[MUSIC PLAYING]

RICHARD BEIGI: Thank you all very much for the invitation. I'm Dr. Richard Beigi. I am a professor in Reproductive Sciences at the University of Pittsburgh School of Medicine. And for now, about nearly the last five years, I've served as the president at UPMC Magee-Womens Hospital. I've actually been at UPMC Magee-Womens Hospital for 22 years. The first 15 or so-- 12 to 15-- was really, a lot of clinical work and academic work. And I got the opportunity to consider the VPMA role in 2015, and I finally chose to do that.

And then about three or four years into that role, the opportunity to lead the hospital was put to me, and I decided to go in that direction. And it's been a very interesting time. And that decision occurred about a year or so before the recent COVID pandemic descended upon us. So given my previous academic life, that I'm still trying to stay active with, my training is an OB-GYN. And then after that, I came to Magee in 2001 and did a reproductive infectious disease fellowship, which really is infectious diseases in women, and how it affects pregnancy and surgical site infections and STDs and things like this.

During that time, I also did a master's degree at the University of Pittsburgh in clinical research, which is very similar to an MPH. A little less epidemiology, a little more statistics. And that was my background training. So after my fellowship, I actually went back to the town, Cleveland, where I had done my residency, my first job. And then after being there a couple of years, the new chairman at Magee, Dr. Allen Hogge, who I'd known when I was a fellow, called and asked me if I would consider coming back.

And the reason I'm going through all this is because that is foundational to what I want to talk to you about today, which is really pandemics, in general, with the focus on COVID, of course, but the intersection of science and leadership. And that'll become clearer why I'm giving you this background. So with that being said, why don't we go ahead and dive in. And my commitment is to get through the slides in relatively short order, and then leave time for questions at the end. Or if things come up during the middle, certainly we can entertain questions as they come up. So thanks again for the opportunity to speak to you all.

I have a few disclosures of relevance. I am a member of the American College of Obstetrician Gynecologists COVID-19 work group. I'm currently serving as the Co-PI for the NIH-sponsored MOMI-vax trial, which is an observational study of pregnant, lactating, and postpartum women and their babies who received various forms of the COVID vaccines. But I have no commercial conflicts of interest.

So I'm going to start, over 20 years ago, with-- everyone remembers this-- the tragedy that was 9/11. Shortly after that was followed by the anthrax attacks. And then within a few years, we had the first SARS outbreak, which was very aggressive, but was much more limited in its scope. We're very thankful for that.

And then shortly after that, we had Hurricane Katrina, which for those who remember, this was an absolute disaster from many perspectives. And it really led-- at that time, which was a little over 20 years ago, it led a lot of institutions and a lot of the current leadership, including the federal government, to really narrow their focus and begin to think about, how can we prepare for either biological conditions, such as SARS or flu pandemics, as an example, or other disasters that have biological implications, like a Katrina? Things like that.

And also, this was happening in the backdrop of the terrorist attacks and the bioterrorism. And UPMC was no outlier to that. There was a major focus and investment on being prepared for these types of outbreaks. So as this was going on in 2005, 2006, that's when the previous chair-- who I, again, known, Dr. Allen Hogge-- reached out to me and said, look, there's a lot of planning going on around this at UPMC. Giving your infectious disease training, is this something you would think about coming back and leading for us at the hospital and in the Department of OB-GYN? Which I was flattered that he had called me, and I ultimately did decide to move back in 2006. I happen to be, coincidentally, from Pittsburgh. Same with my wife. So we had parents here, and we were having kids at that time, so their grandparents were here. So it all made sense.

And what the charge was really to come back and begin to conceptualize scenarios-- like I said, either man-made or biological in nature-- and how to really plan for what that might mean for, specifically, the pregnant population, their unborn children. And as many of you are aware, often, the women serve as the family structure and obviously, drive a lot of the access to care for the family. So when you talk about preparing and managing that population, it really brings the whole idea of the family in.

And then, Magee is a unique maternity hospital. There's a little more than a handful-- probably 15 to 20 large-scale maternity hospitals across the country that do a large scale, large volume obstetrics and with that comes a lot of unique considerations. So I thought this was a good thing to dive into given my training and the fact that I was from Pittsburgh. So we did move back.

