

Lessons learned from CDC's Global COVID-19 Early Warning Surveillance System

[Announcer] This program is presented by the Centers for Disease Control and Prevention.

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Philip Ricks, an epidemiologist at the Centers for Disease Control and Prevention who is based in Côte d'Ivoire. We'll be discussing lessons learned from CDC's global COVID-19 early warning and response surveillance system.

Welcome, Dr. Ricks.

[Philip Ricks] Thank you very much. It's nice to be here.

[Sarah Gregory] Your study is titled, "Lessons learned from CDC's Global COVID-19 Early Warning Surveillance System". What exactly is an early warning surveillance system?

[Philip Ricks] Early warning in response is just organized mechanism that we use to rapidly detect or respond to any signals that we might get through different sources that would indicate that there's an acute public health threat. And so, the early warning and response surveillance system is just the way that we used at the beginning of the COVID-19 pandemic to gather and manage and analyze all the publicly available data that was out there about cases and deaths that were happening outside of the United States (this was in the very first few weeks of the epidemic, before it was even declared a pandemic). So this was the system that we used during that period.

[Sarah Gregory] Tell us a little bit more about why you studied CDC's global, I think you call it, EWARS.

[Philip Ricks] EWARS, yeah, we do. So it was December 31st, 2019 (it was New Year's Eve), and of course, someone has to work New Year's Eve, and that was me. So I'm sitting in the Global Disease Detection Operations Center, and through our own EWAR system, I see a report of SARS in China. And whenever you see SARS in China (whenever you see SARS), you get concerned because it is an immediately reportable illness. And so, I reached out to our respiratory division and to the CDC office in China and said, "You guys seeing about...anything about this?", "Do you have any more information?", "How many cases?", "Is it spreading?". And so, just through that, I ended up becoming the point person for situational awareness as the epidemic started to unfold. And then on January 13th, there were cases that were detected outside of China for the first time. And on the 20th, the CDC activated its Emergency Operations Center, and I became the lead for COVID surveillance. And at that time, it was all international cases. So I was in charge of all of the surveillance for COVID-19 in the pre-pandemic phase. And so, having implemented and led the team that did surveillance, it was really important to study this EWAR system and see how did it respond in this (what was to become) a global pandemic in an age of near-instant data availability. There's just a surplus of data through many, many different sources, and so it was important to see how well this system did.

[Sarah Gregory] What was it like to work on this project after WHO declared it a pandemic? Where were you and what were you doing?

[Philip Ricks] After WHO declared it a pandemic, actually, I then left the Emergency Operations Center because the entire surveillance system was taken over and wrapped into a different type of surveillance system. Actually, we stopped doing EWAR after it was declared a pandemic, because we weren't able to get the kind of information and data that we needed anymore. There were just too many cases, we were just too overwhelmed at that point. So we really just went to collecting aggregate data.

So after that, I went back to working for Global Disease Detection Operations Center, where I then, of course, followed COVID for the next year and a half. But my life was very much like other people's lives (working from home). I'm from Chicago, and suddenly everyone in Chicago that I know is suddenly calling me to ask me about what's happening with COVID, people are looking to you for a lot of information and a lot of reassurance, everyone in your neighborhood wants to talk to you about it.

So I was living COVID like everyone else in the United States (I was on lockdown). But fortunately, there was a great sense of comradery still from the people that I had been working with at CDC. I was still very much engaged in the work of CDC. And just because COVID was happening, there were still other major health threats happening throughout the world—we were coming out of a major measles epidemic, polio was starting to make resurgence in certain places (vaccine-derived polio). So life really did...my life was like everyone else with COVID—working from home, trying to stay connected to family and friends, trying not to worry, and then trying to be positive. I think it helped being an epidemiologist and understanding how diseases happened made it a little less frightening and scary for me.

And COVID-19 had hit me like it hit everyone. I had a very close CDC colleague who contracted COVID early in the epidemic (I want to say in April). She was a really wonderful person and really a great epidemiologist and just an incredible person, and she died of COVID. She was in her mid-40s, her name was Sara Lowther. She was really a tremendous person, and I, after being cooped up at home, was about to put down a deposit on a puppy, and she had these two lovely cocker spaniels that I knew. And so, I adopted them. So here I am in Côte d'Ivoire with these two lovely cocker spaniels that were left to me from a dear friend. It hit everyone in many different ways. And these are great dogs and thanks to them, I think that they are one of the reasons I survived the COVID lockdown because I at least walked them three or four times a day and got to know everyone in my neighborhood from seeing the dogs and all the kids got to know the dogs. So there were moments of light, even during the tough times of COVID lockdown.

