UC SANTA BARBARA

THE Current

March 3, 2026

Sonia Fernandez

HIV patients are especially vulnerable to extreme weather events

Extreme weather events (EWEs), such as floods, blizzards, hurricanes or droughts, threaten everyday normalcy for millions of people around the globe. Coupled with trying to get timely health care, EWE exposure can change the course of an infectious illness for both individuals and local populations. But who — and where — is most at risk?

Focusing on human immunodeficiency virus (HIV) , scientists from UC Santa Barbara, UC San Francisco and City University of New York (CUNY) have collaborated to begin answering this question. In the process, they have created a historical record that links real-life climate and weather data to a large multi-national (2.2 million) cohort of people living with and at risk for HIV.

“People living with HIV are an especially vulnerable population, many of whom live in areas that are historically and/or increasingly prone to severe weather events,” said UCSB geographer Frank Davenport. “There was not a lot of research in this area and this was a unique opportunity to expand our overall understanding of the health impacts of extreme weather events.”

This approach, according to the scientists, can be used to illustrate the effects of extreme weather on other widespread illnesses, which in turn could guide policy

decisions that may mitigate the effects of EWEs on a person's health and treatment, improving health outcomes.

Supported by the National Institutes of Health, the research is published in the journal Geohealth.

Drought vs flood

HIV continues to be a significant public health threat in many parts of the world. In response, clinics are often set up amid HIV hotspots to deliver care, therapy and education, and to manage the disease in the population.

"There are drugs that can keep the viral load low," explained lead author Sophia Arabadjis, a UCSB geography graduate and CUNY postdoctoral researcher. In this way, HIV can be kept at a manageable, chronic, level. "But when you have disruptions like floods and droughts, where people may not have access to the right drugs, care or basic food/water supplies, the viral load begins to build in these patients," she continued. If those patients are unable to stay on top of their regimen, their conditions can become infectious — not only worsening individual health, but also putting the local population at increased risk of HIV acquisition. This risk is on top of other existing vulnerabilities that could lead to negative HIV care outcomes, including comorbid conditions, vector-borne and other diseases, social challenges such as stigma and economic-driven sexual behavior, and infrastructure constraints.

Taking data from sources including UCSB's Climate Hazards Center, the researchers calculated the risk of exposure to drought and to flood at 777 HIV clinics in the NIH-funded International epidemiology Databases to Evaluate AIDS (IeDEA) network from about 1981 (drought) and 2006 (flood) to 2023. "Looking at floods and droughts over 40 years gives us a sense of repeated exposures for certain clinics," Arabadjis said. "If we think about the patients attending those clinics, we can start to capture exposures across the life course."

"Drought risk is easier to model than flood risk," said co-author Davenport, a member of the UCSB Climate Hazards Center, which for almost two decades has been monitoring climatic conditions in places like Africa and Latin America in an effort to forecast potential droughts, which can lead to famine. Droughts can be predicted as early as the most recent rainy season, which is a critical time for crops

and generates water supply for livestock, he said. However, floods “are more acute,” with parameters that are less easy to define and data that may be less complete, or vary regionally in completeness across the globe.

“The effects of drought on HIV outcomes tend to be more indirect,” Davenport continued. Lack of food contributes to existing health, financial and social vulnerabilities. People may have to migrate for work, which can disrupt the course of a patient’s treatment, or engage in transactional sex to augment income, which increases the risk of spreading the virus.

Floods, meanwhile, affect buildings and infrastructure. “People may be displaced, and roads may be destroyed, which makes it difficult to access the clinics,” Arabadjis said. Interruptions to power could affect clinics’ ability to provide care, she added, and there is an increased risk of waterborne or mosquito-borne diseases such as cholera and malaria.

According to researchers’ analyses, Southern Africa’s IeDEA sites are currently the most exposed to extreme weather conditions, topping the charts in both drought and flood displacement risks.

“Because different clinics within HIV care networks have different risks for flood and drought exposure, in the long-term pinpointing which clinics are at-risk helps us target resources and mitigation efforts across the network,” Arabadjis said. While the publication does not examine location- and patient-specific health outcomes — that may be a paper for another day — it does provide a foundational historical record for future, more place-specific research, and the approach may be applied to other locations with endemic communicable diseases.

Research in this paper was also conducted by Sheri D. Weiser at UC San Francisco; Zachary Shahn, Ellen Brazier, Avantika Srivastava and Denis Nash at City University of New York; Andrew Maroko at Mount Sinai Institute for Health Equity Research; Keri N. Althoff at The Johns Hopkins University; Timothy John Dizon and Mark K. U. Pasayan at the Research Institute for Tropical Medicine in the Philippines; Ana Maria Viceda Cabrera at the University of Bern, Switzerland; Gad Murenzi at the Rwanda Military Referral and Teaching Hospital; Antoine Jaquet at the University of Bordeaux, France; Aggrey S. Semeere at Makerere University, Uganda; and Yanink Caro Vega at the Instituto Nacional de Ciencias Médicas y Nutrición, Mexico.

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Media Contact
Sonia Fernandez
Senior Science Writer
(805) 893-4765
sonia.fernandez@ucsb.edu

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