And I just want to set the stages that realize this conversation around the interface between pathogens and humans is in recorded history as long as humans have been recording history, right? It's this ongoing battle, so to speak. This was nicely depicted by Pieter Bruegel in 1562 in this picture of *The Triumph of Death.* And you can see, this is about the Black Death coming through. And you can see, there's a lot of dead bodies. This is really just to remind us all that what we just went through-- COVID-- while there were a lot of specifics and we really endured some specifics around that, this idea of pathogens bumping up against humanity is as old as humanity itself.

When we started to think about how to plan and how to conceptualize what we may need to be up against coming up in 2006, we needed not to look much further than the modern flu pandemics. Everyone's probably aware of the Spanish flu, which was really, a misnomer. It really didn't start in Spain, but regardless, that's the name that's stuck. And then the other various flu pandemics throughout the 20th century, you can see some of the mortality associated with that, the viral strains. But really, the Spanish flu was really the prototype for a novel flu virus spreading rapidly through population, and how do you manage that? And what does that mean for the pregnant population and others?

This is some old data-- I think, this was from *JAMA* back in the day-- showing how in different locations, this was mortality in America and Europe during this, and how you had normal rates. And then, all of a sudden, you had this huge spike in the fall of 1918. And then you see another spike down here. And if this graph-- if this picture went out further, you'd probably see other spikes, not unlike what we saw with COVID.

But the unique thing is when you start to talk about the pregnant population, this is a number of deaths by age group graph. And you can see for all years surrounding 1918, but excluding 1918, they're in the green. And what you can see is the typical thing you see with flu, which is lots of death in the very young and in the very old. And that's what this green line depicts.

If you look at 1918 only, the spike in this 25 to 34 division, this represents the unfortunate, but common reality that pregnant women and pregnancy itself predisposes to worse outcomes from various infectious diseases. And in this case, a viral infectious disease-- respiratory infectious disease. So I think, this puts into perspective, the impact that this particular virus had on the pregnant population.

And just in the interest of time, to sum up, if you look at the 20th century pandemics and even the 19th century pandemics, it's very clear with these novel strains that pregnant women, unfortunately, suffer higher morbidity, higher rates of mortality, and it's really linked to their ability to manage the pneumonia. In addition to the higher risk for the mother, there's, also, a higher pregnancy wastage that was seen in these previous pandemics. So when you really think about that, that really makes pregnant women and facilities that care for large scale-- have large-scale obstetric services, they really have a central role in thinking about how to manage this.

So this was the backdrop that we came into as we started to think about this. And I think even back then, everyone realized it wasn't an "if" question it was a "when." And why is that? Because for this particular virus, flu is constantly mutating. And it really is those sporadic large-scale changes in the genome that leave large segments of the population completely lacking immunity to those particular strains. Not to mention, the fact, we still have, obviously, a very highly susceptible population. Lots of travel with this particular virus. Turns out with COVID, as well, people are infectious even before they know they have it.

So this milieu sets us up for ongoing-- at this point, flu pandemics is what we were focused on. So we did a bunch of planning here in the non-flu pandemic times realizing that at some point, we would probably have another flu pandemic. And then within a couple of years of being here, for those who remember this, we had H1N1. And this was not really a surprise, but there were novel components of this.

I love this cartoon. This is what everyone was dealing with at the time. Where did this come from? Was this-- it was originally called swine flu. Again, we had a false alarm in 1976, but this one was actually from there-- we think from that population. But I want to show you a few graphs that came out early in the H1N1 situation that show the same thing that I just showed you around the Spanish flu in 1918.

These are US hospitalization rates per 1,000 population. Again, hospitalization was predominantly in the very young and went up in the old. But again, we saw this-- this is deaths, now-- we saw this disproportionate spike in deaths in this 25 to 49. Very similar to what we saw in that graph I showed you in 1918. Again, a big chunk of this, unfortunately, is represented by pregnant population, which had anywhere from a five to 10-fold increased risk of dying if they got H1N1.

So it was very interesting being in an obstetric hospital. For many people in the society as a whole, especially considering what we just went through with COVID, for many people, I think, H1N1 wasn't really that big of a deal. People got sick, we had some admissions, but it wasn't this big thing like we just went through with COVID.

