

# Risk Prediction for Pediatric Patients with Suspected Ebola Virus Disease

*[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. Alicia Genisca, an assistant professor of Emergency Medicine and Pediatrics at Warren Alpert Medical School of Brown University. We'll be discussing risk prediction for children with suspected Ebola virus disease.

Welcome, Dr. Genisca.

[Alicia Genisca] Thank you so very much for having me.

[Sarah Gregory] Let's refresh people's memory about what Ebola virus is.

[Alicia Genisca] Ebola virus is a virus that can cause a very severe and often fatal infection, and it's typically spread by coming into direct contact with either infected blood or bodily fluids or even items that have been contaminated with infected bodily fluids. The signs and symptoms are not very specific and can include things like fatigue, muscle aches and pains, vomiting, fever, and even unexplained bleeding. And with Ebola virus, there is a very high mortality rate (50% in most outbreaks), and even been recorded up to 90%.

[Sarah Gregory] How many outbreaks have there been in Africa?

[Alicia Genisca] Well, the first report of Ebola virus disease was in 1976 in what is now the Democratic Republic of the Congo. And to date, there have been just over 30 Ebola virus outbreaks on the continent of Africa. The largest outbreak involved several countries, mostly in West Africa, and that was from 2014–2016. And in that outbreak, there were about 29,000 cases with just over 11,000 deaths from Ebola.

[Sarah Gregory] And how many people in the United States have gotten it?

[Alicia Genisca] In the United States, so far there have only been 11 persons treated for Ebola. This, again, was during that 2014–2016 outbreak, and the majority of those people were healthcare workers that were traveling from West Africa to the United States.

[Sarah Gregory] And your study is specifically about children. So how many children anywhere have gotten it?

[Alicia Genisca] So it depends on the specific outbreak. But overall, children represent between 20–25% of patients in an Ebola outbreak.

[Sarah Gregory] Okay. So kind of recapping here, gathering all these people together in the United States and in Africa, how many people have died from it?

[Alicia Genisca] Around 15,300 people have died from Ebola virus disease.

[Sarah Gregory] And as I said, your study focused on children. Why children?

[Alicia Genisca] I am a pediatrician first, and one of the cardinal rules of pediatrics is that children are definitely not little adults. Disease processes can manifest differently in pediatric patients, so it's really important to understand what those differences are so they can be

addressed appropriately. And previous literature in this area has focused mainly on just adult populations or mixed populations of adults and children. Really, there has only been one other study that focused on children, but that has not been validated.

[Sarah Gregory] Medically, what do you mean children are definitely not adults?

[Alicia Genisca] In multiple different disease processes, children might have different manifestations of a particular disease. Additionally, there's a challenge when dealing with pediatric patients because not every single child is going to be able to tell you exactly what is going on with them. So looking for the signs and symptoms that might be more associated with a pediatric patient versus an adult patient would be important to know, because again, children may not be able to express what exactly is going on with them.

It also comes down to the physiology as pediatric patients as well. Once you get to be an adult patient, a lot of the physiologic manifestation of disease is going to be the same. But for pediatric patients, it can change depending on how old you are. An infant's physiologic state is going to be different than a child who is school age and is going to be different than a child who's a teenager.

[Sarah Gregory] What were you specifically looking for in your study?

[Alicia Genisca] In Ebola virus outbreaks, it's incredibly important to be able to quickly diagnose patients so that they can initiate supportive treatment. And with non-specific symptoms, it is challenging to know right away who might have Ebola virus disease and who does not. Having early identification of patients with Ebola virus disease can help to prevent the spread of the disease so that you can quickly separate patients who are positive from those who are not. And even though there are rapid diagnostic tests that exist, they are not widely available. So you really have to wait on definitive testing to diagnose Ebola virus disease. It may not come back right away. And our goal was to create a predictive diagnostic model and turn it into a scoring tool. So clinicians could use it at the bedside when they were evaluating a child that could possibly have Ebola virus disease.

[Sarah Gregory] What geographic areas did you focus on?

[Alicia Genisca] Our study looked at pediatric patients from the 2014 outbreak in West Africa, specifically in Sierra Leone and Liberia. And in order to see whether our model and our scoring tool worked well, we then validated, using pediatric patient data from the 2018–2020 outbreak in the Democratic Republic of the Congo.

[Sarah Gregory] Were there differences in ability to obtain data from those different areas?

[Alicia Genisca] The basic demographic, primary laboratory, and signs and symptoms data were all the same. But that being said, it is very challenging to obtain information during an outbreak.

[Sarah Gregory] You must have had a lot of partners in this study. Can you tell us about them?

[Alicia Genisca] We collaborated with in-country staff from the International Medical Corps in Liberia, Sierra Leone, and the Democratic Republic of Congo (and DRC). And we also partnered with colleagues from the Ministry of Health in Liberia, University of Georgia, and the University of Massachusetts Medical School.

[Sarah Gregory] What was the general criteria for inclusion in this evaluation?

[Alicia Genisca] We were looking at children who were less than 18 years of age who presented to the Ebola Treatment Centers. We did not include children that we didn't have complete data

on. And we also didn't include children who died within the first 24 hours of arriving to the Ebola Treatment Center.

[Sarah Gregory] You talk about 12 predictors in your study. What were the 12 predictors included?

