TWiV 1346 Clinical Update

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Vincent Racaniello: *This Week in Virology*, the podcast about viruses, the kind that make you sick.

[music]

VR: From *MicrobeTV*, this is *TWiV, This Week in Virology*, Episode 1346, recorded on August 6, 2026. Oh, my God, all these sixes. I'm Vincent Racaniello. You're listening to the podcast all about viruses. Joining me today from New York, Daniel Griffin.

Daniel Griffin: Hello, everyone.

VR: Those are real books behind Daniel. They're not a fake background, right?

DG: No, this is true. I could even - A bunch of those, yes, I was author on and stuff. Yes.

VR: I think your tie is prions.

DG: It's interesting. I've got a yellow and orange prion, but this is blue. A blue background with little coccidial and gram-negative rods. It's waterborne illness bow tie.

VR: Waterborne illness, which is appropriate for these days, right?

DG: Yes. We're going to talk a little bit about that. Let's jump in. I was sitting with Barnaby, my son, yesterday. What quote should we use? We went through some Rick Riordan and a few others. I actually settled on a Teddy Roosevelt quotation. Teddy was an interesting fellow, actually. I'll say, particularly how he interacted with Panama was quite interesting. Anyway, “This country will not be a good place for any of us to live in unless we make it a good place for all of us to live in.”

VR: This is pretty relevant today, Daniel.

DG: It really is. This is the kind of leadership you want. The idea that I am the president for everyone. I want to make sure everyone is safe, is able to pursue all those things that our government is supposed to protect and ensure, pursuit of happiness. Let's talk a little bit of news, but then we're also going to get into more of the science. This is just, I think, straight news: Senate confirms Erica Schwartz as CDC director. People may have watched some of the interactions that went on during this process, but we read in *CIDRAP*. You can read in a lot of places, but here I'm going to link to *CIDRAP*.

“The Senate, Tuesday, August 5, voted to confirm Erica Schwartz, MD, MPH, JD, as the director of the Centers for Disease Control and Prevention. The vote was 51 to 44 in favor of confirming Schwartz, who spent 24 years in the U.S. Public Health Service,” commissioned, of course, “and served as deputy surgeon general in the first Trump administration.” I was bothered, I think, by this, that the vote was pretty much along party lines with only one Senate Democrat, Tim Kaine, voting in her favor. It's just terrible the way the appointment

of the director of CDC has just become such a political thing. It's a shame.

VR: She is very well qualified. However, during her hearing, she was very evasive. If she really is going to do what she said, at the end of this *CIDRAP* article, she says the nation's health and well-being will take primacy. I will never compromise on that. The first time she refuses to obey RFK, let's see if she gets fired.

DG: I hope she does well. I think we're all hoping finally we have a proper CDC confirmed director. It seems recently that RFK Jr. has been walking back a few things. I'm not sure if he's as popular with his base as he used to be. He was on that, I think it was a CNN interview, where he basically said, "Hey, people should get vaccinated." Then I think his MAHA people are not so happy that under him and Trump is more pesticides in the waters and in our food. Yes, good luck, Dr. Schwartz.

We have a new report from the U.S. Government Accountability Office. Public health preparedness: experts identified actions to improve surveillance for emerging disease threats. What GAO, so that's a government accountability office, what GAO found. Emerging infections are infections that are new. Sometimes it's COVID-19, something that comes in or have existed but are reappearing in an area. Measles is the example there. This is per the Department of Health and Human Services.

As the federal lead for public health, HHS partners with thousands of entities at all levels of government to conduct surveillance for emerging infectious disease, doing so through continuous data collection, analysis, and sharing of health data needed to plan for and respond to such threats. Experts on a round table GAO convened suggested a range of actions that the federal government could take to improve U.S. emerging infectious disease surveillance. GAO categorized experts' suggestions across four areas related to collaboration, data, methods, and communication.

Now, four areas with examples of federal actions experts suggested to improve emerging infectious disease surveillance. Collaboration, I think that's straightforward. Increased coordination by creating a multisectional, multidisciplinary leadership group. It's a collaborative group. Data quality and infrastructure: strengthen data quality by identifying, developing, and using standards for surveillance data to give us the data. Surveillance methods, so optimize surveillance by evaluating effectiveness of surveillance systems and methods. Communication: huge; improve awareness and perception of public health and surveillance by developing a communication strategy.

Then basically a key theme and experts suggested actions for improvement was to unify efforts between animal and human health sectors. You can think of some people that are really on board with that “One Health” approach, in recognition that emerging diseases often affect both. For example, experts suggested that a multisectoral, multidisciplinary leadership group should be created to direct surveillance planning and activities across federal agencies, including those responsible for both human and animal health.

Now, such a group could address a lack of centralized authority to direct cross-agency surveillance activity, leading to inconsistent collaboration that hinders the effectiveness of U.S. surveillance for emerging infectious diseases.

VR: This sounds great. It's never going to happen in this administration.

DG: It really sounds great. You're like, obviously, this is really common sense, straightforward, but yes, is it going to happen?

VR: No.

DG: In a lot of ways, as we're seeing now, who really wants to be involved in this and in the public light and how partisan health and how we respond to such things has become.