But that was actually not the case at Magee. We had a fair number of pregnant women, unfortunately, coming in getting quite ill and becoming septic very quickly in front of our eyes. So it really was a reminder of how pregnancy is a very special time for susceptibility, unfortunately, to worse outcomes from some of these respiratory viruses.

Now after 2009 H1N1, which lasted about a year and a half, which is, again, typical for these novel strains, we then had in the mid part of the last decade, we had an Ebola outbreak in West Africa. Again, we start to see data showing that pregnant women are uniquely susceptible to worse outcomes. Really bad story for the babies-- for the unborn baby's in this scenario. For moms who got Ebola, very near 100% pregnancy wastage in those cases.

And then shortly after that, we had Zika. And that seems like a million years ago now after going through COVID, but this was a big deal, right? Zika was a big deal. This was the first congenital, first novel infection causing congenital viral malformations in about 30 or 40 years, at least. So this was a big scare for many young, reproductive age women around the globe. This occupied quite a bit of our time here, in terms of thinking about emerging infectious diseases in pregnancy.

So it was really because of this experience that I had and following these things, that I was asked to participate in a couple of activities. One was I was asked to write for one of our head journals, a review article about emerging infectious diseases in pregnancy. What do we need to think about? We need to think about the impact of the disease on pregnancy itself, and that is very gestation-- can be very gestational age specific. We need to also think about pregnancy on the disease course, how those two things interface.

What about countermeasures? Like, are they safe to give? Should we give them? There's this ethics of "first do no harm." And for many years, based on some of the thalidomide and other scares, there's a lot of risk aversion to treating pregnant women. But of course, from an obstetrician's perspective, these women need to be treated and deserve to be treated, and deserve to have decision-making capability about what treatments they do and don't want like any other adult person.

So the more you get into this, it's like anything else. The more you start to dig into the research and get in the field, you realize there's so many unanswered questions.

I also had the opportunity to participate in this really fantastic group from Hopkins and UNC, the PREVENT working group, that really helped me think about some of these ethical issues, and how to approach novel countermeasures, novel vaccines during pregnancy. And I felt very-- I feel very privileged to have had these opportunities. And I think that it led to-- in the lead up to COVID-19, it helped us make our way through this because this concept was really not novel to me in any way. And in fact, I had been asked to come and work on this. So from that perspective, it really was beneficial, my past history-- my past experience with how to think about some of these problems and how to work our way through it.

So let's go back now three and a half years. Seems like an eternity ago. The first quarter of 2020, a lot of fear, a lot of unknowns, just a lot of a lot, right? So let's go back-- if it's possible, I'll take you back to when we didn't know much about COVID. We still, in the grand scheme of things, don't know nearly enough about COVID compared to some of our other knowledge of other viruses, but it seems like an eternity ago when we were first thinking about this.

But this is some data from the CDC that came out relatively early in the pandemic really, before we started to see a lot of disease here in Pittsburgh, but it shows pretty quickly that the disease was, all age groups were susceptible to disease. However, if you look at the hospitalizations and the deaths, it's concentrated predominantly in the elderly. And that narrative really continued to play out for most of COVID. And is still what we see from an epidemiologic standpoint.

And, as I just mentioned, the bulk of the overall hospitalizations were really in the elderly and/or those with comorbidities. And they-- the teams did a very nice job at the CDC and others, outlining what those conditions are. But what about pregnancy? Because we have always approached infectious diseases, in general, certainly novel infectious diseases, that pregnant women are more likely to have worse outcomes should they get infected. There's no data to suggest that they're more likely to get the infection. We're really talking about how they process it, and how they do after they get the infection. But there was no data, so driving up everyone's anxiety.

So this is where we were. And for the first three to six months, it really wasn't clear. And actually, some of the data coming out of China and even Europe-- remember, Italy had a really bad time of this before we started to see high level cases in the United States-- it really didn't suggest, actually, that pregnancy was a high-risk condition, which was a little baffling to a lot of us. This came out early and said pregnant women may be at increased risk.

So we were left kind of making recommendations based on our best guess. The data was certainly not robust. The only thing we had were case series. But we, also, had this history of knowing that it's very likely at some point, the data will begin to demonstrate that pregnant women, unfortunately like many other viral epidemics, have worse outcomes.

