SARS-CoV-2 Vaccines Episode Transcript

SUMMARY KEYWORDS
vaccine, virus, scientists, protein, infected, SARS-CoV-2, infection, immune system, variant, pandemic, antibodies

SPEAKERS
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COLD OPEN:

Lorena Zuliani-Alvarez 00:00
I think we're hitting a very important point here, which is the transmission. So, transmission is so important for a virus, right? Because a virus cannot live outside the cell. So if a virus land in this table, it- unless like somebody touches it or whatever, it is transmitted in a different way, it will die.

Robyn Kaake 00:19
Unless you're going around licking tables. *[Laughs]*

Lorena Zuliani-Alvarez 00:20
Yes, exactly, I don't know. It will just die there. So the virus is being kept alive because it's transmitting and transmitting every day. So the moment that we stop transmission, we stop this virus forever. So that's something that we have to think about all the time. And I don't think people look at these diseases in that way.

INTRO:

[Upbeat music starts playing in background]
Robyn Kaake 00:41
Welcome back to Biologists Being Basic, a podcast where we talk about basic research, why we care about it, and why you should too. I'm your host and resident basic biologist Robyn Kaake. Each episode, I'm joined by fellow scientists, as well as some non-scientist friends to ask questions, talk science and have fun. In the fall 2020 and early 2021, we produced episodes on SARS-CoV-2 and COVID-19 research. These episodes are really good introductions into the world of SARS-CoV-2 research, some of the basics on the virus, and the long-term damage that it can cause. We recommend checking them out if you want to learn more about the virus. A lot has changed since then, and safe and effective vaccines are now being distributed around the world, and here in the United States these are being made available for free for everyone. Though a number of new treatments have moved into and through clinical trials, the best way to prevent infection, severe illness and death are these vaccines. There's a lot of information being provided by media, by governments, by scientists, by doctors, and by people on the internet, and we know that finding trusted sources that speak plainly, and take the time to explain things clearly can be difficult. And often legitimate questions are unanswered or

sometimes dismissed. So in today's episode, we are focusing on the SARS-CoV-2 vaccines, how they were developed, how they protect you from infection and illness, and how we know they are safe and effective. And at the end of episode, we'll also answer some questions that are commonly asked about SARS-CoV-2 vaccines. Helping me with this discussion today is my B3 co-hosts Kelsey Haas.

Kelsey Haas 02:24
Hi, I'm Kelsey. I'm a graduate student at UCSF in Nevan Krogan's lab and I study Influenza A viruses.

Robyn Kaake 02:33
And our friends and colleagues Lorena Zuliani- Alvarez and Ujjwal Rathore.

Lorena Zuliani-Alvarez 02:39
Hi, everyone. I'm Lorena. I'm a senior scientist in Nevan Krogan's lab at UCSF, and I work with viruses and immunology in the lab.

Ujjwal Rathore 02:51
Hello, everyone. I'm Ujjwal, I'm postdoc in Alex Marson's lab and I study viruses; mainly I study HIV virus.

Robyn Kaake 02:58
And joining us to make sure we stay on point, will be our guest, Laura Gladson.

Laura Gladson 03:05
Hi, I'm a PhD candidate in the Environmental Health Sciences program at New York University and I study the health impacts of air quality.

Robyn Kaake 03:13
Alright, thanks, guys. Let's get started.

[Music slowly fades]
So hi guys thanks for joining me today to talk about vaccines. I thought it would be good to start off by explaining what vaccines are and how they work to protect us from various pathogens and toxins. So Lorena and Ujjwal, you guys are kind of like our resident virologists experts, at least for today, would you like to start us off by explaining in general what a vaccine is and how it protects us from illness?

Lorena Zuliani-Alvarez 03:53
A vaccine basically is like a biological entity that has either a part of a virus, an attenuated virus, or a modified toxin, that is training your body's immune system to basically recognize the pathogen and eliminate it quickly once you get infected. So it's basically training your body and protecting you from getting the infections or the consequences of that infection.

Laura Gladson 04:19
I have a question. I'm wondering, is it ever possible for a vaccine to give you the disease that it's trying to vaccinate against?

Lorena Zuliani-Alvarez 04:27
It's very unlikely because the vaccines are modified versions of those viruses or bacteria or toxins. So basically it doesn't have the complete arsenal or the virus itself to produce or replicate inside your body. So it just wants to present your body some part of it so your body's able to recognize it when the actual pathogen goes inside.

Laura Gladson 04:51
So is this why some people can't get vaccinated? Like someone who has cancer or some kind of condition, maybe their body can't handle the vaccine, but a healthy body is going to be just fine. That kind of the reasoning behind that?

Ujjwal Rathore 05:07
I think that's true for some vaccines, but not really for the COVID vaccines because the three COVID vaccines which are being used in the US, they all have a small part of the virus. So you can never get COVID from these vaccines. It's not possible.

Laura Gladson 05:22
Okay, that's really interesting.

Robyn Kaake 05:24
Different vaccines are different. So, vaccines against certain types of viruses, or like historical vaccines from way back when used to be like, either just different versions of a virus that didn't cause as severe of illness, or that, um yeah, it was an attenuated version. And yes, those you could get sick from, and if you didn't have a highly functioning immune system, it could cause more severe illness. But yeah, the vaccines that are today, that you would get for Coronavirus, are not a virus itself. Which is kind of like a good segue, actually, into what I wanted to talk about next, which is that, there are a number of vaccines that we've received as children, as adolescents, as adults. I thought it'd be nice to talk about some of these different vaccines, and how they're similar and different to each other. Some of the ones that are probably the most familiar with people, because we try to get them yearly, are the flu vaccines. Kelsey, I know you did some research on flu vaccines and you are studying flu, do you want to talk about, what the flu vaccine is, and how this maybe compares to some of the other ones like DTaP or the MMR or the HPV vaccine?

Kelsey Haas 06:51
Sure. The flu vaccines come in a lot of different ways that you can make the vaccine but they primarily just contain the virus proteins. So either the two primary antigens of flu, which are two proteins that are on the virus's like membrane surface, and those are hemagglutinin, which is abbreviated as HA, and neuraminidase, which is abbreviated as NA. So when you're talking about flu, a lot of times they'll hear like 2009 H1N1, or 1919 H1N1. And so the H and the N correspond to the hemagglutinin and neuraminidase proteins, specifically. So you can either have those two proteins in your flu vaccine, or you can have proteins purified from the entire virus that's been inactivated and like, busted up. So kind of what Lorena was talking about before you're seeing very small parts of the virus, but it's not the entire thing.

Robyn Kaake 07:51
Lorena or Ujjwal, do you have anything to add? Or do you know how these are different from some of the other vaccines? I mean, the Tdap and DTaP and DT are like the- you know… tetanus and like, they're against… what toxins? -and not necessarily the pathogen itself.

Lorena Zuliani-Alvarez 08:11
Yeah. So yeah, that will be the other vaccines, the ones that are called toxoid vaccines. So they're modified versions of the toxins that these bacteria produce, which are the things that are going to harm your body. And then the MMR vaccine is actually attenuated versions of these viruses. So again, it's a different mechanism as well. And I think the HPV vaccine is a virus like particle, what is called, but again, is a form of the of the capsid of the outside of the virus. So your immune system will recognize what is in the surface of the virus, which is the first thing that the cells will see when you get infected.

Ujjwal Rathore 08:51
I would like to add to what Lorena said that, you know, so we can have different types of vaccines. You can take a viral particle inactivated with a chemical and that becomes an inactivated vaccine. You can take a part of the virus, and just a small part of the virus, and then use that as a vaccine. Or what you can do, for example, in case of the toxoid vaccines, you just bac- these bacteria they produce some kind of toxins, and the toxins cause symptoms in the body. So what you can do is you can take the toxins that are basically proteins, you can use chemicals on those toxins and destroy them so that they can't function anymore, and then put those into the body and then again, they work as vaccines. The idea here is to actually fool the immune system by showing it kind of a picture of a pathogen so that the system starts recognizing it. And then when the body sees it, the actual pathogen, it's ready to fight with it. And you can do it in many, many different ways.

Kelsey Haas 09:45
Yeah, Ujjwal brings up a really good point, actually, so maybe I'll just amend my previous answer a little bit. So most of the flu vaccines are, in comparison to the SARS-CoV-2 vaccines, they have protein components, but like Ujjwal said, you can also have versions of vaccines where you have the whole virus that's been inactivated. And so there are versions of the flu vaccine that are like that as well.