VR: This administration wants everyone sick.

DG: Well, we're going to talk about that because that's interesting. One of the big things that somebody has been pushing for decades is this whole connection between autism and MMR. Once again, we learn that vaccination does not cause autism. We have the article. How many times are we going to have to learn this? We have to learn it again. This is robust. It's timely. The article, "Association Between First MMR Vaccination Before Age 2 Years and Childhood Autism in a U.S. EHR Cohort of 2.5 Million Children," was published in the *Pediatric Infectious Disease Journal*. I like the fact they've got 2.5 million children right up front.

These are the results of a very large, retrospective cohort study using the Cosmos electronic health record database that includes 2,560,035 U.S. children with linked birth, parent data, and follow-up through age 8 years. To minimize bias related to exposure timing and healthcare utilization, they performed pre-specified age-based landmark analysis evaluating the first MMR vaccination administered between 11.5 and 24 months, and then adjusted hazard ratios for autism were estimated.

I'm going to talk a little bit about what this landmark cohort analysis actually means. Here's the deal as to what they're going to do. In the primary 11.5 to 24 month, this landmark cohort, and the landmark basically is the age. You're saying in this particular age when they get their primary shot, was the first MMR vaccination associated with autism? The answer was no. The adjusted hazard ratio was 0.97. Across all age-specific landmark cohorts. Now you start breaking it. You say, "Well, let's look at 11.5 to 18 months." "Let's look at 18 months to 24." You're looking at the timing. All negative.

They do this negative control analysis. You basically get the null estimate. The adjusted hazard ratio is basically one. You've got a confidence interval of 0.99 to 1.04. Really, when you went through looking at the different ages, no association between MMR vaccination before 24 months and childhood autism. I think this is really key because there's this idea out there that seems to be growing is, "Well, I just want to be safe. Maybe I'll wait." I want to point out here in 2.5 million children, you're basically saying it's not safe to wait. There's no safety issue with giving your child the MMR vaccination. There is a safety issue with leaving your child exposed to getting measles now that we're seeing thousands and thousands of cases of measles in our country.

VR: Yes, but they will find some reason to discount this.

DG: I'm hoping they don't. This is really robust. It's clear. I think this is going to be out there in the mainstream media for people to see and discuss. There's no connection. We have looked. There's no hiding. There's no obfuscation. Is that fancy word?

VR: Yes. This all started with one misguided physician, Andrew Wakefield, publishing bogus work. It has continued since then. In the '90s, this was published, wasting so much money and time. There's no connection. Can we move on, please?

DG: It's crazy. You're kind when you say misguided. This was not misguided. This was a malevolent, fraudulent, dishonest individual who was basically trying to use misinformation to make himself money, and he's done that. This man has made millions. I don't know how

people like that sleep at night, but very clearly, this was a strategy to try to get money in a court case. The data was fraudulent. The study was retracted. They just used that, oh, it's big, the dark state or whatever, the deep state is doing all this stuff. Yes.

I'm very excited about this. There was an NPR podcast thing that my son, Barnaby, was listening to yesterday. Now we have the article. I'm very excited this morning to read this article by Christina Jewett in *The New York Times*. It's *The New York Times*. I'll be behind that paywall, so maybe she'll send it out as a free share. “FDA Approves Moderna's mRNA Flu Vaccine.” The approval of the vaccine called mFlusiva. We going to be able to remember mFlusiva? I want the mFlusiva. It needed mRNA somewhere in the title, unfortunately. How are we going to remember that?

VR: Do you remember what the name of the mRNA COVID vaccine is?

DG: I remember Spikevax and Comirnaty, but then there was a better one, better than Spikevax. I don't know what that one's called.

VR: Yes, the modified one. Let me look it up.

DG: The NextGen or something, the NextGen Spike or something. Yes, I don't. Then the one by Novavax. Everyone calls it Novavax. You're like, "Oh, the Novavaxavoid. I want the Novavax, not the Novavaxavoid."

VR: It's mNEXSPIKE without a T.

DG: Yes, at least there's a little M in there. I guess the little mFlusiva. I want the little mFlusiva. Anyway, it's manufactured by Moderna. This is amazing that this happened because RFK Jr. has canceled 22 projects meant to develop vaccines with mRNA technology through the government's Biomedical Advanced Research and Development Authority. Initially, as we covered, the FDA refused to even review Moderna's application for approval earlier this year, but quickly reversed course after a public outcry. Yes, public, we have some power if we get really upset and vocal.

Now, it's interesting. The new vaccine is authorized for people aged 50 to 64. I'm in there. The FDA issued an accelerated approval for adults 65 and over, which allows widespread use and can be converted to a full approval if the results of a follow-up study are deemed acceptable. We'll probably basically see a lot of this. This is based on a study that we discussed. I'll even leave a link. There was an article discussing this study. It was the article, “Efficacy and Safety of an mRNA Seasonal Influenza Vaccine in Adults,” in *The New England Journal of Medicine*.

