

Vaccine Infodemiology with Jessica Malaty Rivera

Ologies Podcast

January 5, 2021

Oh hey, it's your college roommate who used to mix beer into Metamucil, Alie Ward.

The vaccine. Vaccines. Covid-19 vaccines. What is the what? Who gets it? What's in it? How does it work? When can people make out with strangers again? All good questions which we will get to.

But first, some thanks up top to everyone at [Patreon.com/Ologies](https://patreon.com/Ologies) for making this show a reality. You can join for one hot dollar a month. And thank you to everyone who has subscribed, and rated, especially reviewed the show, because you know that I read them like a goblin so I can select a freshie each week. And this one, it's from LittleGlassFox who said:

Thank you, Internet Dad (that's me) for this beautiful piece of Internet art. I am but a chicken nugget in the sweet and sour ocean of knowledge that is in Ologies.

Hop in, folks. Let's get sticky.

Okay, vaccine infodemiology. So, infodemiology: it is a real word and it is the science of managing infodemics, which is also a real word. It's an overabundance of information, some accurate and some not, occurring during an epidemic. Can you even believe that there is the perfect ology for these times and also the perfect Ologist? So, I was waiting for the right time to do another Coronasode and with the vaccines rolling out, I knew we all had questions. So, about four days ago, I all-caps asked this Ologist that day what her afternoon was like and she's a champ and hopped on the horn.

She is the SciComm lead at the COVID Tracking Project, which collects and publishes the most complete Covid-19 data available for the US and territories. It's helmed by The Atlantic, which is doing stellar pandemic coverage. Big shout out to Ed Yong, personal hero there. FYI: remember that this is a podcast. It is not an appointment with your doctor, so please seek advice from your own medical professionals when you're making choices about your health. Cool? Cool.

The first 20 or 30 minutes of the interview deliver some critical updates to Covid protocols, so please listen and spread the word on that. And also, we talk about how curves are measured, why testing before a gathering is not a good safety measure, fomites on surfaces, and more. And then, the vaccine talk.

Okay, so this Ologist you're about to meet is a microbiologist who got her Masters in Emerging Infectious Diseases from Georgetown University School of Medicine. She is also an infectious disease epidemiologist with the COVID-19 Dispersed Volunteer Research Network and an expert contributor for all kinds of news outlets. So, speaking from just a few miles apart in LA, we cover the curves, the spikes, how the holidays will affect the data, what to expect in the next few months, the difference between vaccines, how they work, mRNA, Tom Cruise, how many people need to be vaccinated in order to have widespread protective effects, why there is a vaccine hesitancy, historical fashion blunders, sore biceps, outdoor picnics and why it's not time yet to wistfully pack your masks in mothballs with this wizard of data, this matriarch of metrics and slayer of flim-flam, Vaccine Infodemiologist, Jessica Malaty Rivera.

Alie Ward: This is one of those that I am obsessed with already!

Jessica Malaty Rivera: My name is Jessica Malaty Rivera and my pronouns are she/her.

Alie: Great. Oh my gosh, I'm so excited to talk to you and I'm thinking that this would be the subject of vaccine infodemiology, would that be correct?

Jessica: Totally, yeah. You know, an infodemic is when there is an overabundance of information, some of it accurate, some of it not, that is occurring kind of simultaneous to an epidemic. It makes it really hard for people to find trustworthy sources and reliable guidance when they need it most. And they kind of go hand-in-hand with infectious disease outbreaks. I mean, since the origin of studying infectious diseases, we've seen that there have always been in-tandem outbreaks of bad information when it comes to an outbreak of also pathogens.

Alie: And so, have people been studying infodemiology since before the digital era? Like, were there pamphlets during the Spanish flu that were like, [*old-timey voice*] "It's actually transmitted by leeches!"

Jessica: Yeah! I mean, it didn't have the name 'infodemiology', but people have been tracking misinformation and disinformation for a long time. You could even go back to when the smallpox vaccine was derived, which was done through the process of variolation and they used cowpox virus to determine how to inoculate people, and there were rumors about people turning into cows if they took the cowpox vaccine. And, you know, of course they had to do counter misinformation campaigns to kind of correct public perception of things. It just didn't get named 'infodemiology' until much later.

Aside: So, these *cownter* misinformation campaigns came about because 'vaccine' itself comes from the work *vaca* for cow after Dr. Edward Jenner poked a farm boy in the late 1700s with a needle full of pus, giving him a mild intentional case of cowpox that also delivered immunity from the more deadly smallpox. This farm boy was the son of a landless laborer. His name was James Phipps and he lived well into old age.

Dr. Edward Jenner let Phipps and his family stay for free in a cottage which later became the Edward Jenner Museum. And on the property is a little thatched hut known as the Temple of Vaccinia where Dr. Jenner would chill, and write, maybe play video games, and would also administer vaccinations free of charge to the poor, none of whom turned into cows, just in case you wanted to cry a little every time you think of the word 'vaccine'.

Alie: What drew you to this field?

Jessica: Yeah, my background is in emerging infectious diseases and I love all things related to infectious diseases, including how they're talked about. I do a lot of science communication and, you know, when you are talking about science and when you're talking about infectious diseases, there needs to be a lot of precision about how you do so. Otherwise things get misconstrued and misinterpreted and then you end up dealing with two outbreaks. My work, years ago, was on a lot of vaccine-preventable illnesses and vaccines is a fraught space of misinformation and disinformation. And so, to kind of help advance my work as an infectious disease researcher, I had to also study the infodemiology that surrounds it.

Alie: Oof. Did you get chickenpox as a kid or did you get the vaccine?

Jessica: My parents sent me to school to get it! I remember that! I was a kid of the '80s, I remember when it happened. My parents were like, "You're going to school, you're getting the chickenpox, we're doing the Aveeno bath." [*"Itchy."*]

Alie: Oomph! Same. Yeah, we didn't have a vaccine for it. I grew up in the '80s too so it was like, "You're gonna get it at some point. Get it into your system to get it out of your system," essentially.

Jessica: Yeah.

Aside: Okay, PS, the chickenpox vaccine was developed in 1985 but it would be another decade before it entered the arms of American littles in 1995. Japan and Korea were early adopters, they got it back in '88. Side note fun fact: shingles, that excruciating swath of blisters that erupts across your chest and armpits is caused by the same virus, so if you had the chickenpox vaccine, you likely will not get shingles. But if you had chickenpox, you can still get shingles later in life unless you get a vaccine for shingles. Isn't it fun that there's a party in your body?

Okay, so if your kids are pissed that you couldn't get them a PS5, just remind them that you had to walk uphill both ways covered in crusty blisters and then start crying about shingles. That will make them disperse, unless they're future vaccinologists, or immunologists, or vaccine infodemiologists.

Alie: Growing up, were you ever kind of morbidly curious about these kinds of phenomena, or history, or anything like that?

Jessica: You know, as a kid I always loved science and I thought I would actually be a doctor, and to my parents' dismay I decided to not become a doctor [*laughs*] and just do research instead. And honestly, I think it worked out for the best because at the heart of my, kind of, hesitation is that I'm a giant softy and so I don't think I could have handled the clinical side of it. [*laughs*] I'd really much rather have separation by computer screen.

Alie: And when it came to doing your thesis and getting your master's in this, how did you decide what you wanted to really focus on for that?

Jessica: Yeah, so back in the early 2000s, I was recruited to be part of this group at Georgetown that was in the School of Medicine, funded by the government, and it was in the Division on Integrated Biodefense.

Aside: Remember: on the heels of 9/11 and Y2K, the early 2000s was an era of quiet chaos, face rhinestones and low-rise cargo pants with whale-tail peekaboos. There was a lot to fear.

Jessica: It was essentially a contract to track emerging threats that were in animals, plants, humans, to essentially predict the next pandemic. So we were tracking everything in about 50 languages all over the world. Outbreaks of Ebola, outbreaks of, you know, influenza, in fact our team detected the emergence of the 2009 H1N1 pandemic in Mexico. A lot of people have been saying 'it's not a matter of if, it's a matter of when'. We've been saying that for a long time, so very unsurprised that we're in the situation we're in right now. And my work at Georgetown led me to the program at Georgetown where I got my Master's in Emerging Infectious Diseases.

Alie: And when you first heard the news about SARS-CoV-2, [*news report: "Tonight, US airports on high alert, screening passengers for symptoms of a deadly new virus."*] do you remember where you were or what you were doing when you first heard, "Yeah, there's some virus but it's..." you know. What did you hear?

Jessica: I remember it was kind of mid-December when we were hearing whisperings of it. The first thing I did was look up some of my professors to see if they were tweeting about it,

and some people that I know in this space. And you know, there were some kind of raised eyebrows and like, “We gotta follow this, we gotta see what’s going on.” But I, like many people even in this space, January and February was like, you know, “It’s probably just going to be a respiratory virus, if it’s like SARS-1, you know, it may kind of die out in a bit.” I did not expect in the very beginning for it to be such a devastating global pandemic with so many confounding factors. It wasn’t until the first week of March, and I remember the day was March 8th, when I was like, “Oh shit, this is actually happening.”

Alie: When it comes to SARS-CoV-2, this is such a huge question, but we’ve been riding this since March, obviously, and you know, 300 000 deaths now in America only; where are we at with this virus in terms of a curve, and how do you track that? I mean, you are heading up *The Atlantic’s* Covid tracking, how do we even measure that?

