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Discomfort or death? New study maps hot spots of child mortality from diarrhea in Africa

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New high-resolution maps pinpoint areas across Africa with concentrations of child deaths from diarrhea and show uneven progress over 15 years to mitigate the problem.

"Diarrhea is highly preventable, and tens of thousands of child deaths from diarrhea could be averted each year if interventions targeted mortality hot spots across Africa," said Dr. Bobby Reiner, lead author and Assistant Professor of Health Metrics Sciences at the Institute for Health Metrics and Evaluation (IHME) at the University of Washington. "However, stakeholders need to recognize the uneven distribution of diarrhea within countries means national strategies will be much less effective than focused, local interventions."

The study, covering 2000 to 2015, maps the entire African continent in 5x5 square kilometer units and was published today in *The New England Journal of Medicine*. National and provincial maps of diarrhea in Africa often mask inequalities at the local community level, according to IHME researchers.

This precision health mapping helps clinicians and policymakers identify communities where children are most vulnerable to dying from the disease and tailor appropriate interventions.

The Bill & Melinda Gates Foundation funded the study, part of a five-

year grant that enables IHME researchers and collaborators globally to map a range of health metrics in 5x5 square kilometer units. The research is part of the Local Burden of Disease project at IHME and led by Dr. Simon I. Hay, Director of Geospatial Science at IHME and Professor of Health Metrics Sciences at the University of Washington.

Accounting for more than 330,000 child deaths in 2015, diarrhea was the third leading cause of death and disease in children in Africa. The vast majority of diarrheal diseases are attributable to preventable causes. Established interventions include rotavirus immunization; ensuring access safe drinking water; sanitation and hygiene programs; and minimizing exposure to contaminated food.

The study examines prevalence and incidence of diarrhea and diarrhea-related mortality for children under age 5. Diarrhea is defined as three or more abnormally loose or watery stools within the previous 24 hours in a child younger than 5 years of age. Study findings cover 52 of 54 countries in Africa, excluding the island nations of Mauritius and Seychelles.

Researchers found more than half of all diarrhea-related deaths among children occurred in 55 of 782 total first-level administrative subdivisions (i.e. states, provinces, or regions) across Africa; these jurisdictions are home to 35% of the total population of Africa.

While many countries reduced their diarrhea child mortality burden uniformly at the local level, others saw divergent trends emerge. In Nigeria, for example, mortality rates were improving in some local areas at the same time as they were worsening in others. As a result, in 2015, child mortality rates among Nigerian states differed six-fold, with estimates ranging from 1.6 deaths per 1,000 children in Bayelsa state in the southwest to 9.5 deaths per 1,000 in Yobe state in the northeast.

Despite mortality reductions across nearly all locations in Africa over the 15-year period, several countries saw increases at the local level in certain parts of the Central African Republic, Gabon, Ivory Coast, Nigeria, and Zimbabwe.

"We observed diarrhea mortality declines across nearly all locations, but several areas across Africa with persistently high mortality from 2000 through 2015 are at risk of falling even further behind," said Reiner. "Our precision public health maps are critical tools for calling attention to areas where diarrhea-related child mortality is stagnating or worsening, despite proven interventions."

Additional findings include:

- Ninety percent of first-level administrative subdivisions (i.e. states, provinces, or regions) saw declines in diarrhea-related child mortality between 2000 and 2015, with several locations achieving substantial reductions:
    - Timbuktu, Mali: 19.25 child deaths per 1,000 in 2000 to 4.08 in 2015
    - Gao, Mali: 16.23 in 2000 to 3.48 in 2015
    - Luanda, Angola: 13.78 in 2000 to 1.76 in 2015
    - Benguela, Angola: 13.63 in 2000 to 2.11 in 2015
    - Cuanza Sul, Angola: 13.05 in 2000 to 1.99 in 2015
    - Uige, Angola: 12.75 in 2000 to 1.85 in 2015
    - Cabinda, Angola: 12.46 in 2000 to 1.62 in 2015
    - Huambo, Angola: 12.54 in 2000 to 1.78 in 2015
    - Kuanza Norte, Angola: 12.32 in 2000 to 1.73 in 2015
    - Maradi, Niger: 13.87 in 2000 to 3.11 in 2015

- Some areas in northeastern Nigeria, southeastern Niger, and southern Chad saw their high diarrhea-related child mortality rates change very little over the 15-year span.

- For example, eight regions in Chad with high mortality rates in 2000 also had rates higher than six deaths per 1,000 children in 2015:1. Hadjer Lamis: 8.73 in 2000 and 6.69 in 20152. Kabia: 9.14 in 2000 and 6.43 in 20153. Logone Occidental: 9.45 in 2000 and 6.32 in 20154. Logone Oriental: 9.38 in 2000 and 6.03 in 20155. Mayo-Boneye: 8.90 in 2000 and 6.33 in 20156. Mont De Lam: 9.31 in 2000 and 6.09 in 20157. Tandjile Est: 9.51 in 2000 and 6.23 in 20158. Tandjile Ouest: 9.76 in 2000 and 6.46 in 2015

- Many of the concentrated areas of diarrhea-related child mortality in 2015 were found in Nigeria, Ethiopia, and Niger.
  - For example, three states in Nigeria—Yobe, Bauchi, and Gombe—accounted for six percent of all diarrhea-related deaths in Africa, while encompassing only one percent of the population at risk.

- The first-level administrative subdivisions (i.e. states, provinces, or regions) with the highest diarrhea-related child mortality rates in 2015 were the following:
  - 1. Yobe [Nigeria]: 9.51 deaths per 1,000 children, increased from 8.05 in 20002. Bauchi [Nigeria]: 8.253. Gombe [Nigeria]: 7.86, increased from 7.68 in 20004. Hadjer Lamis [Chad]: 6.695. Tandjile Ouest [Chad] 6.466. Kabia [Chad] 6.437. Borno [Nigeria]: 6.358. Jigawa [Nigeria]: 6.349. Mayo-Boneye [Chad]: 6.3310. Logone Occidental [Chad]: 6.32

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The study, "Variation in Childhood Diarrheal Morbidity and Mortality in

Africa, 2000-2015," is available online at IHME's website, www.healthdata.org .