You get an extra 27% efficacy compared to the standard flu shot. Now, the vaccine efficacy in that study was against RT-PCR-confirmed protocol-defined influenza-like illness caused by flu A or flu B from at least 14 days after vaccination through the end of the flu season. Pretty, this isn't like hospital or death or so sick you need to go to seek medical care. This is a pretty low bar. This is actually just like, [sniffs] I got some symptoms, and I tested positive. Preventing even very mild disease. I know which flu shot I want, Vincent.

VR: Is this going to be available this season, you think?

DG: They actually say it's going to be available in a few weeks. Moderna's ready to pump it out. That's one of the things they talked about is that one of the great things about mRNA vaccines is you can get them out pretty darn quick, like the production time. This will be great in the future because they can always adjust the target if it turns out, "Hey, we picked

the wrong." You don't have to pick six months ahead of time which particular type of flu you're going to target. You can say, "Oh, wow, this is the one that's causing a problem." Within 60 days, you got the new one out.

VR: I got a text from CVS yesterday, and it said, "The new flu vaccine is here," but I can't imagine that this is it. Mostly the -

DG: It must be the new flu vaccine, like the new one this season.

VR: It must be the new version or the old version, if that's clear to everybody.

DG: For you, it'll be like the high dose, one of the high dose ones.

VR: I can never get the high dose. It's always out of stock.

DG: Maybe this one will have good supply. Be curious. We'll give everyone an update.

VR: There's just one dose of this mRNA vaccine.

DG: Yes.

VR: That's it. I'll wait for it.

DG: Let's talk about *Cyclospora cayetanensis*. Not a virus.

VR: Is that something going on with *Cyclospora*?

DG: Yes, we just got a health alert a couple of months after the problem started. Unfortunately, to start off with a little bit of, it's pretty crummy: all these people with explosive diarrhea, but two deaths linked to cyclosporiasis in Michigan. I'll leave a link into an article in *The New York Times*. Health officials in Michigan reported two deaths linked to this outbreak. The outbreak has now spread. There are cases reported in 47 states, Hawaii, Montana, and New Mexico. We're not seeing yet - They're probably cases, but we just haven't seen them.

Then they have this really nice map. I'll leave a link into it. This is in *The Washington Post*. CDC expands largest known cyclosporiasis outbreak to 15 states. It's the biggest one so far. On this map, you can see where there are reported cases everywhere. You can see the heartland where it's linked to shredded lettuce sourced by Taylor Farms de México.

VR: All these other pink states with reported cases, what is that linked to? Also, shredded lettuce or something else or what?

DG: No. There apparently are multiple sources. It's not all just coming from Taylor Farms Mexico. You've got all these areas. You've got North Carolina. We think there's another outbreak going on. Let's go through this. First, the CDC. The CDC is aware of 10,468 lab-confirmed domestic cases, 12,255 additional cases that require further investigation. Then you can break it down. Michigan is giving us 12,218 cases; 193 have ended up in the hospital, so pretty bad. Then the two deaths, as we mentioned.

North Carolina, 867 as of Tuesday, 33 folks in the hospital. Missouri has over 1,000 cases, so 1,095 cases. We've got the cases in New York. I pasted in this article; you have hundreds of cases in New York. I guess I'll just pop that in. 553 reported cases in New York. It's still ongoing. They have a nice - I'll leave a link to the New York City government DOH. You can see we're still going on. We're still seeing cases. We should leave a link. I'll pop in a link to

our *This Week in Parasitism* podcast where we actually discuss, review. We talk about an hour about *Cyclospora*. It's amazing that we could do that, but there's so much to talk about there.

I was looking for a picture, and I found it. It was in this article in *Forbes*. "It's The Water, Not Produce, Likely Driving *Cyclospora* Outbreaks," by Judy Stone. I do think this article needs a little bit of thinking through. Do you like the picture of that dude just hanging out there in the field and there's water everywhere?

VR: Yes. The picture's great, but I don't agree with the headline.

DG: Yes, I think that there's a problem here. Let's talk about it. We read here that we rely heavily on irrigation systems. We're going to talk a little bit about what's going on here. A 2023 irrigation and water management survey found that 45% of all water used as irrigation came from surface water. It isn't just coming up from a well. It's the stuff that is on the surface. It's in these canals. This is important because the surface water that we're going to end up using to water the crops can be easily contaminated, and with this particular organism, it doesn't take many organisms to make you sick.

Now, we're going to talk about this because, as we're going to circle back to, they're going to talk as if this is something that's happening here in the U.S., as though the crops are getting contaminated here in the U.S., but we're clearly seeing the majority of these issues are coming from something that's going on in Mexico. This actually probably applies to Mexico as well. U.S., particularly, but also in Mexico, employer-provided housing for the people involved in the crops is generally crowded. There's often poor sanitation.

The drinking water may come from springs or wells, and while the wells are monitored before people move in, they could potentially get contaminated down the road because there's no requirement to ever check them again. They could get contaminated, and then people could keep getting sick. The idea here is that the workers are out there in the fields. They're supposed to be given water and bathroom breaks, so they can go to a facility and the feces ends up hopefully in a sanitation system. We hear lots of complaints that they're really not being allowed adequate breaks.