[Sarah Gregory] Can you tell us a little bit about how CDC works in Côte d'Ivoire, generally?

[Philip Ricks] In Côte d'Ivoire, CDC has really two programs. One is the HIV/AIDS program, and their focus really is supporting the country to ensure that as many people as possible get tested. And for those that are tested, that 90%—I'm going on the old 90-90-90 rule, which may have changed; that's not my area of expertise, but it used to be 90-90-90—we want 90% of the people to get their result, 90% of the people who are positive to get on treatment, and 90% of those people to be adherent to treatment and have undetectable viral loads. And so, that's one area of work that CDC does. And they support lab systems, they support clinics, they support a lot of community engagement. They tend to be the main anchor of CDC activities in the country.

However, there is another part, which is global health security. And I work in the global health security side, and our job is to help a country be able to detect, prevent, and respond to any

public health threat. I'm an epidemiologist. Our areas of work are we try and help the country develop their surveillance system, their laboratory capacity, their workforce development across all of these different areas, and of course, emergency response. We call those our 'core four'—surveillance, lab, workforce development, and emergency response. So in my work, I work a lot on workforce development and in surveillance. So I work very closely with the Ministry of Health and other national public health institutions. In terms of workforce development, I'm really trying to help them to have a lot of their own epidemiologists out there who can help detect outbreaks, just like I was attune in Atlanta with COVID (or measles or anything else), improve their surveillance systems so that they are timely and accurate, and also help them on developing research priorities, developing operation research plans so that they can have better public health policies and they can have better responses. For me, I really love being an epidemiologist and I love being overseas because you really get to be on the ground, you work with your national colleagues, shoulder to shoulder, and you're out there. If it's COVID, you're out there on an outbreak response. When I got here, we had an Ebola outbreak, so we're on the ground doing outbreak investigations, we're doing trainings. So I mean, it really is good to really be on the ground, out in the field with people, and you get to do both. So it's a great post. I'm very, very happy to be here.

[Sarah Gregory] Yeah, I don't know how many people realize how potentially exciting it can be to work at CDC and all this international investigations. I'm very happy with what I do at CDC and for the journal, but what you all do is, I think, incredibly interesting and valuable and exciting.

How did CDC work to find the information about confirmed cases of COVID-19 in various countries around the world?

[Philip Ricks] Well, first, we always use our formal information sources. We go to ministries of health (their websites); we look at WHO data (which WHO makes public); also, public health institutes that put out information or release statements or different laboratory networks that might put out other information. So we of course use those. But we also use informal sources—media reports, social media feeds. There are various data aggregators, one of which is called Epidemic Intelligence in Open Source (or EIOS), and they just literally comb through thousands of online publications or pieces of information looking for key words. And anything with that key word, they grab it and cross it out as COVID or measles or whatever.

We also use information that we get by email from colleagues. We mean, we have 59 offices around the world, so we were getting information from our CDC country offices all the time in addition to them asking us for information. Anything that was informal, we then sourced it. We tried to find the actual official announcement of that case. And in the early days of the epidemic, you could do that. We weren't following data from China or the United States. We were following data from other countries (so, Thailand, for example). You could say, "We think this is the 17th case. It's a man, he's x years old, or...and we think he's from this part of the country. The case was identified here.", and you could start to look through the official sources and actually find that case.

So we documented every case, we only soundly confirmed cases, we downloaded all of the source documents and we archived them, and we put all of that information into alignment. So we had a line for every patient, and we had all kinds of information on them—we had demographic characteristics, we had date of onset, we had all kinds of information. And so, we

had that in a database that we made available every day. And we collected data from...we started at eight in the morning, and our cutoff was midnight of that day. So when we reported data as of a given day, we reported for up until midnight.

[Sarah Gregory] When you began your study, what were you hoping to learn?

[Philip Ricks] We wanted to know was our system valid? Were we getting correct data? And so, we had looked at case counts, we looked at death counts, we looked at the countries that were reporting cases, and we just compared that to WHO because WHO is considered the Gold Standard, because all of their data comes directly from the country. This is data that the country reports that says, "We've got this many cases". We compared what we accounted for the country with what WHO accounted for the country. Then we wanted to also just be...were we consistent with not just with WHO, but other surveillance systems? And so, we looked at the data that was collected by the European CDC and by Johns Hopkins, because they were major surveillance instruments during COVID. People were referring to their dashboard all the time. So we compared our data with their data, and we wanted to see is our data valid and is it consistent with other surveillance systems?

