# Episode 88: Vaccines, Variants, and Long COVID

**Chris Dall:** [00:00:06] Hello and welcome to the Osterholm update COVID-19, a podcast on the COVID-19 pandemic with Dr. Michael Osterholm. Dr. Osterholm is an internationally recognized medical detective and director of the Center for Infectious Disease Research and Policy, or CIDRAP, at the University of Minnesota. In this podcast, Dr. Osterholm will draw on more than 45 years of experience investigating infectious disease outbreaks to provide straight talk on the COVID-19 pandemic. I'm Chris Dall, reporter for CIDRAP News, and I'm your host for these conversations. Welcome back, everyone, to another episode of the Osterholm Update podcast. There have been many mysteries during the COVID-19 pandemic, from the origins of the coronavirus to the patterns of case surges and declines to the emergence of new variants. There are many aspects of this pandemic that we still don't fully understand and may not for quite a while. As Dr. Osterholm likes to say, we may know less about this virus now than we did back in April 2020. One of the most mysterious aspects of the pandemic has been the numerous reports of people who've continued to deal with symptoms like fatigue, shortness of breath and cognitive dysfunction, just to name a few, long after they were initially infected, whether they were infected by the original version of the coronavirus that emerged from Wuhan or one of the variants that have taken center stage over the last two years, many of these long COVID patients have been suffering for months and searching for answers that don't yet exist. Today in the podcast, we're going to discuss what we currently know about long COVID and answer to the best of our ability, some listener questions about it. We'll also provide our weekly overview of the pandemic in the United States and around the world, talk about the limits of China's zero COVID policy, assess the Biden administration's response to the Omicron surge, and share the latest Beautiful Place submission from one of our listeners. But before we get started, as always, we'll begin with Dr. Osterholm's opening comments and dedication.

**Michael Osterholm:** [00:02:01] Thanks, Chris, and welcome to all of you. Back to another episode of the podcast, we so appreciate you spending your time with us. This week is going to be information dense, and I need to warn you that ahead of time, try to make it usable but dense in the sense of any time we're talking about something like long COVID it does require sharing a fair amount of information about what we know and don't know. I want to start out by acknowledging we're in a better place today in the United States and many parts of the world than we were a week ago. Yet in some of those places in the United States, it is worse. The hospitalization levels are even higher now than they were a week ago. But on a whole, the country, I think, is moving through this viral blizzard that I talked about. Today we'll talk a bit about what that means. What does that future look like with COVID, particularly with Omicron in the weeks ahead, we'll cover that also. But I want to begin this week's podcast with, first of all, an acknowledgment to many of you who have corresponded with us in the past week sharing your feedback on our podcast and what's happening to the country. And we again can't thank you enough for that feedback, your suggestions, you have really helped shape this podcast into what it is. And so while some may find this to be somewhat of a silly or corny concept, I really do appreciate this podcast family. And there's no group within the podcast family that I think about more than those who are immune compromised and those who are suffering long COVID. I think at this point, these are ongoing challenges that we have with this pandemic, something you deal with day in and day out. And it's in that light that today's dedication is to those who are suffering from long COVID. We hear you. We know that this has been a major challenge every day, just some cases just getting out of bed, being able to function in a way that resembles what you were like before COVID ever entered your world. And so to you, we dedicate this podcast. And in that dedication, I want to leave you with again, more good news. I'll go for good news wherever I can find it. And that is that just in the last week from this podcast posting to the previous podcast, we've gained 15 minutes and 50 seconds of sunlight. Today, we have nine hours and 36 minutes of sunlight in the Twin Cities. And more importantly, there is an important trend here. Since the winter solstice on December 21st, we've now gained 49 minutes and 49 seconds of sunlight. We're on the right track, and for those who are in the southern hemisphere just experience our joy at more sunlight and clearly enjoy what sunlight you have right now.

**Chris Dall:** [00:04:48] Mike, we touched last week on Europe and China, and I want to go back to those two places to start our international discussion. Let's start with Europe. It seems like some countries like the United Kingdom and Denmark and France aren't following quite the same Omicron trajectory as we saw in South Africa. What do you make of that?