Also, there's a rule, there's got to be an adequate number of toilets. The whole idea is you've got to have one toilet and one hand-washing facility for every 20 workers. These facilities have to be within a quarter mile of each worker. If you've got explosive diarrhea from *Cyclospora*, let's think about this, and this is how it comes together. Are you going to travel a quarter mile to go to that bathroom and then back, so it's a half a mile round trip to go to the bathroom, or are you going to just go pop a squat over by the side and maybe rinse out, clean yourself in the irrigation canal, and now that irrigation stuff that you've contaminated is now going to be sprayed or distributed all over the crops?

VR: I just don't buy this, Daniel. I'm sorry. People are eating shredded lettuce at Taco Bell. They're not squatting, or what did you call it?

DG: Well, so what happens is, so here we are in Mexico, because that's where the lettuce is coming from.

VR: Is that where we were talking about here? [crosstalk] This picture is supposed to be a guy in Mexico?

DG: Yes, that's where this is going. You're down in Mexico, and you're going to water your lettuce crop, and so you've got all these canals running around. You've got your people who

are out there harvesting the lettuce for you, and those people, the toilet's a quarter mile, half a mile round trip away. When they've got diarrhea, because you have *Cyclospora*, you're going to get diarrhea; you're just going to pop a squat there because you're not going to make it to and from the bathroom, however many times a day with the diarrhea.

VR: You're saying these workers are contaminating the water, and the water is contaminating the lettuce. Remember, it has to sit for seven to 14 days and has to activate.

DG: Which it does before you finally -

VR: In the water?

DG: Well, no. It just has to get the little oocysts on it, and they're sticky. Then one to two weeks of it sitting there, it goes through the sporulation process. Now it's infectious. Right there, if you put the bad right, you're not going to get sick. It needs that week or two, and that week or two is when it's being shipped to you in New York or Michigan.

VR: The problem here is they're talking about OSHA mandates. This is Mexico. This is not OSHA. They don't mandate.

DG: Yes, you're right on. That's the problem because this isn't happening in the U.S.

VR: No. I don't know. They're talking about the cuts to CDC and this, and that has nothing to do with Mexico. I understand that it's endemic in Mexico, and yes, this could happen, but it has nothing to do with toilets.

DG: They're blaming Trump and DOGE, and we hate Trump and DOGE, right? No, I'm on board with you. I think there's problems with this story.

VR: I totally agree that the CDC has been decimated and emasculated and every word you can think, but I don't know what it has to do - I don't even mention Mexico here. I don't know if you edited this article because it's very discontinuous.

DG: No, yes. These are just little excerpts, but you are right. This argument doesn't hold water. Can I say that? That was a little bit of a pun.

VR: You could. Sure.

DG: Yes, there's a little bit of an issue here. I think it's like, oh, yes, and you get angry, and all these cuts, and they no longer check for anything, and CDC loses 3,000 employees, and the food safety, they lose almost a thousand employees, and the FDA is cut by over 4,000 jobs, and then FoodNet is no longer surveilling for any of these things.

VR: This is coming from other countries where *Cyclospora* is endemic. This is not happening in the U.S. because of us irrigating lettuce. That's my understanding. Maybe I'm wrong.

DG: No, you're right. You're right. I think that's why it's good for us to have this discussion. I was talking to some folks yesterday, and I was like, "Listen, just buy locally sourced vegetables, locally sourced lettuce."

VR: Not so easy.

DG: It is hard. Yes. You can certainly try to find some locally sourced raspberries.

VR: Now, in the summer, it's a little easier, but once we get into the winter, everything is

going to come from somewhere else.

DG: Or wash your lettuce, right?

VR: Well, we decided on *TWiP* that that didn't work.

DG: It's really hard because it's so sticky.

VR: We read the paper, yes.

DG: Yes, the oocysts are so sticky.

VR: I was on a plane the other day, and I didn't eat my salad because I didn't trust it. I don't eat salad anymore.

DG: Hopefully, we've shed some light. Yes, this is at least the thousands and thousands associated with Taylor Farms. That's coming from Mexico, so it doesn't have anything to do with what's going on here.

VR: This headline, water, not produce, is driving it. No, if the water just sat there, it wouldn't drive it. It has to get on the lettuce. The lettuce is driving the outbreak.

DG: This reminded me of this conversation I had repeatedly with Dickson, which was, he's like, "I don't understand how people are getting COVID from the wastewater." I'm like, "They're not. They're not." The wastewater just tells you they have COVID, and they're - I don't understand how they're getting it from the wastewater. I'm like, "Oh, Dickson, you're killing me." Anyway, let's get into Ebola.

VR: Well, they don't get polio from wastewater either.

DG: True.

VR: It's an indicator.

DG: Yes, you are right. We're going to be talking about wastewater later, so don't worry. We won't let a good, well, for you guys, Saturday morning go by without a discussion of wastewater, but for us, Thursday night. Ebola: there was an article in *Science*, and it was, “Did We Miss the Beginnings of the Ebola Outbreak?” I think the answer is yes. We read here that the epidemic ignited in January, perhaps even earlier, and they actually mentioned where. The idea that it was a patient seeking care may have brought it to the city from a rural area.