Robyn Kaake 10:12
And this is vaccines that most of the people in America have received. Because most school kids have to get these vaccines to go to public schools. If you've ever stepped on a nail, or been poked with something metal, you've probably gotten a booster shot for tetanus. So that's to prevent something like lock jaw. And I think what's kind of interesting about some of the vaccines that we get now more regularly as adults, like women or men can get HPV vaccine, it's actually against a bunch of different serotypes of HPV, the most common ones that can cause cancer are the ones that you're protected against. And then for flu, they actually also have different flu versions, right? Different flu subtypes that they're protective against. Do you want to explain why we get protected against multiple different versions of flu subtypes?

Ujjwal Rathore 11:23

Yes, CDC and FDA, they every year look at the circulating strains. And they try to predict on the basis of circulating strains which strains are going to be present when the vaccine is going to be ready. And so the predictions can be off, they might not be accurate. So if your predictions are very accurate, that year, you are going to get very efficient vaccine. But if your predictions for which strains are going to be circulating, those are not very accurate, then, you know, the vaccine might have less efficiency.

Laura Gladson 11:49
All right, so why then do we need to get a flu shot every year instead of just once?

Kelsey Haas 11:56
Yeah, like one of them is that we have like… it's a- it's a prediction based on the predominantly circulating strains. So a second reason is that flu mutates very, very quickly. And so even if the vaccine protects against the strains that are circulating that flu season, flu is able to mutate really quickly. And so the antigens are a little bit genetically different, and sometimes this is enough to allow for, kind of like escape from immune detection. So even if the vaccine triggers the right immune response in your body, there will be genetic drift and genetic shift over time, and so flu will look different as the flu season progresses. And so this impacts the vaccines ability to work effectively against the virus.

Robyn Kaake 12:42
And when we say, you know, efficacy or effectiveness of these vaccines for flu, what are we talking about? You know there's a different efficacy for each vaccine. The yearly flu vaccine, what are we looking at in terms of how protective it is?

Kelsey Haas 12:59
Yeah. So there's efficacy and effectiveness, and they're measured differently.

Ujjwal Rathore 13:03
Efficacy is what you mentioned, for clinical trials. Yeah. So efficacy is what you mentioned, clinical trials and effectiveness in the real world. So you- like when COVID vaccines were being tested and in the clinical trials we found that they're 94%, effective, but that was talking about efficacy. And in the real world, that might change.

Laura Gladson 13:23
I thought I heard that it was better in the real world with the COVID. Is that true, or am I getting that backwards?

Ujjwal Rathore 13:30
It's it depends on how you're defining effectiveness. And again, even in the real world... So earlier, the way it was defined was that... So for different vaccines in different countries, it was measured in a very different way. And so I always say that, suppose we… if we were studying in different schools and we compare our grades, it doesn't make sense to compare our grades, right? Because we were in different schools, different teachers graded us, and so similarly, for the effectiveness of vaccines, that's the case. But uh, but the real-world situation is dynamic, and it's changing as new variants are emerging. And so we can't, we can't put a single number on the effectiveness of these vaccines.

Lorena Zuliani-Alvarez 14:07
The main outcome that we look at with a COVID vaccine is that can it protect us from severe COVID? Can it protect us from hospitalization? And that's why it was an emergency kind of release of these vaccines. And everything was done so quickly because we were trying to prevent more people getting severe disease. So I think that was the main thing.

Robyn Kaake 14:29
We say quickly. But this isn't like a brand-new technology. This is someone's career life work. It's been being developed for a long time. This was just the first real life instance where we said, okay, this is a huge challenge. Let's put these vaccines to the test and let's get them into people so that we can see how effective they are. And... *[trails off]*

Ujjwal Rathore 14:58
I get this question a lot, a lot that why… how these vaccines are made so quickly? It's a very important question to answer because we should explain that we started studying SARS in 2003. So we had 17 years of experience studying a virus from the same family. And then we knew how spike protein looks like, what mutations make it make it more stable. And with the mRNA technology, it was being developed to tackle other viral infections. So we had like both sides of the coin ready. And so when the pandemic hit we were able to, like combine all this information and develop them quickly.

Lorena Zuliani-Alvarez 15:34
Yeah, and actually Moderna had… has two vaccines in phase two clinical trials for ZIKA. And I think HIV, as well…? Ebola yes, sorry, yes, that's true. Although these mRNA vaccines have also been used for HIV, or they're trying to in other companies. So yeah, definitely, people knew that they were safe, which will be the phase one clinical trial. And they were already coming into these other phases to test their efficacy.

Ujjwal Rathore 16:04
Yeah, I think ZIKA was already in phase two.

Robyn Kaake 16:07
So then, this is maybe a good time to ask an answer. So what is an mRNA? vaccine? And how is this different from say, other vaccines that we may have received against other pathogens? So what makes something an mRNA vaccine versus some other type of vaccine?

Ujjwal Rathore 16:29
To answer this question, I would like to first discuss what is DNA and what is RNA. DNA is like a recipe book. And genes in DNA, they are like recipes. And these recipes make dishes which are called proteins. So proteins are the action molecules of the cell. And so now imagine that you have a recipe book, which is written in a foreign language, for this imagine it's written in Hindi. And if you can't read Hindi, then although you have DNA, you have the recipe book with you, you can't make a dish. So you have to translate it. So that's where an intermediary thing comes in. So if it's written in Hindi, you translate it into English. And that's when you make a dish. So RNA is that intermediate molecule, which

codes for proteins, so it makes the action molecules. So what these Moderna and Pfizer biontech have done, is that they have designed these RNA molecules, which encode for a viral protein. And so what scientists have done is they have taken the RNA molecule, which encodes for the spike protein, which makes the spike protein and they have put it in a kind of oily ball. So oily bubble. And because the RNA is very unstable, so you can't put it directly into the body, so they put it in a lipid or oily bubble, and then it's put into the body. And then this lipid bubble goes in, enters inside your cells, and then your body cells, they look at this RNA, and they make a protein out of it, because that's what they do. When they look at RNA, they make proteins. And that protein, Spike protein is then detected by our immune system. And our immune system generates antibodies and T cell responses against it.

Laura Gladson 18:11
My question is, on the actual virus, is the Spike protein, the dangerous part? Or is it just what helps the virus get into the cell and then cause damage? Is that correct? Because I've heard people be all afraid of this, like, I don't know, shedding the Spike proteins, because it's like, oh, how you're putting this Spike protein in our body or something. But that's not actually the thing in the virus that's the problem, right?

Lorena Zuliani-Alvarez 18:39
Because the Spike protein is in the surface of the virus, right, it's the first thing your body's gonna see when the virus enters, and then it's what the virus uses to enter the cell, basically. So the virus has to fuse with the cell to be able to enter and put all this genetic material inside the cell and replicate. So that's what this Spike- the function of the Spike protein.

Robyn Kaake 19:03
I mean, the mRNA molecule is gonna go away, your body's gonna turn it over, it doesn't last forever, it lasts for a short period of time, and then it goes away, which is actually why we get two shots, so that you can reintroduce and reactivate your immune system against it. But also the Spike protein itself isn't going to cause you harm on its own. It is gonna make your immune system get active. That's why some people feel sick afterwards because their immune system is really active and it's your immune system actually, that's making you kind of have that kind of sick feeling that makes you tired, or gives you a headache or gives you a fever. That's just your immune system doing what it's supposed to do. But the Spike protein itself doesn't actually hurt you. You need the whole virus particle to cause infection and to cause disease. So Spike alone, if you were to just produce by protein, it might make your immune system activate, but it's not gonna cause COVID, you're not giving people COVID, because your cells had some Spike protein being produced.

Kelsey Haas 20:08
And you yourself also don't have COVID.

Robyn Kaake 20:11
Yeah. And it will go away. And then it goes away, and it's done.

Laura Gladson 20:16

It's like your sounds like your body's just doing like a practice round. So like, when it actually confronts COVID, it can get rid of it, very quickly, so you don't actually get infected. Is that right?

Robyn Kaake 20:28
Right. And when you actually get infected, that's the virus telling your cells to make *all* of its proteins. And then all of those proteins make a virus. So if you were to just actually get the virus infecting you, your cells are turning into little virus making factories. So they're also producing Spike protein, along with all the other proteins, and the genome and everything else that goes with it. So yeah, that's maybe a question hopefully, we can answer. Like nope, that vaccines are safe. I did want to ask Lorena and Ujjwal, so maybe one of you could explain what the difference is, you know, the three vaccines that are in the United States are Pfizer, Moderna, and Johnson and Johnson, those are the probably the three most popular that are being given to people in the United States. So what's the difference between these vaccines? Why do you have to get two for Pfizer and Moderna, and only one for Johnson and Johnson,

Lorena Zuliani-Alvarez 21:36
The Pfizer and the Moderna are based on this technology that we just described, the mRNA vaccine. And the Jensen vaccine is based actually on an adenovirus. So basically, this is a virus that acts like a carrier, so it will... it is a DNA virus. So in this case, you are going back into the recipe book as Ujjwal was referring to, and then that DNA will make an RNA and that RNA will make a protein. So again, this virus will deliver a piece of DNA, that will produce the Spike protein in your body. So the three of them are targeting the same component for virus, which is the Spike protein, because as we were referring, this is the thing that is on the surface of the virus, and you can get a very good immune response against it.