**Michael Osterholm:** [00:05:08] Well, Chris, much like we did during previous surges, our group has been watching what's playing out in countries hit with the Omicron variant to try and get a sense of any patterns that seem to appear and can inform us what we might experience here. Of course, we know that there is no one size fits all models for these surges, which can be influenced by an endless list of things that distinguish countries. I know I've touched on this in previous episodes, but so many variables ranging from things like population demographics to the level of protection from previous infection or vaccines, the type of vaccines being used, efforts to get additional doses into arms, health care infrastructure, you name it. We can quickly complicate any elaborate head to head comparison of surges between different countries. That being said, I still think there is value in tracking these paths to at least get some sense for the things like the timing of the surge, the relationship between cases, hospitalizations and deaths, or even what the descent might look like after that peak has been reached. Now maybe it's just me, but it feels like we've been dealing with Omicron for so long. However, in reality, it's really only been two months since news of the arrival first broke. So although its impact in that relatively short span of time is undeniable, with no shortage of countries experiencing surges from the variant, there's still a lot of uncertainty surrounding the weeks and months that follow apparent Omicron peaks. Of course, with South Africa during their surge weeks prior to many other countries, they have really been the earliest example we have of what this variant's trajectory might look like. So if you look at them as a model of Omicron impact, you could clearly see the rapid and dramatic rise in cases. Well, as we now know, that ascent has basically been a universal experience for countries that have had the variant take over. Not long ago, after South Africa's rise in cases, we saw those first signals of somewhat reduced severity, but there was also an increase in hospitalizations, so we knew it was far from benign. But the rates of cases experiencing severe disease and requiring things like supplemental oxygen or ICU level care wasn't as high as we had seen during previous waves in the country. For this reason, I hesitate to use the word mild. It seems somehow that that conjures up in people's minds that all cases are mild illness. Know what we're talking about is the overall spectrum across the population just has fewer severe cases. Of course, since those earliest days, we've seen a growing body of data support the role that vaccines can play in preventing these outcomes and have indications that Omicron's virulence is lower than that of previous variants like Delta. Now, there's still a lot of ongoing work being done to better understand disease severity with Omicron. So I don't at all think we have a complete sense of what's playing out. But many countries up to this point have experienced an apparent reduction in the rates of severe disease that follow surges of Omicron cases, much like we saw in South Africa. However, in some countries like Austria and the U.S., the rise in Omicron cases still resulted in a record high number of patients admitted to the hospital with COVID, including a significant number that have required ICU level care. In fact, in the U.S., ICU admissions approached a peak of 26,500, which moved us beyond the highest levels hit during our first Delta surge, which peaked at 26,000 in early September. Even as the number of Americans admitted to an ICU with COVID has declined over the past week, it now sits at 25,500 versus 26,500. It remains painfully close to the all time high of 29,000 set during the country's surge last January. So clearly there have been and likely will continue to be exceptions to the South African experience of elevated hospitalizations that peaked below levels hit during previous waves. Again, this is where these differences and things like vaccination campaigns, demographics or even baselines from previous surges between countries could really play a role in the overall impact that Omicron might have on the health care system. And finally, as you mentioned in your question, Chris, we're now seeing some apparent differences in the overall trajectory of Omicron waves between countries. As I touched on last week, cases in South Africa grew rapidly for the span of about a month before hitting a peak and heading back down. It's now been a month and a half since they reached that peak. On December 17th, they had 23,500 cases, and although the decline has been evident, cases still remain more than 10 times higher than they were prior to the surge. On January 24th, there were 3,100 cases reported versus what was reported in mid-November before Omicron of less than 300 cases. Again, this is that extended tale I mentioned, which I think is worth recognizing even in those countries like South Africa and even Australia, Canada and Ireland, that experience notable declines after reaching a peak. However, now we're seeing signs of even more prolonged waves or tails in several countries that were hit by Omicron fairly early on, including the U.K., Denmark, Ireland and Norway. Now, I'm not going to pretend that I know exactly what's leading to these ongoing increases or apparent plateaus. In fact, I still have yet to understand why places like the U.K. or even Minnesota had months of elevated activity with Delta, while others saw a fairly sharp rise and fall. I think it's far too early for us to know for sure why this is happening. In the meantime, I think there are some noteworthy developments in some of the places that are worth following. First, let's look at the U.K.. Like South Africa, they experienced the clear rise in cases with Omicron. However, it's worth noting that unlike South Africa, the U.K. Omicron surge emerged on top of an already elevated Delta baseline. Regardless, cases went from less than 50,000 a day to more than 180,000 a day in the span of just several weeks. When cases peaked there in early January, we saw initial signals of a pronounced descent, much like we saw in South Africa. However, after a couple of weeks of declines which took cases from 180,000 a day to 90,000 a day, things appeared to have stalled for the past week. In fact, there's actually been a slight rise in the average daily cases since Friday, going from 90,000 then to 93,000 today. Now, I know I've said many times that I'm hesitant to put a lot of stock in the case numbers, and that's still true. There are many challenges to the accurate reporting of cases today related to the availability of testing and the backlog of reporting in local and state public health systems. But we've also seen some early indications of growing hospitalizations occurring in the U.K., so I think it'll be important to keep tabs on how this situation in the U.K. unfolds. Maybe we'll end up being a temporary blip and declines will resume shortly. Hopefully that's the case, but I also think it's in our best interest to consider that this might be another example of what an Omicron dissent could look like. Why do I say that? Well, remember that the U.K. has fully vaccinated 72% of its entire population. Let me repeat that, 72% of its entire population. Of course, there are a few dozen countries with rates that rank above that, but from the standpoint of countries like the U.S., where the rate is 63% as opposed to 72%, the U.K. coverage is noteworthy. This is especially true when you look at who is vaccinated there. Nearly 95% of the 60 plus year olds in England have been fully vaccinated, and of those who are fully vaccinated, more than 90% have received an additional dose. In fact, 64% of their population eligible to receive an additional dose have done so. In the U.S., we still have 88% of 65 year olds and older who have been fully vaccinated. Again, this compares with 95% in the U.K.. Of the 88% of individuals in this group that have been successfully vaccinated, just 63% have received an additional dose. Even when we look at residents of U.S. nursing homes, less than 65% of those eligible to receive additional doses have done so. Of course, we've seen what these differences in vaccination rates has meant here in the U.S., with record high hospitalizations, elevated ICU admissions and growing deaths from this latest surge, which I'll cover more in detail shortly. Again, this compares to hospitalizations in the UK peaking at half the levels reached during their record high alpha wave last January, 20,000 cases now versus 40,000 then. And the number of patients on ventilators hitting levels that were less than one quarter of what they were last year. So any stagnation in the Omicron descent for countries like the U.S. could be far more costly from the standpoint of severe outcomes. Delayed descents would also prolong many of the societal challenges we've been faced with due to staffing shortages. Again, if you look at the U.K., they're seeing signs of some reduction in COVID related absences across the health care system, which dropped from 45,000 in early January to around 35,000 this week. However, that's still well above the levels reported in early December, which stood at around 12,000. So delays don't bode well from a health care delivery standpoint. In addition, a story published in the Financial Times on Tuesday of this week stated that the COVID related absences in schools across England reached a record high last week, with one in 20 school aged children isolating at home. Meanwhile, almost one in 10 teachers were off last week due to COVID. In fact, nearly a quarter of schools in England had at least 15% of their staff out, with one school reporting that half of their staff was absent due to COVID illness. So you can get a sense for what this trajectory and any hiccups along the way really means. On the subject in U.K., schools were actually seeing some hints that they could be playing a major role in this recent plateau. If you look at data over the past couple of weeks related to cases by age group, you can see that the incidence has actually been rising among children zero to 14. In addition, case rates have also been growing in the 35 to 49 year olds, many of whom would presumably be parents of the school age children. Notably, as of late last week, these were actually the only age groups seeing a recent rise in cases. So this could be indicative of students returning to classrooms earlier this month following a Christmas break becoming infected and in some cases transmitting the virus to mom and dad. However, it is also important to note that countries like England expect students and staff to take two lateral flow tests each week when school is in session, which might make at least part of this latest uptick an artifact of more routine testing. We'll have to see. Finally, I do want to mention some recent news that emerged from countries like Denmark, the U.K. and Norway that were also trying to understand the implications of. Since Omicron first arrived on the scene, there have been at least three sublineages of the variant identified. Essentially, these are offshoots of the Omicron variant characterized by their own unique mutations. Up to this point, most of the Omicron cases worldwide have been caused by the sublineage, BA.1. However, in countries like Denmark, the U.K., Norway and Sweden, the Omicron sublineage BA.2 is reportedly outcompete in the original one. In fact, in countries like Denmark and even parts of places like India and the Philippines, the BA.2 sublineage has actually become dominant. The latest data from the U.K. shows cases of BA.2 are currently doubling every four days, putting it on track to become the dominant variant there in the next several weeks. Last week, the U.K. actually designated the sublineage of variant under investigation. When you look at the BA.2 sublineage, which was actually first identified in India and South Africa in late December, you see many of those 50 plus mutations that characterize the Omicron variant. However, it also contains around 28 unique mutations that distinguish it and particularly in two genes, one of which forms the spike protein. To put that into context, according to a report out of Denmark's National Health Agency, the differences between BA.1 and BA.2 is greater than the difference between the original variant and Alpha. Now, what these mutations actually mean is still to be determined. Clearly, there appears to be some transmission advantage with BA.2 over the original sublineage, but we're not sure why exactly that's the case. Does it relate to infectivity additional immune evasion? Both. We don't know. In that same vein, we still have yet to figure out how this might alter the trajectory of the surges. As of Tuesday, countries like Denmark and Norway were still reporting increasing cases. In fact, in Denmark, a slight dip in COVID hospitalizations in mid-January has been heading back up ever since. Although the number of patients in an ICU has continued to decline, notably based on early data from countries like Denmark and India, there doesn't seem to be any difference in the risk of hospitalization between these two Omicron sublineages. But again, we still have a lot to learn. This is also why we have to understand the weeks and months and even years ahead could continue to throw us these 210 mile an hour curveballs. So overall, while we've seen some similarities with Omicron waves up to this point, particularly with this initial spike in cases, we're also seeing things that might distinguish the path that this variant might take in different countries. If anything, it's just another reminder that we're still in a position where SARS-CoV-2 is more than capable of dictating our future. Obviously, we have tools that can help, but the very last thing we should do is underestimate this virus.

