Measles outbreaks in Niger linked to rainfall and temperature, study finds

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Rainfall and temperature drive agricultural activity, which, in turn, influences patterns of measles outbreaks in the West African nation of Niger, according to an international team of researchers. The findings

may be useful for improving vaccine coverage for seasonally mobile populations within Niger and other countries.

"Measles is a major cause of child mortality in sub-Saharan Africa, responsible for about 62,000 deaths in the region in 2017," said Alexandre Blake, graduate student in biology, Penn State. "Yet, current immunization strategies achieve low coverage, in part, because they were designed for higher-income countries where children are vaccinated prior to attending school, instead of for highly mobile populations where the median infection age is below school age."

The researchers analyzed weekly reported measles cases at the district level in Niger from 1995 to 2004, as well as weekly cumulative rainfall and average temperature data from the National Oceanic and Atmospheric Administration. Next, they used wavelet analysis, a mathematical tool for uncovering temporal patterns hidden in large amounts of data, and regression, a statistical tool, to investigate the associations between the measles cases and the environmental data. Their findings will appear on July 26) in the *Journal of the Royal Society Interface*.

The team discovered a strong and consistent annual pattern of measles outbreaks that was associated with rainfall. Specifically, they found that the rainy season was associated with a lower risk of measles case reporting, whereas measles cases were higher during the dry season.

"The timing of the beginning of the measles season is consistent with a phase of annual agricultural labor migrations, when people move from rural areas to urban areas," said Blake. "Vaccination strategies that target migrating populations at this point in the season could be very powerful to break the annual pattern of outbreaks."

The researchers also observed a second weaker and more inconsistent

pattern of outbreaks occurring every 2-3 years.

"This second outbreak pattern tells us that other mechanisms are at play," said Nita Bharti, assistant professor of biology. "So even if we could vaccinate everybody before the annual agricultural migration event, there would still be measles cases that are related to other factors."

Blake noted that some of those factors could be inequalities in access to care and movement between adjacent countries, such as Nigeria, where vaccine coverage is also low.

"Niger and Northern Nigeria share languages, culture and economic activities, and as a result, there is a lot of human movement across the border," he said. "But they do not have synchronous measles vaccination efforts, which likely permits the reintroduction of the virus on both sides."

The team concluded that targeting seasonally mobile populations for immunizations could reduce the strong seasonal pattern of outbreaks in Niger and across similar settings.

"Human health and the environment are often stitched together with human behavior," said Bharti. "Understanding the nature of those relationships in sub-Saharan Africa will provide valuable insights on how to tailor interventions in this setting."

More information: Investigating persistent measles dynamics in Niger and associations with rainfall, *Journal of the Royal Society Interface* (2020). rsif.royalsocietypublishing.or … .1098/rsif.2020.0480

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