

Zika Prevention in Pregnant Women in Puerto Rico

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

[Sarah Gregory] Hi, I'm Sarah Gregory, and today I'm talking with Dr. Giulia Earle-Richardson. Dr. Earle-Richardson works at CDC in behavioral science and infectious diseases. We'll be discussing community interventions on the Zika virus and pregnant women in Puerto Rico. Welcome, Dr. Earle-Richardson.

[Giulia Earle-Richardson] Thank you. It's a pleasure to be here.

[Sarah Gregory] You conducted an assessment of how successful community education efforts were in Puerto Rico after the Zika outbreak in 2016. First, tell us a little about the outbreak, generally.

[Giulia Earle-Richardson] Sure. Zika virus is not new. We've actually known about it for many decades. But until recently, it wasn't a serious health concern. Most people who have Zika virus infection have either very mild symptoms or none at all. But it became of particular concern in 2014, when, in Brazil, health authorities started to see a dramatic increase in the number of children born with birth defects. And the mothers of many of these babies were testing positive for Zika virus infection.

So, early in 2015, when Zika virus started to spread across the Western Hemisphere, we began tracking it and it did arrive in the United States. Now, because Zika is primarily spread by the mosquito, the *Aedes aegypti* variety, which lives in tropical climates, the main concern was with Puerto Rico and the other territories of the U.S. in the Caribbean. And we were expecting to have many more cases there and, in fact, since 2015, when we started tracking cases, we've seen, in Puerto Rico and the U.S. territories, nearly 37,000 cases of disease. And you compare that to the continental U.S., which has only seen 6,000, you can see why it was much more of a concern in the Caribbean area. And in terms of babies born with birth defects, again you see the similar, much-larger problem in Puerto Rico and the U.S. territories. They're recording roughly 170 cases of babies born with birth defects or problems related to Zika infection, whereas across the entire continental U.S., we've only recorded a little over 100 cases. We're also concerned about Zika infection because, in rare cases, it can be related to a condition called Guillain-Barre syndrome. That's a disorder in which the body's immune system attacks the nerves and it can lead to loss of muscle control across the body, even total paralysis.

At the time we were beginning to be aware of these more severe consequences of Zika infection, it was also discovered that, in addition to being spread by mosquitoes, it can also be spread by human sexual contact. So, for all of these reasons, particularly the association with birth defects and because there was no known treatment or preventive vaccine, in early 2016, the World Health Organization declared the virus spread in the Western Hemisphere to be a public health emergency.

[Sarah Gregory] So, what were the community efforts and were they developed by CDC or health programs in Puerto Rico itself?

[Giulia Earle-Richardson] Yeah, before I describe them in detail, I want to just give little bit of an introduction to kind of the perspective of the behavioral science team, 'cause I think it will

help describe the programs. We really...when we, when we think about behavior, we really think about not sort of just increasing knowledge. Kind of in the early days of public health, we used to think, you know, if you increase knowledge, that will change behaviors. Tell people not to smoke and, you know, because it's harmful, and they won't. Or give someone a repellent and explain why it's important to use it, and they'll use it. But what we've learned over the years is this is actually not true. And this is why many of the early public health behavior change programs have turned out not to be very successful. Now we understand that human behavior is really much more complex than that. So, in our team, we use a three-part model for thinking about behavior and behavior change related to health. And the first part of that is a person's capability to do the behavior. It's partly knowledge, but it's also skills. You know, are they able to do what we're asking them to do? Are they able to maybe avoid a bad behavior? And then secondly, we're talking about opportunity. You know, the person may know and may have the skills, but are they actually having the opportunity to do this behavior? For example, you know, we tell a woman to cook healthier meals for her family, but if she doesn't have access to healthier foods, then it's...she doesn't have the opportunity to do that. And then the third thing is motivation. You know, they may have all the knowledge and skills and opportunity in the world, but it's not going to happen if people aren't motivated. So, we really try to think more than just about educating people, we talk...try to think about how do we increase capability, how do we increase opportunity, and how do we increase motivation.