Then they go on to say, by the time health authorities in the distant capital Kinshasa recognized the disease as a type of Ebola, a widespread sprawling epidemic was already underway. They interviewed 97 people and looked for likely Ebola cases by identifying households with at least two deaths within 21 days and symptoms suggesting Ebola. They also reviewed photos, WhatsApp messages, doctor's notes, even biographies read at funerals that mentioned the deceased's symptoms. Everything pointed to widespread Ebola infections, they say.

One transmission chain started with a 50-year-old woman identified only as A, who died on January 25 after vomiting blood. Her mother died six days later. Her husband fell ill but recovered. On 11 February, A's nephew died bleeding profusely from facial orifices. He was buried the next day during a funeral attended by many people. The nephew's wife died a few days later, and then their child. Several more people in the family passed away. Others

fell ill but recovered. Really pushing this back to January.

VR: I've heard January thrown about previously, and everyone said, "Oh, no, April, May," but this, yes, this is January.

DG: Yes, no, April was what I had heard initially, but this really pushes it back. Maybe that's going to affect this next graph we're going to talk about. CDC updates: they're up to, in the DRC, 3,874 confirmed cases, 1,751 confirmed deaths, so a really high fatality rate. They say number of days since the first case, and they have us in the first 100 days still, but go back to January. Then we're like February, March, April, May, June, July. That puts us six times 30, 180, so maybe we're farther than the first 100, but they still have this exponential approaching 4,000. Not good.

Measles: the number keeps going up, 2,370 per the Hopkins tracker, so basically an extra 50, and that's actually pretty similar to what we're seeing. Actually, you ready for this? The CDC has a higher number than Hopkins, 2,371, so they have an extra 53 cases just this last week of monitoring.

VR: Did you hear RFK on CNN? He said, "We controlled all the measles outbreaks in the U.S."

DG: Yes, you just - How do you know if RFK Jr. is lying? Do you know this?

VR: His lips are moving.

DG: Yes, you got it. Now we're going to move into, and I thought we would do this in real time. We're going to do this live, so going to go while you and I are here and look at the CDC wastewater because they hadn't updated this. I was wondering what was going on. Everyone, you can follow the link as well. Basically, what are we seeing? A little bit of activity. Did you go as well, Vincent?

VR: Oh, I should go to the CDC site?

DG: Well, I'm going to copy and paste it in for you. Basically, when we zoom out, we see this pattern where we keep having these spikes. It looks like there's a little bit of a rise in the West. That's what we talked about last time.

VR: Yes, actually they do. It's plateaued, though.

DG: Yes, just a little bit. It's plateauing down in the low zone. Let me just paste that right in for us here. Not much activity.

VR: They have some categories here for wastewater activity. For SARS-CoV-2, very low is up to 2. What does this 2 means, the amount of virus in wastewater? Do you know what these numbers are, 2 and 2 to 3.4, et cetera? What does that mean?

DG: I don't, actually. There's a lot of places, if you look at the actual, where are we getting the data at the state level, there's a lot of areas with limited coverage. We think there's moderate activity in Missouri, but we have limited data. We think that there's low activity in Mississippi, but we have limited data. That's a part of the issue. I think we'll keep mentioning that. Unfortunately, it looks like we have issues here where we may not have the data we want. If we start seeing it on the ground, I'll make sure to talk about this.

VR: These numbers are missing something. How can they publish just numbers on the table without saying what they are?

DG: They should have a nice, basically, explaining what the data really translates into as far as units.

VR: It should be right there where the table is, not somewhere else.

DG: They have these categories, and they say low, it's these numbers, but then what are the numbers? Then you have to go to this other place to understand. People have criticized that. They can define very low and then just change the definition to keep you there.

VR: Are you seeing COVID cases now, Daniel?

DG: Not really. There was a case the other day where the test was positive, but it didn't make any sense because they had come from an outside hospital where it was negative. They actually have to say they're visiting from Bangladesh. They repeated the test. It was negative. There were no symptoms. Didn't make any sense. It was a false positive, just like the Taylor Farms.

This is an interesting one. Maybe it's going to relate to some other topics we'll talk about. We have the article, "Household Transmission of SARS-CoV-2 in Washington and Oregon, United States, 2022-2024," published in *JPIDS*. This group conducted a prospective observational household study in Oregon and Washington, USA, and during 2022 to 2024. The participants completed enrollment, weekly and follow-up symptom surveys and submitted sera and weekly nasal swabs. Swabs were tested for SARS-CoV-2 by PCR; a subset of positive specimens underwent whole-genome sequencing. Sera was tested for the antibodies.

They identified 617 households with a distinct index case, of which 90% were symptomatic, 41% were children. Thus, it's in the *Journal of Pediatric Infectious Disease Society*. The estimated secondary infection rate was 16%. I think that's interesting because we've got this new prophylactic medicine, and in that study, secondary rates were 9%. These are lower than the first year or two. Remember, it was like 50%. It's important to think about. Here, the estimated secondary infection rate was 16%, reflecting 203 secondary infections among 1,267 household contacts.

Among household contacts, factors associated with secondary infection included low anti-nucleocapsid antibody titers, like doubled it, residing with an index case who was symptomatic, that basically doubled it, had viral detection greater than a week, doubling it again. Among 136 sequenced index secondary case pairs, 94% shared lineage. These were 94%, 95% of the time, these were from that person in the household.