[Sarah Gregory] How did you use the CDC information that you gathered during the EWARS team era?

[Philip Ricks] We put out daily internal and high-level situation reports. I was usually getting up—me or my deputy, we traded off days—but we were getting up probably at three or four in the morning in order to get the report out by, like, five or 5:30 in the morning because it's going up to very high levels through the country through the national chain of information. These situation reports that we were developing (using the data from midnight), it included global, regional, or country-specific information on cases and deaths. We had curves that showed the number of cases, we did an analysis of exposure because that was some of the information we had in the database—were you a contact of a case? Were you a traveler? Were you a taxicab driver? We looked at demographic characteristics, and we were looking also for geographic spread or clusters of cases. We had unusual clusters in the beginning. We had clusters in Singapore, we had clusters in Korea. Some of them were workers, some of them were people who all worked in the tourist industry, they're taxicab drivers.

And so, all of this information was part of our situation report. This went to national leaders, this went up to the White House on a daily basis. And within CDC, this went to top CDC leadership along the way, and it really helped them to be able to identify countries that might be at risk to prioritize our support for different countries because you can't be everywhere at the same time, so you got to say, "Who's most at risk? What assets do we have? What can we put there?", and also major concerns to assess the risk of importation to the United States.

These reports were also shared with our country offices, because they need to know what's happening. They need to know what's happening right next door to them, which helps them to prepare. We gave this data to modeling teams, and they used the line list to estimate the first case fatality ratios outside of China. They developed models that predicted, like, what's the incubation period or how long between you being exposed to you getting sick? They analyzed and found and came up with statistics for the time for people being sick or severely ill to death. They also helped in all of the analyses about risks for importation to the United States. But these analyses, they gave us our first understanding of basic epidemiology of COVID-19 because we did not know. We were learning every step of the way. It helped us inform risk assessment, identify hot

spots. And one thing that, of course, everyone looks to CDC for is travel information and travel notices. So of course we were sharing this information and having discussions with our travel group in terms of the informing people about travel risks, because in the beginning, no one was sure where they could go, where they could not go. So a lot of this information was really important for directing the United States' response to COVID-19.

[Sarah Gregory] What were the lessons learned about EWAR system and what were some of the benefits of the system?

[Philip Ricks] The purpose of EWARS is early detection of unusual events that indicate an outbreak and that enable us to respond rapidly. And what we discovered was that the CDC EWAR system was most useful in the early phase of the pandemic (or I should say, the epidemic), which is what it was supposed to do. It alerted us to unusual events; it alerted us to, first of all, the COVID-19 in the beginning; it alerted us to unusual clusters; it alerted us to the risk for disease spreading. It worked really well in the early parts because we had a lot of very specific case data. We had a lot of detailed data, so we could do those types of analyses. It was able to give us a broad view, but at the same time, it could also be flexible enough to give us country-specific data or regional data, which we needed to analyze travel warnings and things like that. But it was really critical...it was a really critical part of CDC's functioning in this international outbreak.

It was nice to see that our data was valid in terms of WHO data and that it was consistent with Johns Hopkins and European CDC. That was really reassuring because some of us did use very similar methodology in terms of doing surveillance. So it was nice to see that we were all in the same ballpark (we were all showing the same trends). But maybe...even though each of these systems had their own objectives, that there's probably room for us to work together and not be redundant. Maybe there's a way to divide and conquer this having to do international surveillance and global surveillance in the midst of a pandemic. But it was good to see that all of us...our data were consistent. We were caught in the middle of an epidemic and our priority was response (our priority was to respond). And maybe we missed an opportunity in terms of being more forward-facing to the public, making our data publicly available the way that Johns Hopkins did. But I think that overall, what we learned was the system worked. The system worked very well, and it was a very powerful and effective tool for assessing risk and responding to this novel pandemic.

[Sarah Gregory] Well, kind of along those same lines, what could have worked a little better? Did you discover any limitations, or do you now have any recommendations for just disease surveillance, in general?