And so, you know, with that sort of more complex way of looking at it in mind, the first thing we needed to do before we started to do these programs, was really go to Puerto Rico, understand the factors that were influencing women's behavior. And so, in early 2016, a team led by one of our coauthors, Christine Prue, and also, Dr. Carmen Perez, a behavioral scientist with the CDC Dengue Branch in San Juan, Puerto Rico, undertook this kind of early assessment, where they did in-depth interviews, they did focus groups and rapid surveys of pregnant women and other people in the community, just really to understand the social context of Zika in Puerto Rico. They asked people about, you know, how much they knew about Zika, they asked them what they were doing to protect themselves, they were asking them about how easy it was to obtain the things they needed to protect themselves with, like repellent and bed nets. And they also asked them kind of, what...what was getting in the way of doing some of these recommended behaviors. And some examples of those behaviors would be wearing CDC-recommended mosquito repellent every day, even when you're inside; you know, wearing long-sleeve shirts and pants; sleeping under a mosquito net; and using a condom throughout your pregnancy.

And Dr. Prue's team also used this as an opportunity to kind of pretest a few ideas they had about intervention programs and get feedback. And then another key part of this initial assessment was finding and partnering with a really good local partner. And the partner we worked with was the Puerto Rico Department of Health Women, Infants, and Children Nutrition Program, and that's commonly known as the WIC program. In Puerto Rico, a very high proportion of pregnant women participate in this program, so it really became an ideal local partner for doing this assessment.

And what they learned from that was that women actually knew a lot already about Zika and what it might mean for the pregnancy. But there were a lot of barriers for them taking the prevention steps. There was very high rates of poverty; in some parts of the island, women also had problems with just physical, you know, transportation and getting to places where they might

buy materials for prevention, you know, even if they could afford them. Another thing they told us was that they were troubled by the large number of prevention behaviors we were recommending. I mean, it...because it was such a new outbreak and we didn't exactly know which would be the most effective prevention steps, there were as many as 10 different things we were asking them to do. And some of those behaviors, like using a condom, were pretty difficult for women to internalize and follow right away because it really was asking them to think about the behavior in a new way. You know, women who are pregnant are just not really used to the idea of using a condom. It's also behavior that requires participation of another person. So, again, some of the barriers to behavior weren't about knowing how it could help you, but it was really about the social context that they were in. So, that's a little bit of background of kind of how we were thinking about the problem and what we were trying to address.

The education and empowerment programs that were developed were really a collaborative effort between the Puerto Rico Department of Health and the CDC Zika response in Puerto Rico at the time. And the programs that we tracked, there were actually four different programs. The first one was undertaken by the Puerto Rico WIC program. They simply expanded their ongoing prenatal education service to include an orientation about Zika virus infection. They gave a presentation of between 20 and 30 minutes for small groups of women who were there for the prenatal visit, and it gave them an opportunity to ask questions and learn more about how to protect themselves.

And at the same time, the response had developed a second intervention to go with that, that we call a Zika prevention kit. And these kits are basically bags containing mosquito repellent, condoms, a larvacide that you put in standing water, a bed net, and then more printed educational materials. And whenever it was possible, this kit was given to pregnant women at the same time as the WIC orientation. And the contents of these kits also had been pretested during Dr. Prue's initial rapid assessment, so we had some idea of the things that would be adopted and were most appealing to women. The idea behind the kit really is to put these items in women's hands, not just for the obvious of reducing the barriers to action, but also it provides kind of a visual reminder about the need to do the behavior. They would see it, they would think about protecting themselves, and they had everything they needed right in front of them. So that barrier was reduced.

A third community program that was undertaken at the same time was much broader in scope. It was a multimedia campaign known as "Detén el Zika," which in English means, "This is how we stop Zika." And this program aired prevention messages on television, radio, print, and social media. And one of the featured components of this progr...of this project or this effort was a television ad that showed couples or pregnant women and their families performing different Zika prevention behaviors together. So, it showed them using repellent, it showed them setting up bed nets, and all of them working together to remove standing water and put up screens. So, this was really more targeted at motivation, and it was...part of the motivation angle was to motivate not just the women, but to encourage their families to support them in doing this.

