens.

Alie: How did you keep your spirits up when you were in a leper colony with three diseases?

Dr. B: It was incredibly inspiring to see people with leprosy making a positive contribution to their own lives and each other's lives. They call them leper *colonies* because they're ostracized, and they work together, they have an economy. They were creating crafts, and innovating ways of sustainable farming before the rest of the world was even thinking about it: caging animals over fishponds so the poop would fertilize the fish, and then they have this way of keeping the whole thing going. It was a very admirable approach to living with a disease.

And then while I was *in* the leper colony, there was an attempted coup. [*English woman: "I beg your pardon?"*] This was in Liberia in 1989, so it was the first harbinger of the 1991 civil war. I was there, I heard all the gunshots... machine gun fire. I'm Canadian, so I don't have deep experience with firearms anyway, but that was on such an intense scale that it was... incredible. And it was when I was in the leper colony that I thought... I was almost thankful for being there. Thankful for being sick and in a leper colony with all the stigma that implies, and they basically avoided us entirely.

They went through the village where the colony was. Definitely there were deaths and other atrocities of war, and we were completely isolated and protected from that. So, parasites saved my life!

Alie: Oh my god, I'm never complaining about anything again, ever! Now, when it comes to viruses, is a virus a parasite? What is a virus, what does it look like, what are we dealing with?

Dr. B: I consider the term 'parasite', and many do, as more of a way of life than it is a particular branch of the tree of life, because *parasite* literally means 'to dine at another's table'. It comes from a Greek word. So, it's really a way of making your way in the world, and it has evolved independently across many, many different groups of living organisms. Bacteria can be parasitic, viruses can be parasitic, eukaryotes... And then across the tree of life many different kinds of eukaryotes can be parasitic from single-celled organisms like *giardia*, or *entamoeba*, or *plasmodium* (which causes malaria), all the way to nematodes, tapeworms, flatworms and all that great wormy stuff.

So, it's a way of life. [*"It's a lifestyle choice!"*] Arguably, many folks do not classify viruses themselves as living organisms because they, kind of, cheat and use the host cellular machinery to metabolize. That's what everyone is kind of dickering about, but I consider them a life form.

Alie: What are the basic components of a virus and what's the difference between, like, an RNA virus....? When you've got a spikey little glob coming to take over your life, what is it equipped with?

Dr. B: Viruses are fairly simplified, but they're very diverse, and they're not even one single lineage. When we talk about viruses, they probably arose multiple times. If they didn't and they evolved from the same ancestor, we can't track it back far enough in time to say one way or the other.

They have a fairly simple structure and it depends on which group of viruses you're talking about. The viruses I work on have a simple *nucleocapsid*, sort of like a lipid bilayer

membrane with proteins that stick off it, and that membrane structure contains the genetic information of the virus and that's it. Genetic information, some kind of coating, and then some proteins that stick off the end in the case of viruses that infect eukaryotes. They use these proteins to bind to the host cell, and then fuse into the host cell, pass the host membrane into the body of the host cell, and then that's where they pick up all these other functions they need. They co-opt the host genome to make the building blocks they need to replicate their genome.

Aside: Imagine a double layer outside that has all these very fetching protein accessories, that just stick on to your cells - just bust into them and then hack your coding to make more of itself! It's slick - also impolite.

Dr. B: And then depending on the *kind* of genome, and that too is very diverse across the different viral groups... There are virus with double-stranded DNA genomes like ours, and there are viruses with single-stranded RNA genomes like the new, novel Coronavirus, and the mosquito-borne viruses I study in the *Flaviviridae* family which includes Dengue and Zika.

Alie: Tell me a little bit about the novel Coronavirus. Why is it called the novel Coronavirus; why is it COVID-19, and how long we have even had an inkling that it existed?

Dr. B: It's gotten a new name now. We all got on the same page. The name officially is [*drumroll...*] SARS-Coronavirus-2. [*"A sequel!"*]

SARS stands for Severe Acute Respiratory Syndrome. Virus, so Coronavirus, CoV. And there was a SARS-Coronavirus. It emerged in late 2002-2003 in Hong Kong via a wet market - similar to this situation. It's about 80% related to *this* coronavirus, so that's why we're calling it SARS-CoV-2.

It has even closer relatives in known viruses that are out there. In 2015, 2017, some of those viruses are up to 96% related to this virus. In theory, we've known about this particular virus, or at least its very, very close relatives, since 2015 or 2017.

But we didn't know about this specific virus until it was first documented in China in the city of Wuhan and associated with a case cluster around a wholesale market. It's called a seafood market - Huanan Seafood Wholesale Market - but it sells lots of other different kinds of things, including live animals, wild and domesticated animals. It's got lots of different potential bridge vectors - bridge animals - that could've brought the virus from a bat reservoir to humans, but we don't know.

That case cluster was right around the end of December - December 30th, 2019. So the disease that this is causing, it's called Coronavirus Disease, so the name of that is COVID-19. So that's where COVID-19 comes from.

Alie: Oooohhh, got it. For the year, okay.

Dr. B: For the year and for the disease. It's just like HIV is Human Immunodeficiency Virus, and the disease is AIDS. Same thing: HIV virus, AIDS is the disease. SARS-CoV-2 is the virus, COVID-19 is the disease.

Alie: Oooohhh, that makes so much sense!

Aside: Okay, so COVID-19: Corona Viral Disease from 2019 = COVID-19. Also after doing a chiropterology episode, I know that bats get a lot of flak. They take a lot of guano from us.

Alie: How do they know that it wasn't from a snake that a bat ate... Do they know for sure that it was the bats? Bats are so beleaguered when it comes to infectious diseases.

Dr. B: For bats, it depends, actually. Bats are hit way harder by fungi - with viruses, maybe, it depends. Based on the genetic information that the virus that we're collecting now shares with viruses that were collected from other bats... There were also viruses that were collected accidentally from a survey of other animals - in this case it was a pangolin. We call it *metagenomic* because people were characterizing the entire genetic soup without maybe looking for this in particular. Out there in nature - independently from bats and from pangolins - there have been sequences that look similar to this virus that was collected from humans.

There's not been a direct link to any particular animal in that seafood market that could have been the bridge vector or even any particular bat in the market that could have been linked to this emergence event. It's all being done using circumstantial evidence of the actual genetic relationship of the virus. That's different from SARS. In SARS they actually went and sampled specimens in the market and were able to draw a direct link. We're not there yet. We're using the genetic information in the virus to say 'this is what it is'.

Aside: So what does one do on a Saturday morning? Hop on the horn with your favorite bat expert! I dialed up the bat phone where chiropterologist and bat conservationist Dr. Merlin Tuttle, of MerlinTuttle.org, was standing by.