[Alicia Genisca] The predictors that we included were age, sex, and also the symptoms that are included in the World Health Organization's definition for Ebola virus disease: that includes fever, headache, breathlessness, bone or muscle pain, weakness, abdominal pain, hiccups, unexplained bleeding, gastrointestinal symptoms (like nausea, vomiting, and diarrhea), and then also having an Ebola contact.

[Sarah Gregory] Tell us about the predictive model tool that we're talking about here that you were developing and evaluating.

[Alicia Genisca] Using the 12 candidate predictors, we entered our data into a logistic regression model. And that model selected the variables that were significantly associated with a child having a diagnosis of Ebola virus disease. We then converted this information into a scoring tool that we called the Pediatric Ebola Risk Score (or PERS). And our model found that the diagnosis of Ebola virus disease in children was associated with bleeding, having a known exposure to someone who has Ebola virus disease, or actually not knowing that they had come into contact with someone who had Ebola virus disease. And we also know that it was negatively associated with abdominal pain.

[Sarah Gregory] You mentioned some WHO criteria, but they also have their own predictive model. How does this one differ from that one?

[Alicia Genisca] So the WHO guideline for diagnosis requires you to have information on several variables, which you may not always be able to get at the setting of an outbreak or even with a pediatric patient, depending on their age or who's available to provide a history for that patient. And with the Pediatric Ebola Risk Score, you really only need three variables to determine the risk of a patient having Ebola virus disease—so again, if they've had bleeding, an Ebola contact, or whether they've had abdominal pain. Through our study, we found that our model performed better than the WHO criteria for identifying pediatric patients with Ebola virus disease in West Africa. And when we applied it to pediatric patients from the DRC, it performed similarly to the WHO guidelines. And this may be due to the difference in prevalence of EVD during the two outbreaks.

[Sarah Gregory] And clarify for us here, what data did you use to create the tool?

[Alicia Genisca] The data comes from pediatric patients who presented for care at the International Medical Corps Ebola Treatment Centers in West Africa and in the DRC.

[Sarah Gregory] Dr. Genisca, were there any surprises?

[Alicia Genisca] Whenever you do a study, you look at the literature that has been done beforehand to see what their results were and if you have any overlap. And the one prior pediatric study had identified that older age, conjunctivitis, and Ebola contact were predictors. So we had this commonality that Ebola contact was a predictor. But in our study, we found that bleeding and abdominal pain were strong predictors for Ebola virus disease.

[Sarah Gregory] Along that same vein, I imagine there were many challenges creating and evaluating this tool. Do you want to tell us about some of them?

[Alicia Genisca] One thing that came up a lot, and we would just have very, very robust discussions about ‘how do you objectively define variables for pediatric patients when you're doing this type of data collection?’ So for example, vomiting or fever, it's very easy to say ‘yes someone had that symptom’ or ‘no, they did not.’ But variables such as breathlessness or feeling weak can be a bit more challenging in that an older child may be able to accurately report this, but a younger child may not be able to do so, or an infant would not be able to do so at all. So that was one of the interesting challenges that we talked about as we were creating the tool.

[Sarah Gregory] What are the most important public health implications of your analysis and this predictive tool?

[Alicia Genisca] Well, we really hope that the PERS can be used as a bedside tool for clinicians in order for them to be able to promptly triage pediatric patients according to their risk for having Ebola virus disease. And in that way, they can start the appropriate medical care according to their risk.

[Sarah Gregory] Is there anything else you want to add to how you're going to use this tool going forward?

[Alicia Genisca] We are in discussions with our colleagues on the ground to see whether the development of a paired app that could be used on a smart phone would be helpful in the field.

[Sarah Gregory] Tell us about your job and your career path.

[Alicia Genisca] I'm a pediatric emergency medicine physician, which means that I take care of children who come into the emergency department for care. And while I always knew that I wanted to be a pediatrician, I did not always know that emergency medicine would be part of my career. I've always had a strong interest in global health, and when I completed my pediatrics training, my first job as a pediatrician was working abroad in Ethiopia and then in Colombia. And in those settings, in addition to taking care of patients, I actually did a lot of education for trainee physicians, nurses, and community health workers on how to approach pediatric emergencies. And this led me to formalizing my education in pediatric emergency and really ignited my passion for teaching about the subject matter both at home and globally.

[Sarah Gregory] Well, you've clearly done some very interesting things. What do you think is the most exciting thing you've worked on?

[Alicia Genisca] It's an interesting question. I have to say I'm very grateful for a career that has allowed me to enjoy different facets of my field. I work clinically as a physician in a busy emergency department, and I get to take care of and interact with pediatric patients and their families, which is extremely gratifying. And I also have been able to do exciting research, including this work on pediatric Ebola, to shed light on pediatric emergency care topics. And additionally, I really enjoy medical education, whether that be directly supervising medical trainees or working with colleagues abroad to strengthen their home systems to provide emergency care for pediatric patients. There's so much of what I do that I consider exciting, it would be hard for me to choose just one.

[Sarah Gregory] Well, thank you so much for taking the time to talk with me today, Dr. Genisca.

[Alicia Genisca] Thank you so much for having me. I really appreciate the opportunity to talk about what I love to do.

[Sarah Gregory] And thanks for joining me out there. You can read the June 2022 article, Risk Prediction Score for Pediatric Patients with Suspected Ebola Virus Disease, online at [cdc.gov/eid](https://cdc.gov/eid).

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

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