Ujjwal Rathore 22:24
Just to add to this, so I think what all these different vaccines are doing is that they are showing a picture of the virus to the immune system. And there are ways, different ways you can do that. So, as Lorena said, that you can take you know, adenovirus, which is just a common cold virus, it causes very mild cold, and that too, like scientists have modified this virus, so it can't even cause cold. So it's an inactivated cold virus, and you put this DNA for the Spike protein into this virus and deliver it to the cells. Or you can just take mRNA directly and put that into cells. Or you can- what you can do is you can take for example, there are vaccines, which are protein based, you can just directly take this, you know, Spike protein and put it into the body. So the idea is to show a picture of virus to the body, so the body starts recognizing it, and is ready to fight with the virus when and if it ever comes.

Robyn Kaake 23:19
And so there's like a lot in the media or on the internet, and people are asking is one vaccine more effective than another. They want to wait for the best vaccine. Or there's a lot of questions about oh, which vaccine should I take. And what would be our advice to people about what vaccine to take?

Ujjwal Rathore 23:42
Whichever you can get first, your hands on, just go and get that vaccine.

Robyn Kaake 23:46
Absolutely.

Ujjwal Rathore 23:47
We are lucky that almost all COVID vaccines are really good. And all of them prevent, like severe cases and prevent hospitalization. And that's what we want, right? We don't want to go to the hospital. So just go and get the vaccines. I would say the race is not between different vaccines. It's between vaccine and the virus. So you don't want to get the virus while you're waiting for a good vaccine.

Robyn Kaake 24:11
As of this recording, which is August 12th 2021, are vaccines approved for children? And how young is this approved for children in the United States?

Ujjwal Rathore 24:28
So vaccines that are approved for people above the age of 12 years. And but I think Pfizer is doing a trial on children younger than 12 years and they are going to release the results for children from six to 12 years old in next month. And then a couple of months later, I think by October or November we will get results from another trial which they are doing in children between age six to five or six years. So I think by this year-end we should have vaccines for children as well.

Robyn Kaake 24:59
You know there's a lot of guidelines and things change a lot, almost daily, it seems like sometimes, but for parents or people who are living with those who are maybe vulnerable or who can't get the vaccine for medical reasons, how could those people protect their children, their loved ones? And how can we as a society, protect people who can't get vaccinated yet?

Lorena Zuliani-Alvarez 25:26
So well, the first thing will be like to follow the guidelines, like for example, use a mask, don't go to crowded places, practice social distancing, because what is important here is that you don't transmit the virus to these people. And we know how this virus transmits, it's transmitted through the air, like we're talking, especially if we're in closed spaces, if we are in places with a lot of people. So if we trying to reduce the amount of contacts that we have, especially if we live with one or more people, then we will be protecting them from getting the virus.

Robyn Kaake 26:02
I mean, and probably like number one is get vaccinated yourself if you can.

Lorena Zuliani-Alvarez 26:07
Well, yes, I'm assuming that you are vaccinated. But yes. *[Laughs]*

Ujjwal Rathore 26:11
Yeah, I would say the same way. Like, in the past, when inactivated vaccines were being used and some of those had live, or live attenuated vaccines, and there was risk associated with those vaccines, because the whole virus was there, it was weakened, but it was still there. And so there was no

possibility of giving it to cancer patients and people with immunosuppressed state. So in that case, also the best idea was everyone in the family, everyone in the neighborhood or everyone possible who can get the vaccine, should get the vaccine. Then the chances of getting infected and transmission reduces. And that's how you can save children or elderly or people who are vulnerable who can't get the vaccine.

Robyn Kaake 26:48
Right. I think the idea and the goal is to have herd or community immunity so that the virus will just hit an immune person and get stopped where it is because it can't, it doesn't have a place to go. Basically.

Ujjwal Rathore 27:05
I think it's a continuous process, right? It's not that if you reach a lot of people… like that if 90% of people are vaccinated, then we'll reach herd immunity. But the question is what we are talking about, we're talking about when is the infection- when are the infections going to stop. And the more number of people vaccinated, the lesser infections we're able to get. That's the thing. So if we have 90% people vaccinated, then we are going to get less number of new infections, then 70% people infected. And that's how it's a continuum. So I don't think we should ponder too much over immunity numbers. And we should think about, the more the number of people vaccinated, less the chances of those who can't get vaccinated… for them to not get severe disease.

Robyn Kaake 27:45
It's a little bit like, um.... like in college, we used to have these collective decision-making classes, where you would talk about the hypothetical of getting fireproof roofing. And so the idea was, oh, you know, 90% of people get fireproof roofing, I'm probably fine, because the fire will get put out by those- it won't be able to spread. But if you happen to live next to 50% of people who don't have fireproof roofing, then that isn't going to protect your house, right? So the best way would just be have a fireproof roof on your own house, and also protect your neighbors. So it's kind of this collective decision making problem of, we all have to do it if we're going to protect each other. And yes, maybe one or two people could just not get it. But that's not really the best way of making that decision for yourself.

Laura Gladson 28:44
Well, and I think my understanding, too, is that there already is a certain fraction of the population that can't. Like the cancer patients, or immunocompromised or people with a chronic health condition. So like, we already have a chunk that can't get it so, like, they have the out, they have a good reason. Everyone else kind of needs to take on the task and take care of everyone. You know, that's how I think of it.

Ujjwal Rathore 29:11
Yeah, I would say that instead of relying on higher immunity, we should rely on vaccines because they are more reliable.

Robyn Kaake 29:19
Okay, so, I'm gonna shift us. I'm gonna move us on a little bit. So there are a lot of side effects that are reported for, well for a lot of different vaccines, but also for the SARS-CoV-2 vaccines, all three of them.

And for a lot of people, they think that maybe the risk of COVID-19, and getting illness for them is not very high personally. And so why bother getting the vaccine if it's going to make you feel sick for a couple of days, and I thought it would be good to talk about our own experiences. So Lorena, Ujjwal, Kelsey, myself, Laura, why we decided to get the vaccine. And we can talk about any of the side effects that we ourselves experienced. And then kind of what the downside of short-term and long-term effects of actually getting COVID-19 or catching SARS-CoV-2, versus the short-term effects of the vaccines that we received. I guess I'll just start. So for me personally, I got the Pfizer vaccine, I- so I had two shots. I was pretty much fine. I felt a little bit tired. I had a headache, maybe a fever for a couple days. So I took it easy. Uh... didn't do any heavy exercise. And then I went about my life like normal and was very, very happy that I was protected from SARS-CoV-2. And that was… I planned a trip to go see the rest of my fully vaccinated family because I was the last one of the four of us. So yeah, that was my vaccine experience. No bad side effects for me. Maybe it felt like I had a bruise on my arm where I got a shot.

Lorena Zuliani-Alvarez 31:16
I actually got COVID-19 at the beginning of the pandemic. So… and I can tell you is pretty nasty. But I survive. I felt really sick for a week, very debilitating disease, I think. But then when the vaccines arrived, I wanted to get it and one of the reasons is because how long does the immunity that you develop during infection last. So it was shown very clearly that if you get vaccinated, your immune system is prepared for longer to protect you against the virus, than if you actually get the virus on its own, because when you're infected it depending on your symptoms, and how well your immune system is stimulated, that response will change basically, over time. And people were showing that after for six months of getting COVID-19 your antibodies levels will start declining. But when you are vaccinated, basically you're boosting your immune system and that can protect you for much, much longer. Now there are so many studies that show that people that have been infected and vaccinated are above general population have been protected against COVID. So when I got vaccinated, I actually got symptoms. And I think it's because my body also was kind of remembering what happened before. But I just felt sick actually, for a couple of days very differently from when I actually got the disease.

Kelsey Haas 32:42
Yeah, I mean, it wasn't too bad for me, I think. My sister Paige, who's also a B3 co-host, and I both got Pfizer and got it on a Friday. So we both basically were couch potatoes for the weekend. But yeah, just what most people have experienced fever, body ache, fatigue, but nothing in comparison to what it would be like to actually get COVID, so in that regard, we were like this is totally fine. Please give us this over anything else. My sister's partner Sean also got the vaccine, but when he got it, I just thought it was funny because he also got a fever. And so he was having literal fever dreams. And so in his dreams the vaccine was like being processed through his knees by like little guys like running on one of those water windmills, and so in his dream, it was like his body was like churning through a little like windmill with these dudes running around his immunity. And that's how the vaccine worked. And it was all located in his knees.