Alie: I wanted to get your opinion and your expertise on coronavirus and how the bat conservation community is dealing with rumors, and just about bats being in the spotlight in a negative way.

Dr. Merlin Tuttle: We're deeply concerned. I've had emergency requests from Malaysia, China and Myanmar, all just in the last couple of days, trying to head off eradication of bats.

Alie: I'm sure that your bat line, your bat phone is probably pretty overwhelmed right now.

Dr. T: We're getting contact from all over the world! It's a huge step back for conservation of bats worldwide. Whether some of these coronaviruses in other animals first evolved in bats, it doesn't seem to me to be overly relevant to the current situation.

The first hypotheses were that it came from eating cobras or krait snakes, then it was pointed to pangolins, and I even read one paper that said they weren't going to go further with testing pangolins which had a 99% match. They found anywhere from about 80-96% genomic match with bats. That's really pretty meaningless given that we're 96% genomically identical to chimpanzees! I don't think anybody going on a date is worried about whether their date's gonna turn out to be a chimpanzee!

Alie: [laughs] That's very true! Even on Tinder, you don't know what you're going to get, but you're probably not going to get a chimpanzee!

Dr. T: You know, all life on earth is related at some point. What we know is that we have searched bats far more intensely than other animals because they're a virologist's dream come true! You can set a net or trap in front of a cave with thousands of bats and have all you can handle in terms of sampling in minutes. They're quick and easy to handle...

By comparison, how would you like to go out and try to get 30 cobras for your sample, or 30 hyenas? Most of the other animals are hardly being looked at relative to bats. Bats make absolutely superb scapegoats. They are little understood to begin with, and match them with viruses that are little understood... You know, the only viruses people know about are the ones that kill us. We have more viruses in our bodies than we have cells.

People fear, they rarely tolerate, and often kill. Every animal on Earth carries viruses that could potentially be harmful. There is *no* animal on Earth more dangerous than our fellow humans, yet we're fingering scapegoats to seemingly avoid admission of where the real problems are.

Aside: So, researchers think that while it may have been hanging out in bats for a long while, it wasn't until humans came in contact with, perhaps, a pangolin, which is an animal that looks kind of like a cross between an anteater and some wind chimes made of seashells. They're critically endangered in some areas because they're the world's most trafficked mammal, prized for their meat and medicinal properties of its scales. Humans tend to come in contact with these intermediate hosts, like camels, and pangolins, and civets when we're catching and eating them. So, the finger kinda points back to us as a species.

And as long as we're talking about finger-pointing, during a talk Dr. Bennett gave at the Cal Academy, she made another great point about the xenophobia that can spike during an outbreak. She reminds us that these pandemics come from all corners of the globe, from all kinds of animals. Our common flu has killed, by CDC estimations, between 12,000 and 30,000 people in the U.S. just since October 2019. And the 2009 H1N1 swine flu, which came from pigs in North America, infected 11-21% of the global population, killing half a million people.

MERS, aka Middle East Respiratory Syndrome, aka Camel Flu, can be transmitted through contact with camels, or by ingesting unpasteurized camel milk, and it's a highly dangerous disease to those with comorbidities. SARS, Severe Acute Respiratory Syndrome, initially came on the scene in 2002, and though the mortality rate was high, there were just over 8,000 cases, resulting in 774 deaths. So, influenzas can be much more threatening.

Now, SARS and MERS are both coronaviruses, which are round, spiky things that are *almost* an adorable pestilence.

Alie: I've seen pictures of it, it looks like a Koosh ball, an evil, evil Koosh ball. Or a dog toy with bad intentions, just trying to live its life. I know it's just trying to do its hustle; we just don't really like it. I mean, congrats, for being so successful so fast, but we don't like it. What exactly is it and how is it different from other coronaviruses? Is a cold a coronavirus, technically?

Dr. B: No. Well, not necessarily, I should say. So when we refer to the common cold, there's actually tons of things that can cause common colds. [*Alie: Ahhhh!*] There are a group of viruses called rhinoviruses that cause common cold-like symptoms. There are two coronaviruses that jumped into humans from animal reservoirs that are in a different group of coronaviruses that I think up to 10-20%, maybe 30%, of common colds are due to these human coronaviruses, but they're in a completely different cluster than these coronaviruses that include MERS, and SARS, and now SARS-2. This other group is called the beta-coronaviruses, and they are not typically what we think of as common cold-like symptoms.

Common cold is usually upper respiratory with nasopharyngeal, and throat, and a lot of blowing your nose and sneezing, whereas this virus – as well as SARS-1 and MERS – are more associated with pneumonia-like symptoms. So they're infecting the lower respiratory tract. The same with SARS-2, that it seems to be associated with mostly lower respiratory and that comes with certain pathogenic implications, because that's where you would get, sort of, pneumonia-like symptoms associated with the lower respiratory tract.

Aside: Okay, so most of this interview with Dr. Bennett took place in an office, but afterward I thought of a few more questions. So I met up with her in the planetarium at the Cal Academy that evening after her talk and before our museum nightlife panel to ask her just a few more things.

Dr. B: This virus infects respiratory tissue, so it's mostly lung tissue, lower respiratory tissue. And then sometimes upper respiratory. Basically, the symptoms are associated with a dry cough, fever... Fever is the most common symptom. 88% of all sick people develop fever, and it's not a particularly high fever, 100.4° and up, so people should check their temperature! Dry cough, fatigue – kind of like when you get the flu, you feel body ache and fatigue. And then shortness of breath. And shortness of breath, we used to think was the most common symptom, up there with fever as the most-most common symptom, but it's maybe about 20% of people developing shortness of breath.

Alie: Okay, I heard that COVID-19 can cause your lungs to fill up with blood? Or is that just a rumor?

Dr. B: So, the people that are really getting this disease very severely are getting pneumonia. So anything that infects your lower respiratory tract can eventually result in pneumonia. And that's basically an inflammatory response of your body that fills your lungs up with fluid, fluid that your body produces to fight infection, but it kinda goes crazy. It's what we call a 'cytokine storm.' There are many kinds of pneumonia. It's basically inflammation of the lungs, it can be caused by different kinds of bacteria. This is definitely consistent with viral pneumonia, which is really mostly associated with this really, sort of, overwhelming cytokine response. So it's a big immune response that you're getting. If you're coughing a lot and you're trying to get rid of the fluid in your lungs, probably blood might be in the sputum, but in general it's pneumonia.

