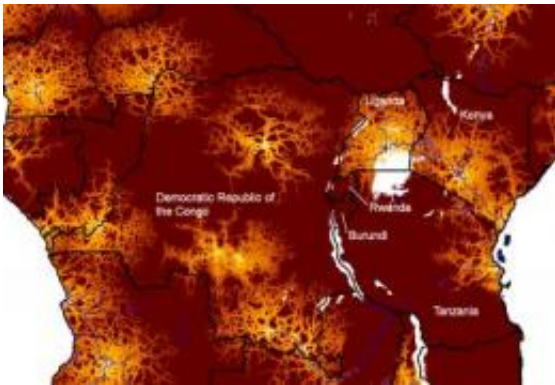


Scientists join forces to explain HIV spread in Central and East Africa

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The gradient of colors indicates the estimated travel time to the nearest city with a population of more than 500,000, with yellow at one extreme indicating short travel times and red at the other extreme indicating long travel times. The graphic explains accessibility factors affecting the spread of HIV from central to east Africa. The virus was circulating at stable levels in the urban centers of the Democratic Republic of Congo, but these centers were isolated. Once the virus reached east Africa, connectivity between population centers combined with better quality transportation networks and higher rates of human movement caused HIV to spread exponentially. Credit: Andrew J. Tatem/University of Florida

Scientists studying biology and geography may seem worlds apart, but together they have answered a question that has defied explanation about the spread of the HIV-1 epidemic in Africa.

Writing in the September issue of *AIDS*, a research team led by scientists at the University of Florida explained why two subtypes of HIV-1 — the virus that causes acquired immunodeficiency syndrome, or AIDS — held steady at relatively low levels for more than 50 years in west central [Africa](#) before erupting as an epidemic in east Africa in the 1970s.

Essentially, the explanation for the [HIV](#) explosion — obscured until now — involves the relative ease with which people can travel from city to city in east Africa as opposed to the difficulties faced by people living in the population centers of the Democratic Republic of Congo, the point where HIV emerged from west central Africa in its spread to the east.

Later, as the epidemic raged in the east, cities in the Democratic Republic of Congo — a vast country almost as big as all of Western Europe — remained disconnected and isolated, explaining why the virus affected only about 5 percent of the country's population, a level that has not changed much since the 1950s.

"We live in a world that is more interconnected every day, and we have all seen how pathogens such as HIV or the [swine flu](#) virus can arise in a remote area of the planet and quickly become a global threat," said Marco Salemi, an assistant professor of pathology, immunology, and laboratory medicine at the UF College of Medicine and senior author of the study. "Understanding the factors that can lead to a full-scale pandemic is essential to protect our species from emerging dangers."

Investigators used databases, including GenBank from the National Center for Biotechnology Information, as well as actual [DNA](#) samples, including samples recently collected in Uganda — the vicinity where HIV entered east Africa — to follow the virus' molecular footprints since its emergence in the 1920s.

"HIV mutates rapidly," said Rebecca Gray, a postdoctoral associate in

the department of pathology, immunology and laboratory medicine.

"This is a successful strategy for the virus, because it evolves quickly and develops drug resistance. But we can use these changes in the genome to follow it over time and develop a history of its progress."

Researchers wanted to know why, the virus smoldered during the 1950s and '60s, before spreading like wildfire through east Africa in the 1970s.

A fateful piece of the puzzle came in the form of geographic information system data, which uses satellite imagery and painstakingly takes into account the availability and navigability of roads between population centers, transportation modes, elevation, climate, terrain and other factors that influence travel.

"We were able to use geographic data to interpret the genetic data," said Andrew J. Tatem, Ph.D., an assistant professor of geography in the College of Liberal Arts and Sciences and a member of UF's Emerging Pathogens Institute. "Genetic data showed once HIV moved out of the Democratic [Republic of Congo](#), it expanded fast and moved rapidly across Uganda, Kenya and Tanzania, all while staying at low levels in the DRC. What was happening was the virus was circulating at stable levels in the urban centers of the DRC, but these centers were isolated. Once it hit east Africa, connectivity between population centers combined with better quality transportation networks, and higher rates of human movement caused HIV to spread exponentially."

HIV was prevalent in about 15 percent of the population in Kenya in 1997, although it has since dropped to about 7 percent, according to the Kaiser Family Foundation. As of 2007, an estimated 22 million people were living with HIV/AIDS in sub-Saharan Africa. About 1.1 million Americans have HIV or AIDS, and an estimated 5.1 million people in India are HIV-positive. In Eastern Europe, HIV infections more than doubled from 420,000 in 1998 to 1 million in 2001.

"If we can predict the specific routes of an epidemic, we can find the geographic regions more at risk and target these areas with medical intervention and strategies for prevention," Salemi said. "In terms of health-care applications, coupling genetic analysis with geographic information systems can give us a powerful tool to understand the spread of pathogens and contain emerging epidemics."

Working with Maureen M. Goodenow, Ph.D., the Stephany W. Holloway university chair for [AIDS](#) research at the UF College of Medicine, UF researchers collaborated with an array of scientists hailing from the National Institute of Allergy and Infectious Diseases, the Rakai Health Sciences Program and Makerere University of Uganda, and the Johns Hopkins University. They refer to the combination of techniques that led to the discovery as "landscape phylodynamics."

"It is the first study that has given us a clear picture of [epidemic](#) history of HIV in east Africa, including the geographic routes and the time scale that it occurred," said Oliver Pybus, Ph.D., a researcher in the department of zoology at Oxford University who did not participate in the study. "Genetic analysis of the HIV genome provides the family tree of the virus, combined with spatial analysis of high-resolution data of land use, topology and other factors. There is a huge potential in doing that kind of analysis, but it requires a rare combination of specialists in different fields to come together."

Source: University of Florida ([news](#) : [web](#))

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