[Philip Ricks] Yeah, there were certain limitations of the data we had. It's publicly available data, so we didn't always have very good clinical information (which we would have liked), but it's certainly less accurate than medical records. The other thing was that the level of detail of information really started to decline as things advanced. So this paper looks at surveillance that was done over seven weeks. In week one, almost everyone was giving us data on age and gender. And then, by the time we got to the seventh week, suddenly now we had less than 50% of cases with age, and that was just because the number of cases just exploded, and so there was just no way for people to collect individual data.

Different countries...the third limitation was that different countries reported or collected data differently, so it wasn't as standardized as we like. We also didn't have death data. We only had

aggregate death counts, we didn't have a line list of each of the deaths to match to the cases. Those were some of the limitations of the study.

[Sarah Gregory] This all happened so quickly and was so stunning and astronomical in its dimensions, from endemic...just the first couple of cases to endemic to pandemic. What about challenges doing this study? When you look back at it, were there any challenges?

[Philip Ricks] For us, you're right, it really was mind mental. Our biggest challenge was just manpower. We started out as a team of one, and then we were a team of seven people rotating off and on. We worked seven days a week...just the amount of work that was required to develop this system and maintain it. The second week, a team of four people worked 200 hours and by the last week, we were working 350 hours. So it was just overwhelming a little bit in terms of the type of manpower required. And that was one of the reasons that once we weren't getting the level of detailed information, it didn't make sense for us to continue to try to have a line list. But we still then still did use EWAR, because we then did it on a very smaller basis for certain countries.

I think the other big challenge for us was duplication of cases. Sometimes you hear about one case, and it sounded like another case, and you still have to chase down and untangle things. And so, that was a challenge. But I have to say I had an amazing team, and I had an amazing deputy, and they just did a real consistently, thorough, and accurate job. And everyone just went the extra mile to be sure that we got the right data.

[Sarah Gregory] What about surprises? Obviously, everything was a surprise in the beginning. But are there any particular surprises you want to mention?

[Philip Ricks] Of course, the spread was just surprising. But I think for me, personally, the biggest surprise was the way that information about transmission unfolded. When we first heard about this, it was in a wet market in Wuhan, China. All the cases were people who worked there, so we thought it's direct contact. And it would make sense—it's from an animal, people who are butchering it...so they're a contact. That's a whole different picture from what we found it out to be. Then, data starts coming in and we start realizing that there are family members...okay, so it's close contact of people who had direct contact. Then, we start to realize, okay, but it's not just household contact. Every step of the way, I think that what we hoped wasn't true, unfortunately turned out to be true. And that was that it is spread.... spread through community transmission, just being around people, right? By respiratory droplets.

As that evolved and that information became clear, already cases had now spread around the world, and it was just really surprising. Yeah, it seemed that at every turn, what we hoped wasn't true was, in fact, true. But there was really no other way for us to know that in advance until the data came in. This was the nice thing about this system is that it gave us some really granular data to see that happening. But we couldn't know it until the data came in and told us that. That was also very frustrating, because we wanted to know, like, how was this spreading? How was this spreading so quickly? How was this spreading beyond borders so quickly? I remember the cluster in Italy, when it was...there were these clusters in Italy, and we're like, "These are not really close people. These are people who play on the same soccer team or go to the same café or whatever.", and that was really like, hmmm, now this is really concerning, that this can just be spread by community transmission. So yeah, I think that those were the surprises and the fluctuations, those early two months.

[Sarah Gregory] We already talked a little bit about lessons learned, but what do you think are the most important ones?

[Philip Ricks] The most important one is that EWARS works. An epidemic that develops into a pandemic...it works. It was integral to guiding our response in the early days of the epidemic. It was most useful, of course, in the early parts where there was a lot of case-level data—we could get information about demographics and symptoms and things like that. It became less useful to us as more cases occurred and we didn't have that level of individual data, because that individual data was what we needed to understand transmission and risk and propagation of this illness.

So I think that, again, it works. It works well. It works best in the beginning. There's probably some room for international collaboration around an event like this, we all don't need to be doing the same thing. I think looking back over the epidemic, I think there's been a lot of issues about information and sharing of information, and I think that maybe this was an opportunity for us to have done better. But I think that CDC very quickly started making a lot of information very publicly available. CDC actually has a new data modernization initiative, which I think will put the agency in a better position for collecting data and reporting data earlier in future public health events. But EWARS is still...even though at a certain point it wasn't good globally, it was still quite good on a national level or at a regional level or at a local level because that's also what we use for contact tracing, clusters. It still is useful on a smaller scale, even after you have an international pandemic.