Aside: Cytokines are proteins made by your immune system, and they do all kinds of signaling to moderate inflammation and immunity. When those cytokines go a little hog wild, it can affect the entire body, doing really intense damage to lungs, and the liver, and the kidneys. And so a cytokine storm can cause multiple organ failure. So just think about that when you feel too lazy to wash your hands well, or when you just can't resist touching your face. Multiple organ failure versus using some soap? Soap it is! Okay, but now back to the structure of the actual virus.

Dr. B: It's a coronavirus because of these spike proteins that prick off. I mentioned that the viruses have this containing nuclear capsid, these genomes inside, and then sticking off of this nuclear capsid are proteins that are really important to help the virus bind to the host cell and then fuse. So what they have to do is bind and then they trick the host cell into, basically, engulfing it. It's called phagocytosis, and they engulf it into an internal bubble

inside the cell called an endosome. And then once it's enclosed in the cell, it needs to punch through the host cell membrane to get into the cytoplasm of the cell and do its thing.

And so it uses proteins to both bind to the cell, and then once it gets engulfed, it uses proteins to tunnel, to basically open up a gateway, fuse and pump itself in. So the spike protein is very important in SARS-Coronavirus-2, as well as the original SARS-CoV-1, for binding to the host cell. So these proteins determine what we call the 'host tropism': the kind of host it can bind to, and then the kind of cells within that host they can move into. They're very important and they give it this sort of beautiful halo effect because these spike proteins kinda stick out like a funny crown.

Alie: Yeah, and that's where the 'corona' comes from.

Dr. B: And that's where the corona comes from. Yeah.

Alie: Aha! And now I've seen the exponential growth curves. Have you seen the animated graph where they're all just cruising along and then you see coronavirus and you just see it on this upward trajectory that is horrifying? Why is it so scary and so successful so fast?

Dr. B: There's a lot of unanswered questions. We know that its spike protein does differ from the first SARS. The first SARS was different in that it caused a higher rate of mortality. Case fatality rate was around 10%, but it didn't transmit quite as rapidly. You would get infected with the virus and then it might take four to five days to develop symptoms – we call that the incubation period. And then for days after that, another four to five days, you wouldn't be able to transmit, and then you'd only start to transmit after you'd been sick. And so it made the first SARS easy to contain, even though it was scary deadly.

This virus is not as deadly. It's rolling in at around... the estimates vary depending on whether it's a population of older people with comorbidities or other health challenges, but it's coming in right around 3%, plus or minus.

Alie: But what about conflicting reports that say the danger is no big deal, less than a fraction of percent, versus others that put the death rates much higher? Who's lying to us, and what do they want out of it? Is nobody lying? Is everybody lying?!

Dr. B: There are two words being used here. One is mortality, and one is case fatality rate. We don't know how many people have the virus, so if you divided the number of deaths by all of the *unknown* people that could have it, then yeah, maybe the mortality rate would be pretty low. But what we're saying is it's about... SARS had one in ten die, that was the case fatality rate.

With SARS-CoV-2, COVID-19, the *case* fatality rate – and we are talking about COVID-19 the disease now – that is 3%-3.4%. That's when you know it's a case, what are the chances of dying. So you have to be really careful what you divide it by. The deaths by the total number of *known* cases, or the total number of potential infections. And that's a really, really hard number to get a handle on because unlike SARS-1, where you had your incubation period and then you had your symptomatic period and then you could transmit, with SARS-2, you could start transmitting right away, even before you have any symptoms. Or at least we think so.

We don't know exactly when, but your asymptomatic, or incubation, period can last up to two weeks. On average, six or seven days, but up to two weeks. And as far as we know,

people can transmit before they're symptomatic. So that means it's a lot harder to get a handle on. When people report cases, that could be as long as 14 days after they've been capable of transmitting to other people. So, the estimate of the reproductive rate of the virus is pretty high. It's varying from, any one individual could infect two others, up to four others. And in some places, in closed settings like nursing homes or cruise ships, the reproductive rate of the virus has been even higher. Way higher. On the order of measles higher, which has a reproductive rate of 12 to 18.

Alie: Oof!

Aside: Quick recap: the reproductive rate means how many other folks an infected person could spread it to. Spreading an airborne disease to 12-18 others? Yeah, there's a reason that measles vaccines are a good idea. The flu's reproductive rate is about 1.3, meaning if you got it, you'll give it to about 1.3 people, and SARS-CoV-2 is estimated at about 2.2. But it's still pretty early. Right now, as of March 9, 2020, there have been 113,000 reported cases of COVID-19, and about half of those – 62,000 – are fully recovered. 3,895 people have died. Remember: that rate of reproduction for SARS-CoV-2 can vary a lot depending on close quarters, and some folks are in living situations that put them at greater risk.

Dr. B: People are concerned because we don't know how many infections are out there that could be transmitting, and when we report cases, we are really only getting the tip of the iceberg. We don't know how big the base of the iceberg is. So that's why we're trying to prepare ourselves.

You described the epidemic curve. In China we know... we can look back and trace the epidemic curve. We know that the low levels of cases started in the end of December. We can actually use genetic information to predict the origins of that human form, and it's looking like mid to end of November that this ancestral virus was around, the one that's causing COVID-19. We started to detect the cases December 30th. We started to see growing cases through January, big boost through Chinese New Year, and we are peaking through February, and finally we are hitting the top of the curve.

Now if you look at the cumulative cases, it's starting to level off, and if you're looking at the number of new cases per day, it's starting to go back down the other side. And this whole thing in China, at least from ramping up, to hitting the peak, to going down the other side, has taken about two months or so, two-and-a-half months. So, the big question here in the U.S. is when we will start to hit that curve and start to really increase exponentially in terms of the number of cases that we detect, and then how high that curve will go. Will it be as intense as it was in China, or will we use different methodologies to keep it flatter? And if we flatten the curve, will that make the curve last longer?

Aside: So if you look at overall COVID-19 cases, the curve starts off small, and then goes skyward, and it's still headed skyward. That's overall global. But if you look at just mainland China, where most of the cases have originated, it reached a peak and it's starting to cruise to the right instead of going straight up. So where can you get COVID-19 data? I'll put links to these sources on NextStrain and GitHub at AlieWard.com/Ologies/Virology.

But where can you get COVID-19 itself?

Alie: And now where is it? Is it on door handles, is it on airplane trays? Where is it and how do we not get it?

Dr. B: Yes. Right. So this is what we call a virus that transmits by airborne droplets. There has been some evidence of fecal transmission, so it has been found in those kinds of... [*hesitates*] body products. [*Alie laughs*] But when we say airborne droplets, that basically means that it's in the water droplets that we produce when we sneeze or cough, or if we're rubbing our eyes, nose, or mouth, or capturing a cough and depositing those on surfaces. So, wherever the droplets land or are put by our hands, for example, is where the virus can be picked up by the next host.