Laura Gladson 33:49
[Laughing] Oh my gosh, that's so funny.

Ujjwal Rathore 33:51
So I got the Moderna vaccine. And after the first dose I had a sore arm, so I was not able to lift my left arm for one day, but then started improving and I had mild fever. After the second dose I had high grade fever, it was 102 degrees Fahrenheit. And... but I was fine in a couple of days, like for two days I had fever but on day three, I was able to watch Netflix very comfortably there was no problem absolutely at all. Yeah, and I would say that back in India a lot of my family members they were not that lucky they didn't… get you know the vaccine in time, and some of them had very bad experiences and some of my relatives actually passed away. So, I feel really lucky that I was able to get vaccines at the right time and I think you know the fever you get for two days or three days that's nothing as compared to even if you get a moderate COVID, that's going to be much worse than a couple of days fever. And you know you can- fever you can get because of anything. You might be thinking that okay, I'm not going to go and get vaccines because I might get a fever for two days. But you might just get catch common cold and then you might have fever for two days, but so I would say it's it was, it was very mild for me as well.

Laura Gladson 35:04
So I also got the Pfizer vaccine. And I really just had, like Robyn, a little bit of a headache, and I was tired for about half a day. But I was just really grateful to get it, I kind of just jumped on and got signed up as soon as my age group was available in my county. I was actually out in New York City when COVID started. And it was, I don't want to say traumatic, but you know, kind of this collective trauma of just like being in one of those places where you were, the city went dead quiet, and all you could hear were ambulances all day, you know. And to me, it was like, um, you know, you see in all these movies of like, the pandemics, like the happy ending is when the vaccine comes out. I'm personally kind of shocked, that it hasn't been more of a happy ending for a lot of people's views. To me, that's what it is like, that's like the miracle of modern medicine. And like all the effort that's gone into it by you know people who really care about this and have dedicated their lives to this. And actually, I personally was really excited to get the vaccine, because I was pretty terrified of getting it, and not just getting it and experiencing it, but then having some chronic condition come out of it. I work in air quality, so like respiratory diseases, something that's part of our research, and, and just being around kind of learning about that every day, I really didn't want to get one of those diseases or one of those conditions. Because I mean, like your breath is your life. It's like every, you know you take a breath every couple seconds, like to have a disease that affects that is like, really terrible. And so if you can prevent that, that was like a big one for me. It's just I don't want some long-term consequence from this. Yeah, so give me the vaccine.

Robyn Kaake 36:55
I mean, there's been a lot of studies that have come out, not just about long COVID, or like long-term COVID, which is a little bit different than having, I think long-term side effects of COVID. But they've shown also that COVID can damage not just your lungs, but your heart, which is pretty scary.

Laura Gladson 37:15
Oh my gosh.

Robyn Kaake 37:16

Yes.

Laura Gladson 37:17
I didn't know that. Ooh.

Ujjwal Rathore 37:19
Yeah, even- even the beta cells of Langer and so even your pancreas, so COVID can even damage, you know, cells in your pancreas. And so you might become more prone to diabetes.

Robyn Kaake 37:31
Yeah, so there's a lot of... even for young, younger, healthier individuals who can get this virus, you can have something that sticks with you for the rest of your life, where you're more likely to develop heart disease or other age-related diseases that you might not have developed otherwise. And there's like stories, we did an episode talking to the Conklin and McDevitt lab, yeah, about some of the studies on athletes who then were having these like, problems performing because their hearts were so damaged.

Laura Gladson 38:14
Oh my gosh.

Robyn Kaake 38:14
It's just, it's not something to mess around with the symptoms of COVID, and the unknowables of long-term COVID are much more dangerous than feeling a little bit tired or a little bit sick or a little bit feverish for- I mean, I think for each of us, it was like, two days and then done.

Ujjwal Rathore 38:33
Yeah, yeah. Yeah. There's like a switch was- something was switched on or off again.

Robyn Kaake 38:37
Yeah.

Ujjwal Rathore 38:39
Yeah. But it was different, like, for example, with my mother, she… she got COVID after getting the first dose of Oxford AstraZeneca vaccine, so she was not fully vaccinated. But it was like 30 days after getting the first dose of the vaccine, so she had some protection, and so she never developed serious symptoms. She never- like her oxygen saturation was always maintained. And we were pretty scared for her. But so, she never had like high fever, never had a lot of cough, no serious symptoms, but it took her more than two months to regain her strength. And you know, was it because of lung damage or something, we don't know, because she didn't get a CT scan done. But it took a really, really long time for her to recover, even from mild symptoms.

Robyn Kaake 39:22
In the media, there was a link of one of the vaccines to blood clots. And I thought maybe it would be good for us to talk about. You know they did put the vaccine… they paused giving the vaccine out. But then they did the tests and they studied it, and now the vaccine is back in circulation. Can we talk

about, what um... a little bit about what those studies were and why scientists felt it was safe to put the vaccine back into circulation? And just so that we're also aware, it was the Johnson Johnson vaccine that was um ... was related to.

Ujjwal Rathore 40:02
Yeah, yep. So Johnson Johnson and also Oxford AstraZeneca vaccine, it's not being used in US, but in other countries. So they were report… so the first thing is that at times, you see some rare side effects coming up. And you don't know whether they're actually really because of a vaccine, or it's just because at the population level, you see prevalence of the disease. And so if you're giving it to, like millions of people, a few people are naturally going to have some of those symptoms. But when the trials are going on, you would like to pause, right? Because you would like to pause, and you would like to figure out, was it really because of a vaccine? Or was it just, you know, it was not related to the vaccine. So you give it a pause, and then if you find it's unrelated, or it's, it's extremely rare, and the benefits outweigh the risks, then you restart trial. So I think that's what happened with Johnson Johnson, that it was found, basically, the whatever rare, rare or extremely rare side effects are, they- like the benefits of vaccines really outweigh those side effects. So it makes sense. So even so as far as the blood clotting is concerned, SARS-CoV-2 infection can itself cause blood clotting, and the risk of getting blood clots from an actual infection is much, much higher than the risk of getting it from any of those vaccines.

Kelsey Haas 41:15
A really common, and kind of like, maybe breezed over a little bit, side effects or risk of blood clotting for women is, especially when you go on birth control like that you're increased, you're at an increased risk for blood clotting. I'm curious if either of you or any of you know, how the risk of blood clots with the J&J vaccine compares to the risk of developing a blood clot on birth control?

Lorena Zuliani-Alvarez 41:40
I think it's minimal, actually, I think it's lower is very low.

Robyn Kaake 41:44
It's much, much lower for the vaccine than for birth control.

Lorena Zuliani-Alvarez 41:49
Yes.

Kelsey Haas 41:49
Okay. So maybe that can also help put it in perspective, because the risk of blood clotting for women on birth control is something that is not very, like publicized.

Ujjwal Rathore 41:59
But I think that these side effects are so rare that it's very difficult to study them, because... because they're so rare that it's difficult to figure out that if you're getting one case in 100,000, or in a million of you know, blood clotting, then whether it's the normal rate of blood clotting, it's a little higher than that. And so there are many studies done on this, but it's, I would say, it's a very complicated field. And to

figure out actually, if there is a serious increase, like significantly increases or not, it's very difficult to say that.

Robyn Kaake 42:29
At the time of this recording, there's a lot of news about the Delta variants. And that it's basically the most predominant variant, certainly in the United States, but globally, as well, I believe. Lorena and Ujjwal, can you talk about what do we mean by the Delta variant? And, you know, what's different about Delta, then maybe the original version of SARS-CoV-2?

Lorena Zuliani-Alvarez 43:04
Yeah, so the Delta variant is basically a mutation of the, what we call the early lineage virus, or the reference virus. So this... the virus is going through these transmission events, especially now that it has transmitted to a lot of people around the world, basically, it's acquiring new mutations, and it's evolving. So we are seeing evolution on real time, basically. And this virus had acquired mutations in the spike protein that we mentioned before, which allowed it to infect better the cells, to transmit from cell to cell, but also other mutations in the genome that will give it some advantages basically, once it infects the individual. So it seems like the Delta variant, the big advantage that we are seeing is that it can get transmitted much, much better than the original virus. And for that reason, it's now the predominant variant, and is called a variant of concern.