**Chris Dall:** [00:19:49] On China, you and Dr. Ezekiel Emanuel of the University of Pennsylvania argued in a recent op ed for the New York Times that China's current zero COVID policy is unsustainable and will ultimately prove to be a huge mistake. How so?

**Michael Osterholm:** [00:20:05] Well, first of all, let me start out by saying that I think that this is an issue around the COVID pandemic that is yet to really be appreciated or understood. What we heard from people was exactly what we published in our op ed, that China has weathered the pandemic well so far. Even with about four times the population of the United States, China has had fewer than 140,000 confirmed COVID cases and fewer than 6,000 deaths since January 2020. When we look at that and compare that to the United States, where 860,000 people have died and some 2,000 more are dying each day, you can argue, who are we to comment on what goes on in China? Well, first of all, we all recognize that the methods that they've used to keep case numbers down have been major lockdowns, isolation of individuals for weeks at a time. And what I think we were trying to highlight is that this is a whole new stage of the pandemic. The less infectious variants that we're seeing in China lent themselves to this more draconian measures to shut down transmission, something I don't think most of the rest of the world would ever accept. But even now, those measures are not going to be successful against a highly infectious variant like Omicron. If you look at what's happened in the last week, we now know that at least 30 major Chinese cities have reported locally transmitted COVID cases. And yet we have Chinese leaders very clearly articulating a zero COVID policy. What that means is that they are going to literally shut down for periods of time, local, regional and even in some cases, provincial areas for every aspect of life, not just work, not just manufacturing, but their ability to go to grocery stores. Their ability to actually associate in everyday life. Well, as we've seen with Omicron, it is like trying to stop the wind. You can deflect it, but you can't stop it. And so our whole point was is that zero COVID policy is not going to work short of ultimately shutting down the entire country. The Chinese zero COVID policy has finally met its match in a variant that is that highly infectious. And so to Zeke and myself, when writing this piece was just to say the world has to understand that if China continues to pursue this policy, we had to expect major disruptions in critical supply chains. Those who have been listening to this podcast over the months know that our group has been very actively involved looking at critical life saving drug shortages and of 156 drugs that were tracking, many of them originate in China as API, active pharmaceutical ingredients. If anything were to interrupt that in any major way, the implications for that on a global basis for critical lifesaving drugs would be huge. I could go through a laundry list of other critical products or services that we need. So I think the challenge we're raising is not that in fact, we are supporting or somehow commenting in a negative way about the draconian measures they use. You know, I don't believe that they are in the best public health interest, but they've worked against the variants up until now. That will not continue. Also, when we see potential for widespread transmission in China, we have to understand there is no other country like them in the world in terms of vulnerability. And what I mean by that is because of their very active efforts to suppress previous transmission most individuals in China, the vast majority of them have never encountered the virus and developed natural immunity. On top of that, we now know that the Sinovac and Sinopharm vaccines for which they have vaccinated large segments of their population are largely ineffective against Omicron. The data have already been coming out, showing not only do they not prevent infection, but they have limited ability to reduce serious illness. So you put that combination together with the fact that Chinese medical care is so different than we see in the western world. Right now, if you look at the number of ICU beds in China, they stand at about 3.6 per 100,000 population. That's between eight to nine fold lower than the U.S. estimate. Also, data from the World Bank shows that in China, they have 198 physicians per 100,000 population, compared to a U.S. estimate of 260 physicians. So when they do see a large increase in ill individuals, they're not in a position to provide the kind of care that we are actually providing here in the Western Hemisphere or, for that matter, around most of the world. So our point was China will do what it's going to do. But if they continue to pursue a zero COVID policy, Omicron will beat them. It will. And the implications are not just for Chinese citizens, which obviously are critical and real, but it's also for the supply chains for the world. And those too are critical and real.

**Chris Dall:** [00:25:19] Here in the U.S., as we've been tracking over the past few weeks, the states initially hit by Omicron appeared to be well into a decline in cases, while other parts of the country are just starting to see their peak in infections. So once the entire country has been through this Omicron cycle, Mike, will we return to pre-Omicron levels of cases or could we see several weeks of a higher baseline?