That's different from something like measles, which is truly airborne and can actually float in the air as an aerosol. And that's why measles can potentially – if you don't get vaccinated – can be highly, highly transmissible. This is not measles. It's not fully aerosolized and airborne. It's probably most likely to infect people through being coughed on directly, have droplets land on you directly, or you pick up the virus from a surface.

Alie: And then you rub your eyes, or rub your nose, and it gets into a mucus membrane?

Dr. B: Yeah, or you hold your hamburger, and you take a big bite, and your hands have touched the burger. So it's basically any potential surface you have touched with your hands or other body part that then you introduce to any of your own mucus membranes [“*Warm and moist!*”]

When viruses deposit things on surfaces, we call those fomites. So I'm fondly referring to my iPhone as a *phone-ite!* [*both laugh*] You can imagine, right, that potentially I'm handling the phone, I'm putting it down places, other people might be picking it up, like my daughter or something. So clearly, as a precaution that we can all take, is to wash our hands before we use our hands to touch our mucus membranes like our eyes, or nose, or mouth, or food that we're going to put in our mouth. And cover your cough or sneeze, because you don't want to be a spreader. And remember: We could be walking around without symptoms and be spreading the virus.

Alie: And our phones are disgusting, right?

Dr. B: They're disgusting! Keyboards, and microscopes, and doorknobs, and elevator buttons! So avoiding touching any of those really common surfaces is just a great thing.

Aside: Just a sidenote: I love how she said common, everyday items like keyboards, and doorknobs, and elevator buttons, and phones and... microscopes! Ahh! Is this amazing lady a molecular epidemiologist or what?

Alie: Okay, so that's good to know that it's not that your phone might be disgusting, your phone is dirty, like it has more living on it than a toilet seat or something, right? Something insane like that?

Dr. B: I would not be surprised. I think is probably very true.

Alie: And how long can the virus that causes COVID-19, SARS-2, how long can it live just hanging out on your phone, hanging out on a button?

Dr. B: So, I actually don't know. I was looking in the published literature for that information and I didn't see a study. I've heard people in the press or maybe casually mention different times, like 24 hours, 36 hours. With flu, with influenza, it can persist for 24 hours or more, but it's a totally different virus, and it depends on the temperature. So actually, flu does really well...

it persists longer when it's cool and dry, which is one of the reasons why influenza does well in dry winters in the temperate zone when we're crowded together indoors and they're living in cool, dry environments. We don't know enough about SARS-CoV-2 to really know, but for sure I would not doubt that it could persist a goodly amount of time, but we don't really know exactly how long that is. At least I don't.

Aside: We're about to get to more common quandaries that we're all facing, and you know I usually do your Patreon questions, but I had no idea I was doing this episode until about one minute before. So I just played it by ear.

Also, for each episode we donate to a charity of the Ologist's choosing, and this week it went directly to the California Academy of Sciences. The mission of the California Academy of Sciences is to explore, explain and sustain life. They have 1.5 million visitors every year, 46 million scientific specimens and collections. They do scientific research, public engagement, environmental literacy programs, and sustainability education. Plus it's just a really great, fun, beautiful museum of science. California Academy of Sciences – awesome. A donation goes straight to them, thanks to these sponsors.

[*Ad Break*]

All right, back to what I think would have been your questions.

Alie: What do you think of the runs on hand sanitizer, and hand sanitizer on Amazon being like \$200 dollars, and you cannot buy a Clorox wipe anywhere, they're all sold out – have you stocked up? Do you have a bunker full of canned food? What's going on?!

Dr. B: No, no. I think just like anything we could potentially get, whether it's seasonal flu, or coronavirus, or rhinovirus, a common cold virus, it's plenty to wash your hands, and soap and water is just fine. You don't need an ethanol-based hand sanitizer. An ethanol-based hand sanitizer doesn't hurt either. I mean, it's not a substitute for washing your hands with soap and water. Washing hands with soap and water is better, but hand sanitizer is fine, but it's not necessary.

If you touch something, just go wash your hands as soon as you can before you touch your mucus membranes and you'll be fine. We don't have to carry hand sanitizer in every pocket, in every car. You can also make your own disinfectant for surfaces, or you can just use soap and water on surfaces. So, soap and water on surfaces, or any cleaner that's 60% ethanol or more. You can buy rubbing alcohol from... Uh-oh, I hope I didn't just start a run! [*both laughing*]

Aside: Heads up – don't use straight rubbing alcohol on your hands, or you might cause a skin burn, or drying, or cracking. Some folks are trying to make their own hand sanitizer. They're just going full DIY Pinterest mode, using two-thirds rubbing alcohol and a third aloe vera gel to moisturize. But experts are like, "Yo, if you get the concentration wrong, or you contaminate it using non-sterile tools to make it, it's not going to be as effective as store-bought, so don't bother.

"Can I douse my mitts in whiskey?" you ask, "as long as I'm holed up drinking it, hoping not to die?" Well, first off, have some water, my friend. Also, whiskey isn't high enough proof. Neither is vodka! Tito's vodka responsibly discouraged hoarding, and tweeted out, "Per the CDC, hand sanitizer needs to contain at least 60% alcohol. Tito's Handmade Vodka is 40%

alcohol, and therefore does not meet the current recommendation by the CDC.” So, I’m sorry to say, you cannot fix things by splashing booze on your body. I know, it’s disappointing.

Dr. B: You can also make surface cleaner out of bleach. I have a lab here, I disinfect surfaces with 70% ethanol or 10% bleach, but it turns out you can get away with a 3% bleach solution. Just make sure you leave things wet; you don’t dry them off right away.

Alie: Because that bleach needs time to break down some...

Dr. B: Yeah, a little time. Same with ethanol wipes. So if you’re buying wipes, make sure they’re still wet when you use them. Don’t use them until they dry out.

Alie: And don’t use it and then dry it off with a dirty towel, say.

Dr. B: Good point.

Aside: Let’s take a moment to revisit the disinfectiology episode with Dr. Evan Rumberger, who is a bleach chemist at Clorox in northern California. He has dedicated his career to killing gross stuff that could make us sick.

[clips from Disinfectiology episode]

Aside: How is bleach disinfecting things? Some research that came out only about a decade ago zeroed in on the hows. According to a study published in *Cell* magazine, the active ingredient in bleach causes proteins in bacteria and viruses to unfold, in the same way that a fever would fight an infection. When you spray it first on the counter, you can leave it there to kick some bacterial and viral asses for like five to ten minutes, depending on your counter.

Alie: What about the smell of bleach? I learned on the lab trip that the more bleach you smell, the more it’s busting up cell walls, is that true?