And sure enough, within six to nine months of the identification of the virus, data started to come out, not robust, but we started to see this. This one's from the CDC. Ellington published this, showing higher rates of hospitalization, higher rates of ICU admission, mechanical ventilation. Also, started to see some impact on the pregnancy in terms of higher rates of preterm births, maybe some higher rates of NICU admissions. These types of things.

What about the baby? This is something we always consider when we are dealing with any virus or any bacterial infection, but especially, an unknown virus.

Is there vertical transmission? By that, I mean, is the virus transmitted through the placenta into the baby or shortly after birth? It turns out that, that can happen, but it actually appears to be very uncommon. And that is very similar to what we see with influenza. There is early neonatal transmission from sick family members or mom, but we don't see high levels of fetal transmission here.

But we did start to see some data suggesting we were having higher rates of adverse pregnancy complications like preeclampsia, like coagulopathies, some stillbirth data. The data now indicate that newborns born to people with COVID-19 are also an increased risk for admission to the Neonatal Intensive Care Unit, but it's unclear, how much of that is because babies are born preterm or with other complications versus the babies themselves having a worst case. Now I will say, as the pandemic has unfolded and as we got different strains, including starting with the Delta strain, it does appear that, not unlike flu, that neonates are uniquely susceptible to worse outcomes, but it does not appear to be quite as powerful as what we see with flu.

So what do we do about it? So there is the concept of maternal immunization, which neatly defined is boosting maternal levels of pathogen-specific antibodies that can then pass through the placenta and then provide fetal and neonatal protection sometimes up to six to eight months of life-- really, the point is really thought to be about six. I literally just saw an article this morning suggesting that some of that protection against neonatal pertussis can actually expand out to eight months, but most people and most of the data will suggest that three to six month protection from that maternal antibody in the baby's fetal and now, neonatal circulation-- preventing disease in the newborn, which is really important because for a lot of respiratory infections, newborns are not candidates for vaccines until they're at least six months old.

So this concept of maternal antibody, whether it be induced from a vaccine or natural from an infection, has been seen for well over 100 years. And has been epidemiologically noted for well over 100 years. Old studies talk about how women who got smallpox while they were pregnant, when their babies were born, seemed to have less of a severe course. Also seen with pertussis, there's been a global effort around neonatal tetanus prevention for probably, 40 to 50 years using mother-- to immunize mother with a tetanus booster providing that protection to the neonate, drastically decreasing the rates of neonatal tetanus.

So we've known about that epidemiologically, but coincidentally, about six months before the H1N1 pandemic happened, this study was published in the *New England Journal,* which was actually, an important finding, but the study was not powered for influenza. But what this study showed-- it was an RCT done in Bangladesh. And the control arm was the mothers got influenza vaccine-- and what it showed, for the first time demonstrated in an RCT, is that if you immunize mother, you get less disease in the mother, but you also get less disease in the newborns out to six months. Incidental finding in the study, but worthy of a *New England Journal* cover article.

So this was really, the first proof of concept. And since then, there's been numerous publications for flu, pertussis. Now, there's RSV, COVID. They've all shown the same things. Immunize mother, you get neonatal protection. Depending on the robustness of the immune response and the certain pathogen, you can get protection anywhere from 40% to 90%. It varies by vaccine and by pathogen. But the bottom line is that, it's a really powerful intervention because you're immunizing one person, and you're getting protection in two. And realize for some of these, it's also really important for the mother to prevent disease, not just the neonate, right?

So whenever we talk about immunizing pregnant women, however, there's also this-- there's always this balance out there. I alluded to this before, the safety of pharmaceuticals, safety of vaccines during pregnancy. The most prevalent concern is safety, obviously, and that's not an unreasonable thing for any woman who's carrying a baby to worry about. Is this going to harm me or my baby?

Potential risks from the vaccine itself, maybe from the side effects. The vaccine causes fever. Are there any potential risks to the baby? Birth defects? Obviously, with live attenuated vaccines, we don't give those deliberately during pregnancy. But these are all things that are out there when you think about this. And certainly when the COVID vaccines came out-- and I'll show some slides, why I think this was so prevalent-- but boy, there was a lot of questions.