Jessica: You know, we’re in a really bad place, to be completely frank. We are kind of in the thick of what is a terrible surge that’s reflected in our case data and especially in our hospitalization data. The amount of people that are in the hospital right now is a record high and we’re seeing a number of hospitals throughout the country sounding the alarms that they are at their breaking point. ICUs are either at full capacity or nearing full capacity.

And you know, the data kind of flows in a very linear direction. You have an increase in cases, you expect an increase in hospitalizations and then eventually some deaths to follow. Considering the lag in the data, you’ll probably see them a few weeks after hospitalizations start spiking, so we’re about to see, unfortunately, a lot more loss in the months of January and February. I think that that is going to be very sobering, especially in light of the fact that now we have two vaccines available. We’re still going to have to go through some dark days before we can start seeing the light at the end of the tunnel.

Alie: And what is different about this wave than initial waves? I know nobody is, at this point, hoarding hand sanitizer and up-charging for N95 masks, but why are we seeing these kinds of devastating losses when we’re this far into it?

Jessica: There are so many reasons for it. I will say that there is a degree of seasonality to consider here, and what I mean by that is, you know, when there’s cold temperature it drives people indoors, and we know that indoor activity is very high risk, especially unmasked indoor activity. On top of the fact that it’s the holiday season which is another reason why people end up congregating indoors. And so, those two things are kind of, you know, some of the main reasons why flu season is seasonal, it drives people indoors with cold weather and holidays, et cetera. There’s also a degree to which the virus can transmit better in these kinds of climate.

The social aspect of it too is that people have pandemic fatigue, which is a completely understandable sentiment, especially now that we’re ten months in and a lot of people have been like, you know, “I’ve sacrificed a lot, I’ve canceled trips, I’ve postponed weddings, and deferred all these things, and for what?” And this is the part of public health that’s so tricky: you don’t see what you’re preventing, because you’re preventing it, right? And it’s really hard to see the fruit of something that just seems really painful, and it’s about encouraging people to, you know, remember that their sacrifices are not in vain.

Alie: And now, you deal with infodemiology, maybe too much information that can be conflicting. There was a study that came out maybe two months ago about masks, and

essentially the 100-character headlines were: “Study Proves that Masks Aren’t Effective at All.”

Aside: So, for a little more background, at the beginning of this pandemic, scientists weren’t sure if masks were going to help. Then they were like, “Yes, No... Totally...Yes.” In late November another study blared from the headlines saying that masks didn’t halt the spread of SARS-CoV-2 or Covid-19.

Wait, what?

In the age of, “I read the tweet, so I pretty much get the article,” a lot of folks got confused. Now, the headlines about masks not being effective were about a Danish study, and if you read the actual paper it explains that masks *DO* help prevent the spread of Covid-19, but just that participants just didn’t use their masks correctly or frequently enough. But more people read and retweet splashy headlines than actually click the story. [*sigh*]

So, is exasperated mask chatter common among infodemiologists?

Jessica: Yeah, that’s such a great question. Honestly, a group of researchers and myself just submitted a paper on how public trust shifted because of the conflicting messages on masks. I think in many cases, masks being the primary example, a lot of scientists have just been in damage control mode because of how poorly we spoke about Covid-19 and ways to prevent Covid-19.

To come out swinging and saying, “Don’t buy masks, don’t wear masks, masks don’t work,” to a 180° of, “masks do work, masks prevent transmission,” created a lot of legitimate confusion and distrust. To rebuild the trust has been an upward battle because it just gave enough of the people who are the pandemic-denying type just enough ammunition to sew discord and create more division.

Alie: Were there plague deniers? Were there Spanish Flu deniers? Were there Cholera deniers?

Jessica: Absolutely.

Alie: There were? Okay.

Jessica: Absolutely. In the 1918 pandemic influenza, there were anti-maskers. There were anti-mask clubs in San Francisco. [*“That is the worst idea I’ve ever heard in my life.”*]

I mean it was a thing. You have to think about this in the sense that humans haven’t evolved too much. Skepticism is something that is a common sentiment. Fear is also a common sentiment. And honestly, infectious disease outbreaks is scary. There are a lot of unknowns. I think when that happens, the emergence of snake oil salespeople, and people who are trying to kind of create alternative responses to “mainstream media,” or whatever it was, newspaper publications, back in the day. They come out of the woodwork because they’re trying to make sense of the chaos.

Aside: See a certain modern wellness brand proving that it can sell rocks to shove into your cooter for \$66, then got sued for selling them. Then continued to sell them. So, I can imagine that actual snake oil face serum would sell like organic, non-GMO, hot cakes.

Jessica: The field of emerging infectious diseases is not new. It’s been of federal interest for a long time. But we’ve just devalued it and defunded it for so long, taking away from the research, taking away from public health. That it put us at this very vulnerable position where pandemic preparedness was an afterthought.

You know, looking back as somebody who worked on pandemic prediction, it kills me because a lot of people are like, “Why don’t we have a weather forecasting system for diseases?” And I keep saying, “We did! We had it. It was funded.”

Aside: Just heads up, the National Security Council’s Directorate of Global Health Security and BioDefense was dismantled under John Bolton in 2018. So, it was funded...

Jessica: ... and then it wasn’t. In so many ways, we are still dealing with the consequence of devaluing public health as a country. I mean, the Covid Tracking Project started because we were trying to find data on testing that just wasn’t publicly available in one place. So much of why this virus went so rampant in our community was because we didn’t have an infrastructure for testing and then related contact tracing that could have stopped new outbreaks.

Aside: And if you’re wondering, “How much worse is Covid-19 than the flu?”

Well, the influenza death toll in 2019: 34,200 Americans. Covid-19: around 350,000 and counting. With lockdowns, and masks, and hand sanitizer, and everything cancelled.

So, Covid-19 why are you like this?

Jessica: I think that this one is unique in the sense that it is highly infectious and has caused a number of ailments beyond the asymptomatic transmission which is, of course, confusing and frustrating. These completely unknown long-term effects and the duration of these long-term effects is what makes this especially concerning.

It’s not just one of those diseases that leaves you when you fully recover. In fact, ‘recovered’ is a term that is very problematic when we talk about Covid-19 because, what does recovery even mean? There are people that are months out of their diagnosis who are still dealing with cardiovascular issues, and lung damage, and neurological issues. So because of that, it makes this so much more of a Pandora’s box than any other coronavirus we’ve seen.

Alie: I know we have much more readily available tests than we did in March and even through May, but how are you looking at the data and saying, “Okay, well we didn’t have a lot of tests, so how do we know how many cases that we had, versus now, versus how virulent this strain is?” What kind of numbers are you crunching?

Jessica: Yeah, that’s such a good question. One thing that we try to emphasize with the data is that no single metric can be looked at in a vacuum. They are all pieces of a puzzle that you need to look at together because one metric by itself doesn’t tell the whole picture.

So in the beginning, we didn’t have a lot of testing. That definitely influenced the number of cases that we were able to see and, kind of, the scale, the proportion of which people were hospitalized and dying. Right now, testing has increased, but we’re still not testing enough. In fact, we’ve never tested enough.

The Harvard Global Health Institute has estimated that we should be doing *millions* of tests per day in order to out-test the virus so we can get to what they call ‘suppression levels’ of disease response. And the data requires some caveats and some context, saying, “Okay, if you compare what’s happening today to March, you have to remember that back in March there wasn’t a lot of testing and right there is a lot of testing.”

But that also causes people to make incorrect causal claims like, “Oh, we’re seeing more cases because we’re testing more.” But if you look at the charts, if you look at the slopes of

these lines, a lot of times you will see that cases are outpacing the growth of tests. Which is, again, reinforcing the fact we're not testing enough.

Aside: And Jessica says that even with enough tests there's still the aspect of infodemiology of the disease surrounding the positivity rates. So, it's important to compare apples to apples to get a comprehensive view so you're not cherry picking the data that has better optics and using it to justify policy change.

So, in a country that's not super big on the metric system or Celsius, what kind of metrology are we talking?

Jessica: Some jurisdictions will define tests as unique people. Or as specimens, or as encounters. Those can mean different things, so one data point can be reflected in different calculations as different things. You can have an individual who is testing positive on Monday, but he had six samples collected in that week. So, is he one test or is he six specimens?

And it's making sure that we understand how each state and jurisdiction defines the terms, and then can make those calculations accurately. I think where it gets really tricky is when you try to compare the metrics. When you try to say, "this state looks like this and this state looks like that," when, if you look at the way that they're doing their math, it's different. However they record it could work for them, but it also makes comparisons less clean because of that.

Alie: Yeah, that makes sense. One versus six? That's a big ol' difference.

Jessica: It is. Yes, exactly.

Alie: Now, testing. I noticed in LA that the lines before Thanksgiving were absolutely bananas. I got exposed before Thanksgiving, so I ran out to get a test, which was not fun. Lines were crazy, so I assume a lot of people were getting tested before family gatherings so they could say, "Hey, I'm clean. Let's eat some mashed potatoes."

How is that affecting the case rates? Because you can test negative and still have it, and just not have enough to show up on a swab. What's happening?

Jessica: Yeah, it's really important to remember that you don't test to justify a change in your behavior. All a test result is telling you is if there's a presence of detectable virus at the moment of testing. That's it. It doesn't tell you anything about the rest of your day or the future.

Testing as a strategy is not truly an effective way to control the disease. It's really kind of a diagnostic for that moment. That's why it needs to be considered in tandem with things like proper quarantine so you can reduce your likelihood of having virus that's not detected when you get tested and you end up doing what you were going to do.