We have a study here, and I'm going to go, a study where we're going to talk a little bit about figures, and we're going to talk a little bit about virology because I think there's a viral group here that a lot of our listeners may not be familiar with. This is an article published in *Nature*. There's a ton of data here. There's like figures, and then there's supplementary figures. This is a topic that I know we've covered several times: "Virus Reactivation in Acute and Long COVID-19."

As our listeners are familiar with, there's this finding that during SARS-CoV-2 infection, you can get reactivation of chronic viruses such as Epstein-Barr virus, cytomegalovirus, yet the full extent, temporal dynamics, and immunological impact of viral reactivation, well, I'm going to say even after this remains incompletely understood. Here, these folks are going to do these multi-omic longitudinal investigations looking at 1,154 hospitalized patients with COVID-19 from the IMPACC cohort.

They actually go ahead and they identified significant reactivation of *Herpesviridae*, I think we all know what that is, and then the *Anelloviridae* during acute COVID-19.

VR: Racaniello.

DG: The Racaniello, so the *Anelloviridae*, the Racanielloviridae.

VR: It's kind of similar. Racaniello, it's different.

DG: Maybe that will be helpful for me to remember.

VR: Anello means ring. Anello is ring in Italian because the DNA is circular. It's a single-stranded circular DNA genome.

DG: Is it negative?

VR: Could be either one.

DG: Oh, interesting.

VR: It doesn't matter because when it gets into the cell, it's copied and it's double-stranded.

DG: Interesting in this study, and we're going to walk through a few of the figures, but they found that reactivation correlated with disease severity, host immune effects, and clinical outcomes. They highlight the prevalence of chronic viral reactivation during acute COVID-19 and Long COVID. They say their findings challenge the prevailing view that chronic viral reactivation is primarily a consequence of immunosuppression, demonstrating that reactivations occur frequently in immunocompetent individuals during severe illness and in association with increased systemic inflammation.

Additionally, they provide this demonstration of persistence of viral reactivation in convalescence and report an association of *Anelloviridae* with Long COVID. The study provides immune, transcriptomic, and metabolic signatures of viral reactivation that they say, and I agree, could inform future strategies. To predict what's going to happen, how to maybe treat COVID-19, how to maybe prevent or treat COVID. Let's walk through just a few of the figures.

This is open access, so everyone can actually look at this, but it's not exactly the easiest study to walk through. Figure 2 is pretty nice. You've got a number of these viruses, so CMV, EBV, HSV-1, HSV-2. The *Anelloviridae* and the enteroviruses grouped together, they didn't break them down into specifics. Then they look at which participants were positive for the viruses, and then they're going to basically also look at complications and comorbidity and the associations. What do you think looking at this, Vincent?

VR: It's quite clear that there are viruses reactivated in acute COVID. I just don't know what they mean because it could just be a consequence. It may not do anything, right?

DG: That's the issue in this first figure. It establishes that, OK, we're getting this activation, but what is going on? The next thing they go through, well, we're going to jump ahead to Figure 4. Again, these are all correlates. We have not established causality here. They're very good about saying that. The next is they look at the correlate between the reactivation of these viruses and inflammatory cytokines and chemokine expression. It's really nice. You can basically see, and they do a heat map, positively associated with the virus, negatively associated with the virus.

There's a number of these inflammatory cytokines, and then they even follow them over time that are positively associated with the virus reactivation, CMV, EBV, HSV-1, the *Anelloviridae*. The *Anelloviridae* don't get a lot of hits. It's really just IL-18 and CXCL11. You get a lot of hits for CMV and HSV-1 and EBV.

VR: How do they associate a virus with a particular cytokine or chemokine?

DG: You're really looking, and you can break down people who have the reactivation and people who don't.

VR: I see. Not everyone has all the viruses reactivated. Most people, right?

DG: Yes, and they look at different places too. The EBV, they're looking nasal, and they're looking in PBMC, so like 35% of the different groups are having, we'll say, EBV reactivation, where HSV, it's like 40%, 50%, but then you look at CMV and it's only around 10%, let's say. Then you can compare them to the 90% or the 70% and see if there's any kind of correlation, people who have it, people who don't, what's going on with the cytokines.

Then what's probably the most interesting, I think, and this will be maybe something that gets some attention, is they, in Figure 6, they look at associations between these viral reactivation detections and Long COVID. They actually find a number of things that are positively associated with the virus. They find neutrophil degranulation. I think there's still a lot. Yes, there's still a lot to do here, but -

VR: The title is telling: associations.

DG: Yes, associations, correlations.

VR: Chronic reactivation and Long COVID. We don't know if this is a cause of long COVID or a consequence of it. It's important to look at it, I agree, but this kind of study, an observational study, can't tell you that.

DG: Yes, and I think that's tough because a lot of people are out there using antivirals and it becomes this issue, like, are these reactivations causing Long COVID or is there something about people that are developing Long COVID that have these viral reactivations? [crosstalk]-

VR: It could very well be that you reactivate during acute COVID and these infections persist, and they can be part of the symptomatology of Long COVID, but we just don't know that. We don't have the data to say that.