Will COVID-19 affect my fertility? Are they safe during pregnancy? If I already had COVID-19, why do I need to take some theoretical risk during pregnancy and get a shot? I'm nervous because the vaccines are so new. I'm young and healthy, why should I get vaccinated?

So there's a lot of legitimate questions out there. There were also a lot of questions, unfortunately, based on pervasive misinformation that we all know was rampant, and we all live through and try and manage the best of our ability.

This is a quick schematic to remind us that in non-pandemic times, there's multiple phases to studies. This still occurred during the pandemic, but this process was greatly accelerated. In my opinion, this is one of the most important takeaways from the pandemic was the ability of the vaccine industry to step up and really, within less than a year, condense this process and to take a product and develop high-level efficacy and safety data, such that it enabled us to use that within the year, viral isolation. That's really amazing. That usually takes many years. And it just really condensed that down to 14 months, which is really, an absolute amazing thing if you really think about it.

Now remember, there was research on mRNA technologies there for about five to 10 years before, but these vaccines were the first time a vaccine of this nature was really studied at this scale, and then implemented in the population. And it has a novel strategy, right? It has a novel mechanism. The body will utilize the body's own cells to generate that coronavirus spike protein, which then generates an antibody response in the recipient so that it protects future infection.

But if you think about the fact that the mRNA vaccines were basically, a novel platform, we've got a lot of misinformation around there, and the mechanism for which it works is a little complicated, you can understand at least some of the consternation around using this type of vaccine, at least. And then when you think about pregnant women, it was understandable, to me, why people were nervous about this.

But remember, this is not a live virus vaccine. We have a long history of using non-live virus vaccines very safely and effectively in pregnancy. There was actually no adjuvant in here so there was no concerns there. People were nervous this would enter the nucleus and alter the DNA. That doesn't happen. But nevertheless, those myths were out there.

Having said that, an important to know that during Operation Warp Speed, there were no pregnant women included in those trials. And that's a whole different talk as to why that occurred. How we think we can do that differently at different times, and how we've written papers about that, that's a separate concept. But the bottom line is that no pregnant women were included. So you can-- again, that leads to the concept that people were nervous about this.

But as the vaccine started to be used, we started to see data come out. This is some of the early data looking at using the CDC's V-safe mechanism to look at some of the side effects from vaccination. And you can see, pregnant is in the deeper blue and the non-pregnant in the lighter blue. You can see looking at either Pfizer or Moderna, there's basically no difference here from side effects, which is good.

And then the V-safe also had emerging data looking at comparing background rates of common pregnancy complications or common things that people may be worried about, including miscarriage and stillbirth, some pregnancy complications, and then impacts on the neonate. You can see that it was very-- it became quickly-- not obvious-- it became clear to myself and others who spend a lot of time thinking about this, that this vaccine was going to be OK.

But we didn't have the hard data, this is observational data, but there was no increased risk from the vax-- from the impact of pregnancy. There's no safety signal, shall we say, in any of the data that came out. Nevertheless, there was significant vaccine hesitancy, right? Not only in pregnancy, but across the world, we saw a lot of that.

Now to put that into perspective, it is important to note that vaccine hesitancy has always been a part of the story around immunization since Jenner's time. Early cartoons depicted that-- and if you look at this one closely, and this was in one of the Pitt magazines about 10 or 15 years ago-- people believed that because Jenner had used the cowpox virus, it was close enough to smallpox to generate a similar enough response that it would actually prevent against smallpox, which it did. People started to believe they would start to develop cow-like features.

You can see down here, this is depicting Jenner as the grim reaper. "Triumph of degeneration." Misinformation, fear, and using that to sow fear in others and drive vaccine hesitancy has always been there.

And if you really stop and think about it, without a level of scientific understanding or training, it's not really unreasonable. Because what you're really doing is taking either a piece of the virus, an inactivated part of the virus, something that's been generated to look like the virus, and you're putting it in healthy people. So that's always been part of the narrative.

We know that has been-- vaccination has literally changed humanity in the last 100, 120 years, but it's not hard to understand, especially at the early outset with smallpox, when people would get sick from the smallpox inoculation. Much more than you see, we get a couple of days of side effects now from COVID or flu or whatever, sometimes. But people got really sick, and actually, some people died from the varialization from the smallpox vaccine early on. So this has always been part of the narrative.