**Michael Osterholm:** [00:25:42] Well, Chris, as you mentioned in the first part of your question, the viral blizzard that's hit the country is still following that storm track concept that I touched on over the previous weeks. For those living in areas where they were affected earlier, like many states in the northeastern United States, these past several weeks have offered some relief. As an example, if you look at the regional case rates, the Northeast as a whole has gone from just over 300 cases per 100,000 population on January 11th to 123 cases per 100,000 population on January 25th. Yes, I'm aware of that reporting artifacts could mean that these numbers aren't exactly precise. But if you look at the per capita cases there they've been cut in half in the last two weeks. Fortunately, many states in that region, including Maryland, New York and New Jersey, are also reporting evident declines in hospitalizations. So again, we're seeing the indications of what this surge cycle might look like, despite the lack of completeness of case reporting. At the same time, we have to recognize that although things appear to be improving in some areas of the country, the activity that's being reported in these places remains significantly higher than it was prior to the surge. In fact, most of the states seeing recent improvements are still reporting cases and hospitalizations at levels exceeding those reached at the height of their surge last winter. So while I surely don't want to minimize or downplay this progress, I think it's important to consider the context. The descent from these surges takes time, and although I'm certainly hopeful that in the coming weeks will only bring about more improvements for these places, I think is still too early to assume such a scenario will be universal. In addition, there are numerous parts of the country that are still in the midst of this surge. For these states, which include Alaska, Arkansas, Idaho, Oklahoma and West Virginia, that sense of relief really doesn't exist for the time being. So despite signals of declines in overall U.S. cases and hospitalizations, we're still in a precarious position in some states. As a quick overview, according to the data reported on this past Tuesday, average daily cases in the U.S. stood at just over 652,000, compared to the peak of almost 807,000 cases reported on January 14th. Yes, it's an improvement, but there's clearly a lot of virus that is still circulating in the country. And again, these are only the cases that are being confirmed and reported, so it's only a fraction of the actual number. Meanwhile, there are still nearly 149,000 Americans hospitalized with COVID as of today. This is also down from a peak of 158,000 hospitalizations last Thursday, so some signs of improvement in this area are occurring. However, compared to the previous all time high of 133 hospitalizations set during last year's surge, we're far from where we should be. A similar theme emerges when you look at the ICU bed levels. Around 25,500 Americans are currently in an ICU with COVID, down from a peak of almost 26,500 reached last week. But considering that the peak of our first delta wave reached 26,000 and the record high last year approach 29,000, even with our 25,500, we're not in a great position. This is especially true when you compare our current levels to those reached during the valley that separated the country's two delta waves this past November, where it reached 11,000 or the numbers reported last summer, when it was as low as 3,500. And finally, although it's not unexpected, one of the most tragic trends we're seeing is a clear increase in COVID deaths being reported. As of Tuesday, an average of nearly 2,400 Americans were dying from this virus each and every day, moving above peaks reached during the country's first surge in April 2020, when then it was at 2,200 deaths per day and the Delta Surge, when it was at 2,100 deaths per day. Of course, with more than 3,300 deaths a day reported during the height of last winter's wave, it is yet to be our deadliest surge. But considering that vaccines were essentially a non-factor at that time of last year's surge, it is so difficult to comprehend the position we found ourselves in. Just think, based on Tuesday numbers, the country is reporting a COVID death every 37 seconds. Let me repeat that every 37 seconds. This means that in just one hour's time, basically the length of this podcast, we could expect another 100 Americans to die from COVID. For even more context, an average of just overnight 900 Americans die each day from heart disease, an additional 1,650 die from cancer. These are and have been for quite some time by far the two leading causes of death in this country. And right now, with a daily toll of nearly 2,400 deaths, this virus ranks far ahead of them. As I've said before, I'm not sure what the ceiling will be for daily deaths. However, with 34 states reporting an increase in deaths over the past week and being a lagging indicator, I think we can expect this number to grow. So how does this happen in a country like the U.S., which is awash in vaccines? How have we found ourselves once again ranked among the top 12 countries worldwide with the highest death rates? Well, encountering a variant as transmissible as Omicron clearly hasn't helped. However, unlike those countries that have really limited the damage caused by Omicron surges, we're seeing the results of an inadequate vaccination rate. Again, with just 63% of our population fully vaccinated, we rank behind 60 countries. Let me repeat that again, with just 63% of the population fully vaccinated, we rank behind 60 countries. In addition, at least 50 countries and territories have administered additional doses to larger centers of their population than the U.S.. I hear this debate time and time again about is this really a pandemic of the unvaccinated or not? Well, it's not if you relate it to just infection. But if you relate it to serious outcome, including death, this is a pandemic largely of the unvaccinated, and that remains true. Make no mistakes. The vaccines remain remarkably effective at reducing the risk from COVID. While Omicron has undoubtedly led to more breakthrough infections, the latest U.S. data on case rates by vaccination status show that as of late December, unvaccinated adults were two times more likely to be confirmed cases compared to adults that were fully vaccinated. Many would say that's not a very significant number, but this next one is a game changer. Regarding deaths, unvaccinated adults were 20 times more likely to die from COVID compared to those who are fully vaccinated. Let me just say that again. Regarding deaths, unvaccinated adults were 20 times more likely to die from COVID compared to those who are fully vaccinated. When you factor in the additional dose, the reduction in risk becomes even more apparent. Again, the latest data published by CDC this past week shows that U.S. adults who received an additional dose were nearly four times less likely to test positive compared to unvaccinated adults and 97 times less likely to die from the virus. Again, I have to repeat this. The CDC data shows that U.S. adults who received an additional dose were nearly four times less likely to test positive compared to unvaccinated adults, but 97 times less likely to die from the virus. Wow. Even after you adjust by different age groups, the impact is clear, as Eric Topol, a dear friend and colleague, mentioned in a recent Twitter thread covering this data, he said I'm not aware of anything else in medicine that reduces death by 99%, unquote. He is so right. This is still a pandemic of the unvaccinated. So as I've said many times, these vaccines are not perfect, but they are remarkable. I'm not implying that the country would have been shielded from any surge in infections with Omicron if our vaccination rates, including additional doses, were 10 or even 20 percentage points higher, I am certain that many of the hospitalizations and deaths we're seeing would have been avoided. And although that's a tragic commentary, I'm also grateful that many Americans who have received a second or third dose of vaccine were spared these outcomes. Without these vaccines, things would be much, much worse. Regardless, I know of too many situations where people have done their part and receive the doses they're eligible for, only to experience difficult breakthrough infections that eventually lead to their hospitalization and tragically, in some circumstances or death. So whether you're one of the millions in this country living with a condition that leaves you immunocompromised, you're the parent of a child who is not yet eligible to receive a vaccine, or you're simply concerned about the prospect of what a breakthrough infection might mean. Just know you're not alone. We hear you. We see you. We care. Many of us share these concerns and know that a lot more can and must be done going forward. Whether that relates to things like improving our vaccines, which we must do and expanding our available therapeutics, which we must do. So to get back to your question, Chris. I'm not sure exactly what awaits the country following this viral blizzard. Ideally, we'll see rapid and uninterrupted improvements in cases, hospitalizations and deaths. However, for those places just reaching peaks, I think we can expect that activity to remain quite high for some weeks ahead relative to the levels reported pre Omicron. Beyond that, I'll defer to that familiar concept of humility, something I feel more and more every day and remind us all that there will be new variants in the weeks and months and years ahead. We don't know yet what they mean, but we have to be prepared for their arrival.

**Chris Dall:** [00:36:27] Mike, over the past few weeks, the Biden administration has pursued a number of strategies to get the Omicron surge under control. They've started sending free rapid tests to people's homes. They're making N95 respirators from the National Strategic Stockpile available to the public, and they've opened up more vaccination clinics. Is this enough? Is it too little, too late? And do they need to be more proactive about preparing for the next variant?