DG: Yes, we don't know yet. I'm glad people keep looking because there's people out there suffering, and so we need to -

VR: By the way, we will do this paper on *TWiV* tomorrow, deep dive.

DG: Oh, fantastic. I'm excited. I'll look forward to that.

VR: We're going to.

DG: No one is safe until everyone is safe. We are now, in August through October, we are doing our American Society of Tropical Medicine and Hygiene fundraiser, and this is a special one. What we have decided to do, and people know that Dickson Despommier, who I talked about earlier, a close friend of all of us, a founder of Parasites Without Borders, frequent participant on our podcast, he passed away, and we are working with the

American Society of Tropical Medicine and Hygiene to create a Dickson Despommier annual talk for the next five years, and it's going to have to do with global health and parasitology and things like that.

We're actually trying to raise $100,000 so that we can go ahead and work with ASTMH to create that annual lecture series. We'll be announcing it, hopefully, fingers crossed, all of them. We'll be announcing it this fall at the annual ASTMH meeting, and this is a big one; we're hoping to get up to that maximum donation of $100,000 for that lecture series in memory of Dickson.

VR: Yes, it should be fun.

DG: Yes, I think that this is something that I think would really be special and really appropriate for all he's done.

VR: He liked that meeting a lot, so it's perfect. It's time for your questions for Daniel. You can send yours to Daniel@microbe.tv. John writes, "If more efficient refrigeration and transport had preceded the polio vaccine, might we be or have been reading of polio outbreaks from imported lettuce? I don't think we were importing produce on any scale back even in the '70s. Thoughts."

DG: This is a good question, Vincent. Let's say someone in Mexico has polio replication going on their GI tract, and they do what I talked about. They go, and they squat over there in the canal, and then we spray it all over the lettuce, and then we bring it into this country. What do you think? Would the virus stay on the lettuce? Would it survive?

VR: I know of no case of polio other than person-to-person transmission. It's exceedingly stable. The virus is exceedingly stable. There's no question that it would remain infectious on lettuce. In the heyday of polio, there's no foodborne polio. I understand the lettuce didn't come from long distances back then, but there would be lettuce grown in the U.S., and workers might contaminate it. I don't think it would happen, no.

DG: Yes. It is interesting. You could think it's such a hearty virus, why couldn't that happen? Back when you had it in the U.S., as I mentioned, we didn't describe these foodborne polio outbreaks.

VR: No. It was always fecal-oral contamination with people transmitting it by hand. There were lots of investigations of the route of transmission. People suspected flies at some point. Flies would land on feces and pick it up. No, nothing except suspected person-to-person. I don't think so, but it's an interesting idea. Yes.

Marianne writes, "I thank you for providing clinical updates every week. I'm concerned about a September bridal shower luncheon menu, which includes fresh, uncooked vegetable salads. The wedding is two weeks after the shower, and I wouldn't want anyone to become sick from cyclosporiasis. Seems like Nassau County is reporting just 17 cases. Should I throw a caution to the wind or ask the restaurant to provide a cooked alternative?"

Daniel, what is an uncooked vegetable salad? I don't even understand what that is.

DG: Yes, I think that's just basically a salad. You don't cook the tomatoes, you don't cook the lettuce, you don't cook the radishes, whatever, the shredded carrots you put in there. Yes, this is a little bit of a challenge. I think I talked about locally source your vegetables. Now, here in Nassau County, Long Island, we have a lot of local produce. We have a farmers' market here. Every weekend, what about that? What about locally sourced salad

ingredients? That would be great.

VR: I would agree. You get it locally, and then you're good. Don writes: "Daniel and Vince, this message is in response to 1342. Daniel makes the statement that *Cyclospora* can be washed off fresh produce. This is not a scientifically sound recommendation. Washing is generally a poor way to remove any contamination from any fresh produce. Washing has at most a one or maybe two-log reduction. There's also some evidence that parasites like *Cyclospora* are more difficult to remove than bacterial or viral contaminants. We don't know the median infectious dose for *Cyclospora*, but it's unlikely that washing will significantly reduce the risk, even given a moderate level of contamination. Expert opinion is also that washing pre-washed leafy greens is not recommended." He provides a link for that.

DG: Yes, we'll pause there. Hopefully, we've talked about the sticky oocysts and how hard this is. We agree with you, Don. This is not easy to get that stuff off. My wife goes through this ritual where she washes the lettuce, and then she spins it, and then she dries it off. Yes, but as mentioned, it's really sticky. It's hard to get the oocysts off there once they're stuck on.

VR: Don says that washing is a poor way to remove any contamination. I think you have to wash your produce because they have dirt on it, for God's sake.

DG: Yes, it has dirt. As mentioned, you say, oh, a log reduction with each washing. You have to do it a couple times. You rinse it off, then you rinse it off again, and the salad spinner.

VR: If everyone stopped washing their lettuce, don't you think we'd have an increase in foodborne illness? I don't know.

DG: Yes, I suspect so. Yes.

VR: "Daniel also talks about person-to-person spread. When a person is infected with Cyclospora shed oocysts, they're not immediately infectious. They require two weeks in the environment to mature and become infectious." We don't know why, but we do know this is the case." We clarified that on the *TWiP*, right?