And when you think about vaccine hesitancy, it's really, for most people, it's a continuum. There is the population that is anti-vax no matter what. I would suggest, that's still the minority of the population. The data suggests that's still the vast majority of the population, regardless of what vaccine you're talking about. But what we're really talking about is moving people along this continuum to getting them to vaccine acceptance for the majority of the population that have any hesitancy at all.

I like to think about this roughly in thirds. There's a third of the population that will take vaccines regardless. There's a third that won't. That's probably, a higher number than what it is. It's probably more like 10% or 15%. But then that middle area is where this paradigm of moving people along with data, with talking to them about the risk, not only of the perceived risks of vaccination, but the perceived risks or the real risks of not getting vaccinated, that's a real discussion we had with a lot of our patients during this time.

I want to highlight that this whole thing around the COVID vaccine that came out was going to be harmful, was going to affect people's fertility, or did, it was all a myth. There's no data to suggest that. There's been multiple studies looking at the fertility issue. There's now been many studies looking at the safety and the efficacy. There's really no signal of a problem.

Because of that, ACOG feels very comfortable saying this at this point, that there's no evidence that COVID-19 vaccines affected fertility. And we recommend this for pregnant women to prevent disease in themselves, but also, to prevent disease in their newborns. And we are recommending that this fall to get the newest updated version of the COVID vaccine.

Also important to remember that, it's not like the COVID vaccines were just put on the market and no one's paying attention anymore. There's all the post-marketing and post-surveillance that's built into the system. These are just three of those mechanisms that continue to provide ongoing reassurance.

So we evolved from lots of vaccine hesitancy, lots of nerves, lots of fear to an unequivocal recommendation that yes, pregnant women should be vaccinated against COVID-19 during the pandemic and certainly, thereafter. Not unlike influenza. At the end, I'm going to take you through a quick timeline of how we got to that through the ACOG group that I am privileged to be a part of. And now CDC is saying unmistakably clear, yes, pregnant women should get vaccinated.

Taking us back to that time just a little bit of how the group that I was privileged to be a part of thought about this process. So from viral isolation, late 2019, early 2020 till December 2020 when we actually had vaccines available to be given, there was no-- very little clinical-- there was no randomized controlled trial data. There was a little bit of data from-- a little bit of observational data from a few people that got pregnant in those trials, but effectively, no data. There was only some animal model data that didn't show any safety signals. So we had basically, a data-free zone.

However, we know that it wasn't a live virus vaccine. We know that there was really no biological plausibility for causing harm. And by this point in the pandemic, we had pretty clear data that suggested that pregnant women were at higher risk for worse outcomes if they got COVID.

Despite that overall data, this is where the Vaccine Advisory Committee for ACOG really felt strongly that while we couldn't come out at that point and say, with no shadow of a doubt that women should get vaccinated, we definitely felt like they should have the opportunity to decide for themselves, whether they should be vaccinated or not. So that was the recommendation that we made.

We worked very closely with the CDC. And the recommendation was made that pregnant women should have access to these vaccines, including pregnant health care workers. Remember, when these vaccines were rolled out, the first phase was health care workers. And a lot of young, reproductive-aged women are a big part of the health care workforce. So we felt very strongly that these women should be able to look at the information they have, compare that to what the risk of not getting vaccinated, and make their decision. And believe it or not, that was, like, a pretty big thing for CDC and ACOG and everybody to say, because there was so much risk aversion at this point and there was so much misinformation out there, so we were able to successfully do that.

As we went over the next few months, the data started to come out of V-safe became more robust. More vaccines came on the market. But really within six months, based on that data and the lack of adverse events and the ongoing data showing that we definitely had a susceptible population to worse outcomes, ACOG felt very comfortable saying ACOG recommends giving this vaccine to pregnant women.

Again, no randomized controlled data at that point, but I think that the experiences of the previous pandemics, knowing that data-- knowing how these infections can really rapidly take hold of a pregnant woman and send them down the wrong direction very quickly. There's also another human involved, the fetus-- we felt very clearly that no biological plausibility, clean safety record, no adverse outcomes, and a real threat of a bad problem, we felt comfortable making that recommendation.