So, it was a very flawed strategy for a lot of people to test and travel. We even saw some places, I think it was in South Carolina, where they even created a slogan like, "Take a test to take some turkey" or something like that. Or "test to turkey." And I thought that was just so misguided because it's telling people that this is like an immunity passport; that a negative test was somehow a license to do whatever you wanted to do. And that's just not the case. Detectable virus could have been detected later that evening or you could be exposed the moment that you walk out of the testing clinics.

So, in the process of traveling itself is kind of where the risk of exposure is greatest. So we are definitely seeing an impact on the data from Thanksgiving in a number of places. Unfortunately, right now the data is still a little bit shaky because we just finished the Christmas holiday and we're about to go into the New Year holiday. So, the data itself is going to be pretty whacky for the next couple of weeks and also negatively affected because of people's behavior during the holidays.

Alie: Right. I imagine if more people are traveling they might not be getting tested during that week too. Or the testing facilities are closed around New Year's or Christmas.

Aside: So, I'm recording these asides in my closet on January 5th, 2021, and currently the global death toll is 1.84 million, with the US, of course, leading those numbers.

Now, according to CovidTracking.com 125,544 people in the US are hospitalized for Covid-19. Some of them, as reported by the LA Times, dying in hallways. Now, that is the wide, wide angle lens. Let's zoom in to life's minutia with one question you'll likely have.

Alie: Should we still be wiping off our groceries?

Jessica: I get this question, honestly, probably every day.

Alie: [laughs] I'm sorry.

Jessica: No, no, it's a legitimate question. So, I always say, personally I don't. I found it to be wasteful of the resources that we're using to clean things like all the spills that my children have around the house during a normal day. I'm like, "I don't need to be going through these things faster!" If I feel, like, concerned if there was somebody who just recently touched it like a delivery man, what I'll do is usually I'll just wash my hands after I handle the package, just out of an abundance of caution.

But what we know from the data is that fomite or surface transmission is not a main driver of infections. The main driver of infections is prolonged exposure to a confirmed case. So because of that, I think that it can make people just chill out a little bit and not worry so much about touching things and getting sick from that stuff.

Alie: By prolonged exposure, is that defined as like, 15 minutes in a 6x2 room, or 20 minutes in a 10x10? How do they figure that out?

Jessica: Unfortunately, that's also a variable calculation. So, the CDC changed their metric for what is considered prolonged exposure. Now, it's 15 cumulative minutes with somebody who is a confirmed case in a 24-hour period. It used to be 15 consecutive minutes.

Cumulative is very easy to tabulate because if you were around somebody, working with somebody, and they were intermittent interactions in a kind of total 15 in a full 24-hour period, that's considered exposure. But again, some jurisdictions define it differently.

I would say that it's usually an extended period of time. Several minutes, much more exacerbated by lack of presence of masks. That is going to be the main driver of infection, that you are exposed to a direct person.

Alie: You know, I think that one thing that's funny is that human beings are so used to getting together to eat or drink something. So it's like, "I haven't seen you in a while. We're just going to eat outside." The *one* thing you can't do with a mask is smell roses and eat stuff.

So, do you think that part of the driving of these exposures is that we are trying to gather to take our masks off to eat?

Jessica: Yeah, I think that there's a lot of activity that's happening that's causing people to cut some corners. I'm actually reminded of a few weeks ago, the Mayo Clinic reported that 900 people in their staff were exposed to the virus or tested positive. They were saying that it's probably directly linked to their eating quarters, the cafeteria in the facility, because that's where people were eating. And you're like, "It's so easy for that to happen!"

Yes, outdoor dining is definitely going to be on the safer end, but if you're doing it at the same table inches away from each other, I think that people get really kind of legalistic about the six-foot rule. They think that if we're six feet or more that droplets can't transfer. But they absolutely can. I mean, it's a relative space of when we think droplets usually fall to the ground from gravity, but droplets can travel much farther. If there are different conditions in the air, like wind, that can take them even further.

So, it's not a fail-proof system to be just eating outside to avoid transmission. In fact, I would be much more comfortable if people just kept their masks on and, like, socialized with masks on the whole time and avoided putting things in their mouth while they're with other people, because when you do that you let your guard down, you take sips, you eat, and that's where the exposure happens.

Alie: Now, vaccines. Let's talk about 'em. I think from the beginning, we were like, "As soon as this vaccine rolls out, I am going to a foam party, I'm going to host a rave." That's not quite how it works.

I have not gotten one yet. I'm not in that top tier of frontline workers, as someone who hosts a podcast that I record in a closet. Can you tell me a little about vaccine flimflam? What do we need to know? I know that there's a Moderna one, there's a Pfizer one. How are they working?

Jessica: I'll start by saying that I get choked up every time I talk about this because it just exceeded our expectations. I remember early in the spring when the FDA was trying to come up with some of the guidelines, of which they were saying, "If it is at least X, then we will approve it." They were shooting for 50% efficacy, which is around the ballpark of the flu vaccine. The fact that we have two vaccines that are over 90% effective literally gives me chills. It's just so, so spectacular, and I think that that is something that should cause people to not only feel relief, but also just great expectation for what's going to happen, assuming though, that the vaccines don't just stay effective in their vials.

Vaccines are one thing, vaccinations are another. We need people to take the vaccine, and that's how we're going to see the efficacy data in practice. There's a lot of misinformation when it comes to these particular vaccines, namely on the technology that was used for the vaccines, which is not technically very new. We've been studying mRNA vaccines and the research behind this for decades. They've been in trials in various forms for a number of years, so it's just because we had this concentrated effort that didn't have any of the red tape and the bureaucracy that slows down clinical trials. It was like the best-case scenario for a group project: all hands on deck, everybody did their part, no distractions. We got to the end, and we had amazing results.

Alie: Is it true that one of the vaccines was, kind of, developed within 48 hours but it took a lot more testing?

Jessica: Yeah. When we got the full genome for the virus early in the year – I think it was January 11 when we got the full sequence from China – within 48 hours, Moderna was able to derive what would be the prototype for their mRNA vaccine.

Aside: More on mRNA in a minute.

Jessica: Several weeks after that – I think March 16 – was the first dose of the first Phase 1 trial. We are talking about record speed. And that’s one of the major advantages of mRNA: it’s so easy and quick to produce. It allowed us to go straight into Phase 1 with the pre-clinical stuff happening at the same time. There were no steps that were skipped. It allowed them to get into clinical trials very soon after that isolation.

Alie: Do you know who got it? Do we know who the first sticky-pokey was?

Jessica: Yes, we do, and I remember the picture.

Aside: Okay, so, I looked up the photos from March 16, 2020, when most of us were still dubious about this disease’s impact and were considering it, at most, a one-week stay-at-home order to maybe binge through our Netflix queue, or Marie Kondo a closet, or wringing our hands at tweets saying that [*fancy voice*] Shakespeare flourished during the plague.

But on that day, Jennifer Holler, a 43-year-old mother of two, wore a tank top, a tattoo gracing one shoulder, she has a wavy bob. She seems like someone I would’ve hung out with in college, maybe sneaking off with to see The Cure (no pun intended). Anyway, on March 16, 2020, she sat on the edge of a doctor’s table outside of Seattle and became the first human Covid-19 vaccine recipient. She said about the experience:

I wanted to do something because there’s so many millions of Americans that don’t have the same privileges that I’ve been given.

I want to make her a Bundt cake and give her a gloved high-five and the non-shot arm. Now, if all of this was going on way back in March, why have I been wearing pajamas nearly every day for a year?

Jessica: The clinical pipeline varies, and in general it takes about 10-15 years sometimes for things to go from bench to market, and that’s because clinical trials take a long time, they’re really expensive, and sometimes you don’t get as much enrollment in them as you want. Those are all the issues that were directly addressed with the unfortunately-named Operation Warp Speed. They were fully financed. They had tons of money to keep them from having any interruptions going from phase to phase. There was a *ton* of interest. People were very enthusiastically enrolling to become participants. There were no bureaucratic steps that needed to be dealt with. A runway had been paved prior because of all the research.

Aside: Hey, just a little data. 95% of people named Me can’t say mRNA on the first try so feel free to celebrate this with a tiny imperceptible butt dance, or just enjoy my failures.

Alie: And, when you talk about [*stumbles*] mRNA... mRNA! Oh my gosh, I can’t do this. [*Alie and Jessica laugh*] When you talk about [*slowly and carefully*] mRNA vaccines and that we’ve had them for a while, can you explain a little bit how they work and why people, kind of, have eyebrows raised about them more or are curious about them?

Jessica: Yeah. So, people hear mRNA and they immediately think, “Oh, that’s genetic material. That makes me think of genetically modifying things. That means it’s going to change my DNA,” and then you quickly end up in the “5G/GMO/tracking microchip” conversation that is just so scientifically not the case; it’s just straight out of fiction.

But I can understand how that can be confusing because a lot of people don't remember things like mRNA, and what RNA does, and what DNA does. To put it simply mRNA essentially is, giving your body a message. It gives your body a cheat sheet like, "This is what the spike protein looks like. You should make the spike protein so if you see it again, the actual virus, you can fight it." That message, I can't remember who said it but someone had a tweet that was like, "Think of it like a Snapchat message. It disappears after some time. It sends you the message and then it's gone," and it gives your body the framework to build it.

I think an important detail about the biology of this too is that the mRNA goes in and is in the cytoplasm. It doesn't actually enter the nucleus of the cell, and the nucleus is where the DNA is. The mRNA and the DNA of your cells do not interact at all. It is not possible to modify our DNA. I think a lot of people are really stuck on the genetic material, but in fact, all viruses have genetic material. There are RNA viruses, there are DNA viruses. What happens when you get a viral infection is that the virus injects its genetic material into your cells and tells the cells to make more and explode more infected cells out of the original cell, the host cell.