**Michael Osterholm:** [00:36:55] Well, first of all, Chris, let me say at the outset that I continue to have a role in advising the administration in that I talk frequently to some of the leading experts in the White House, in the various agencies about COVID, what's happening and what we must do to control it. And I feel very fortunate to have that kind of access to these individuals and these are people who are really committed to making a difference. They want to make a difference. It's not political to them, you know, it's not economic to them. It's people's lives. So I want at the outset say that in that regard, I very much appreciate the efforts that are being done and having been in a public health role like a state epidemiologist, I learned early in my career you could never please everyone. What you had to do is just know what were the North Star moments in your career? What were the things that you needed to accomplish to protect the public's health and be prepared to take whatever comes with it. And oftentimes there would be a lot that would come with that. But when I look at what's happening right now with the administration and I share these comments with them, I worry that there's far too much happy talk. And if you're a politician today, you want happy talk. You need that. I understand that. We have to be in a place where we can motivate people. We can give them a sense of empowerment. We can give them a vision and hope for the future. I get that, I want that and I want to be a part of that. But at the same time, we have to level with the public as honestly as we can about the strengths and the weaknesses of what's happening. And in some cases, those weaknesses can be really a challenge. And what I mean by that is, is that no one wants to admit that the response is inadequate. Yet as a consumer of health care in the community, a doctor and nurse delivering the health care, public health officials trying to do what they can to prevent transmission they see right away through any rose colored glasses initiatives where it's all about rah rah rah, you know, trying to get the percentage points of approval ratings higher and higher. Let me just give you some examples where I've been very concerned about what the administration has done and what they should do. Let's take schools. My God, can you come up with a more hot button item in the schools? No. But how we describe schools during the Omicron surge has been absolutely a disaster in terms of understanding what was going on at those local school district levels. All of us want our kids in school. Let's not have any further debate on that. That's the best place for them to be. They should be there. But imagine if I said to you, Oh, you know, there's a Category five hurricane bearing down in your community. It'll be here in three days. Do you think we'd have schools wide open? What if I said to you, oh, by the way, there's going to be a blizzard over the next 48 to 72 hours, 38 inches of snow, 40 mile an hour winds, oh, and by the way, it's going to get down to minus 20. Sounds like Minnesota. Point being is would we have school in session? No. Well, we have become so ideologically oriented towards the school issue. It's either schools are open or they're not, and they must be open. And I've had so many superintendents who have said that the president's own words have come back to haunt them from parents who demand the schools be open. Even though 25 to 30% of the teachers are out sick. An equal or greater number of staff are out sick and they don't have any bus drivers. They have janitors overseeing study halls of 300 students because they don't have anybody else to do it. Is that education, is that safety? So back up, don't say schools must be in session, how proud we are, like the hurricane, like the blizzard, allow them the next two or three weeks to do whatever they can to keep their schools open. But allow them the freedom not to be wrong if they can't because of the number of people who are out sick. I mean, this is common sense to me, this is not rocket science. So I think that there is an example of where a message can hurt us because it did pit many in the local communities against each other because some said look at the United States saying have everybody in school. Superintendents saying how can I do it? Could you imagine if somebody was in a school, unsupervised, vandalism occurred, fire started, some student got hurt, seriously hurt. You think what the feedback would be would be? Well, we had school open. That was great. No. So I think there's one example and I could go through other examples like this right now. I personally have been involved in the last two weeks with numerous numerous situations of trying to find COVID infected individuals, either the monoclonal antibody treatment or the drugs, particularly the Pfizer drug. And our system in this country right now is a disaster for that. These are people who couldn't get tested in a timely by PCR, which they needed to have that before they can become eligible for the drug because testing was broken down. Then once they did qualify, they had terrible problems finding the drug. So you can tout all you want, that there are all these drugs out there. But if we don't have a system to get those four million doses to the people who need them, what do we have? We have a system in chaos. So what I would have said is we're making every effort right now to streamline testing so that we have a prioritization in testing. I mean, why are we still testing school kids once a week or, you know, the first time they go back to school, these are useless tests. I've said that over and over again. Testing when kids come back to school one time is like buying a house that has a smoke alarm that only works the first day you're open. Ok, that's it. You need a test every day. So why waste those tests? Put them to good use, testing people who might be eligible for these drugs and turn those around quickly make that a fast turnaround. Not three days, not five days. You know, if I'm infected with the virus and I'm just looking to see whether I can go to work or not, that's very different than somebody's life saving drug availability. So we could do more there. We should be talking about that. So to me, I could go through this whole system, whether it's testing, whether it's drugs, whether it's messaging. And just level with the public, what's going to happen. I've heard from so many health care workers anger, anger. I'm talking about anger at the administration for touting the fact that a thousand DOD support staff were coming into our communities to, in a sense, be the Calvary to come save us from COVID. Well, make no mistake about it, these thousand individuals are really welcomed. They are very much needed and thank you. Thank you. But be honest about the fact that the 20% absentee rate we're seeing among health care workers in many communities in this country means that over two million health care workers are not on the job right now or haven't been over the last 10 to 14 days. 1,000 versus two million, let's just acknowledge that that is going to be a severe challenge. 500 million new tests arriving well after the surge has really peaked, when, in fact 500 million means one and a half tests on average for the whole country, there's 330 million Americans. Is that a lot? That doesn't even begin to address the surge, so I appreciate the effort, but let's acknowledge we're going to be really short and don't paint it as if to people, we've now solved the problem. The same thing with masking. We are way too late. You know, we're getting masks out now, that's great. Ok, but we have to acknowledge we missed most of the surge. So I think just leveling with the community more like fireside chats to say this is what's going on, this is what's happening because the community knows. I mean, you can't buffalo the people out there in the field they know. And that, to me, would be a very helpful message just to say what you know and what you don't know. And just be as honest as you can. To a fault. And if it doesn't look good for you, say this is not good, but this is what we're doing about it, and this is how we're going to do it. And we're not going to promise you 500 million tests that took weeks and weeks and weeks to materialize long after the peak had occurred. So that's my message to this administration. I do believe these are people who want to make a difference. These are people who are dedicated to protect the lives of all Americans. And it's hard for me to even say this, but I want them to be successful and they're not going to be if they don't start messaging in a more honest and in a more simplistic manner of relating to the everyday person on the street about what's happening. So I hope this is a positive message. It surely is not meant to be one where I'm trying to tear down anyone in the administration. I'm begging them to please message in a way that will not only make a difference in terms of what people can do or how they do it, but the people will trust you, the people will believe in you and people will recognize you have their best health as your highest priority.

**Chris Dall:** [00:46:55] So now to our COVID query segment, which is going to focus this week on long COVID. Before we get to listener questions, Mike, can you provide an overview of what we know about long COVID at this point?