Ujjwal Rathore 44:01
So when viruses replicate these mistakes happen, and sometimes you get viruses, which are better in transmission, better in some function than the original virus. So with Delta virus, it's seen that the viral loads are higher in people who are infected with Delta. And so that because they have more virus in their body, so they have more chances of spreading it, the people who are infected with Delta, which is a matter of concern. And I can tell you, can tell this from personal experiences as well, that in India, when the second wave was going on, most of my family members, they got infected. I think they were all almost infected with Delta, because that was a dominant strain variant circulating at that time. But even then, those of my family members who were vaccinated, they had very mild symptoms. And so what I would say is that we sometimes we worry about oh, there's a new variant and so we should whenever there is a variant which is better at transmission, we should take more precautions, obviously, you know, be more careful avoid-... wearing a mask or avoiding crowds. But most important thing is the vaccine. Because vaccine, masks, and distancing still protects us whether it's delta and *[mumbled]* and spit out any other strain.

Robyn Kaake 45:16
So a lot of people are vaccinated, and we hear about these breakthrough infections. Are the vaccines that we have and the vaccines that we've been given, are these effective against Delta? And you know kind of along those lines, is there going to be a point at which we'll need booster shots?

Ujjwal Rathore 45:37
Very good question, Robyn. So the vaccines we are getting, they're highly effective against Delta as far as hospitalization and severe disease is concerned. Sometimes what might happen is despite getting the vaccine, you might get a break- what is called a breakthrough infection in the media, which means

that you might get infected and you might have mild symptoms. Because vaccines, they don't make a shield outside of the virus content. Or if you if you are exposed to the virus, it might still go in and replicate a bit, but then your immune system will kick in, it will start making antibodies, and then those will, they will clear the viral infection. So it's most likely going to be mild. But severe disease, yes, it's the vaccines are very, very effective against severe disease, I would say as effective as they were a year ago, the well- it... its operating at that time. So for booster shots, I... so people have different opinions about whether we need booster shots or not. Germany last week declared that they are going to be giving booster shots to people in the country. And then some other countries have started giving booster shots, some more vulnerable population. I think, I personally think that we will not need booster shots anytime soon. Because it looks like the vaccines are holding up pretty well. But we might need booster shots for specific populations, very vulnerable populations, for example, elderly people who didn't have good response to two doses of the vaccine. So there was a study where they looked at patients who underwent transplants, and they found that giving a third dose actually helps in you know, getting higher level of antibodies and better protection. So I think it might make sense to give booster dose to some people, but I don't think it will be required at the whole population level.

Robyn Kaake 47:20
And we have to also take into consideration that this is a global pandemic, and that in order to stop the virus, everyone needs to be vaccinated. So, I think you try to weigh the benefits of giving some population extra immunity versus just trying to get immunity to the entire planet. So that we're all protected, and we can get rid of this virus instead of having it keep mutating and transmitting around the world.

Ujjwal Rathore 47:54
Yah I think that's definitely better thing to do. But now then the question comes that suppose for example, in US, we have like, if there are a lot of people who are not ready to take vaccines, then what will you do when you have vaccines? And you, in my opinion, you know we should share the vaccines and get the whole world vaccinated as early as possible. But then within a country, this question might arise that if 30% population is not ready to take the vaccine, should we give boosters to the remaining people, because the vac- probably, that's what you can do.

Robyn Kaake 48:25
Right. And the vaccines do expire. So, there wer- in the United States reports of certain states that basically let 1000s of their vaccine doses expire and go bad because they didn't use them. So you know yeah, at that point, I would be like, yeah, give me a booster shot. *[Laughs]* Sure.

Ujjwal Rathore 48:48
One of my friends asked me a very interesting question about vaccines. He asked me that, "Ujjwal if I have got both the doses of the vaccine, but I get an infection after that, and it's a mild infection. Does it mean that it was like kind of a booster? Like because I- because it didn't give me too much- it didn't give me any serious symptoms, and I got virus again. I was like, okay, like technically, I would say that was a booster, but it was boosted with live virus, and you don't want such boosters. Because once virus gets into the body it does other things as well. So don't go out and take the booster from the live virus.

Robyn Kaake 49:26
Yeah, don't go trying to do that. Like it's still better to just not get infected, I think. Yeah. Which is a little bit along the lines of my next question, because a lot of people bring up the idea of, well, I want to have natural immunity. I want to get infected with a virus so that the natural course of events will have happened, and I'll have this natural immunity, which is better than being vaccinated, and I wanted us to address this. I want us to address why getting a vaccine could actually, and is actually better than getting infected with SARS-CoV-2, and having quote unquote, natural immunity, and what's the difference between being vaccinated and being infected.

Lorena Zuliani-Alvarez 50:12
Yeah, I think that we already touched on some of these points. One is the basically the long-term effects of the disease. So when you get infected, what will happen to you like chronically like you can have, you can develop long COVID. Or you can develop side effects that can last for a very long time, you never know what's going to happen. The second thing is that probably, you know, you don't get the levels of antibodies or protection that you will get when you get vaccinated. So that's the main difference, I will say, and also the vaccines will provide longer protection over a period of time.

Ujjwal Rathore 50:49
And I would like to add that, you know, why would you like to pay more for something when you can get it for like, less cost, right? So there is much more cost with the infection. The cost, we told, with vaccine was fever for a couple of days. But with an actual viral infection, there'll be lung damage. And so some of you might know this, that if the lung tissue, the alveoli tissue in the lung is damaged, and it is scarred, it will never regain its… so the gases can never be exchanged from it. So you lose your certain lung capacity in that. So it's a too bigger cost to pay for. You know just going out and saying that I'll get immunity from natural infection, I would say that, we need to be smart, and choose the best option available. And that's definitely the vaccine.

Robyn Kaake 51:33
I think of it too um... So when you're getting the vaccine, the vaccine is giving your body like, really good instructions of "this is bad, I'm very bad, as soon as you see me attack me", and it's all the things that the body sees first. But when you're getting naturally infected, your body produces antibodies against a lot of the pieces of the virus, most of which are not protective, and won't help you. So your body is actually remembering and protecting itself against things that don't actually protect it. Whereas the vaccine, the antibodies you produce, they all protect you. So you're developing a better immunity actually, by being vaccinated than you would by natural infection. So in this situation, natural is not necessarily better. It's just what happens when you get sick.

Ujjwal Rathore 52:27
Yeah, yeah, and it's very natural, you know, because ultimately, your body's generating and developing the capability to fight the virus. The molecule, we are putting in the vaccines that just stays in for very short period of duration. After that your body does whatever needs to be done. So it's, the immune response is very natural. And it's like, you saying that, okay, I'm not going to do work out in a fitness center because I will just walk around, and if I develop more muscles from there, that's good enough. But suppose we are going to participate in Olympics, you know you might actually go and train for that

event. And this is like this pandemic is kind of an event which is going on, and we need to prepare for it to take special steps and vaccines are those steps.

Kelsey Haas 53:09
Yeah, I was trying to think of an analogy for it. And I think the best one that was in my head, just because I'm sitting at Gladstone so I'm looking at the UCSF pool on the roof across the street, is like if you don't know how to swim, and someone pushes you into the pool like, yes, you can have a natural swimming ability, and maybe you can get yourself to the edge. But wouldn't it be great if somebody gave you like, instructions on how to get to the edge? Or wouldn't it be great if someone threw like a little like lifesaver, like little red life raft or something? Like, so yeah, you can like naturally swim to the edge, I guess if you've never swam before, but yeah, like Ujjwal was saying it's a much higher cost, because you're probably going to swallow pool water. And you might not make it to the edge. Like it's a bigger risk.

Laura Gladson 53:54
Well and like how many of these people saying I want the natural reaction, like take Tylenol over the counter drugs? Like, like, is everything in your life natural? Like, that's just a silly, I find that silly. I don't understand what that means. Like, what's natural? You know, nothing about our modern life is natural. And that's why we have such long lifespans and like such high quality of livings. I mean, you know.

Ujjwal Rathore 54:18
Yeah, yeah, that's, yeah, that's true. But I understand why people have such doubts, because there's a lot of misinformation out there. And if you are not a subject expert, it becomes very difficult to figure out what's right and what's wrong. So I think it's very natural for people to feel confused, and I think we scientists need to go out and talk more and communicate more so that you know, people get the right information.