So, it's language that people are familiar with but don't really understand the details of how it works. It's in fact extremely safe, and very affordable to produce, and is probably going to be a new frontier for vaccine development.

Alie: Is this the first time it will be widely used? What's the corner we've turned with it?

Jessica: This is the first time we've had an mRNA vaccine advance to this level in clinical trials and have at least Emergency Use Authorization. They're going to continue for full authorization, they're going to continue being evaluated, but there have been attempted trials for things like Zika, and even the flu, and rabies.

Aside: So, yes, we've been working on mRNA vaccines for other viruses including the one that causes mono. The fragile messenger RNA is protected in a little fat bubble, and those disappearing instructions tell our immune cells, "Hey, build the spikey proteins that are the hallmark of this coronavirus," because 'corona' means 'crown', which would be cute if it weren't so deadly. Our cells then churn out this little spikey protein, our immune system sees them and builds antibodies to have in its arsenal in case we get the real SARS-CoV-2 in our system.

Now, previously, vaccines have schooled our immunity not through this messenger RNA but via inactive or dead viruses like in the polio and flu vaccines. Although, 'attenuated' or milder live viruses, like in the chicken pox and measles, mumps, rubella vaccines, also exist. There's also toxoid vaccines with inactive toxins like the tetanus vaccines. There's heterotypic vaccines in which you're inoculated with one type of disease (i.e. cowpox) to protect against another (i.e. smallpox). There are also recombinant vaccines, and those use an organism with the DNA of a different organism. Those are being explored for an Ebola vaccine.

These Covid-19 vaccines are, yes, the mRNA type which is exciting because rather than give you the whole virus, it's just telling your cells, "Hey, make examples of this protein and then antibodies to match. Keep an eye out for these spikey bastards," is what it's telling your cells. Now, if the mRNA vaccines have been in the works for rabies, mono, and Zika, why are these Covid vaccines the first to be approved?

Jessica: Because those situations are not nearly as emergent as SARS-CoV-2, those pipelines weren't as financed and prioritized because they weren't as severe. But because we are in a public health emergency and because this virus wasn't slowing down, it wasn't dying out the way SARS-1 did, or even the way Zika subsided in its severity, it continued on with full force.

Alie: When it comes to the difference between Moderna and Pfizer, is this a Pepsi/Coke situation? Is this a Mr. Pibb/Dr. Pepper, same difference? And who gets what?

Jessica: I don't think that we're going to be in a consumer market when it comes to these vaccines. I think it's going to be based on what is shipped where and what is available to you. Both of these vaccines are excellent. The differences between the two are so nominal and don't actually affect the recipient much at all. In fact, I think the bigger thing is the logistics of storage, where Moderna has the advantage of being stored at warmer temperatures and is much more durable in the refrigerator for a longer period of time. I think it's more of a logistical advantage, but when it comes to the physiology and what it does to the body, these are both amazing vaccines with very similar safety and efficacy profiles. [*"Bring it on."*]

Alie: Do both of them need a second shot weeks later?

Jessica: Yes, they both do. Pfizer is two doses separated by 21 days and Moderna is two doses separated by 28 days. That booster – that second dose – ensures that we get that full efficacy measured. One dose is not sufficient. If people think that that's the case, that would be really problematic. We really need people to have the complete dosage to ensure we're seeing the maximum effect of the vaccine.

Alie: And when are Normal Joes who are just podcasting in their closet... When do they get stuck with it, in a good way?

Jessica: You know, I've had the expectation that I, as a healthy average-aged adult, will probably not get vaccinated before the end of late summer or early fall of next year just because there are so many logistics that need to go in place to get all the priority people vaccinated first.

We've seen about two million doses administered, but we've already seen 11 million doses shipped. That already is raising a red flag to me about the efficiency of how we're getting to these priority groups. We need to make sure that all frontline healthcare workers get vaccinated, that people who are living and working in long-term care facilities are protected. Long-term care facilities represent 1% of our population but 40% of Covid-19 deaths. That is an absolute tragedy. We need to be protecting those vulnerable populations. Then in a trickle-down effect, going from elderly people, to people who are at-risk for severe outcomes, then to Average Joes and Janes like us.

Alie: I have so many questions from listeners. Can I lightning round you?

Jessica: Yes, of course.

Aside: A thunderstorm of lightning round in just a minute, but first, we donate to a charity of the Ologist's choosing. This week, Jessica requested that it go to 500 Women Scientists whose mission is to serve society by making science open, inclusive, and accessible, and transform society by fighting racism, patriarchy, and oppressive societal norms. You can find out more about them at [500WomenScientists.org](https://www.500WomenScientists.org) which is linked in

the show notes. That donation was made possible by sponsors of the show who you may hear about now.

[*Ad Break*]

All right, [*in a sing-song voice*] let's give your questions a shot.

A lot of you had the same question about the percentage of folks needing to be vaccinated including Emily Okerlund, RJ Doidge, Emily A, Amanda Kriss, and Nicole Wackerle.

Alie: So. Many. Questions. Audrey Leger asks: Possible outcomes if a large percentage of the population refuse to get vaccinated or just fail to return for the second dose of the vaccine?

Jessica: Such an important question. When it comes to vaccines, that is the only context in which we can talk about herd immunity. I know people were so desperate to achieve herd immunity in the context of natural infection, but herd immunity is specific to vaccines. The measles vaccine is one of the most effective vaccines we have; it's over 95% effective. And when we have the population dip under 90% vaccinations, we start to see outbreaks. That is informing how we're determining what the threshold is for Covid-19.

Now, nothing compares to the way measles is infectious. It lingers in the air for hours; that's why you get advisories if somebody has passed through LAX with measles because it can persist in the atmosphere for a while. That's not necessarily the case for Covid-19, but because it is so lethal, and problematic, and disruptive, the thresholds I've heard have been anywhere from 70-85% of the population. That's a lot of people.

We have 330+ million people in America. I've heard at least 200 million will need to be vaccinated – fully vaccinated – in order to get any sort of semblance of herd immunity. It is concerning that vaccine hesitancy is a persistent theme that could prevent people from getting any doses. It's also concerning that people might also not complete their dosage which would not ensure full protection for the person being vaccinated.

Alie: Do you have any stats on how many folks out there – at least in America – are like, “Nah, I'm good”?

Jessica: There have been a number of studies or polls that have been done. I've seen various percentages. I've seen 30%. I've seen 40%. One poll said 52% which made me fall out of my chair.

Alie: [*high-pitched voice*] Whuuutt.

Jessica: You have to also remember that vaccine hesitancy, that's not a monolithic community. There are a number of communities – and I would say mainly Black communities and people of color – who have legitimate reasons to distrust the medical community because of reasons like Tuskegee, gynecological experimentation on Black bodies, even what happened with birth control studies in Puerto Rico.

Aside: So, an all-too quick but very important aside, in case you're not familiar with these historical crimes. So, the Tuskegee experiment was conducted in the US from 1932 to 1972 and it was run by the US Public Health Services and the Center for Disease Control. It observed the effects of untreated syphilis in 600 Black men – men who were told the study was for six months, but it lasted 40 years. They were told that they would be treated for the condition, but they were lied to. They all waited for healthcare

promised to them, but it was withheld so that scientists could simply observe how they died. 128 of them did, from complications.

Also in the US, over 60,000 people, typically of color and suffering financially, were forcibly sterilized between 1907 and 1963 under eugenic legislation. And fast forward to now, when systemic racism still puts people at risk, and higher proportions of Black, Latinx, and Native populations are dying from Covid.

So, before side-eyeing those who side-eye some medical procedures, this history, context, and outreach is really important.

Jessica: You know, these are legitimate reasons that have caused the institutions of pharmaceutical companies and medical institutions to become untrustworthy. That's why I think that this enormous vaccine campaign that none of us in our lifetime have ever experienced or witnessed needs to have as tailored and as concentrated of a vaccine communications campaign, too. And with very tailored messaging for communities that may have various reasons for distrusting the vaccine.

Alie: What's the best way to get the information out into the communities that need it the most?

Jessica: Yeah, it's not a simple answer, because I think, again, these communities... even these communities within the communities are not monolithic. I think they have various degrees of trauma and distrust and confusion because of the messages that have been put out.

I think that when it comes to Covid data, it's already bad, but we already know that it's not even complete. This is like scratching the surface. Our demographic data is so inconsistent from jurisdiction to jurisdiction that what we *think* we're seeing is that Black people are dying at a rate that's at least two times greater than white people in the United States. That alone is just an indication of a widespread problem when it comes to equity, and access, and care in the United States.

That being said, I think that kind of messaging needs to come from community leaders. I think we can't just be having top-down, white leaders speaking to everybody with one message about the safety and efficacy of it. I think it has to be from Black leaders in science, and Black researchers, and other people of color who are in positions of leadership, and even community leaders. I'm talking everybody from church leaders, mosque leaders, and barbershop owners. Everybody, so that it's becoming a community conversation.

I think it's also important to know that this is something that needs to change when it comes to how we even do clinical trials. Very early on in the Phase 1 data, the representation in those trials was really bad. And I was encouraged to see that in the Phase 3 data we had... I think it was 10% representation with Black people in Phase 3 data and 20% in the Latinx community, and we just need more of that. We need more people to participate and to be part of this process. And I love seeing the advocacy for that.