And then the fourth effort, that was going on roughly at the same time, was the offer of free residential mosquito spraying services. When a woman went to her prenatal WIC visit, they were offered this free service and if they indicated that they were interested, the WIC program provided their contact information to a local professional mosquito spraying service that was contracted with the Puerto Rico Department of Health. And during the response time, over 3,000

homes were sprayed using this program. And we were really interested in not so much looking at the effect of the program spraying, but really just looking at what was the effect of being offered the service for free on women's decision to have their home sprayed. So, just a side note about that last program. During the time that it was underway, CDC also did an evaluation of the number of mosquito larvae around women's homes, and found that it really wasn't effective in reducing the number of mosquitoes, probably because, selectively spraying homes of pregnant women, if you're not spraying the entire community, you know, it's difficult to reduce the overall number of mosquitoes. So that program ended up being discontinued during our tracking period, but nonetheless, we did cover it in terms of understanding the effects on women's behaviors.

[Sarah Gregory] So, you were just talking about a preassessment. So, when did you actually collect the data and what were you trying to discover, finally?

[Giulia Earle-Richardson] So, we collected interview data throughout July 2016 to June 2017, with 2017 being the end of the outbreak, when Puerto Rico Department of Health called the end, the outbreak over, basically. So, what we did during this period is we had nine monthly or bimonthly telephone interview rounds with women who were participating in the WIC program, and they were randomly selected from their participation rolls.

So the aim of this data collection was really twofold. First, during the outbreak response, because 2016 and 2017 was really the height of when it was going on, we were collecting data from the women in terms of, Were they receiving these programs? Were there any problems with implementation? You know, what was their knowledge going into the interaction with the intervention? And then also, of course, what were the performance of their Zika-prevention behaviors throughout and at the end? But the purpose, initially, was really about having a very quick method to provide feedback to the response leadership, you know, on a monthly basis, to let them know if implementation was going as planned and whether there were issues. And there were a few times where we were able to alert them to issues and kind of get things back on course.

At the conclusion of the outbreak response, so after June 2017, we had the opportunity to combine all this implementation tracking data to really look at how the interventions performed throughout the whole period, and to try to do a little exploration into which behaviors, because there were 10 overall, which of these were more influenced by the programs and maybe which would be ideal targets for future efforts. And so, it's really the second goal that our paper deals with.

[Sarah Gregory] So, what were your methods? How did you conduct this assessment?

[Giulia Earle-Richardson] Well, again, we collaborated really closely with the Puerto Rico WIC program, I think as I mentioned. They allowed us to use their enrollment of pregnant women rolls as kind of a sampling frame. We had a random sample of 300 pregnant women participating in WIC each month that we called. Our Spanish-speaking interviewers did an initial telephone interview every month for 2016, and then during 2017 it was reduced to every other month. And in this interview, women were asked about their experiences with the four programs, as well as their knowledge about Zika virus disease and prevention. And after this first interview, we recontacted a subset of half of the respondents, 150 women, and asked them specifically about

their Zika prevention behaviors, whether they were using repellent, using condoms or abstaining from sex, wearing long-sleeve shirts or pants, sleeping under a bed net, removing or covering standing water or using larvacide in water they couldn't remove, or putting screens on windows and doors.

In terms of the analysis, in order to assess the performance of the Zika prevention behaviors, we transformed the interview responses into kind of a scaled variable for each behavior, so from “never” to “always.” And then we were able to take that measurement from each woman and look at differences in behavior frequency, according to whether women reported having participated in any of the programs or not. And so, in this analysis where we were kind of comparing participation and performance of protective behaviors, we also controlled for a range of factors that might have affected the results in some biasing way, like age, education level, and poverty, and so on.

[Sarah Gregory] So, do you feel like these intervention efforts were successful, ultimately?

[Giulia Earle-Richardson] Yes, but to get to a, maybe a more full answer to that question, I think I'll have to, you know, split out “success” on a couple of different levels. I mean, at the first level, our initial question was, “Are these interventions reaching pregnant women in Puerto Rico, who were they...you know, the people they were targeted for?” And our data show pretty clearly that they did, with the WIC Zika orientation, 93 percent of our respondents said they had participated. The Zika prevention kits, three quarters of the respondents received them. And about half the women recalled some exposure to the “Detén el Zika” mass media program. And even the spraying program, which was discontinued after three months, during the time it was running, two thirds of women reported exposure to the offer. So, overall, when we put that all together, nearly all the women that we were interviewed were exposed to at least one program. So, you know, at the most superficial level, it was very effective in getting to women.