Robyn Kaake 54:44
Yeah. That's a really good point Ujjwal, and something that I wanted to talk about. So I'm going to bring it up now because I think that's a good segue. There are a lot of people that are hesitant against getting vaccinated, who don't want the vaccine, or they're more afraid of the vaccine than they are of the virus. Or maybe they just don't trust the officials or the people who are telling them to get vaccinated. And there's so much misinformation everywhere. How, if you were just a normal person, how would you go and find out what to believe and what not to believe? And so I thought, I don't want to... I think a lot of times people will belittle other people's concerns or say that, well, I'm an expert, so just listen to me, without actually listening to concerns. And rather than try to tell people… try to dissuade people from every theory, or misinformation, or piece of misinformation that is available, I thought it would be better for us to talk about how we process information, especially when we go and… you know I'm a subject expert in a very small piece of information. It's not even vaccines, I'm not an expert on very much at all, actually. So when I get pieces of information that are different from each other, what do I do when I'm confronted with two different pieces of information. I thought it'd be good for us to just tell people how we go about figuring out for ourselves what we think is true, and what we think is misinformation. And so, when you come across contradictory reports, or just new pieces of information, how do you judge whether or not to trust it? And how do you make decisions that could affect your household, your family,

or your own health? Um, happy to kick us off, but I'd love to hear from you guys as well about how you handle these types of things.

Lorena Zuliani-Alvarez 56:58
I mean, I try to go to the source of the information. I think, like sometimes the media, they try to sell papers, and they try to sell, you know, stories and they put things in the headlines to call your attention. But for me, I always tried to go to the source of information, I try to see even the plots, the data, and see like, they're saying there is a difference, there's actually a difference. Is this bar really big? Or is it small? Like I try to judge it myself. And that's one of the first things that I look at when I see something that I'm not sure about. I'm sure you have other ways, too. But me being a scientist, that that's what I will do, basically.

Ujjwal Rathore 57:45
Yeah. Yeah, I think being the scientist makes it a little easier, because you have we will not you basically try and go find the data or the logic for it. But if you are not a scientist, it's a little difficult. And I think the way probably we should do it is basically, we know over a period of time, build good resources for any information. So you might have heard other things in the past and then you can figure out basically, okay, whenever I hear things from this source, they're mostly right. And so you basically, you've tried to find reliable sources. That's one way one way of doing it. Then other way of looking at it is, you know, I think, like, in my school, I learned how to spot conspiracy theories, and what are clear signs of conspiracy theories, like how to spot fake news. So those are the skills you need to learn and then was one most important thing is like, for example, what are the- what is the majority opinion in that subject area? So what are the majority of experts saying that right? So if in the particular area like 99%, people are saying the vaccines were really nice, and there is one random person is saying, okay, oh, no, this gives you trouble then... and you trust that one person. So there should be very strong reason to trust that one person against the 99 other people, right, I would also look at on what basis they are saying those things, and then also look around and logically try to think, for example, if you think vaccines are bad, then so many countries are just giving vaccines to everyone. Their politicians are getting it themselves and we see that countries who vaccinated most of the population, they're doing much better the countries where the vaccination rates are very low. So you just try to yourself also analyze it. So, you don't always need very granular data to as a scientist, to look at. Sometimes you can look at the bigger picture and at the population level, you can see. So, if you just observe, I think things more carefully, instead of believing what the media is saying, then I think things like for example, for vaccine it's getting clear, right that people who are who are getting vaccinated are getting milder symptoms. So you I would say find right sources to read things. Find out subject experts who are very reliable. See what's the majority opinion in the field, and then use your own logic.

Lorena Zuliani-Alvarez 1:00:04
Yeah, I agree with you, you will- in- in actually using common sense. Like the other day my mom sent me news, like oh, the Pfizer vaccine can protect you for years. And I was like, well, there's only been one year right, since we started putting these vaccines, so they cannot make these claims, for example. So just try to use also the common sense when you read this news. And as you will say, trying to see what is actually happening around you, and connect it to it.

Robyn Kaake 1:00:32
Yeah, I like to think of it as like the gut instinct. If something sounds wrong, usually I'll sit, and like, yes I do think the news likes to sensationalize some things. And I would say even just not talking about scientific things, if I get different pieces of information about the same news event… say a celebrity has done something that's bad. And someone's reporting on it, the first thing to do is go find another source, and see what other sources say, and just try to find multiple pieces of different information from different people, all of whom don't have a stake in the game. You know, like I want as unbiased of opinions as I can get. And then also, if I see that an opinion is biased I try to feel- or figure out, is there a reason for this bias? Is there some sort of money that is being exchanged? Or is someone you know, politically motivated, or someone financially motivated? Or, you know, what- what might be someone's even if they don't know, the bias themselves? What might be their bias going into something? But I think uh, you know, the layman's version of what Ujjwal said, is to, yeah, seek out trusted sources who usually give you good information, try to get multiple sources of information. And then yeah, like Lorena said, try to use your like gut instinct, common sense. If something doesn't line up with timelines that you yourself know of, or if someone is doing something that you know not to be true, then maybe that's not a very trusted source.

Ujjwal Rathore 1:02:17
Yeah. And then there are things like, for example, if people are saying that, okay you get infertility because of vaccines then you should do everything about it if that's the case. Then after giving billions of doses, like 4.8 billion doses so far of vaccines throughout the world, you should have seen some cases, some confirmed cases of infertility, right? And then if you think that, it's not in one country right? So you have to see like, you can think of political reasons in one country, but the politics of one country differs a lot from the other country. And then money wise also, right? So there's so many sides. So you might think… sometimes people might think, okay these scientists are paid for, that's why they're saying all these nice things about vaccines, but like all the scientists and all the countries, like majority of them, 99% of them, that doesn't sound logical, right? Because then we don't trust humanity at all. Because then if- so... I think we, sometimes we, we want to believe that a very unique or different opinion is the right one. But that might not be the case.

Laura Gladson 1:03:16
Something, I think that's helpful for the lay person, if you see a news story, and they're just reporting on a single study, that's pretty suspect, unless there's a bunch of other studies coming out showing the same thing. And so, for a lay person, it might be helpful to look up news articles on reviews, or systematic reviews, where they look at all the studies that have been done over the last, you know, five or 10 years on this, obviously, with COVID. You can't really do that. But I'm sure there are some reviews coming out now that there's been so many studies in the last couple years. So that's helpful.

Robyn Kaake 1:03:49
Yeah, I like your point about if it's only looking at one study, maybe try to find more sources. It's kind of like what we do as scientists as well. Like, is your study repeatable? Can a different scientist somewhere else actually repeat your results?

Ujjwal Rathore 1:04:04

Yeah, yeah. So and this, and I think that's the problem, why news media is not able to cover it properly. There's a limitation, right? Because the nature of it is to have a breaking news as fast as possible. Whereas in science, if you give it time, then the evidence becomes stronger and stronger, or the, you know, bad studies, you know get filtered out. And-

Lorena Zuliani-Alvarez 1:04:22
Yeah, and I think it's because people are watching the scientific, like process in real time for the first time in their lives. Where you're getting data, and you're trying to confirm that you're trying to see if it's reproducible. And that's what scientists do all the time. They question the results. And they try to see oh, yeah, did we make a mistake? Is this real? Is not real. And as Ujjwal say, as time passes, we confirm the hypotheses that we have at the beginning. So yeah, we just have to wait.

Ujjwal Rathore 1:04:49
Yeah, yeah. Yeah, and I think it's a very good point that, you know, as information evolves, the data evolves, the scientists also collect their models and make them better. But it's not like we every time we find new information everything is changed always. So Isaac Asimov wrote a very good essay on this topic called "The Relativity of Wrong". And what he said was that at one point in time, we used to believe that Earth is flat. Because it was, for all practical purposes flat, because the curvature is so small, that you can assume it to be flat and do most of the things. But then we figured out it has some curvature. And then we started thinking it's more spherical. And then we figured out not even spherical. It's a you know, I don't know how to call that shape... spherically looks like it's an elongated... ellipsoid. But now we can see it from satellites, we can see it from you know… so now it's not going to become flat again. Right? So if you were wrong initially to think that flat, then we were wrong to think that it's spherical. But the degree of how much wrong we were was reducing, right? And we were getting more and more accurate in the process. So if you think that, okay, they initially used to think that Earth was flat, so they might be telling it wrong now as well, but now we can see, we can see the Earth from space, and you can see what the shape is. So it's not possible to be wrong about the shape of earth anymore.

Robyn Kaake 1:06:02
Yeah, I think it's tough as scientists, because I think we go in with things… You go into something like, I have a hypothesis. And it is a hypothesis, it is not a true-ism, I'm not going to prove something, I'm going to test something. And my hypothesis, very well might be wrong. And that's okay. And that's as a scientist, something that we're okay with and encourage and don't feel bad about. But when people are watching you have a hypothesis that is wrong, then yeah, that I think is a little bit harder for scientists. You're like, well, but that was the whole point I was testing. I was testing to see if I was if my hypothesis was supported. And my hypothesis wasn't supported. So now I will come up with a new hypothesis. And that's the scientific method. Whereas a lot of people, and a lot of questions that I think scientists get asked, it's like, well is this true or is this not true? And can you prove this? And when are we going to prove that this is right, and this is wrong? And it's like, scientists don't do that, we don't prove things. We test and investigate and study them. And then we tell you whether or not evidence supports one hypothesis or another. And it sounds like we're being so convoluted. And so… you know maybe hoity toity, like eh- that we don't use clear, concise phrasing, but it's because that's not our job. Our job is to go test things and to go see what- where the evidence takes us.