But it's shaping the narrative to be a little bit different. Instead of saying, "They are not trusting," it's saying, "The medical institutions are not trustworthy." How do we rebuild that trust? And I think it's through leading through example. It's putting people of color in positions of leadership so that they're running it. I think Dr. Kizzmekia Corbett is a perfect example of a champion for this. She was the lead researcher at the NIH for the Moderna

vaccine and has been a huge advocate for representation in trials and even representation in the vaccine and making sure that communities of color are getting the vaccine.

Alie: Yeah. She's [*in a singsong voice*] amazing!

Jessica: She's amazing.

Alie: She should be [*sings*] followed on social media, immediately. [*laughs*]

Jessica: Yes. Everyone follow her.

Alie: Yeah. She's great. I'm hoping to get her on for a Vaccinology episode when things calm down just a tiny bit. She's got kind of a lot on her plate at the moment.

Aside: We are fawning over 34-year-old vaccinologist Dr. Corbett, aka @KizzyPhD on Twitter, whoms you should follow immediately. BTW, her Twitter bio says, "Virology. Vaccinology. Vagina-ology. Vino-ology. My tweets are my own. My science is the world's." So yes, you'd better believe I am crossing all of my fingers that one day I get to quietly fangirl into a mic with her. She's all over the news for being just an incredible vaccine badass.

Also in the news, a New York Times article published last week brought up the lopsided distribution of vaccines, saying:

The world that emerges from this terrifying chapter in history will be more unequal than ever. Poor countries will continue to be ravaged by the pandemic, forcing them to expend meager resources that are already stretched by growing debts to lenders in the United States, Europe, and China.

A lot of folks, namely Deborah, Lydia Zimmerman, Anne Hardtke, Natalee Bates, and first-time question-asker Mado Christie had questions about this.

Alie: And a lot of folks, on that equity tip, wanted to know: How do they make sure that everyone has equal access to this, even around the world? In terms of making sure that, yeah, it's not just the privileged that get access to this.

Jessica: Yeah. So one of the goals of Operation Warp Speed was that the vaccine would be free to everybody in the United States, regardless of insurance status, which I think is a good goal. I hope that in practice that actually happens. I've heard something about maybe the dose itself is paid for but the vaccine administration is something that is paid for like a copay. I hope that that's not the case, but the intention was that there would be free vaccines available to everybody in the United States.

Now, there is a very real issue of vaccine deserts that exist in the United States because of rural places, and even vaccine deserts all over the world. And I think that that is one of the challenges of having these vaccines that require such cold storage. I think Moderna was thinking ahead, in the sense that they wanted something that was more shelf stable, or I guess refrigeration stable, and much more affordable to ship. But these are really expensive logistics. And the cold chain process of administering and delivering vaccines and other drugs to remote places is really complicated.

I mean, we have seen war in Pakistan and Afghanistan be directly linked to polio resurgence because they couldn't get the cold chain all the way through without it being disrupted because of lack of refrigeration, lack of power. That's a very real concern when it comes to access globally for the vaccine.

Alie: So if someone just doesn't leave a hot truck on a loading dock full of...

Jessica: No, they shouldn't. *[laughs]*

Aside: So, patrons Deb Berlin, Rosa, Amanda Mueller, Leanna Shuster, and Rachel wanted to know, in Rachel's words: Why do different vaccines need different temperatures? And other very... chill... questions.

Alie: Can you explain, briefly, what the cold chain process really means? Why these vaccines have to be so chilled?

Jessica: Yeah, so the mRNA vaccines have to be stored at extremely cold temperatures because mRNA itself is very fragile. It degrades easily when it's outside of its normal environment inside the cells, right? So think of it like food. If you take meat out of an animal, it's not going to just be okay outside. It needs to be refrigerated to preserve it. And because it is so fragile, it needs to be stored at such a cold temperature. Now, what they did in making it less fragile – previous iterations of mRNA vaccines proved to degrade much faster – they created these lipid layers outside of it, these fat layers to make sure that it was a little bit more stable.

I've gotten a lot of questions from people, like, "Oh, can our bodies take injections that cold?" It's not administered frozen.

Alie: Oh!

Jessica: It is thawed and it's given to people at normal temperatures. It would not be injectable. It's a liquid, so it would need to be thawed first before it's injected into our bodies.

Alie: René Fuentes had a question: I heard that one of the Covid vaccines prevents symptoms, and the other may also prevent transmissions. So what mechanisms in the vaccine could account for and contribute to the difference? Are you still contagious if you've had the vaccine?

Jessica: Such a good question. And it's not necessarily the mechanism that we're looking at. It's how the study was designed. So, the Moderna vaccine trial ended up having some data that showed that asymptomatic transmission was reduced because they *looked* for it. It's kind of like a project where you put out all your questions that you want to answer and you collect the data that you were able to answer.

Pfizer didn't have that on theirs, but it's not to say that it's not. It's intended to do both. It's intended to prevent severe illness, because what we want to do is avoid people going to the hospital and dying. But it's also intended to prevent infection; primary infection and secondary infection. The real way to know that is through real life and the way to measure it in a trial would have been to do a ton more testing to see who was testing positive and if they were getting sick or getting others sick.

Aside: So Jessica reminds us that these trials were designed with the priority of reducing severe illness, and they're going to be analyzing this data for a lot longer and observing the duration of the immunity. Now, Phase 3 trials involved tens of thousands of people, and they found that the vaccines prevented severe illness in around 95% of them. That's huge. And remember, these rates were determined 7 to 14 days after the second dose. So by no means is someone in the clear if they've just gotten the first shot.

The CDC says that no matter how your body learns about the enemy, whether it's through attenuated live virus, or dead viral strains, or in this case, mRNA protein-building

instructions, the body is left with a supply of memory T lymphocytes, as well as B lymphocytes that will remember how to fight the virus in the future. And the CDC says it typically takes a few weeks for the body to produce the T lymphocytes and B lymphocytes after vaccination.

Therefore, it is totally possible that a person could be infected with the virus that causes Covid-19 just before or after vaccination and then get sick because the vaccine just didn't have enough time to provide protection. It's kinda like, you can't expect to harvest carrots the same day you buy the seed packet. Your immune system has some work to do. So please see: my blood boiling reading a misleading clickbait headline about someone who came down with Covid a week after vaccination.

Now, as for contagiability, which is sadly not a word. Scientists don't know yet if the vaccine prevents asymptomatic infection or if vaccinated people can transmit the virus if they have an asymptomatic infection. So they have some numbers to crunch. They have some data to collect. Just give 'em a second, people.

Jessica: It's the same reason why we haven't said that once you get it, you're immune for life – because we haven't had long-term data to make any conclusions about anybody's immunity. But what we do know is that vaccines typically induce a much more robust immune response, more robust than a natural infection. In a case like this, we expect that a vaccine will produce a stronger immune response than a natural infection.

Alie: Oh, okay. That's good, right?

Jessica: That's the hope, yes.

Aside: Now, what about shapeshifting? Is SARS-CoV-2, the virus that causes Covid-19 symptoms, mutating? So, I think all of us, including patrons Rachel Weiss, Taniya Heuchert up in Can-ay-di-a, Kaycee Kaiser, Vanessa Frey, John Galvin (on behalf of their favorite person), Sam Kilgour, Melissa Wise, Caitlyn Powell, Starr, Cat Lindsay, Rebekah Wofford, and first-time question-askers Sarah Gandy, Madison Campbell, and Perry Wilson are curious and probably a little scurred, TBH.

Alie: Many people asked about different strains. What's goin' on with the new flavors?

Jessica: Yeah. So, in many ways they're not new. I think the one thing that can be very comforting to people is knowing the fact that RNA viruses mutate all the time, and they mutate as they replicate. And they replicate through new transmission. So those are a lot of big words there. It means that the more cases, the more bodies that it finds to go into, each time it replicates, makes more of itself, it has these mutations. Now, mutations sound like a very Frankenstein, scary, apocalyptic kind of thing. But it's really not. Sometimes it's as benign as a typo when you're sending an email. Yes, some typos can be horrible, but we're not seeing this turn into something that is so unrecognizable that we have concerns about the vaccine efficacy.

I think that's on everybody's mind right now: "Are we vaccinating ourselves against something that is no longer a threat?" I think that's not the case. We don't have any data to suggest that the mutation has outpaced what the vaccine will prevent. In fact, it's much more likely that this vaccine will still be effective against all of these strains, because the vaccine is triggering the very infamous characteristic trait of the virus, which is the spike protein. And I think that we still need to be studying this, but I don't think it's any cause for panic. Viruses mutate. It's very normal. We probably have had cases of these mutant

strains or these variants of the virus in the United States for months and we're just identifying it now, and I don't think it's any cause to panic.

Aside: But in case you're wondering: Does this strain, seen in a rise of London cases, have a name? Sure. You can call it SARS-CoV-2 VOC 202012/01, or B-117 for short. Now, it's got a few mutations, one being in the receptor binding domain of a spike protein at a very specific position, but vaccines are what is called 'polyclonal', which means that they reproduce a few different spike proteins to teach the immune system what to look out for.

Scientists think this strain doesn't cause more severe Covid-19, but it does appear to be more contagious. And with 1.3 million travelers just loping through US airports just this past Sunday after the holidays, well, get cozy in your jammies, folks. Southern California already has six cases of this new strain at press time. New York's got one. So, there's still plenty of time to Marie Kondo the linen closet, maybe the entire garage.

Jessica: I think what the underlying theme of this topic should be is trying not to "get it" period. This should be the biggest reminder to folks that we're in this until everybody gets vaccinated. So, keep wearing your mask, keep practicing physical distancing, keep saying "no" to social gatherings and stay outdoors as much as possible, because the less opportunities that the virus has to infect new people the less opportunities it has to mutate.