Dr. Evan Rumberger: Yeah, that’s true. The bleach smell – our consumers, a lot of them love it, because it’s a good indication of coming into a clean bathroom. I can tell you, nothing better than being at the ball game and going into the bathroom, and if you smell bleach in there, it’s like, “Okay, we can go in here,” right? *[both laughing]* Or at a restaurant. That’s a really good sign, just knowing how well it works at disinfecting.

The smell is the smell of the bleach fragmenting up the things it comes in contact with, that is a little bit of what you’re smelling. That’s a nice cue that it’s done its thing.

Aside: Good to know! So the next time you think, “Hmm, it smells like bleach in here,” think, “Oh wow, smells like a lot of destroyed pathogens and ripped-apart viruses.” Aromatherapy in these trying times.

[end of Disinfectiology clips]

And now, back to virologist Dr. Shannon Bennet.

Alie: What about symptoms? I know that some people can be asymptomatic. My fear, because I travel a lot – I was on a plane this morning and I’ll be on one tomorrow – my parents are immunocompromised, and I’m supposed to see them in two weeks. What if I pick it up and I don’t know, and I give it to them? We all know that those masks aren’t doing anything. What do we do?

Dr. B: Right. I too have an older mother who has asthma and I certainly wouldn't ever want to give her this. Like I said, it's not measles where it's going to fly through the air. But definitely droplets can travel about six feet. So if you develop symptoms, clearly you would want to avoid close contact with them. But before you develop symptoms... If you don't have symptoms you're not coughing, so you're probably potentially depositing fomites around. So just like we can use good hygiene to protect ourselves, you can also use good hygiene not to transmit. If you're washing your hands frequently, not only are you not liable to give it to yourself, but if you did touch your face and hands, wash your hands again. Wash your hands before you prepare food. Don't share cups, glasses, straws, with your family members. We should all not do that right now, that would be good. And don't cough... cover your coughs and sneezes, even if they're just starting with a tickle.

Alie: Is it better to have Kleenex with you, or to have a handkerchief?

Dr. B: I have a young daughter, fourteen, and when she was growing up it was the 'Batman Move'. [Alie laughs] Pull your arm up and sneeze into your elbow, or cough into your elbow.

There are some interesting rumors going around about whether the virus can persist on fabric surfaces. We know for sure that it can persist on hard surfaces, but how does it persist on fabrics? That, I think, is still up for question, if it would persist longer on a handkerchief or on your sleeve. Maybe the best course is to use a disposable Kleenex, throw it out, wash your hands.

Aside: Okay, rapid fire.

Alie: Paper towels or hand dryers?

Dr. B: I'm a big fan of paper towels.

Alie: What about the Internet rumor that [singsong] SARS-Corona-2 is an escaped biowarfare pathogen from the Wuhan Institute of Virology?

Dr. B: They have the same outfit that we have. They have a Chinese version of the Centers for Disease Control and Prevention, a Chinese CDC. The rumor out there, and I don't want to repeat the rumor in case it's propagated, but the rumor was that they might have been involved. Of course, many labs, especially government labs, are going to keep pathogens, and cell cultures, and different things to study. So it's completely plausible that... All of the labs around that support us and develop vaccines and drugs have some forms of these things to study. I don't put any stock into the rumor at all. The genetic evidence supports that it's not an engineered virus.

Aside: If you hear the word 'recombination' in regard to this or other viruses, don't get scared of a term you don't know. It just means that a few viruses can mix up their DNA, co-infecting the same host and exchanging genetic segments. Recombination in SARS-CoV-2 may have been because there were multiple animal hosts, not because someone in China is trying to start the apocalypse.

Rumors spread by Rush Limbaugh and *InfoWars'* Alex Jones, the latter of whom had a self-described form of psychosis, and convinced people that the Sandy Hook shooting was a hoax. Jones stated recently that SARS-CoV-2 is the work of "Chinese communists" and that it's "man-made," sentiments that managed to be not only racist, but sexist too.

Trevor Bedford is a Seattle-based virologist at the Fred Hutchinson Cancer Research Center, and has done amazing work on the genomics of SARS-CoV-2, and he has a thread debunking these conspiracy theories. It's on Twitter, it's definitely worth the read. I'll link it on my website at [Alieward.com/Ologies/Virology](https://www.alieward.com/Ologies/Virology). While you're at it, just follow him on Twitter at @trvrbr.

And for the health of yourself *and* the planet, stop following potato-faced hatemongers.

Speaking of faces...

Alie: What about masks?

Dr. B: Masks. Masks are not all equal. There are many kinds of masks out there: There are paper masks that are not necessarily adequately filtering the air. Then there are masks with these little built-in filters. The rest of the mask is much less permeable, and they're called N-95s. 95 refers to the amount of air it filters, the amount of particulates it filters out of the air. N-95 means that it filters 95% of the particles.

In a healthcare setting, where you are in a crowded space, and droplets are flying, they are definitely recommending N-95s or higher, N-99s, be used by healthcare professionals, by people who are in closed spaces where they cannot escape a flying droplet, because of this whole six-foot rule, and where they're concentrated and crowded with people.

For most of us going about our day-to-day, we're probably picking the virus up mostly from fomites. A mask is not going to protect you from fomites. This is not measles where it's flying through the air. You're going to know if you're within six feet of somebody that's spraying droplets. The mask won't help for fomites. Unless, I guess, some people could argue, "If I'm wearing a mask, I'm not touching my face," but I bet you if you're wearing a mask you're touching your face even *more*, because you're adjusting the nose piece...

Not only that, but people need to understand that all of the masks that are available, most of them are disposable. That means, to use them properly, you fit them tight, and you use them *once*, and then you throw them out. So they themselves could become founts of fomite, just by collecting the fomites that you're breathing through the air and then you're touching them. They're not a great idea unless you're in a healthcare setting, where you'll be in very close quarters with direct droplets.

Alie: I read that even people who use those in a healthcare setting have to do tests to make sure that it's fitted properly, and they're easy to use wrong.

Dr. B: They're easy to use wrong, they're easy to use over and over again, and they could give you this false sense of security going into a situation, when if it hasn't been fitted properly, and there are gaps, you're actually pulling in more virus than if you didn't.

Alie: And then there's not enough for the people who need them for their work.

Dr. B: And the last thing we want is for there to be a run on masks, and the people who are really exposed not having access to them.

Aside: The US Surgeon General tweeted an exasperated plea that started with:

Seriously people - STOP BUYING MASKS! They are NOT effective in preventing general public from catching #Coronavirus, but if healthcare providers can't get them to care for sick patients, it puts them and our communities at risk!