Laura Gladson 1:07:40
Because there's always that, you have to leave that possibility that you could be wrong. Because if you're so sure you're right that means science can't continue, kind of. Does that make sense? I don't know.

Robyn Kaake 1:07:51
Yeah, if a scientist tells you, they're like, I'm gonna go prove that this is true. You're like, I don't think I want to trust you anymore.

Laura Gladson 1:08:00
Yeah.

Robyn Kaake 1:08:01
Like, oh...

Laura Gladson 1:08:02
Like, because that means, that means any evidence that comes later, doesn't matter.

Robyn Kaake 1:08:06
Like, you just went out to prove yourself, right, which is not the scientific method. That wasn't science anymore. Okay, so there are a lot of reasons I've seen for people not getting a vaccine shot, we're not going to be able to go through all of them. But some of the common ones I'd like for us to maybe just discuss pretty briefly and try to give more people more information so that they can use that in their decision making. Okay, so one of the common reasons I've seen come up is that some people have been told or have seen somewhere on the internet, that certain blood types, skin color, hair color, is more protective against the virus. And since they have those traits, they don't need to get vaccinated because they're less likely to get infected.

Lorena Zuliani-Alvarez 1:08:54
I don't think there is any- yeah, there isn't any evidence for that.

Ujjwal Rathore 1:09:00
Yeah, that's not true at all. And if you have doubts about such things, then you should ask your physician, you know, your medical authorities, and because this information should come from the right source.

Robyn Kaake 1:09:11
Okay, so some people think if you live in a city, you're more likely to get infected. So if you don't live in a city, you're actually safe and you can't be infected.

Lorena Zuliani-Alvarez 1:09:22
Ah well, that is not true. It's just depends on the people that you get contact with. So you only need one person to transmit the virus.

Kelsey Haas 1:09:31
Or one trip to the grocery store, one trip to the gas station, unless you live completely off the grid and never see anyone ever.

Ujjwal Rathore 1:09:37
Then you have been doing social distancing, probably it's fine.

Robyn Kaake 1:09:42
Winners at social distancing.

Ujjwal Rathore 1:09:44
But you- even if they're meeting one other family and they're traveling, they're going somewhere else, then you are connected with the rest of the world.

Robyn Kaake 1:09:50
Yeah. And with Delta, we know that it can transmit so much more efficiently. So....

Ujjwal Rathore 1:09:55
Yeah.

Robyn Kaake 1:09:57
So, some people have said SARS is just the same as flu. So it's not dangerous to get infected.

Laura Gladson 1:10:05
Aren't they both dangerous?

Robyn Kaake 1:10:07
Kelsey can have some things to say about flu in general as well. Yeah.

Kelsey Haas 1:10:12
Yeah, I would say, so first of all, they're not the same. SARS has a lot more systemic and a lot more long-term complications, perhaps than flu. But regardless uh... flu is also not really safe to get infected. That's also why we have vaccines protecting us against seasonal and potential pandemic strains of influenza. Even with seasonal influenza, you still get 1000s of people who die from complications of infection. And so if you have preventative tools like vaccines at your disposal, you should absolutely take advantage of them.

Robyn Kaake 1:10:50
A lot of people don't like that the vaccine isn't FDA approved. And some people think even that the vaccine is untested.

Ujjwal Rathore 1:10:59

Vaccines have been tested really well, I don't think you can give me an example of what's been tested, you know more than a vaccine for COVID for example, any drug or anything, so they've been tested extensively. FDA has a very long red tape procedure to approve things. So they are taking time, but they gave the… the emergency use association was given to be used for these vaccines, but they will take their own time to read each and every patient's case file. And they should really speed up, it's- so it's basically FDA should do it much faster. That's true. But it's many, many countries have used these vaccines and they have been tested more than any of the other vaccines which were recently developed. Because can you tell me any other vaccine, which is put in so many people, and it's been like, six months after they have been given the vaccine.

Kelsey Haas 1:11:53
I also really liked Ujjwal's point earlier that he brought up that the research into these vaccines started in 2003. Right? I think that was the year that you threw out. And so it's not even really like, oh, in the last year, we just like magically came up with this. It's like this has been an ongoing, evolving process for almost 20 years. And, you know, circumstances align that we happen to be able to turn it around really quickly. But it's not based on like, nothing. It's a culmination of a lot of work.

Robyn Kaake 1:12:25
So a lot of the things that I keep seeing over and over again, is that we don't know the long term effects of the vaccine. Which is hard to say... to combat against because that is true, we don't know the long-term effects of the vaccine, because we've all just received it in the last year, it's impossible to know the long-term effects of vaccine. But I would like us to talk about why that's maybe not the best decision-making reason.

Ujjwal Rathore 1:12:52
Yeah, so you know, you cannot be 100% sure about the long-term side effects of vaccines, but you can be very confident, you can be very confident about whether you are ever going to see long term effects or not on the basis of past experience, right? So it has never happened in the case of vaccine development that people have seen side effects after a few months, a few months after getting vaccines, because that's not the nature of… it's just not logical, because what happens is that you're putting a small part of the virus in the body for the immune system to get trained, right? And that thing stays in there momentarily, for a very small amount of time. And after that it's not even there. And so, logically, it doesn't make sense that vaccines are going to have long term side effects. And but just now think about the virus. Right virus, when virus goes in, it stays in for quite some time. And it then, you know, destroys many different types of tissues and all and those costs are going to be a lifelong.

Robyn Kaake 1:13:54
So some of the questions are, I don't know what's in the vaccine, and I don't want to put anything in my body that I don't know what's in it.

Ujjwal Rathore 1:14:03
Yeah, I would say that you can be rigorous, but the question is that it's- things are going to go into your body, the foreign part- things are going to get into your body, they always get in like bacteria, viruses. So the question is whether you want the foreign virus to enter into the body, or take a vaccine from

outside. Everything is coming from outside, viruses also coming. Can you stop virus from entering into your body? You can't, right? So then the wise thing is to get something which actually is better for you. It's beneficial, instead of getting... because it's- it's not- …this is a choice between virus and vaccine. You are not going to get vaccine, most likely the kind of Delta variants that are more infectious, more transmissible variants we are seeing, you are going to get it. So that I think most of us are going to probably get virus at some point in time, if it keeps spreading like this, but the question is whether you get it before getting the vaccine and after getting the vaccine, that's going to make the whole difference.

Robyn Kaake 1:15:00
I mean, the other idea too is like, we don't live in a void. We are part of this planet, we are part of this world. Me just breathing in and out, I am putting foreign things into my body and I am expelling things out. I have no idea what is going in and what is coming out, because I just can't know. I can't test the air that I'm breathing at all moments in time. When I go swimming, when I go to the ocean, when I go outside, I'm touching water, I might swallow some water when swimming outside, I have no idea what's in there, it's in my body now. You can't ever know everything that goes into your body. In this case, you actually *can* know what's going in your body, because you can get the ingredients, you can ask for the ingredients of the vaccine, you can talk to your doctor about all of the ingredients you can talk to- you can figure out what's in this. So you actually can know what's going to go into your body in this one situation. So just, try not to be so concerned about the unknown. The whole world is unknown, and we still bravely go out and interact with it. So this is just a shield that humans have made that can help you.

Laura Gladson 1:16:19
I feel like the, like the energy behind that question of well, I don't want to put foreign things into my body can be redirected into actually really useful routes of action. Because there are plenty of toxins in our environment, in our water and our air that we know about, and we know of solutions for solving. If you talk to your politicians and you have some… I feel like there's other direct- like, it's good energy. And I think it comes from a good place. Like a lot of them are moms worried about their kids health, that's totally valid. It's just like, that concern has been misdirected into something that really isn't gonna make a difference. Whereas it could, you know, kind of go in a different route with just a little bit of education. And I was reading, or I saw this article on The New York Times, I think, this past week. And it was basically talking about how a lot of people who haven't been vaccinated, it's not… we kind of like blame them, like they're being stupid or whatever, like all this like kind of language around it. But a lot of them are poor, and they have children, and they work a lot. And so being poor, if they don't know the vaccine is free, a lot of them think they have to pay for it. And so they don't go get it, or a lot of them work all day and have children and they just literally don't have time and their employer won't let them go take some time off to get it or take two days to be sick. So I think there's got to be some compassion about there's some systemic issues going on. Yeah… and I'm guilty, you know, I'm guilty of blaming people for not getting it. And I have to remind myself like, not everyone...

