Editor's Note: Supporting materials such as photos and abstracts are available on the online press room: https://astmhpressroom.wordpress.com/annual-meeting-2022/anopheles-stephensi-in-ethiopia/

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New Study Shows Power of Invasive Asian Mosquito to 'Alter the Landscape' of Malaria in Africa with Surge of Urban Outbreaks

New research presented at #TropMed22 provides first evidence linking Anopheles stephensi *mosquitoes — once seen only in India and the Persian Gulf — to an unprecedented dry season wave of infections earlier this year in Ethiopian city*

SEATTLE (November 1, 2022) — A new study has linked an invasive insecticide-resistant mosquito native to South Asia to an unprecedented urban outbreak of malaria in Ethiopia, the most compelling evidence to date that the mosquito, which is fast expanding its range, could cause infections to surge in areas of Africa with previously low rates of disease.

The report, presented today at the Annual Meeting of the American Society of Tropical Medicine and Hygiene (ASTMH), follows reports of a suspicious 40-fold rise in malaria cases in neighboring Djibouti since 2013, with novel evidence that this mosquito, which was not confirmed in Africa until 2012, is a significant threat to the goal of eliminating malaria on the continent.

"Malaria in Africa is typically associated with rainy seasons in rural areas, but this mosquito produced a 10-fold spike in malaria infections in just three weeks in an urban area during a dry season," said Fitsum G. Tadesse, PhD, a molecular biologist with the Armauer Hansen Research Institute in Addis Ababa. "Also, unlike the mosquitos that typically transmit malaria parasites in Africa, this one is best known for its ability to thrive in man-made water storage containers like what you see in rapidly expanding urban neighborhoods."

The outbreak occurred in Dire Dawa, a city of about 500,000 people in eastern Ethiopia that typically records only about 200 cases a year. But between January and May 2022, when rains are scarce and infections are particularly rare, about 2,400 cases were reported. An investigation by Tadesse and his colleagues found that the surge was caused by a mosquito known as *Anopheles stephensi.* They also found that the mosquito was resistant to the insecticides most commonly used to control malaria via treated bednets and indoor insecticide spraying.

Most malaria in Africa is caused by a mosquito species known as *Anopheles gambiae*, with populations rising and falling with the rainy seasons that swell rural waterways. *Anopheles*

stephensi mosquitoes have long been the primary transmitter (vector) of malaria in urban areas of India and Iran. But they were never seen in Africa until 2012, when they were reported from Djibouti, a tiny East African country of about 1 million people that, at the time, had been close to eliminating the disease. *An. stephensi* mosquitoes likely arrived in shipping containers, Tadesse said, but they did not appear to be a significant threat until 2020, when they were suspected as the cause of the steadily rising number of malaria infections in Djibouti since 2013.

Now, new evidence that they were the source of the Dire Dawa outbreak—coupled with recent evidence of *An. stephensi* mosquitoes thousands of miles away in Nigeria in West Africa—is ratcheting up concerns of a new front opening up in Africa's long-running battle against malaria. Africa suffers 95 percent of the world's 627,000 annual malaria deaths, and most victims are children under age 5. In recent years, progress against the disease has stalled.

"This is not like any other malaria-carrying mosquito we have seen in Africa before," said Sarah Zohdy, PhD, a disease ecologist and *An. stephensi* expert with the U.S. Centers for Disease Control and Prevention (CDC) who works with the U.S. President's Malaria Initiative (PMI), a key partner for the Ethiopia study. "This mosquito's ability to persist in the dry season and in urban environments has the potential to alter the landscape of malaria in Africa," she said. "It could cause malaria to expand from a predominantly rural disease to both a rural and urban challenge that also impacts Africa's rapidly growing and densely populated cities, where infection rates have been comparatively low."

Meanwhile, a separate study presented at the ASTMH Annual Meeting reported new evidence that *An. stephensi* mosquitoes are ubiquitous in and around households across nine states in Sudan. Zohdy said the concern with the detection of *An. stephensi* mosquitoes in Sudan—and also Nigeria—is that they could follow the pattern of Djibouti, where there was a lag of several years between the mosquito's detection and its link to a surge of malaria infections.

Zohdy said that CDC and PMI, which is co-implemented by USAID and CDC, are actively working to mitigate the threat of *An. stephensi* by utilizing enhanced vector and disease surveillance. PMI and CDC are also collaborating with the World Health Organization, which just launched an initiative last month to stop the expanding range of *An. stephensi* in Africa. In addition, PMI is leading the deployment of interventions informed by *An. stephensi's* unique biology, including the development of ways to limit breeding sites in urban areas.

What the Ethiopia Outbreak Tells Us About Africa's New Malaria Threat

Tadesse said that in the wake of the outbreaks in neighboring Djibouti, malaria experts in Ethiopia were alerted to the potential threat from *An. stephensi* mosquitoes. He said Dire Dawa is a rail hub linked to Djibouti. When malaria infections suddenly surged earlier this year, he said he and his colleagues "immediately started thinking '*stephensi*,*"* and "we jumped in to assess the causes of the change." Driven by urgency, the team, including Tadele Emiru and Dr. Deiene Getachew, completed their field work in just over two months.

In addition to linking *An. stephensi* to malaria infections, Tadesse and his colleagues conducted extensive tests in water sources around households and neighborhoods where cases occurred. They found evidence of malaria-carrying *An. stephensi* in nearby water containers, confirming what was already known from extensive work in India, where *An. stephensi* is known as mainly a "container breeder." But he said they also found plenty of *An. stephensi* mosquitoes at the edge of streams and nearby rivers.

“We should be careful about considering it as just a container breeder,” Tadesse said. “It can survive in man-made or natural water sources. It also can feed on animals or humans. Basically, our findings indicate it can survive anywhere, so we need to be looking for this mosquito in places where, previously, people were not expecting to find it.”

For example, he said projections that 126 million additional people in Africa could be at risk of malaria from *An. stephensi* mosquitoes could underestimate the threat if the evidence from Dire Dawa of the mosquito’s adaptability is confirmed elsewhere.

“We’re fortunate that this team moved quickly to confirm in just a few months that *An. stephensi* mosquitoes were the source of an unusual dry season urban outbreak,” said ASTMH President Daniel Bausch, MD, MPH&TM, FASTMH. “Robust surveillance to detect and investigate unusual outbreaks in African countries is essential for developing strategies to stop this invasive mosquito from derailing Africa’s efforts to eliminate malaria.”

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