**Michael Osterholm:** [00:47:07] Well, Chris, this is clearly an issue that is front and center for so many of our listeners because they are those individuals experiencing what has been called long COVID, or they're concerned about the potential for becoming an individual with long COVID. And so we hear you, we wish we could give you much more definitive information today. There's still lots of questions, but we're going to do our best to give you what we know, what we don't know. But as I said in the dedication we hear you, we understand the challenges that you're experiencing. And we will do everything we can to continue to promote the importance of studying and responding to what is called by many as long COVID. So let me start out, first of all, by just saying, unfortunately, there are many, many questions that we do not have answers for about what is referred to as long COVID. The CDC defines long COVID, otherwise referred to by many as long haul COVID, in a new terminology post-acute sequelae COVID or PASC, P.A.S.C.. Others still call it long term effects of COVID or chronic COVID. All of these represent a wide range of new, returning, and ongoing health problems that people experience for four or more weeks after being infected with SARS-CoV-2. And as of July 2021, this new PASC or long COVID can be considered a disability under the Americans with Disabilities Act. The CDC lists a wide range of symptoms that are associated with long COVID, including shortness of breath or difficulty breathing fatigue, brain fog, dizziness upon standing, chest pain, depression or anxiety, fever, loss of taste or smell and other multi-organ effects, including the heart, lungs, kidneys, skin and brain, and particularly the multisystem inflammatory syndrome in children. These symptoms sometimes occur in people that have had severe acute COVID, but they also can appear in individuals that have had mild symptoms or virtually no symptoms at all. Results from a study done in Iran published in November 2021 found that being female, having respiratory symptoms in the acute phase of the infection and even having severe symptoms during that phase were all associated with a greater risk of developing long COVID. UK data published in September showed that symptomatic individuals were over two and a half times more likely to develop long COVID of any severity than asymptomatic individuals, and about two and a half times more likely to develop long COVID with symptoms that interfere with their day to day life. The study also showed that the prevalence of long COVID was highest for females, people aged 50 to 69, people with preexisting health conditions and those with high viral load. This was true regardless if their long COVID was self reported or met the two different case definitions used in the study based on symptoms and duration of symptoms. The numbers for the exact prevalence of long COVID vary greatly from study to study. This is because the exact definition of long COVID can vary, and because symptoms of long COVID can often be nonspecific. The UK study mentioned earlier used three different definitions for long COVID and found that the percentage of people experiencing long COVID varied greatly depending on which definition you used. When asked about 12 common symptoms fever, headache, muscle ache, weakness, tiredness, nausea, vomiting, abdominal pain, diarrhea, sore throat, cough, shortness of breath, loss of taste and loss of smell. Five percent of those surveyed that had previous COVID-19 infections reported experiencing these symptoms 12 to 16 weeks after the start of their infection. When asked if those symptoms were occurring for a duration of at least 12 weeks, the number then dropped down to 3%. While the percentages for these two definitions may seem low, they are still higher than what was reported by the control group in the study that did not have previous SARS-CoV-2 infection, clearly supporting a likely cause and effect relationship. These two definitions also failed to include some very common long COVID symptoms, including post-exercise malaise, brain fog, heart palpitations, mood changes and dizziness upon standing. Not surprising when study participants were asked if they were experiencing long COVID, but not specifically asked about the 12 symptoms, the number rose to 11.7%. In addition, 7.5% of the individuals said that their long COVID resulted in limitations in their day to day activities. Other studies reported even higher prevalence of long COVID. A study published in PLOS Medicine just a week after the UK data was published found that 57% of the over 273,000 COVID survivors they studied had at least one long COVID symptom occur within six months following their COVID diagnosis. Nearly 37% had at least one symptom three to six months after. All nine symptoms that the study looked at were more frequently reported following a COVID-19 diagnosis than an influenza diagnosis. Among children and adolescents, studies have reported between less than 1% to as high as 66% of the pediatric COVID-19 cases could result in long COVID symptoms. But a growing consensus, I think, is at around 10% of pre Omicron cases result in long COVID. Unfortunately, there isn't much data yet to suggest which factors predispose kids to long COVID. Another factor that complicates estimates of the prevalence of long COVID is that COVID may trigger new chronic conditions or worsen existing chronic conditions. Some studies may consider this to fall under the category of long COVID and others may not, since these conditions are of a different diagnosis. For example, one is diabetes. Diabetes is a known risk factor for severe COVID, but we are also seeing an increase in the likelihood of adults being diagnosed with diabetes for the first time after their COVID infection. A CDC MMWR from January 14, 2020 analyzed data from two separate sources both analyzes found that new diabetes diagnosis ranged anywhere from an increase of 30% to as high as 166% more likely to occur in patients who had COVID versus those who did not. This report also notes that these results are supported by independent studies. A second example is referred to as POTS or postural orthostatic tachycardia syndrome. A Johns Hopkins group has placed an emphasis on post-COVID-19 POTS. POTS which affect heart rate and blood pressure include symptoms that are often similar to those experienced by people who have recovered from COVID. These include tachycardia, fatigue and brain fog, and while these could be seen as lingering COVID symptoms, it is crucial that these symptoms be assessed for POTS in order to initiate proper treatment. Individuals with POTS prior to COVID infection who become infected with COVID-19 may also experience a worsening of these symptoms. So what exactly do we know? We know that long COVID can involve a very wide range of symptoms, some more serious and debilitating than others. We know that factors such as symptomatic infection, hospitalization, older age, have been a preexisting condition, and being female are associated with a higher risk of long COVID. But that is also not uncommon for those without these risk factors, including those with mild or even symptomatic infection to develop long COVID as well. We may not know the exact prevalence, but we know that long COVID is impacting a significant proportion of those previously infected with SARS-CoV-2, often to the extent that it interferes with their everyday life. This is why additional studies, including intervention trials with various treatments, are going to be so important moving forward and trying to minimize the impact of long-COVID on society. The Guardian recently reported it from March 2020 to September 2021, it was estimated that 1.82 million days were lost to health care workers with long COVID in England. This estimate does not include the burden of Omicron. It is estimated that 2% of the population of England, about 1.3 million, is experiencing long COVID and half a million have had symptoms for more than a year. As a result of this estimate and the effect it has in the health care system, members of Parliament are calling for a long COVID to be recognized as an occupational disease in order to standardize care and implement compensation for workers who are financially impacted by their inability to work. So what don't we know? Well, that's a lot, but let me try to summarize. First of all, what is causing long COVID? Because the term long-COVID is used to describe a complex range of heterologous health problems or very different health problems, it's likely that there is a wide array of biologic processes that lead to long COVID. There are a few theories about what could be causing long COVID symptoms. For example, maybe do to an autoimmune process, the development of autoantibodies or antibodies against your own tissue that cause complications after the infection has been cleared by the body. The mechanism behind the development of autoantibodies during and after COVID are really not clear. This is not a new phenomenon. We have previously documented chronic implications for infections like Epstein-Barr virus and others that may cause the same kind of picture and surely has some ties to the work we've been doing with chronic fatigue syndrome. A second possibility is that long COVID symptoms could be caused by chronic inflammation, elevated interleukin six, a cytokine that indicates an inflammatory process, has been seen in long COVID patients. Or it could be due to a persistent but low level infection in various tissues like the intestine, liver or brain that continue to cause damage. A recent article that is still in preprint found T-cell dysregulation, which is consistent with low level ongoing infection. How many people have or are at risk for developing long COVID? As we've just mentioned, there's quite a bit of uncertainty about the true prevalence of long COVID in both adults and children. What are the risk factors and is there anything besides vaccination and preventing COVID infection that can be done to prevent it? What can we learn about long COVID from other post-viral syndromes that I just mentioned Epstein-Barr virus, cytomegalovirus, human herpes virus, enteroviruses and more? I think this is a very rich area for research. What kinds of treatments or therapies that can help people with long COVID? This must be a highest priority effort right now. And I know that the NIH funded centers are looking at this carefully, but we cannot move quick enough to get more effective therapies to those suffering from long COVID. And how long will long COVID symptoms last? We simply don't know. At this point, we're really only into two years of the pandemic. We need to be able to follow people up potentially longer than that. The hope is, of course, that their symptoms will resolve within two years. But we know we still have people at this point that have been infected with COVID, who are still experiencing long COVID symptoms almost two years later. This is again another area of very high priority research.