[Sarah Gregory] It's now been almost three years since the beginning of COVID-19, and certainly nearing what has been three years when it was declared a pandemic. But COVID is not over yet, despite what some people hope. But today, several countries are also dealing with other epidemics and outbreaks including monkeypox, cholera, and Ebola again. Do you think lessons learned early in the COVID-19 EWARS can be helpful in addressing other outbreaks? Is it going to be used for anything else?

[Philip Ricks] We continue to use EWARS. EWARS is not something new, it's part of International Health Regulations. It is a framework for collecting data, and it lets you quickly detect and respond to outbreaks. This is global health security—the ability to detect, prevent, and respond to public health threats of potential epidemic proportion. And we use it all the time, we use it every day. I use it every day here. You hear about a case of Ebola, you start doing investigations, you start making phone calls, you start verifying, you start calling partners, you start calling the Ministry, the Ministry sends out someone to investigate. EWARS is used all the time. We use it every day.

And sometimes it's done in a very formal way, like an Emergency Operations Center (we have several of them here that CDC has helped to build and train and support). And when you have an outbreak, your Emergency Operations Center is activated and then you really do EWARS on a really organized, systematic basis. But I sometimes get a phone call about something happening, and I pick up the phone call and someone calls someone else, and we chase it down and we verify it, if not in the Emergency Operations Center, but with EWARS. So it is a very, very effective manner for detecting and responding to public health threats. And I think that COVID really emphasized the need for early warning and response, and that it worked really well this time.

I think we all learned a lot from the 2014–2016 West Africa Ebola epidemic, which smoldered on the border of three countries before it became a huge epidemic here in the region and threatened the entire world, let's be honest. And I think that after that, a lot more attention was paid to early warning and response. And so, out of that, people have come to recognize the value of it—responding to something early saves lives, prevents suffering, and it also saves a lot of money. In the Ebola crisis, there's thousands and thousands of orphans from Ebola. So it really is important to detect things early and respond to them early. It's very funny...I would say that five years ago, if I told people I was an infectious disease epidemiologist, they would look at me and think, "Oh, he's a dermatologist", and they would want me to look at something funny on their elbow or something. But truly, it's usually...I was like, "No, that's.... I'm not a... I'm not a dermatologist. That's your epidermis, and that's not an epidemic.". But with COVID, now suddenly people know what an infectious disease epidemiologist is.

And so, I think that people are really starting to appreciate the importance of early warning and response, of surveillance, of having the ability to detect things. And I'm really hoping that out of this comes an appreciation for prevention. I think people take prevention for granted, because you prevent something from happening and they only look at response. They think about the cost of response, they don't think about the savings of prevention. But I think that COVID, and I think these other international outbreaks that we're having, are really making people more cognizant of the importance of early warning and response. And not just for these, “quotes—quotes” exotic diseases, you know, we have pockets of measles outbreaks that started happening years ago. And now we know that because of COVID, a lot of kids didn't get their routine immunizations and we're seeing outbreaks of measles (we're seeing outbreaks of all kinds of diseases), and this early warning response allows us to detect a vaccine-associated polio case or a wild polio case, and things that people don't even hear about that are small but that happen very locally, and they get responded to.

And I want to say, here in West Africa, people think that if there's an outbreak or there's an epidemic of something, that it is the Western countries and all of their money and smart to know how they'd have to come in and help. But there is a great capacity here, and there is a very strong ability and a political will to respond to outbreaks and epidemics and events that threaten the public health.

[Sarah Gregory] Well, Dr. Ricks, it was such a pleasure speaking with you today. And also, thank you for taking the time.

[Philip Ricks] Thank you. I have truly enjoyed talking about this. I hope people hear that this is a passion, and I think that this is a passion that is shared by people who work for CDC. People say, "What do you do?", and I say, you know, it's not just what I do...that being an epidemiologist is not something that I just do. It's who I am. And I think that that passion and commitment is shared by many people who work in public health at the CDC and around the world. I'm really honored to be part of this family in public health.

[Sarah Gregory] And thanks for joining me out there. You can read the November 2022 supplement article, Lessons Learned from CDC's Global COVID-19 Early Warning and Response Surveillance System, online at cdc.gov/eid.

I'm Sarah Gregory for *Emerging Infectious Diseases*.

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