So what if you bought them when you thought you needed them, and now you feel bad or embarrassed about it? Don't be embarrassed! Just contact a local healthcare provider or ER, let them know you have clean, unused masks to donate. MedShare.org is also taking and redistributing them.

I fly a lot, we all know this, and I was on two planes this week for work, and I saw a ton of people wearing these vented N-95 numbers. It's kinda like a Gucci purse – once you know what it is, you see 'em everywhere.

Also, in researching this episode, guess what all my targeted website ads are for? Yep! Even the New York Times sidebar ads are for N-95 masks and hand sanitizers if you've been Googling coronavirus a lot. So when it comes to widespread panic, there's really no escaping commerce.

Speaking of escaping, I was supposed to give a talk at SXSW EDU this week, but it was cancelled.

Alie: What do you think about this particular disease being an excuse to stop going to parties?

Dr. B: *[laughs]* My daughter's like, "When are they gonna close school! When are they gonna close school?"

I for one am not changing my social gathering, but I'm being mindful of the social distancing. The difference is that I am not necessarily shaking hands, hugging, kissing, or sharing a drink with someone, like I might do in a party, like, "Oh, I'll have a sip of that, oh, can I taste your wine?" Those things are definitely good things to not do at this time, but I think at this point social gathering is – we don't have enough indication that the base of the iceberg is so huge that we should stop gathering socially.

Alie: What about, say, trips? Like, I'm going to Costa Rica, so far no cases in Costa Rica, but I'm going in a couple months. One patron who's a friend of mine, Dr. Teagan Wall, she has had part of a lung removed because of Valley Fever, and she's planning on going to Hawaii with her 66-year-old dad, and she's like, "Should I not go? I have a preexisting lung thing, am I being paranoid?" What do you think? Do people keep traveling?

Dr. B: I think the first thing she should do is talk to her medical...

Alie: Yeah, for sure. *[laughing]*

Dr. B: I'm not going to say anything about her own lungs. But absolutely, whenever you travel and you transit through airports, you're passing many, many more people from many, many more places, and you are potentially exposing yourself to fomites and coughs. Again, if you're in an airplane, it's not like measles, it's not going to be flying around the cabin, but if the person beside you, behind you, or in front of you is coughing actively, there's that. So again, I think being mindful that if you do travel, you need to be ultra-careful about touching your eyes, nose and mouth, or food with unwashed hands, and distancing yourself from direct contact with other humans.

I personally am still traveling, I have a wonderful trip planned to do field research in the Maldives at the end of March, March 27th. I'm really, really hoping that I can go. What I'm saying about that is that I'm looking to the CDC and following their travel advisories. If they have issued a travel advisory against a place, and they have issued travel advisories to what

they're classifying as 'Level 3 countries', yes, don't go. I'm not going to go. And you risk, if you do go, maybe not being able to get back as readily. Plus many airlines are cancelling some percentage of flights. Looking to the WHO and CDC guidelines for travel advisories based on destination is what I am doing. And then using safe personal precautions when I do travel to non-Level 3 locations.

Alie: Okay. I'm wondering, do you think that the Olympics are going to be nixed?

Dr. B: [*deep breath*] Well, I think that that is what everybody's talking about.

Alie: Yeah, everybody's talking about that!

Dr. B: Actually, I was just looking at the data in Japan, and they still have not hit the top of their curve. China has, and it's heading down the other side. Japan has not quite. So, depending on how it all rolls, by the time the Summer Olympics occur, it could be down the other side, right? And they could be starting to pull up. [*as if flying a plane*] "Pull up! pull up!"

We have many events here planned at the Academy, and we're just keeping an eye on the data, and not making any premature decisions. Like I said, with diseases, they come in a wave. The wave peaks, and then it goes back down again.

Alie: What causes that drop, actually?

Dr. B: You know, that's a very good question. Most people assume that all the people in a certain population that could have gotten it, at a certain efficiency that the virus might exhibit, got it. We're kind of thinking about it as like a herd immunity. Somehow the population of at-risk, potentially exposed people, that population isn't large enough to sustain ongoing virus transmission, for whatever reason. And there's lots of things that might determine that. In China, it was concentrated in Wuhan, probably many people that could have been exposed, were exposed, and the virus is now running out of running room. Like, maybe kids are not showing symptoms, maybe they're not on the radar. So people that are going to get it that would have showed that they got it is starting to run down.

What we don't know is what the United States is going to look like. We don't know if we're going to have a bell-shaped epidemic curve in a given place or whether it'll be across the whole country. For example, for sure in Seattle, there's definitely a curve going up and coming back down. But it could be that we, at a country level, stay with these very discreet events like that and we never as a country go through a curve where the virus never, nationally, runs out of susceptibles, essentially.

Aside: And quick aside in case you're like, "What's going on in Seattle?" Well, the first US case of COVID-19 appeared outside of Seattle when a 35-year-old man who had recently travelled to Wuhan China came back with it. And as of this recording, nearly 100 folks have been diagnosed and 18 have died in the Seattle area. It somehow spread to a nursing care facility in Kirkland, Washington causing the deaths of 13 residents and spreading to a suspected half of its 180 workers. Although the center is having trouble getting ahold of enough testing kits, the Bill and Melinda Gates Foundation has stepped up and donated \$100 million to global public health authorities to try and fight COVID-19 starting with trying to make testing kits available to Seattle area residents.

So why, you might ask if you are my parents who just asked me as I was researching, are older folks more at risk for this? And why haven't we seen COVID-19 in kids? A few theories

are that as we age, our immune systems just are not as strong and our inflammatory response may be greater causing that cytokine storm that can cause organ problems. Obviously, no one wants to get this and no one wants to give this to anyone.

So what do you do if you feel like garbage? Are there even enough testing kits available right now? Not really. Now the CDC recommends, in any case, to call a healthcare provider immediately and they will assess your symptoms. Also, have a working thermometer available because a low-grade fever is one of those symptoms. For mild symptoms, CDC says stay at home and isolate. Don't spread it to your family. For worsening symptoms, alert your doctor so that if you do come in, they're prepared with the right testing kits and their own precautionary measures. Don't just saunter into urgent care unannounced like a mother-in-law doing a drop by on a Sunday. Give them a head's up first.

Also, a healthy immune system is important, so take your vitamin C, stay hydrated with not-vodka. Get a lot of sleep. You have waited years to have a good excuse to stay in and watch Netflix and nap. You're welcome!

Also, if you need a show to watch, can I suggest *100 Humans* which premieres on March 13th? If you're bored, tweet to Netflix and tell them you love it. Also, take care of your immune system.