But, of course, we're also interested in seeing, you know, what were the resulting levels of Zika prevention behavior performance. And, you know, at this...kind of, before we dig too far into the effect of the programs, we were also just interested in comparing the behaviors. Were there certain behaviors that were, you know, really easy to pick up and other ones which women didn't do? And, in fact, we saw quite a wide variety. Moving or covering standing water seemed to be really already well ingrained in the population—90 percent of women reported doing that. And we think that that may be partly due to the fact that there are other diseases that have been threats in Puerto Rico, like dengue and chikungunya virus, that have been...programs have been addressing removing standing water and cleaning the area for a long time. On the low side, there was very poor performance on things like wearing long sleeve shirts—it was something like four percent of women were doing that—and installing window or door screens, which was probably a cost issue. In terms of mosquito repellent use, I...it was moderately good. About half of women reported using repellent daily. But if you apply a little bit of a tougher standard, you know, according to CDC recommendations, you should be putting it on every day and reapplying it at least once, according to the directions on the bottle. And only about 30 percent of women were doing that.

And then, in terms of changing over time, there were a couple of behaviors that stood out. Using a condom during sexual activity started out at about 30 percent of women reporting always doing this, and it rose to 50 percent, so that was quite a big increase. And another behavior that grew

dramatically over time was the use of larvacide in standing water; that rose from 10 percent to 40 percent. So, those were kind of highlights as far as individual behaviors.

Now the real result that, you know, the holy grail that we're really most interested in, is looking at the association between program participation and the likelihood of performing a behavior more frequently. And I would say, overall, the relationship tended to be positive, meaning women who participated in programs were more likely to also be performing their behaviors, the desired behaviors, more. But looking specifically at the different intervention kits, we saw that...intervention programs, excuse me, we saw that the Zika prevention kits had really strong association, they had statistically significant associations with four Zika prevention behaviors: bed net use, repellent use, larvacide use, and home spraying. And the two, among those that were the strongest associations, were applying larvacide to standing water and sleeping under a bed net. And we think that that's not a coincidence. We think that those are behaviors in which having something in hand—particularly the larvacide, which women told us were not familiar to them ahead of time—having it in hand to look at it and try it, and also having a bed net, which were relatively uncommon in Puerto Rico before they began this distribution, it really seemed to have a large effect in encouraging behavior.

[Sarah Gregory] So, were any of the findings surprising to you, in terms of human behavior?

[Giulia Earle-Richardson] Actually, yeah, there were a few things that surprised me. One thing was that, we, in addition to looking at associations between intervention exposure and behavior, we also looked at a few other social factors to see what their association with behavior might be. And we found that certain factors, like how concerned a woman was about Zika virus infection or the perception of their personal risk, wasn't really strongly associated with what protective action they would take, and I would have thought that it would be. What we found more powerful than women's own perception of their risk or their sense of their likelihood of getting it, was how frequently their friends and family were talking about Zika, whether they were aware of family members taking protective action. In other words, the personal, individual factors seemed to be less influential, and the social, family factors seemed to be more influential. That surprised me and I would really love to study that more.

[Sarah Gregory] Peer pressure.

[Giulia Earle-Richardson] Yeah, well, and you know, in, in...in a positive way, maybe peer support, I suppose. You know, there certainly is research out there to support that it is an important factor, as well. But, maybe when you're expecting, maybe you're also just thinking more about family and not so much in your own head. I don't know, it would be an interesting area to study.

Another thing that I was surprised about was the pretty dramatic increase in women reporting using a condom, every time they were sexually active. You know, at the outset, when Dr. Prue did her initial assessment, women said that they were uncomfortable about buying condoms, that they thought that using a condom when they were already pregnant just didn't make sense, and of course, you know, using a condom is not something you do by yourself, so there's another person to convince that's present. So, to me, I was thinking, you know, if we see a little change, that would be great. But we saw a lot of change, and it really encourages me that, you know, even the difficult behaviors can change. I also would add that the statistical effects we found for

our programs related to condom use were positive and significant, but they weren't huge, they were modest. So, I suspect that there were other things going on that influenced that change, as well. But, nonetheless, I guess, you know, to me, seeing that all these things put together, all the different efforts, made a dramatic difference on a challenging behavior, was very encouraging.

[Sarah Gregory] So, you know, this is always the big question for us here at CDC is what are... what are the public health implications of these results, overall, outside of, say, Puerto Rico?