Alie: Good point.

Aside: And so, to all the folks who asked, "Can you transmit it if you're vaccinated?" such as René Fuentes, Jim Ottaviani, Hannah Soyer, Allison Lopez, Pandora II, Amanda Kriss, Samantha Steelman, Erin Dougherty, Kimisha Cassidy, and Anna Thompson. Right now, transmission is not the focus of the vaccine and they're still gathering data on that. What they do know is that getting the vaccine prevents you from developing serious illness from SARS CoV-2 in the form of severe Covid-19.

So, it's not an eraser for the virus. As one patron, Samantha Wolf wrote in:

Please, please address vaccination versus being able to spread Covid. People need to understand that vaccinated people can still spread Covid. My vaccine is to protect me, my mask is to protect you.

And Jessica echoes that, there's still a lot of data to collect and that process will be ongoing.

Alie: Amy Meagher wants to know: When will we have evidence that the vaccine works to prevent infection?

Jessica: All of the trials were essentially designed to have a read out when they got a certain number of cases that were testing positive, and that is because they wanted to know who's getting sick even when they've got the vaccine, versus the placebo, based on normal circumstances. And they know that these cases, the ones who got sick, were very benignly sick. What we don't know is the ones who are asymptotically sick because they may not have been tested.

But again, it requires so much more testing than what was available in the trials to determine if that was happening. I think in the next several months to year we'll know more about people who were vaccinated who did not get sick at all, whether asymptotically or mildly symptomatically.

Alie: When it comes to infodemiology is that hard to explain the difference between getting the vaccine, being infected but being asymptomatic, versus getting the vaccine and being impervious to further infection?

Jessica: I think a lot of people want to know, “If you get vaccinated can you still transmit it?” Ideally the answer would be no, that you would prevent yourself from getting the virus and transmitting to others. We do know that people who got the vaccine in the trials still got sick, they just got very benignly sick, very mildly sick. And so if that’s the case, they could theoretically still shed infectious virus to others which is why I think, again, it means that we’re going to be wearing masks for a lot longer until we can make sure that most healthy people who are able to get the vaccine are protected.

Alie: That makes sense.

Aside: So, Biden has said that he plans to roll out one hundred million doses in the first one hundred days of his presidency. Dr. Anthony Fauci is like, “It’s doable.” So right now, 15 million vaccine doses have been distributed in the US, but only around 4.5 million of them have been administered. Meanwhile, the more contagious variant SARS-CoV-2 VOC 202112/01, or B-117 if you’re nasty, is out there. So if you can, get the shot, stay alive and let’s kick this thing. Let us get reacquainted with pants again.

Alie: Some people who might be perhaps a little bit scared, Jillian, first-time question-asker says: With how quickly the vaccine was made, we have no long-term studies on how long it will affect us. Is this as scary as it sounds? And Brenna says: My question exactly. And Marina Gurbanov who is a first-time question-asker says: The vaccines have only been tested with adults; how do we know if it’s safe for kids?

How do you allay those fears even in a scientific podcast listening community? There are some people who are like, “Should I be freaked out?”

Jessica: That’s a legitimate question and I think the answer for the long-term thing is actually quite simple. The majority of effects, adverse events, that happen from vaccination happen within hours or weeks of vaccination. We don’t see people years later down the line having severe adverse reactions to vaccines, which is precisely why the FDA did not allow either of the vaccine companies to submit for an EUA until they had at least two months post vaccination data, because it is typically the time frame in which most adverse events, specifically severe adverse events, will manifest in somebody’s body.

So, because of that I’m not concerned about long term effects because what we know about the biology of how vaccines work in people is that events would have happened within the time frame of these trials and in the first few months.

Aside: So, if it hasn’t happened yet it’s unlikely and that’s great news. Now, speaking of expectations and expecting, what about folks with a bun in the oven, just out there all preggo or nursing? A lot of you, including Deborah, Lactation Consultant Betsy Hoffmeister, Diana Burgess, Michelle Krebs, Allison Lopez, and Samantha Wolf and:

Alie: A few people, Zoe Jane, and Courtney Jones, essentially asked: Vaccine and pregnancy/breastfeeding; what do we know, what are the unknowns, what’s the what? And Courtney Jones says: Came here to ask this too.

Jessica: I realize I didn’t answer the other question about kids. I will say that there are protocols being written right now. Moderna has planned to do a pediatric trial come next year, so that data is going to come. Because children have not experienced the most severe

outcomes of the disease in general, they're not the highest risk. This sounds callous, but they're not as highly ranked in the order of who needs to be vaccinated right now, but I think that'll change in the next year or so with some trial data and availability.

Now with pregnancy and breastfeeding, this is something I care deeply about because this is an issue of autonomy.

Aside: No pregnant folks were enrolled in the trial, however some people in lockdown may have [*wink-wink, nudge-nudge, innuendo*] binged their entire streaming catalog and gotten a little busy doing other things.

Jessica: But there were pregnancies reported in both Pfizer and Moderna, and those pregnant people who got the vaccine had much better outcomes than the pregnant people who got the placebo. In fact, all the adverse events that happened in pregnancies were involved in the placebo arm. So, I think that that's reassuring for a couple of things. I think it shows that, one, it's not causing infertility because we know that there were pregnancies that happened in both of those trials. And two, that it was protective.

Another thing to consider is the fact that pregnant people are often not included in these trials and that's because of this abundance of caution and not wanting to cause any kind of concerns for the fetus. But there are two people involved here, there's the autonomy of the person who is pregnant who should make that choice for themselves, and I think this has brought up a really important question for people about, who can make that choice for a pregnant person?

Flu vaccine is a perfect example of how we have decades and decades of data from its public use by pregnant people to show that it is safe and effective. We're probably going to see the same thing with the Covid-19 data. And a number of groups, I think it's the American College of Obstetricians and Gynecologists and another group of physicians who've said that they do recommend that pregnant people and people who are lactating not only just be given the right but they can get the vaccine to prevent infection.

What we do know about the virus is that it is not good for pregnant people, because being pregnant is considered being in an immunocompromised state. The risks of a Covid-19 infection far outweigh the unknowns of the Covid-19 vaccine, which we don't expect to be bad.

Aside: So, getting the virus itself while pregnant could be very risky, and the vaccine may be less risky than getting a bad case of Covid, but more testing is needed.

Also, what if you have a kiddo? When can they get this vaccine? The Pfizer vaccine is approved for 16 and older, and the Moderna is for adults age 18 and up. According to the CDC, among people who participated in these clinical trials, 22.3% had at least one high-risk condition which included lung disease, heart disease, obesity, diabetes, liver disease or HIV infection. But vaccines may not be an option for every individual which is why: Keep those masks in rotation folks and wash them. (I'm talking to myself; I know I have a couple of funky ones in my car. I'm a human.)

Alie: You know, on that note, Nolan Childerhose says: How is testing going on immunosuppressed people? Getting Covid? Getting the vaccine? After my second organ transplant in July, will I have to wait for herd immunity?"

Jessica: That's a good question that I think I can't answer because I'm not a physician, and I think this is going to be very personalized per person. I have seen pictures today on my

Instagram of people who have chronic illnesses and immunocompromised states who are getting the vaccine; people who are frontline healthcare workers who are also dealing with comorbidities themselves. I think that has to be a decision that is decided between your provider and that person. They weren't specifically enrolled in the trials because the trial is intended to get healthy adults first. We don't have data for it, but again I think this is going to be one of those things where, "Do the risks outweigh the benefits or do the benefits outweigh the risks?"

Alie: We did get a lot of questions too about the cytokine storms and autoimmune response being a huge factor of risk when it comes to this infection, and how does that affect those with autoimmune disorders getting the vaccine?

Jessica: Again, I think that it's going to be a very tailored response. I've heard from, like, MS doctors whose patients are on immunosuppressant drugs that tend to fare better because of the way that their body responds and produces cytokines. It's going to be very specific to the type of immunosuppressive state that you're in, whether it's medically induced, through medicine induced, or just because of the illness itself.

I remember early on a lot of doctors were saying that what was causing people to die were these cytokine storm and the body's immune system just attacking itself, and I think we're getting better at caring for Covid and trying to prevent that, and I think that we'll continue to get better at that. I think that some of the therapies is probably the next frontier for major innovation because right now looks like dexamethasone, which is a steroid, is probably our best bet. But we need some more solutions to prevent these types of things happening.

Alie: One listener wrote in named Face and they said: This isn't so much of a question as much as an expression of gratitude. Thanks, Jessica, for all the extra stuff you do on Instagram as well as your real-life work and the Covid tracking project! Her stories have been an absolute rock of information through the rough seas of this pandemic and I'm so thankful that she has shown up to help us non-doctor/scientist people navigate. Absolute superhero!!! Thank you thank you thank you!!!"

Jessica: Oh my gosh, that's so sweet! That's so sweet, thank you. It's my joy. It's overwhelming but it's truly my joy.

Aside: Oh, another fun fact. If you have just shrugged yourself out of the entire vaccine conversation because you've already had Covid-19: first off, I'm very glad that you are on "this side of the grass," as my pops would say, and I hope you're doing well, and I'm so, so sorry to everyone who has lost someone. But if you have had Covid-19 you still need a vaccine, scientists say, because reinfection is possible and it can be brutal.

It's recommended that people who have already had Covid-19 get a Covid-19 vaccine. My 2021 vision board involves Oprah with a syringe just doling out vaccines like cars while I just lose my mind. Also, I'd like to have more milkshakes.

