

Local disparities may prevent national vaccination efforts for rubella

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When public health officials make policies about when and how vaccination programs are implemented, they must weigh the benefits and risks of how infectious diseases spread throughout the country.

However, these analyses are often based on national-level data and, in some countries, may overlook nuances at the local level.

A new analysis by an international team, including Penn State researchers, revealed that the resulting recommendations may keep some countries from realizing the benefits of vaccination and globally eradicating diseases, such as [rubella](#)—a contagious viral infection that causes mild symptoms in children.

The team examined data from Nigeria, one of 19 countries that hasn't yet introduced rubella vaccination, as a [case study](#). Their findings were published May 29 in the journal [Vaccine](#).

"It's this interesting challenge where rubella is a mild disease if you get it as a kid, but it's high risk if you get it as an adult," said senior author Matthew Ferrari, professor of biology and director of the Center for Infectious Disease Dynamics at the Huck Institutes of Life Sciences at Penn State. "All of the policy surrounding rubella vaccination has been guided by that risk in adults, which has been holding back the benefit of rubella vaccination in some countries."

The primary concern among adults is the potential risk for [congenital rubella syndrome \(CRS\)](#), a serious health condition that can occur if a pregnant person contracts the virus. When an infectious disease like rubella is common, people are more likely to contract it earlier in life. And because the rubella virus is immunizing, those who are infected as children won't have pregnancies at risk of CRS when they are older.

Vaccination, on the other hand, reduces the amount of circulating virus, meaning individuals who were not vaccinated as children are less likely to be infected with rubella by adolescence or adulthood, Ferrari explained. As a result, even as the total number of rubella cases goes down with vaccination, the number of rubella infections in people of

reproductive age—who were neither infected nor vaccinated as children—increases, putting those pregnancies at risk of CRS.

Because of this complex dynamic, the World Health Organization (WHO) recommends that countries demonstrate that they can achieve a coverage level of 80% or greater, through either routine immunization or supplemental campaigns, before introducing rubella vaccination. The conventional wisdom has been that when vaccination coverage is above this threshold, the reduced risk of CRS due to less rubella virus offsets the paradoxical increase in CRS risk because infections tend to happen later in life, Ferrari explained.

The research team, working in partnership with the U.S. Centers of Disease Control and Prevention and the Nigeria Centre for Disease Control and Prevention, studied the epidemiology of rubella in Nigeria. Rubella is a comparatively rare disease, so it's difficult to quantify the potential harm and risk of CRS.

These assessments are further complicated by the fact that Nigeria, Ferrari said, is a country with disparate ranges of wealth, vaccination coverage, health care access and [birth rates](#), all of which play a role in infection and CRS risk.

To gain a better understanding of the factors at play, the team analyzed data from a nationally representative serosurvey, which detects the presence of antibodies in blood. The data allowed the researchers to see how many people, particularly women of reproductive age, had rubella antibodies, how many were potentially at risk of rubella infection and where the infection risk was greatest geographically.

They identified [regional differences](#) in transmission between the northern versus southern part of the country, finding that transmission in the north was two-times higher compared to the south. They were also

able to estimate the number of pregnancies affected by rubella infection today.

"We grounded the current infection risk and potential pregnancies at risk in strong empirical data and real-world phenomena," Ferrari said. "Parts of the country can already vaccinate more than 80% of kids, based on their current rate of measles vaccination, but low vaccination coverage in the north is a barrier to introduction across the whole country under the current recommendation."

What's more, the concern about increased CRS cases may not be as bad as conventionally believed, Ferrari noted. The team's new estimates of transmission rates show that the 80% threshold is conservative and that introducing a rubella vaccination program in Nigeria today could reduce the number of CRS cases by thousands in the first five years.

"Some states could see CRS risk increase by hundreds of cases," he said, "but that increased risk would not come to fruition until 10 years down the road"—providing a decade for [public health officials](#) to implement policies and programs to prevent this possibility.

"Strengthening and improving routine immunization programs and advancing them everywhere in the world is a benefit to everyone in the world. The more we do this, the elimination of rubella as a virus on this planet is entirely feasible," Ferrari said.

Tenley Brownwright, a postdoctoral scholar in biology at Penn State also contributed to this paper. Other authors include professor Jessica Metcalf and Taishi Nakase from the Department of Ecology and Evolutionary Biology at Princeton University; Oyeladun Okunromade, Abiodun Egwuenu, Oladipo Ogunbode, Bola Lawal, Kayode Akanbi and Ifedayo Adetifa from the Nigeria Centre for Disease Control and Prevention; and Gavin Grant, Orji O. Basse, Melissa M. Coughlin and

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More information: Taishi Nakase et al, The impact of sub-national heterogeneities in demography and epidemiology on the introduction of rubella vaccination programs in Nigeria, *Vaccine* (2024). [DOI: 10.1016/j.vaccine.2024.05.030](https://doi.org/10.1016/j.vaccine.2024.05.030)

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