I'm going to skip through those, just to say that, that's where we've landed since then. We continue to update this document. This document lives because we continue to get more data. As the data then began to show that not only does it help mom, it protects newborns. We updated the document then. This has been a working document.

The question, obviously, comes up, not only just pregnancy, what about lactating women? There's zero reason not to immunize lactating women. There's even less theoretical reason, in my opinion, because they're not pregnant anymore.

There is theoretical risk of something coming through the milk, but it really is never born out. It's all theoretical. It's all prone to misinformation. There's no data to suggest there's a real risk. So ACOG, also, clearly recommends breastfeeding women should be immunized with these now vaccines that are known to be very safe.

We got to the booster issue. Yes, pregnant women should be boosted. As I mentioned before, I'm part of that MOMI-vax trial. We had the unique opportunity, because it was an observational trial, to enroll women who were in the process, have already gotten the primary series, we're still pregnant, and a bunch of them got the booster. So we have pretty clear data that we've published recently in vaccine.

We're in the process of submitting some other publications to different journals to demonstrate very clearly that getting that booster shot during pregnancy not only was safe, but really boosted the maternal levels. And the important thing there is the higher the maternal level of those antibodies, the higher they are in the neonate when the neonates born. And likely, the longer they last out closer to six months, providing that protection out to six months. So some nice data have come out of those studies.

I'm going to finish up with just some reflections on what we've all lived through the last three and a half years or so. The pictures on the left are from 1918. The pictures on the right are from 2020 through now, just to make the point that we have developed lots of modern methods. We have countermeasures. We got vaccines out in a year. We got medications out within a year. But some things have not changed, really. And I think, some of this was highlighted by some of the public's response.

On the left are pictures from 1918 protesting flu masks. On the right are women in India that are busy making these masks. Then the protesters below, just like 1918, saying the mask is the new symbol of tyranny, which we all believe. It, obviously, is not.

Back in 1918, anti-mask meetings. "Three shot and struggle with mass slacker." I mean, the same. And then looking over at the right, "Oxygen is essential." This same discussion, not unlike the vaccine hesitancy that's always been a part of immunization, this same discussion goes on whenever we have these bad epidemics. How do you balance public health, public safety versus individual rights? It's really, almost an unanswerable question at the end of the day.

Calvin Coolidge has his opinion on it. Liberty is not collective. It is personal. All liberty is individual liberty. The proper balance between individual liberty and central authority is a very ancient problem. This is all just to say that what we've all lived through, while it was very hard, it was very tangible, it was very personal, it's not a new dilemma. We've been dealing with this since the beginning of humanity.

And then, of course, I want to finish with this. This was something that I always found very fascinating. I had the opportunity to listen into my school district's town hall school board meeting at the outset of the fall season of 2020. So we were now, six or so months into the pandemic. And it was fascinating, to me, how many people were speaking with deep levels of passion with still, like, no data. I think, it really speaks to how much fear there was. It really drove a lot of those passionate responses devoid of data. But again, I think, that's part of the experience when we think about these pandemics and how they interface with humanity.

So my last slide is just that we're now beyond the pandemic, for all intents and purposes, but COVID is part of us. We knew this at the outset, it wasn't going to go away, but it's now become endemic. We're being encouraged to get seasonal updates. I will get my seasonal update.

Realize that we will have future pandemics. There's a lot of literature written about how the climate activity, the human expansion into, otherwise, areas that are not developed by humans yet is really creating a more perfect storm for even more pandemics. So not to sound like Chicken Little, but I think, it's very clear to say we're going to have more pandemics.

They are predictably unpredictable in nature and timing, but we know we'll have them, predictable occurrence. And I do think the pregnant population will always be a special population. Those challenging opportunities that they present, the narrative around safety versus individual liberty and people choosing to take medications or vaccines that may have less data, that's always going to be here.

So I believe that's my final slide. I want to thank you all very much for tuning in. I hope this was informative. Just some reflections on some of the work and some of the things that I've had the privilege of working through the last 20 or so years here at Magee. Had so many great mentors that helped me think about this, and I'm really, really grateful for that.

And I just want to open it up for any questions. So thank you very much for the invitation and your attention.