[Giulia Earle-Richardson] Yeah. Well, you know, I think there's a lot of evidence there for further exploration with the prevention kit. You know Zika's not the only context in which prevention kits have been used that seem to work really well for pregnant women, but we could explore this with pregnant women with other disease situations. And, you know, Zika continues to be a threat in other parts of the world, as well. So, I do think there are other types of settings where this might be very useful. And I also think it's notable that women, just anecdotally, in addition to receiving the kit and it seeming to have an effect, they commented that, when they received this kit, they felt like the health department cared about them. And I think in the context of emergency response, having a relationship builder, especially if it's also an intervention that works, has a lot of potential and should be explored in more context.

I also think that, you know, as I mentioned before, I think the issue of family and social support, in terms of assisting with behavior change and encouraging positive behaviors, is important and should be studied more. When we're in these contexts where we don't necessarily know which protective behaviors are going to work best, it seems like we can bring in here a knowledge of the importance of social support, and also, maybe, some lessons about working with a local partner. Again, it doesn't really matter what disease you're addressing or what behaviors you're trying to encourage, I don't think you're going to be able to go into an epidemic situation and have positive effects in a short time frame, unless you have a really effective and trusted local partner, like we had with the WIC program. That would be my strongest recommendation to anyone going into any kind of response context.

[Sarah Gregory] And what is unique about this information that makes it interesting to our very large EID journal audience?

[Giulia Earle-Richardson] Well, I think to start with, I would say Zika is a unique disease. You know, it's both mosquito-borne and sexually transmitted, and it can have a devastating effect on the developing child. And there really isn't another disease out there that has all those characteristics. And, unfortunately, up 'til now there also isn't an effective vaccine. So, you know, there's a lot about Zika that's important and, as I mentioned before, you know, it continues to be a threat around the world. I also think that, in terms of process, you know, we were able to pilot test, implement, and get behavioral feedback on a number of different interventions that were theoretically based. I think this is kind of a good model that could be used in other situations, and I don't think that this has been done before, I don't think... this, sort of, model of analysis is a bit unique. And I think that that is something that ought to be considered for any future outbreak responses.

[Sarah Gregory] Finally, would you like to tell us a little bit about your position at CDC and your area of expertise?

[Giulia Earle-Richardson] Sure. Well, I'm a behavioral scientist with the behavioral science team, working in infectious disease with the National Center for Emerging and Zoonotic Infectious Disease. And my background really is kind of two things. I am both an epidemiologist and a behavioral scientist by training. And our team really works to try to integrate understanding of human behavior into the epidemiology of infectious disease. So, I think my dual background is very helpful. I'm relatively new at CDC, I came in 2016, but prior to that I've worked for nearly 20 years as a researcher looking at health behaviors of underserved populations, especially migrant and seasonal farm workers. And during that time, I was external to CDC, but actually most of my research was supported through cooperative agreements from CDC, through the National Institute for Occupational Safety and Health. So, I feel like I've, in some ways, had a career change, but really, my work and the issues we deal with and the science that we're doing is very similar, because we're continuing to explore health behaviors in low-resource settings and populations that have not always been empowered, and to try to look at ways we can support good health decision making. And I just maybe quickly mention that currently our team is working in support of the response to the Ebola virus outbreak in the Democratic Republic of the Congo. We're analyzing data gathered by the DRC Red Cross, by their volunteers who are doing house-to-house visits and community forums to educate about Ebola prevention behaviors, and we're supporting their community feedback data collection process. Yes, the outbreak is very challenging, but the...it's really exciting to be working with the Red Cross and helping them, again, develop a system where they can collect information about what people in the community are experiencing, and to kind of work through this shift in the way that we think about health behavior. It's not simply about one-way transmission of information—"do this" or "don't do that"—but it's about understanding the community and understanding their barriers, and to try to come up with ways of supporting healthy behaviors, with a little bit more of a complex understanding of what people are experiencing.

[Sarah Gregory] Thanks so much for taking the time to talk with me, Dr. Earle-Richardson. Listeners can read the December 2018 article, *Influences of Community Interventions on Zika Prevention Behaviors of Pregnant Women, Puerto Rico, July 2016–June 2017*, online at cdc.gov/eid.

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

[Announcer] For the most accurate health information, visit cdc.gov or call 1-800-CDC-INFO.