**Chris Dall:** [00:58:55] And now to our questions, and thank you to our listeners, just sending all your questions, we're only going to be able to get a couple of those today, but we'll try and keep addressing these questions over the course of the podcast. Our first question is from Taylor, who writes, "Do we know yet the extent in which the risk of long haul COVID is diminished for those of us who are fully vaccinated, e.g. those of us who have had the complete vaccine three shot series?"

**Michael Osterholm:** [00:59:20] Thank you so much, Taylor, for that very thoughtful question and one that is obviously very important as we talk about the benefits of vaccination. Keep in mind that most studies to date that investigate the protection offered by vaccines against long-COVID were conducted prior to the Delta variant's emergence and certainly before Omicron emergence. So we don't know or understand to the extent that these different variants may influence this outcome. The available data regarding long COVID following vaccination are complex. I wish I could say it was simpler than that. It's difficult to conduct these studies, especially because infections among vaccinated people may be missed if they're breakthrough cases mild or asymptomatic. But a recent study from Israel that is being peer reviewed now reports that people who had SARS-CoV-2 infection and two doses of the Pfizer vaccine were much less likely to report any of a range of common long COVID symptoms than were people who are unvaccinated when infected. Vaccinated people were no more likely to report symptoms than people who had never been infected. On the other hand, there has been studies that show that the vaccination only reduces the risk of long COVID by a half and may even have no effect at all. So we're in this very gray, murky area right now where we clearly need much more data. Remember that vaccination can reduce the risk of long COVID by first reducing the overall risk of infection, and second by reducing the risk of long COVID developing if infected. It's still not clear, though, by how much it reduces the risk, how protection against long term symptoms may wane over time, and how protect it is against Omicron and potential future variants. This is an area that we must we must devote many additional resources to because this would be a very substantial selling point to people to say, look, you don't think you're going to get COVID, but if you did and you had long COVID, think what this might be like, avoid that risk by getting vaccinated. We need these data.

**Chris Dall:** [01:01:24] And our next question comes from Pam, who asks, "Is the Omicron variant less likely to lead to long COVID?" And Mike, this is a question a lot of people have right now, just given how many infections Omicron is causing and the increase in breakthrough infections.

**Michael Osterholm:** [01:01:39] Well, thank you, Pam. And again, another very, very good question. I so wish I had more information to provide. It's frustrating, but I'll do the best I can to tell the truth. Though it's too early to say for certain whether or not Omicron will have long term effects, there is little reason to believe that the potential for a long COVID with Omicron will be significantly different than from other variants. Omicron may be causing less severe disease, and though severe disease does appear to be a risk factor for long-COVID, many people with mild or asymptomatic infections will still develop long COVID. These are not rare occurrences, either. Looking at the UK data, 7% of asymptomatic individuals in the study self-reported having long COVID 12 weeks after their infection, though that is far less than the 17.7% of people with symptoms both mild and severe than self-reported long COVID. It is still a significant amount of people, especially when we consider how many people are being infected with this virus. And just like we saw COVID hospitalizations increase despite Omicron causing more milder illnesses in more people simply due to the high number of people being infected each day, there's no reason to believe we won't see high numbers of people with long COVID following the Omicron surge.

**Chris Dall:** [01:02:58] Well, Mike, we've covered a lot of territory today. Now to a lighter moment, where is our latest beautiful place submission from?

**Michael Osterholm:** [01:03:09] I'm not only happy to share with you the words of our beautiful place today, but a series of pictures that if you click on on the web link, you'll see these are really beautiful pictures. This comes from Bob and he wrote, "Dr. Mike, thank you for your weekly updates. I look forward to hearing your comments and thoughts. July of 2020, after five months of Michigan's lockdown, we were able to purchase a 1985 Catalina 30T sailboat. This has become our weekend retreat away from the stress and nonsense of the pandemic and got us through each week as we had our cottage on the water to look forward to. It doesn't matter whether we were out on Lake Michigan, sails up cruising in the quiet of the lake, away from the struggles on land, hanging out in a cockpit at our slip, working on some required maintenance or taking walks along the channel to hang out at the end of the pier in Grand Haven. The time spent there has given us the strength to look forward and hope the end will be sooner rather than later. We have acquired new marina friends, developed new skills and our marital relationship has grown stronger as we supported and helped each other when we were struggling as individuals. Even though the boat is in dry dock now, anticipation of being back in the water this spring and the memories of last year keep us going. I'm including some pictures from Grand Haven and our lovely Driftin II. Bob." Thank you, Bob, for that very personal story and for the wonderful images it creates in terms of spending your summer on the lake. We have posted the pictures here and they are truly beautiful. Thank you for giving us this moment. And for all of us, I hope that we can find our place on that lake in a boat, no matter what we do or where we do it.