Alie: Do you think our immune systems will eventually get hip to it or do you think that, eventually, they'll have a vaccine in a couple of months? Or is it just, like, wash your hands, the vaccine's not going to come fast enough?

Dr. B: Well, two things. One is that it does take time to develop a vaccine. There are vaccine candidates that are being researched right now and they look promising, but to get that through drug testing and everything could take months to a year. So, stay tuned. But the other question too is how effective a vaccine will be, and with influenza we know that that immunity does wane. It doesn't match anymore and it's not as effective. Whereas with some things like measles, the vaccine's awesome and it lasts decades. So it really depends. All viruses are different and the kind of antibodies they elicit in the human body that could then be leveraged to boost people, give people a vaccine, is still completely unknown with this virus. There are candidates, but there's not enough information.

Aside: A lot of companies are urging workers to telecommute, which I think is a great idea, personally. I will be doing that as much as possible and perhaps so should you, if your job situation lends itself to that, which is a privilege in and of itself. But so, so many people simply cannot afford to take off work and can't telecommute because their job involves being onsite to teach, or to build something, or serve something, or fix something. And for them, it's good to be mindful to try to cut this thing off because some people can't take certain steps to lower the risk.

Oh, and if you're wondering if your dog can spread it to you or others, the World Health Organization says nah. But wash your hands after petting animals anyway. They said nothing about telling your animals how beautiful they are from across the room, which I've been doing. Okay, you know what? Let's try to lighten this up a little.

Alie: The movie *Contagion*: yes or no? Any virus movies that you actually like?

Dr. B: I actually kinda like *Outbreak*. It's a lot cornier, but I love Dustin Hoffman. I think those are all really super fun.

[clip from *Outbreak* movie, screaming in the background, authoritative man voice speaks: "Try to remain calm. Many people are dying and are going to continue to die unless we find this monkey."]

Aside: So, Jarrett was being an angel and helping me as I was scrambling to put this episode together, and this *Outbreak* clip made him rip off his headphones and tell me I needed to contact my favorite disasterologist Dr. Samantha Montano from the Disasterology episode, immediately. Now, it was 10pm her time on a Sunday... I gently texted her and she was up! And down to chat on the phone! Because as her Twitter bio states, she's not just a disasterologist, she's a *cool* disasterologist. So I asked her, what the hell should we do? Should we panic?

Alie: Dr Montano, thank you so much for talking to me.

Dr. Samantha Montano: You're welcome.

Alie: In this COVID-19 fear, and scare, and threat, what do you suggest that people know or do?

Dr. M: The first thing that I recommend is that folks listen to the information being put out by their local public health and emergency management officials. They'll be the agencies that have the most up to date information for your specific area, so following their advice is your best bet.

Alie: Where do people find their local emergency management officials?

Dr. M: Good question. The best thing to do is to just go to Google and search the name of your city, town, or county with emergency management and/or public health and you should have an agency come up. They're all named slightly different, so you have to just search around for it, but once you find their websites, you should be able to find a place to sign up for email or text alerts or at least their social media, so you can follow them on there.

Aside: I did this for the Los Angeles and it pulled up the Los Angeles County Department of Public Health, the California Department of Public Health, the CDC, the World Health Organization. Sweet. So, think locally first, see what's happening nearby.

Alie: Okay, and should we be taking this as the apocalypse is coming or is this just a new disease and so people are just being very precautionous?

Dr. M: Well, I would definitely not say it is the apocalypse, fortunately, but this is something that needs to be taken very seriously. Remember, that for the majority of people that are taking precautions, they're doing so not for yourself but rather for the people around you who are at a higher risk. People who have certain chronic illnesses or are elderly and have those higher risks, we want to make sure that we're not doing anything to spread this around to them.

Alie: So you're not a diva or high maintenance if you're being extra precautionous. You're just being kind, and compassionate, and empathetic to others.

Dr. M: Yes, absolutely.

Alie: Are guys going to start washing their hands do you think?

Dr. M: I would really hope so.

Alie: *[laughs]* That's been one thing that has been quite illuminating. How many guys on Twitter like, "Oh yeah, a lot of guys just cruise right out of the bathroom without washing their hands." How about that?

Dr. M: Yeah. It's disgusting.

Alie: *[laughs]* And then what about the panic or the fear, what should people do emotionally?

Dr. M: I think the most important thing is to just remember to be kind to each other. There's a lot of really confusing and conflicting information flying around, and this is very genuinely scary for a lot of people. I think we want to be careful when we see people taking certain actions that to us may seem slightly or irrational or may seem like they're making a decision out of panic. It's important to remember that we don't necessarily know their individual situation, we don't understand who they're living with at home who may be high risk, what particular needs their family may have. So we want to be careful about how we're interpreting some behaviors that, from the outside, or with more information, or more accurate information may seem irrational, are actually relatively rational reactions for them.

Alie: That's such a good point, because you don't know if someone's immunocompromised, or if they're caring for someone who is, so don't judge people for being cautious.

Dr. M: Exactly.

Alie: How do you feel about people who are stockpiling canned food, and water, and Purell? Do you think there's a need to 'get ready' for, maybe, mandatory quarantines? Or what should we do?

Dr. M: I think the general consensus coming out of official agencies is that there is a recommendation that folks have a supply of food at their homes. The general consensus seems to be two weeks' worth. That, again, is going to look different for different people's situations. I think really the idea with that is if you are in a position where you need to stay home for multiple weeks and it's not safe for you to leave your house, that you are able to feed yourself. With that was said, emergency managers on a daily basis recommend that you have multiple days' worth of food and water in your house for any disaster that may occur, so that's pretty standard advice.

Alie: If you didn't already have that, that might be why you're heading out to get it now.

Dr. M: Right. Exactly.

Alie: What about big events being cancelled or postponed? I know that in some countries weddings are being postponed or banned, gatherings of over a thousand people... I know SXSW just cancelled. Good call, do you think?

Dr. M: It really depends on where you are. It's a situation where we don't necessarily have all of the data that we would ideally want to be able to make the most informed decisions. This happens a lot during disasters, and so officials are needing to make decisions kind of based on the best information that they have. Presumably they're making those decisions based on information that they've been given by local public health officials, so that's a good approach.

Alie: Oh, that's so smart and helpful. I don't know about you, but I've had some stuff get cancelled that I've been like, "Yes! I get to stay home!" *[laughs]*

Dr. M: *[laughs]* That's funny. I'm actually going to a conference tomorrow in Hawaii and it has not been cancelled, and it's been very shocking, I thought for sure it would be.

Alie: I hope you have some hand wipes.

Dr. M: Yes I do. *[laughs]*

Alie: Okay good. Well, I hope you fly safe and send updates from paradise.