Alie: We got a few questions about, essentially, the heart of vaccine infodemiology which is information, a lot of information, and not knowing what to trust. Especially nowadays when, before you'd have to own a newspaper to put out widespread misinformation, and now you just kind of have to click send. Hannah Soyer wrote in and said: First-time asker and proud disabled woman with a compromised respiratory system! I read recently that the majority of children who aren't vaccinated are the kids of white parents who have a

household income of above \$75,000 a year. What's the deal with certain populations being given information that makes them distrust that?

Jessica: There are a lot of interesting facts about the demographics of people who are vaccine hesitant or anti-vaccine. I think that there's a case for the typically white privilege type of demographic that happens. You see that with what's been represented in the outbreaks in the Waldorf schools in California. That usually is a type of demographic that is privileged and has access to a lot of information but also chooses to partake in a lot of pseudoscience and wellness stuff that is scientifically not very sound.

And then you also see the disproportionate burden of targeted misinformation that happens in immigrant populations and communities of color where people may not have access to social media, or the internet, or other resources that can help them parse through what is good information and what's not. And so, I think that this group is also not monolithic. Vaccine hesitancy is not monolithic. You'll see general diversity in the people who are against it, which is why I think that communication needs to be very nuanced and very targeted.

When it comes to a lot of vaccine misinformation right now, social media is just a hotbed of it, it's really overwhelming. I report false information constantly on Instagram. I think that a lot of it is intended to emotionally manipulate and I think that what it really comes down to is a strategy to create fear and panic among parents who are trying to make informed decisions. I'm trying to look at it with the same lens in the sense that I'm saying I, as a parent, too, want to make informed decisions but I don't want to be making them out of fear. I want to be making them based on data, based on scientific consensus.

Aside: Quick history. In 1998 a gastroenterologist by the name of Andrew Wakefield did a very small, unethical, and now fully and repeatedly debunked study on the role of measles, mumps, and rubella vaccines in autism rates and certain pop-cultural figures ran with it. Again, repeatedly debunked. The damage has been done from that and it's been immeasurable.

Jessica notes that social media sites giving more attention to the most shared posts means that disinformation disguised as whistleblower campaigns gets much farther than the reach of vetted journalism sources. A lot of parents – historically moms, women, and people who raise children – may have experiences of exclusion from major health studies or have their symptoms shrugged off by sexist doctors of the past, so they may also have a distrust of Western medicine.

If public health and ending a pandemic that is killing people's loved ones is a team effort, how do we have these conversations? A lot of you wanted to know; I'm looking at you, Rainbow Warrior, and veterinarian Marianne Thomas, Rebecca Kidder, Rachel Casha, Riley McInnis, Adam Weaver, Lianna Hrycyk, Deb Berlin, Julia Hayman, Julia Splitorff, and Dawn Zwart.

Alie: On that note, Jessica Janssen and Jessica Fralin both asked, in Jessica Fralin's words: How can we, the non-experts, help others trust the science and the vaccine? Any easy talking points? What can you tell people who are completely against vaccines? Jessica Janssen says: I have heard that 'anti-vaxxers' is not a nice term. What can you tell folks who are vaccine-hesitant?

Jessica: As a science communicator, a lot of my job is discerning what's worth debunking. Sometimes if you give attention to something that seems outlandish, you end up

breathing more life into it than is necessary. I think that some things need to die because they are probably less of a concern than you think. It's also important to remember that this is a loud minority. They are not the majority of people. I agree that 'anti-vax', and 'anti-vaxxer' can be divisive terms and I try not to use them unless I'm being specifically targeted by somebody who is aggressive.

People who are vaccine-hesitant are also a different group. They're the ones who earnestly want to make choices but feel overwhelmed or know someone with a vaccine injury – which again, it's an important thing to remember that to deny vaccine injury is very ignorant. They happen, they're just extremely rare. So I think it's about knowing which battles to pick, whether to pick them, and encouraging people to be good consumers of information.

A lot of times, if you ask yourself the questions, "who, what, where, when, and why?" when it comes to sources on social media, you can probably determine a lot of details about the information. "Who?" Check the source. Make sure the person is coming from a scientific consensus, and if they're not, that's a red flag. "What?" What is it? Is it a hot take? Is it a forwarded message from a Whatsapp chat room or something? "When?" A lot of times the stuff they're sharing is outdated! A lot of times, they're posting links that are broken but it looks like a PubMed link of some sort and people think "Oh, that must be data."

And "Why?" Ask yourself why they're posting this. Is it to send you to buy supplements? Is it sending you to buy some essential oils and some detox tea that's going to take the metals out of your body? There are a lot of very simple questions you can ask to get to the bottom of why these posts exist online and you can train people to be good consumers of information.

Alie: Is there typically a money trail when it comes to disinformation?

Jessica: Oh, absolutely! Snake oil salespeople have been around since the beginning of time. Anybody who is going to take you away from what they're calling Big Pharma... If you look at people who are trying to say, "Oh, Big Pharma's corrupt, and full of money, and people are getting paid to do this stuff." If you look at the other side of it, well, there are these multilevel marketing schemes selling different products that are intended to keep people away from what they call 'too-allopathic' of care. I think there's a lot of benefit to things being non-traditional and non-allopathic, but it's now created a whole brand of care that causes delayed diagnoses, and fraudulent testing, and supplements that are not only expensive but not helpful.

Alie: I feel like, emotionally, there must be a lot of sociology behind understanding the fear. Some sort of expression of control over your own fate if you are deviating from what you think is being "fed" to you?

Jessica: There's a lot of psychology to this. There is an insatiable hunger for solutions, and remedies, and answers to these very big unknowns, but when you get people when they're emotionally weak like this, and desperate, that's where it becomes extremely dangerous. The misinformation and the disinformation (which is intended to harm), travel faster and farther than the actual data and science. It makes the job of scientists and science communicators that much more challenging because we're putting out two fires at the same time, and one of them is growing faster.

Aside: If you need to have this conversation with someone in your life, there are a few ways you can broach it. You can always remind them that we know the effects of Covid-19, and they can be long-lasting. The Mayo Clinic lists them as: lasting damage to the heart muscle, even in people who experienced only mild symptoms, which can increase the risk of heart failure in the future. There is scar tissue that can develop in the lungs, leading to long-term breathing problems. There are also neurological effects. The Mayo Clinic says that even in young people, Covid-19 can cause strokes, seizures, and Guillain-Barré syndrome, which is a condition that can cause temporary paralysis. Covid-19 can also increase the risk of developing Parkinson’s disease and Alzheimer’s disease. There are also mood changes.

Simply surviving this experience, the Mayo Clinic says, can make a person more likely to later develop post-traumatic stress disorder, depression, and anxiety. As for the vaccine side effects, right now it’s known that soreness at the injection site and fever are both to be expected as the immune system responds. Sometimes just being an alive human means dealing with shitty or unsafe circumstances. No one wants a virus. But how lucky we are that people have committed their lives to finding solutions that can help us dodge this bullet!

I found a really interesting piece by Dr. Robert James Kim-Farley in the *American Journal of Public Health* from 2017. He writes this analogy about a disease being like a curve on the side of a mountain where there’s a cliff. 100 people a year go off of the cliff and die. That’s like the disease. So what do you do? You build a guardrail. And that prevents those 100 people from dying every year. But let’s say three people a year get injured hitting the rail. Some might argue, “Let’s nix the guardrail. The guardrail is dangerous.” However, what you have to do is say, “Well, 100 people would have died so overall the guardrail is a wise precaution to take.” So the cliff is the disease and the guardrail is the vaccine. Guardrails—they’re here for ya!

Speaking of side effects of vaccines, this next question was asked by Julia McDonald, Vesper Holly, and Justin Roberts, who wrote:

I received my first round of the Pfizer vaccine on December 18th and experienced mild to moderate pain at the injection site on days 1 and 2; and then some mild fatigue, chills, and bone pain at the end of day 2, which went away after a dose of naproxen and a full night’s rest. No other side effects after that.

So, first off, to anyone who’s gotten it – YES! Way to go! I have several friends in medicine who have had their first dose and are so thrilled. But why the ouch after a vaccine? And yes, tell anyone who asks that Dr. Ward said that you deserve a lollipop, or a milkshake, or whatever you need.

Alie: A lot of people had questions about why vaccines make our arms sore. What is the biology there? Do we have any idea?

Jessica: Yeah, that’s actually a good sign! On the flip side of it, if you don’t get a sore arm that’s not a bad sign, but it’s a good sign because what’s happening is that your body is saying “Wait a second, there’s something in here that should not be in here, I’m going to fight it!” It is a physical sign of your body mounting an immune response, identifying a foreign thing, and saying, “I need to fight this.” It’s injected intramuscularly, so that whole fight, that brawl, is happening in your muscle, so it can cause some soreness.

Alie: I'm pretty sure I know the answer, but one of the last questions I always ask is [embarrassed sing-song voice] what is the hardest thing about your job? [laughs] It's in your title, Vaccine Infodemiologist. I'm pretty sure it's misinformation, but is there anything that really sticks in your craw?

Jessica: I would say two things. Being this close to the data wears on you because it's not just numbers, it's not just spreadsheets, it's not just plots on a graph. It's people. When these numbers become so astronomically high, it can be desensitizing but then it can also hit you like a ton of bricks. When we started to see hospitalizations creeping up over 100,000 and plateauing there, and staying high in the hundreds, thousands, and deaths now exceeding over 330,000; it gets to be very emotionally taxing. I think that is connected to the second thing, which is the misinformation about those specific data points, which to me seems just impossibly insensitive.

