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Citation/Publisher Attribution

Akanda, A. S., Jutla, A.S., & Colwell, R. R. (2014). Global diarrhoea action plan needs integrated climate-based surveillance. *The Lancet Global Health*, 2(2), e69-70. doi: 10.1016/S2214-109X(13)70155-4
Available at: [http://dx.doi.org/10.1016/S2214-109X\(13\)70155-4](http://dx.doi.org/10.1016/S2214-109X(13)70155-4)

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Global diarrhoea action plan needs integrated climate-based surveillance



Diarrhoeal diseases are the second most common cause of deaths of children, killing more than 1.5 million children annually and infecting billions more.^{1,2} The recently released Global Action Plan for Pneumonia and Diarrhoea (GAPPD) is a comprehensive strategy document outlining plans to end preventable deaths from these two killer diseases by 2025.³ The document calls for a global integrated action plan, spearheaded by UNICEF and WHO, focused on coordination of several action strategies. Additional publications supplement the GAPPD document with information on various bottlenecks and barriers, and solutions to achieve the goals.⁴ However, key questions remain about knowledge gained from existing intervention strategies and how they can be implemented globally.

Treatment procedures such as oral rehydration solution (ORS), antibiotics, and intravenous fluids have saved lives during epidemics, and prevention measures such as access to vaccines, water, sanitation, and hygiene (WASH), and simple filtration solutions, have reduced infection transmission at local and small-regional scales.^{1,2,5} However, such interventions cannot easily be scaled up across vulnerable regions, and thus have not been able to control the increasing global burden of diarrhoeal diseases. In fact, data from UNICEF and WHO show that global focus on and necessary funding for ORS has plateaued since the 1990s;^{1,2} only about 39% of children with diarrhoea in the developing world actually receive recommended treatment. Similarly, uptake of zinc and antibiotics has been poor, even after a decade of successful use in various epidemics.³

The challenge remains—how can we provide safe drinking water and sanitation facilities to more than 1 billion people? Perhaps this goal is possible with strong political and societal commitment, but, with the cost of implementation in present economic trends, many developing countries are likely to miss the Millennium Development Goals (MDGs) in 2015, and perhaps the GAPPD targets in 2025 (eg, India, with more than 1 billion people, has only about 35% sanitation coverage).³ Thus, innovative ways to deliver established treatment procedures and maximise WASH access by integration of engineering and public-health efforts are much needed.⁵

The role of large-scale climate phenomena in provision of conditions conducive to the propagation and transmission of pathogens and disease is well accepted.⁶ Significant spatial and temporal variability occurs in diarrhoeal disease and mortality patterns across affected regions. Results of recent research have shown that pathogen growth, contamination and exposure, and the occurrence and severity of diarrhoeal outbreaks can be moderated by ambient environmental and climatic conditions.^{7,8,9} Large-scale climate events, such as droughts or floods, can directly affect available water quantity and quality, and, subsequently, access to WASH in large areas.^{8,10} A review of publications on global diarrhoeal burden, however, shows that the roles of climate or the ambient environment are yet to be recognised in plans or strategy documents.^{1,2} As a result, a major global action plan such as the GAPPD does not draw attention to the potential of early warning systems based on climatic and environmental surveillance in strengthening of primary prevention strategies or intervention planning.^{3,4}

Climate-based early warning systems can provide reliable information on water quality and quantity, natural hazards, and population vulnerability to potential diarrhoeal disease outbreaks. Such predictive relationships could enable identification of especially vulnerable communities 2–3 months before epidemics occur, and allow timely intervention. For example, recent studies show that location and intensity of cholera outbreaks can be predicted up to 3 months in advance in the Bengal Delta region with understanding of underlying hydroclimatology and satellite-derived environmental variables.^{8,10} Similarly, for Haiti, Pakistan, and Mozambique, different sets of hydroclimatological factors can result in cholera outbreaks.^{7,8}

Vaccines for rotavirus and cholera—the two diseases with the highest child mortality rates and a significant fraction of the global diarrhoeal burden—are at preliminary stages of implementation.³ The use of vaccination as a global primary-prevention strategy can also be rapidly strengthened with the help of an early-warning system, by planning of targeted delivery in vulnerable populations. A systematic synthesis of

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hydroclimatic understanding with microbiological and epidemiological evidence of pathogen transmission pathways will also create a necessary platform for identification of effects of global climatic and environmental changes on disease dynamics.

In addition to investment in medicinal development, ORS distribution, and WASH infrastructure, there is tremendous potential in the use of the vast and freely available climate and satellite remote sensing datasets and space and time information on the dominant underlying processes behind diarrhoeal disease outbreaks. Without the inclusion of such information, we cannot accurately assess population vulnerability or the public-health response capacity of affected regions, nor can we harness the potential of early-warning systems. Climatic and environmental surveillance systems can successfully monitor affected and vulnerable regions over large swathes of territory and identify hotspot areas with useful lead time to intervene.^{6,10}

To control the global diarrhoeal disease burden will need a focus on a combination of recent advances in global predictive and surveillance capabilities using climatic and environmental information, and proven successes in treatment and prevention. Coupled with advances at the local scale of diarrhoeal treatment, innovative solutions such as simple filtration measures during extreme weather conditions, and vaccines

as proven by improved survival rates, an integrated climate-based surveillance mechanism could provide predictive monitoring of vulnerable regions and strengthen the global health community's ability to reduce the disease burden.

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We declare that we have no conflicts of interest.

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