DG: Yes, we talked about the fact that when it comes out, not infectious; it takes this one to two weeks before it actually becomes infectious. The idea that someone's going to use the bathroom and prepare your food, no, it's going to take a period of time.

VR: Finally, "Daniel mentions the possibility of multiple outbreaks. Please note the FDA is definitely investigating multiple *Cyclospora* outbreaks. There had been six outbreaks investigated by FDA this year. One has been closed with no cause identified." He gives a link for that. "A new one was just announced, and in only one of these outbreaks has a cause been linked epidemiologically to iceberg lettuce."

DG: No, this is great stuff, Don, so appreciate you.

VR: Don is chair of Department of Food Science at Rutgers, so Don knows what he's talking about.

He totally knows what he's talking about. He's right on with all these comments.

Connie writes, "Thanks once again for all that you do to keep us up to date. I just listened to the most recent episode, and in answer to an email question, you mentioned that if you had measles after receiving the polio vaccine, it would be wise to get vaccinated again. I'm 77. I

can't remember how old I was when I had measles. I do clearly remember getting the polio vaccine, shot, and then sugar cube, but it may have been before I got measles. Is there any reason to worry about this? I imagine there are thousands and thousands of people around my age in the same boat."

DG: This used to not be a problem. Thanks to some folks, this is becoming a problem because we've got older folks; they may have gotten their vaccine, then they got polio. We're not sure how well that vaccine is protecting you now because of the potential immune amnesia that you could have gotten. Yes, I think there's a lot of folks that are just going to get another MMR just to be on the safe side now that we're seeing thousands of cases of measles.

VR: I'm in this boat. I was born in '53. I definitely had measles, and I got polio vaccine twice. I got it in '55, and then I got it in '62. I probably got measles in the 50s, so I'm probably OK, because I got the vaccine again in the '60s. It was a time when there was zero measles in the U.S., and this was not an issue, and thanks to people running public health in this country, it's now an issue.

DG: Yes. Sorry, I think I misspoke. Yes, it's the polio vaccine that people might need to get done. If they had measles, all right, you're protected there, but yes, maybe the measles, now you're not immune to polio. We have to worry about that.

VR: Now, of course, I worked in a polio lab for many, many decades, so I got immunized many times inadvertently, so I'm not worried. Ellen writes, "Many decades ago, I was diagnosed with *Giardia*, and I was told it would never leave my digestive system, so I would have to be careful to hand wash carefully for the rest of my life in order not to spread it. Is the same true for *Cyclosporidia*?

DG: Yes, so the first, that's not true. Yes, if you get *Giardia*, you can be treated. You can clear the *Giardia*. You could go get tested, see if you still have *Giardia*, and lo and behold, you'll find out that you don't. The *Cyclospora*, yes, so some people can have *Cyclospora* infection for like a month or two, symptomatic for a month or two. Some folks can actually have it for longer and be asymptomatic. There's this asymptomatic carrier state, but no, you can treat *Cyclospora*; you can clear *Cyclospora*, and we mentioned it on our podcast *This Week in Parasitism* the deep dive: TMP-sulfa, so your Bactrim, your Septra are the frontline, and there's some alternatives as well.

VR: Have you seen any cases of *Cyclospora*?

DG: I hate to share if I have or not because it might be a mystery case coming up on *TWiP*.

VR: Although an ID doc might not - it could be dealt with by other physicians.

DG: Yes, that's hopefully true, but I think some of the challenges, if you're going to do over in parasite, you have to know it has to be with the acid-fast aid you got to know to do a molecular test, so sometimes folks end up coming our way, or they end up at the hospital.

VR: Ellen's next question: "Around the same time, there was an article published entitled, "New York, a Tropical Paradise," saying the workers in kitchens of many restaurants in New York City have chronic parasitic infections. In that case, it's amazing how few parasitic infections are reported." Is this true, Daniel, that most of the workers have parasite infections?

DG: There are a number of workers in New York City who actually have parasitic infections,

but this actually, maybe the *Cyclospora* is a good way for people to learn about this. A lot of the parasites, it's very hard for a parasite to go right from one person to another. Like the *Cyclospora*, it needs that one to two week. Let's say you have the giant intestinal roundworm; that's going to, again, it's got to get in the soil, got to have a period of time. There are very few parasites that you can just direct person to person.

VR: What kinds of parasites would be in the intestines of food workers in New York City?

DG: You might have *Ascaris*; that's probably pretty common, but again, that's the giant intestinal roundworm, that's going to need to be in the soil. You might have some *Giardia*; that's potential, but it usually takes a little more of an inoculum than you would see. Maybe *Strongyloides*; probably 10% from certain areas of the world will have that in the intestines.

VR: How about *Taenia solium*?

DG: Yes, you're going to see that in some parts, Central, South America. You're going to see a number of folks with that.

VR: Those are tapeworms, right?

DG: Yes.

VR: That's *TWiV* weekly clinical update with Dr. Daniel Griffin. Thank you, Daniel.

DG: Oh, thank you, and everyone, be safe.

[00:54:42] [END OF AUDIO]