I think that the fact that there are people who still question the validity of the death count and the validity of what's happening in hospitals is so deeply insulting. Both to me as somebody involved in the data, and to the 330,000 families whose lives will never be the same because of the loss that they had this year, who had to say goodbye to their loved ones probably via FaceTime. And to the hospital staff who are absolutely risking their lives and trying to keep people alive while they're doing it. It just seems especially, especially dark.

I'm used to vaccine misinformation prior to this pandemic because I worked in pediatric vaccine education. But this is a next-level type of insensitivity when they specifically question the motives of healthcare providers and even the data itself.

Alie: I can't imagine having that be part of your work, where you can't just tune it out and go back to your normal job and hear about it in blips on the news. And especially being in Los Angeles right now, we're both in LA, any message that you would give Angelinos in particular who are hearing this?

Jessica: I think the situation in Los Angeles right now is deeply concerning. I think that a lot of it has to do with the fact that there are a lot of people who feel tired of all the negativity, and tired of the sacrifice, and tired of the burden that this has had on us, but we're not through it yet. We're actually in the worst of it in many ways. The CDC gave the county a very high social vulnerability score, which is based on a lot of things, it's based on income averages, and education averages, and housing averages, and this county has 10 million people!

Aside: That's right! LA County has double the population of New Zealand with some of the highest priced real estate in the nation, and \$1,200+\$600 of economic relief so far. In case you were wondering, the average price for rent in LA is \$2,375/month for roughly 800 square feet. The Covid rates and the rent are both too damn high.

There are a lot of people who are essential workers working in places where super-spreader events are happening! Yes, there might be a lot of cases happening among homeless people and among people who live in multi-generational and crowded homes, but those people don't live in vacuums. They don't live in bubbles. Those people interact with you because they're the ones who are providing your meals, they're cleaning up in the hospitals where you might be going, they're the ones who are interacting with you in the street or in the grocery store. It's important to know that in this city, you are one degree separated from a lot of these cases given how high the incidence is in this county.

I think that we're in for some dark days in LA County and in California in general. I think it was prudent for the state to order things like refrigeration trucks and extra body bags because there are reports of people in hospitals who are being turned away or shuttled around in ambulances because they can't find a bed! There are beds even popping up in gift shops! This is as acute as it could get.

Aside: So this is serious. This is an industry built on tourism and on multi-million-dollar film and TV sets, and the networks expect you to get it done somehow. I've been shooting intermittently since July, but the Screen Actors Guild just issued a statement today, as of this recording, asking to halt productions. When I tell you to ask smart people absurd questions, I want you to know that I live this.

Alie: When you heard Tom Cruise's rant, [*clip from December 2020 on the Mission Impossible 7 set, Tom Cruise shouting angrily: How many meters is that? People are standing around the {bleeped} computer... {screams:} I don't ever want to see it again! Ever!*] were you like, "Yes! Tell it like it is!"?

[*drumroll...*]

Jessica: No, because I think that what he was doing is, in public health, considered very ineffective. I mean, I was like, "Yes!" in the sense of, "Please stop cutting corners, and be safe," etcetera, but shame, and fear, and anger are not good approaches when it comes to helping behavior modification. We know that from sex education. That's just not how you get people to avoid risk. It's repetition, it's giving people the benefit of the doubt, it's saying things with gentleness and kindness.

Aside: [*sarcastically, in a falsely sweet voice:*] Hey buddy, I understand why you're closer than three meters, but I would be so funk' grateful if you just kept to protocol so this set doesn't get shut down, nutterfluffers! [*fake laughter*] Oh, you!

Jessica: And that's why I feel very strongly about my platform being a judgement-free zone. Do I need to call people "bleeping bleeps," and scream at them, and tell them that they're going to be cut off because they're doing it? No. That's just not how it works. Public health requires a lot of nuance and empathy.

Alie: That's such a good message! I'm so glad I asked a Tom Cruise question! [*Jessica laughs*] I never thought I would ask one. [*clip from Jerry Maguire: "We live in a cynical world. A cynical world."*]

What about your favorite thing about your job?

Jessica: Honestly, it's so surreal that I'm doing what I'm doing. In grad school 10 years ago, I was the girl at parties where people would say, "So, you're studying infectious diseases. Why?" And I would be like, "There's probably going to be a pandemic again." I remember having conversations with friends and being asked, "What are you most afraid of?" and being like, "A pandemic of respiratory disease," and now here we are living my actual nightmare! [*"Nailed it!"*] But also the thing I feel so prepared for.

The fact that I can share this information... The only reason I started doing these 'explainers' on social media was because I started getting all these texts and emails from friends saying, "Can you explain this? What's a cytokine storm?" And I thought I'd just do some Science 101 and I had no idea it would turn into what it turned into.

Aside: What it's turned into, by the by, are 173,000 people following her on Instagram for her great Covid updates.

Alie: Isn't it kind of nuts to think that you've saved lives?

Jessica: I can't even think about it that way. It's overwhelming.

Alie: To think that just by disseminating correct and helpful information you have helped families to avoid having Zoom funerals.

Jessica: Oh, my gosh. I try to empower people and tell people that every one of the sacrifices they make is saving a life. You don't know what you're preventing. In many ways public health is a thankless job. You don't look back and say, "Oh, look what didn't happen!" You look at it retroactively and say, "Oh, gosh, it could have been so much better if we had done these things!" And I think we'll still say that, but I also think that those who have been valiant and dedicated in their sacrifices should know that none of these things are for nothing.

Alie: Such a good message! Thank you for doing what you do and for hopping on the phone with me with literally a moment's notice! [laughter]

Jessica: This was so fun! I loved it.

So ask smart Infodemiologists questions about Tom Cruise because, you know what, you only live once, and hopefully it is not cut short by a pandemic. Very sincerely. To see more stats, you can head to the wonderful [CovidTracking.com](https://www.covidtracking.com). You can follow our guest at the links in the show notes. There will also be a link to her Linktree in the show notes, as well as one to [500WomenScientists.org](https://www.500WomenScientists.org).

We are @Ologies on [Twitter](https://twitter.com/Ologies) and [Instagram](https://www.instagram.com/Ologies). You can be my friend on [both @AlieWard](https://www.patreon.com/Ologies). You can support the show for a buck a month and have me awkwardly lob your questions at experts; that's at [Patreon.com/Ologies](https://www.patreon.com/Ologies). You can get Ologies merch at [OlogiesMerch.com](https://www.OlogiesMerch.com), and you can find other ologites in the wild. We do have masks and they accommodate a filter, folks, if you need them. Shannon Feltus and Boni Dutch manage the merch, and they also host a podcast called *You Are That*, which is hilarious.

Thank you Erin Talbert for adminning the Ologies Podcast [Facebook group](https://www.facebook.com/OlogiesPodcast). Thank you Emily White and all the transcribers for helping to make this podcast available to deaf and hard-of-hearing folks. Those transcripts are available to anyone! They're up at [AlieWard.com/Ologies-Extras](https://www.AlieWard.com/Ologies-Extras). There's a link to that in the show notes. Thank you Caleb Patton for bleeping episodes to make them kid safe. Those are up at the same link.

Noel Dilworth makes sure I show up to interviews at the right time. In the right time zone. Assistant editor Jarrett Sleeper helps put it all together each week alongside The Man, The Mustache: Steven Ray Morris, who hosts the podcasts *The Purrccast* and *See Jurassic Right*. Nick Thorburn wrote the theme music and he is in a very good band called Islands.

If you listen to the end of the episode, I tell you a secret. This week the secret is that I started using this app called Freedom (they are not a sponsor). They block certain websites for certain periods of time so you don't wander off like a lost donkey. But one thing they have is a café option where you can play ambient noise, and I realized that I kind of miss working in coffee shops, and sometimes I think that when I get distracted from work it's just because sometimes I feel lonely and I just want to hear people chattering.

So, listening to ambient coffee sounds. I think they also have some at Coffitivity. It's kind of like the ante-pande days. Which means 'before the pandemic'. I want it to become a thing, like, "ante-pande," and I'm just gonna keep trying to "fetch" it. Nobody wants this term though, except for me.

Anyway, okay, stay safe, get your shots, wash your mask, and de-germ your fingers. We got this. Berbye!

Transcribed by:

Mara Spensieri

Scott Metzinger

Ashley Thurber

Hannah Dent

Stephanie Burkett

Madison Campbell

More links you might enjoy:

A donation went to 500WomenScientists.org

[The Covid Tracking Project](#)

[Birth of Infodemiology: the epidemiology of \(mis\)information](#)

[Vaccines and Global Economic Inequality](#)

[John Hopkins University vaccine info](#)

[Mayo Clinic FAQ](#)

[Infodemiology: what is it?](#)

[Dr. Mike Natter comic on how mRNA works](#)

[Variants \(or “mutant strains”\) info via CDC](#)

[Long term COVID-19 effects](#)

[Eugenics in the US](#)

[CDC info on mRNA vaccines](#)

[Misleading LA Times headline about masks](#)

[Best types of face masks, according to science](#)

[How vaccine hesitancy spread online](#)

[New York Times article about vaccines and equity](#)

[Yearly flu & death rates](#)

[The Dangerous Curve and The Guardrail: Disease & Vaccination](#)

[The rent is too damn high in Los Angeles](#)

Coffee shop noises: <https://coffitivity.com/about>

Website blocker for productivity (not a sponsor): <https://freedom.to>

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