Dr. M: Will do.

Alie: All right, Dr Montano, thank you so much. Wash your hands.

Dr. M: You too.

Aside: Okay. Dr. Shannon Bennett had to jet so we wrapped it up.

Alie: I know you've got to go to a next meeting. I'll ask you the last two questions I always ask. Worst thing about your job, crappiest thing about it? I know that I'm asking this of someone who has had malaria and dysentery in a leper colony during a war, but what's the worst thing about your job? It can be anything.

Dr. B: So I'm actually playing a dual role right now. I'm the chief of science at the Academy as well as an ologist; virologists the molecular epidemiologist. I would say that the administrative parts of my job... Even as an ologist, you have these administrative duties like writing reports and writing grants. That, I do find tedious, but doing the actual research fieldwork, the administrative part of it is a little painful. That's what I liked the least.

Alie: It's so amazing that you could have dysentery as part of your job, but the paperwork is worse. I get it. *[laughs]*

Dr. B: I mean, you could get dysentery from anything, really. [*"That's convenient."*]

Alie: What's your favorite thing about what you do?

Dr. B: So that, exactly the adventure of going out into the field, I love that part. I just love seeing new places and seeing new people. And the feeling of discovery that I might catch a mosquito that contains a droplet of blood that it took from some obscure animal in nature that might have the secret to a new virus that I could discover is so exciting.

And we've discovered new viruses and it's really incredible. Then bringing that secret information back into the lab, and cracking open the genome, and solving it, and doing the analysis, and looking at the family tree of these viruses and how they relate to each other is my absolute favorite thing ever.

Alie: Thank you so, so much for doing this. So in essence, just wash your hands, calm down a little bit, right?

Dr. B: Wash your hands, social distance, stay home if you're sick. A lot of people, we're in this culture where we think, "Ah, we'll just tough it out. Oh, I won't infect anybody. I'll just go to work anyway." But this is not the time to be tough. Just stay home if you're sick.

Alie: Got it. Will do. Thank you, doctor.

Dr. B: You're welcome

Alie: Thank you so much for doing this.

So folks, this is potentially serious, [*deep pitch*] I'm not going to lie to you. But it can be potentially contained faster not with panic. Panic never saved anyone, but preparedness, conscientiousness, compassion, empathy, and handwashing have saved lives. And as someone who has loved ones who are immunocompromised, I'm hoping people stay home when they can, we all do our best to hunker down and let this thing pass over us with a curve that doesn't look like a Six Flags attraction. I myself will be laying low more than I usually do.

And what did we learn? Ask smart people stupid questions and don't touch them, or your face. Don't touch their face either.

Dr. Shannon Bennett is on [Twitter](#) and [Instagram](#) @microbeexplorer. We are @ologies on both. I'm @AlieWard on both. Again, *100 Humans* premieres on Netflix March 13th. We've been working on this show for a couple of years. Sammy Obeid and Zainab Johnson, my cohosts and comedians are great, and wonderful, and you will love them, and I hope it gets you through some self-imposed isolation for safety.

Now links to all the good stuff we talked about will be at AlieWard.com/Ologies/Virology, and I'm going to put that link in the show notes. Ologies merch is available at OlogiesMerch.com. Thank you, Shannon Feltus and Boni Dutch, for managing that. They also have a comedy podcast called *You Are That*, which is great.

Erin Talbert admins the Ologies Podcast [Facebook group](#). Thank you, Emily White and all the volunteer ologies transcribers, for keeping these episodes accessible. Transcripts are available. I'll put a link in the show notes where you can get transcripts and bleeped episodes for kids in the show notes for free. If you ever need to hire a transcriptionist, email HireEmilyWhite@gmail.com. She is incredible.

Thank you to assistant editor, Jarrett Sleeper of MindJam Media and the podcast *My Good Bad Brain* for helping put all these clips together. And of course, huge thanks to editor, Steven Ray Morris of the dino podcast *See Jurassic Right* and the kitty-themed *Purrrrcast* for stitching it all together like one big sloppy genome. Nick Thorburn wrote and performed the theme music.

And if you stick around to the end of the show, you know I tell you a secret this week secret is that I have seen a lady walk out of the bathroom maybe twice in my life without washing her hands. I've witnessed this, honestly, maybe twice. And both times it was like seeing a ghost. I couldn't believe my eyes. I was like, "She's just cruised right out of here! Not even any water on her paws!" And I went back to my table at the restaurant, *I told everyone*.

This entire COVID-19 situation has truly alerted me to how much weird, sad, machismo prevents boys from washing their hands. So boys, we love you. Don't let it kill you. We just respectfully ask you to please wash your mitts. As our friends, the doctors Erins Welsh and Allmann-Updyke from *This Podcast Will Kill You* say: Wash your hands, you filthy animals.

Also, I want you to know that if you eat a lot of goat yogurt, sometimes your pits smell like goats the next day. It's so weird. Has that ever happened to you? But goat yogurt's so good.

Okay. Berbye.

[clip of silly karaoke-style singing of “My Sharona” with lyrics replaced about “My Corona.”]

Transcribed by

Mickey McG.

Emily Stauffer

Ariana Pedersen

Ellesse Oakes

Some links which you may find of use:

[Dr. Shannon Bennet’s CV](#)

[Real time COVID-19 cases via CSSE and John Hopkins University](#)

[NextStrain.org](#)

[NextStrain.org’s “Genomic epidemiology of novel coronavirus”](#)

[GitHub data sets](#)

[Is it from bats?](#)

[Pangolin: an intermediate host for SARS CoV 2?](#)

[Dr. Merlin Tuttle, bat expert](#)

[nCoV-2019 Spike Protein Receptor Binding Domain Shares High Amino Acid Identity with a Coronavirus Recovered from a Pangolin Viral Metagenomic Dataset](#)

[Kirkland, WA senior living center — 70 workers out sick](#)

[Don’t douse yourself with vodka](#)

[The 2009 H1N1 epidemic](#)

[CDC’s SARS CoV 2 guidelines](#)

[Trevor Bedford anti-conspiracy thread:](#)

[Donate your unused N95s!](#)

[What COVID-19 does to your body](#)

[COVID-19 deaths](#)

[Don’t make your own hand sanitizer, okay?](#)

[How many people die from the flu?](#)

[Biowarfare rumors](#)

[Conspiracy theories fact checked](#)

[Let’s not buy facemasks](#)

[Donate your facemasks](#)

[Bill & Melinda Gates tryin’ to get folks tested](#)

[Why telecommuting doesn't work for everyone](#)

For comments and inquires on this or other transcripts, please contact OlogiteEmily@gmail.com