Robyn Kaake 1:17:55
Absolutely.

Ujjwal Rathore 1:17:56

Absolutely. I have seen this happening in San Francisco. So I take Uber these days, I ask- usually I start, you know, if the Uber driver asks me what do you do. And I tell him, I work with viruses. And we start talking about vaccines. And I ask them, did you take the vaccine? And surprisingly, it's a pretty high frequency that they answer me no, still like- like this month. And then I ask them, you know why? What's the reason? Because instead of, predicting why they haven't taken, I just asked them, what's the reason. So I have heard these reasons, one reason is that it makes you sick for two days, and I can't afford to not be running Uber for two days. But then you have to tell them that, because if you get- because you carry so many people every day in your vehicle, and if you get infected, then you are going to be missing out for many more days. So is there a way, is there a way you can you know, figure out when is the best time for you to take off, and you can go and take the vaccine and not everyone gets the side effects as well. So you might be actually able to drive afterwards. And then the other question, is true that a lot of people really don't know that vaccines are free. So even now, even in San Francisco, they don't know that vaccines are free.

Robyn Kaake 1:19:05
Yeah, so those are all really good points. Yeah, it's hard, not everybody has complete information. Which is also if you come across someone who is unvaccinated don't assume anything, and just try to provide them with useful information. The vaccine is free, you can go to a pharmacy to get it. The government is trying to start putting more pop up vaccination sites in more areas. So your local government might be putting vaccination sites at churches or at your doctor's or at certain other arenas now. So I think, that's a really good point, that some people also just haven't had time to go get vaccinated.

Laura Gladson 1:19:56
Can pregnant and or nursing mothers get the vaccine?

Ujjwal Rathore 1:20:01
Yes, yes. Yes. It's highly, highly, highly recommended. So pregnant- pregnancy makes you high risk for severe COVID. And so it's highly recommended.

Robyn Kaake 1:20:12
I think the CDC just added it to their guidance, right. Like, like today almost. Yeah.

Lorena Zuliani-Alvarez 1:20:19
Yeah, exactly. I mean, the data just came out. Yeah. That there was some papers published in the last month and yeah, it's safe. And you can get the vaccine. And yeah, there's a lot of… there were a lot of pregnant women in ICU unfortunately.

Ujjwal Rathore 1:20:34
Yeah, my… one of my cousin's barely survived actually, a couple of months ago. Because she got COVID when she was nine months pregnant, and she was like, one-week due day for delivery, and she got COVID. And her oxygen started dropping to 85%. And then there were no hospitals in Delhi, there was no oxygen in any of the hospitals. So luckily, my wife's aunt is a gynecologist in a neighboring state of Delhi. So she had to be taken from Delhi when she was like, 80% 85%, to a hospital in a different

state. And she… both baby and she survived and they're fine, doing good, well, now. But it was very, very close to losing both of them, basically.

Laura Gladson 1:21:17
That's terrifying. I'm glad she's okay. Thanks for answering that. I feel actually… a follow up. Um, so will like… if you're breastfeeding, will your baby then like be immunized through your breast milk? And is that safe for them? I assume yes, since they're promoting...

Robyn Kaake 1:21:36
Not immunized, protected. Right?

Laura Gladson 1:21:39
Protected, they'll get some antibodies...

Robyn Kaake 1:21:41
Protected. Right. So because they won't have immunity growing up, they still need to get vaccinated. But they are protected as long as they are drinking.

Laura Gladson 1:21:51
Oh, okay.

Ujjwal Rathore 1:21:52
So they basically get antibodies, antibodies are secretly in the breast milk, so they get those antibodies. So it's like giving a monoclonal antibody treatment.

Robyn Kaake 1:21:59
But like, as soon as they stop, they are no longer protected. Yeah,

Ujjwal Rathore 1:22:04
Yeah, those antibodies might survive for some time in the body, but they will get cleared, you know.

Robyn Kaake 1:22:10
It's not, it's not lifelong.

Laura Gladson 1:22:11
Probably like, a couple days.

Robyn Kaake 1:22:14
Maybe a little bit longer. But it's not like..

Laura Gladson 1:22:16
Making up numbers...

Robyn Kaake 1:22:17

Yeah.

Ujjwal Rathore 1:22:18
I would say maybe in terms of a couple of months, or something at max, but not more than that. For sure.

Robyn Kaake 1:22:24
Yeah. This is why even though our mothers have been vaccinated, we still also have to get vaccinated. It's not like by drinking our mother's breast milk, we're protected forever.

Ujjwal Rathore 1:22:33
Yeah, there's one thing I want to add is that we might have people in our family, relatives, friends, who are reluctant about getting the vaccine. And, you know, so I think the way I like to approach them is asking them why, like, what's the reason why? What exactly is the reason instead of just thinking that they have... or assuming reasons, so and then if you just ask them, what's the reason and then you listen to it patiently and try to figure it out with them, at least we can do it, at least for a family, right? It's difficult to do it at a much bigger scale, but- you know, be patient and just be respectful, and then sometimes then people listen. And you can actually start showing them data with, you know, sit with them and start showing them things. Okay, so this is what is the difference. This is the risk. That's why I'm talking to you about this, and you think about it and give them time, then sometimes, people who are on the fence, they agree to jump.

Lorena Zuliani-Alvarez 1:23:29
And I think now they're seeing right, that what is happening right now with people that are vaccinated how well the vaccine is protecting them. And they're seeing those results in real life. And that will maybe motivate more people to get the vaccine.

Robyn Kaake 1:23:43
Yeah, I think just... Yes. When we are approaching people who have not been vaccinated, to come with compassion and without judgment. And yeah, I think um, I mean particularly for us, as scientists, I think it's important that we try to answer questions and answer honestly, but not necessarily try to judge someone for having come to different information. Because people get information from all different sources. We're very fortunate that most of our information is being received by experts, and that we understand it and that it's easy for us to parse through the data. And for a lot of people, a graph looks the same as another graph. And a bar chart looks the same as another bar chart and the ability to differentiate between what is truly scientific and supported by evidence and what is not isn't always clear. So I think just being compassionate and as helpful as possible.

OUTRO:

[Upbeat music fades in and plays in background]
Thank you for joining us today as we come back from a hiatus to talk about SARS-CoV-2 vaccines. We want to extend a huge thank you to every person who is doing their part during the pandemic to keep us all safe, to feed us, to heal us, to keep our daily lives running, and to help support researchers and

medical professionals who are working to combat the virus. Thank you to everyone who is doing their part by following guidance on COVID-19 protocols. We hope that our podcasts can be a source of information and maybe even entertainment during these challenging times. In our roles, as scientists, we always aim to be as accurate and precise as possible, while still communicating plainly. But in case we didn't do this, especially for this episode, which is on a very important topic, if you have any questions, comments or concerns about what we said in this episode, or you just want to say hi, please reach out to us at biologistsbeingbasic@gmail.com or @biosbeingbasic on Twitter or Instagram. We'd love to hear from you, and we will do our best to respond. And if you liked this episode and potentially want to hear more, please like and subscribe wherever you get your podcasts. We want to thank Professor Nevan Krogan who is our boss and the director of QBI. And we want to thank UCSF and the Gladstone Institutes who are our employers. I would like to thank our guests Lorena and Ujjwal for helping discuss this topic, and especially thanks to our guest and all around awesome human being Laura. Thank you to Alexa Rocourt and Michael McGregor, who are our sound engineers and producers. Our music has been Catalyst and Passport from Purple Planet Music. **[Music fades out]**

EXTRA/BLOOPER:

Kelsey Haas 1:26:40
Hi, I'm Kelsey. I'm a graduate student at UCSF in- uh-... wow. What did I say the first time? I did it so well the first time and now I'm like shy.

Robyn Kaake 1:26:49
[Laughing hard] I thought you were trying to think of Nevan's name.

Kelsey Haas 1:26:52
[Multiple people laughing] I was trying to say… I was like...

Robyn Kaake 1:26:54
[Laughing] In oh what's his name's lab?

Kelsey Haas 1:26:56
You know, the guy that I've been working for, for seven years. *[All laughing]* You know, he's really tall or you might have seen him around. Hi, I'm sorry. Okay. Hi, I'm Kelsey. I'm a graduate student at UCSF in- the- see, I always freeze if I want to say a Nevan Krogan's lab or in the lab of Nevan Krogan. And so then my brain can't compute anymore and so then I stop. I'll just okay...