**Chris Dall:** [01:05:01] And finally, what are your take home messages and closing thoughts for today?

**Michael Osterholm:** [01:05:07] Well, thanks, Chris. I have three really summary points that I want to emphasize today. First of all, the viral blizzard is on track. We're not sure exactly how it'll end. Will it be like that snowstorm where the snow comes pouring down and then 24 hours later, it's clear blue skies? I don't think that'll be the case, but I think we will see a major reduction in the number of cases from those surge numbers seen early in the Omicron phase. So we have to understand that we're still in this. It's not like in two to three weeks from now, it'll be all done, but it will substantially change from what it's been. You heard today there are many areas in the United States that are still in the very worst of the days of the Omicron surge. And I just want to offer them the sense that hang on relief is coming. But as much as better days are ahead, we're not sure what that means. We do have to anticipate and plan for new variants that may emerge. A year ago at this time, I kept talking about the variants that this was the game changer. That's why I went from innings of the game to minutes in the quarter. I didn't know what would happen with these new variants. Clearly, you've seen what Delta and Omicron can do. Now, no one wants to hear this, but we have to plan for a potential new Omicron like variant that could have substantial impact on our everyday lives. What does that mean? Well, when we hit this more quiet period coming up, which I think we will. Let's not all just seem to forget about what we've been through because we want a moment of relief. Now's the time to talk about how will we have even better vaccines for the future? What will we do? How will we improve on our drugs and their availability, their rapid availability and develop systems to move these drugs quickly to the people who need them in our communities? What will we do for PPE, personal protective equipment? We need to do so much to improve on PPE. N95s while from an occupational standpoint are incredible tools and they have worked very, very well for protecting us, we need to do much more to think about what are the most consumer friendly effective N95 like PPE devices? What can we do? We need to improve testing. Our testing has basically fallen on its face during this surge and offering additional testing is great, but we don't have a plan for who should get tested, when they should get tested, why they should get tested. We don't have any markers to say just because I get a test if it comes back five days later, is that a failure as opposed to having been one day later? We need to really focus on what we need to do for testing, and we need to address the health care worker and public health workforce issues. Like a battle where many soldiers have gone down in that battle, we have lost health care workers and we have lost public health officials. You don't keep going back in with the same troops, day in and day out, over and over again without replenishing, without trying to understand what they need. How do you support them? So again, in the days ahead, as things become more quiet, that should be some of our most active efforts to get prepared for the future. And if we never need it, hey it was worth it. I hope we never do need it. But as I've said so many times. Hope is not a strategy. And finally, my third point long COVID is real. It's significant. It's challenging, and we must do much more. I'm sorry for all of you who are experiencing long COVID. I couldn't give you more definitive information today. I couldn't give you what you wanted to hear. We have to address that. This must become a global as well as, of course, a national priority. Long COVID is a critical condition that needs the very best of our research and clinical minds to deal with it. So I leave you with the fact that today, each week, I can only hope and anticipate that as we talk about these major summary points, things will be getting better and better, but we can't take our eye off the variants. I will every morning still get up scrape the five inches of mud off my crystal ball, hear that 5th dimension tune humming in the background, this is the dawning of the age of the variants, and we can't let up on that. If we really want to find ourselves one day going back to that new normal, that will be very different than we're experiencing now.

**Chris Dall:** [01:09:53] And you're closing song for today.

**Michael Osterholm:** [01:09:58] Well, this closing song actually is somewhat of a current affairs discussion. It really is all about those people who have stepped up and stepped out to try to make a difference with regard to COVID. And we've heard about a number of performers who have kind of gone the anti-COVID anti-vaccine route, and they've made a lot of news. This is someone who I've seen on numerous occasions in concert, someone whose music means a great deal to me and has been part of my musical upbringing. This past week. Neil Young, who has been a very strong supporter of COVID-19 safety and prevention, decided he didn't want his music to share a home with the vaccine misinformation of Spotify. As you know Joe Rogan, who has his podcast on Spotify, "The Joe Rogan Experience" has become very anti-vaccine full of disinformation, very different than was the experience when I was on Joe Rogan in March of 2020. And as a result of this, Mr. Young basically is pulling his music off Spotify because he refuses to be associated with an organization that continues to contribute to mis and disinformation. And so it really was something I wanted to acknowledge. But it also brought home that one of the songs that I so loved from Neil Young, "Heart of Gold" is all about us on this podcast. It's about all the people who been infected. It's about all the people we've lost. "Heart of Gold" was written by Neil and was recorded in February of 1971. It actually features the backup vocals of James Taylor, someone near and dear to me, as you know from this podcast and Linda Ronstadt. And it was recorded in Nashville, Tennessee, where Ronstadt and Taylor just happened to be at the time. And so they participated in this wonderful piece. The song became one of Young's greatest hits. It reached the U.S. number one single. In Canada, reached number one, and Young actually held the top spot in both the singles and album charts during this time. Billboard ranked it as the number 17 song for 1972, and Rolling Stone ranked it number 297 on their list of the 500 greatest songs of all times. This is a song for which we, all of our listeners here can identify, can appreciate. So here it is "Heart of Gold" by Neil Young. "I want to live. I want to give. I've been a miner for a heart of gold. It's these expressions I never give that keep me searching for a heart of gold. And I'm getting old. Keep me searching for a heart of gold, and I'm getting old. I've been to Hollywood. I've been to Redwood. I've crossed the ocean for a heart of gold. I've been in my mind it's such a fine line that keeps me searching for a heart of gold. And I'm getting old, keeps me searching for a heart of gold and I'm getting old. Keep me searching for a heart of gold. You keep me searching and I'm growing old. Keep me searching for a heart of gold. I've been a miner for a heart of gold." Neil Young. Well, let me just end here by saying that if I ever could have found a place to mine gold for that heart of gold is this podcast and it's the audience that is part of this podcast family. You are the essence of a heart of gold. And I hope every one of you understands that and celebrates that and appreciates that. I mean, look at why do you come back and listen to this crazy guy week after week? There are some people out there that think I actually need some therapy for what I do and how I do it. But this is all about a heart of gold. This is about our moms and our dads, our brothers and our sisters our grandpa and our grandmas. This is all about all those who have been so adversely impacted by COVID. This is our moment to search for our heart of gold and to find it in each other. So I thank you again for being with us this week. We will continue to monitor this closely. Share with you what we know and don't know. And just thank you so much for all you give. Be kind. Just be kind this week. Just take one moment to be kind to somebody who otherwise would not have. I'm telling you it'll make a difference. Be kind. Be thoughtful, and thank you so much for joining us. And thank you to the podcast crew for all you do to make this possible. Be safe, be well, thank you.

**Chris Dall:** [01:14:58] Thanks for listening to this week's episode of the Osterholm update. If you're enjoying the podcast, please subscribe, rate, and review, and be sure to keep up with the latest COVID-19 news by visiting our website CIDRAP.umn.edu. This podcast is supported in part by you, our listeners. If you would like to donate, please go to CIDRAP.umn.edu/donate-now. The Osterholm update is produced by Maya Peters, Cory Anderson, Angela Ulrich, Meredith Arpey, and Sydney Redepenning.