

Mosquito-borne diseases on the rise

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Aedes aegypti mosquitoes are responsible for the transmission of such diseases as dengue, yellow fever, and Zika (Getty Images).

One of the more significant impacts of climate change from a health perspective is a shifting pattern in the spread of mosquito-borne illnesses, a growing problem in parts of the world that have traditionally not fallen into tropical designations.

Aedes aegypti mosquitoes are the vectors of arboviruses causing infectious diseases such as dengue, chikungunya, Zika, and yellow fever, and they represent a serious

public health burden worldwide.

That burden is growing.

Over 11.5 million cases of dengue have been reported as of September 2024, an incidence rate that represents an increase of 228% compared to the same period in 2023. Approximately half of the world's population is currently at risk of dengue, according to the World Health Organization (WHO).

Notably, most cases of dengue are mild, yet they still often cause symptoms like fever, rash and muscle and joint pain. But when left untreated, dengue can become more dangerous, leading to outcomes like difficulty breathing, persistent vomiting, or even death. Children under the age of 5 are most at risk.

The incidents in the United States continue to balloon, though interestingly enough, New Orleans may see fewer cases than other locations. Denser populations of human beings tend to exacerbate the issue.

"This was definitely going to be another year when we will have multiple locally acquired dengue cases in the U.S.," [Dr. Dawn Wesson](#), an associate professor at the Tulane School of Public Health and Tropical Medicine, said. "Most (cases) will be in Florida and south Texas, but other areas are at risk. The southwestern United States could easily see cases in large cities such as Phoenix, Tucson, Los Angeles, etc." In fact, as of this writing, there have been 15 locally acquired cases of dengue in southern California and 35 in Florida.

"New Orleans is not without risk, but as a smaller city, less so."

This push of tropical disease into new populations and health departments unaccustomed to dealing with such issues will necessitate the adoption of tropical medicine and the accompanying mitigation efforts in those areas.

Just as important, in areas where the diseases have more typically occurred, local practitioners will have to be even more vigilant, as warming, humid conditions will only continue to fuel mosquito populations -- and the diseases they can spread.

As the only educational institution with a declared focus on both public health and tropical medicine, located amid the swamps of Louisiana and near the tropics, Tulane remains uniquely situated to study and combat these mosquito-borne disease.

[Dr. Patricia Scaraffia](#) is an associate professor in the Department of Tropical Medicine and Infectious Disease. Since 2014, she has been the recipient of the Corine Adams Baines Endowed Professorship Award. Her lab conducts research on the *Aedes aegypti* mosquitoes, specifically investigating the female mosquito's metabolism following blood meals.

With NIH NIAID support, the studies her laboratory has been performing in mosquitoes using both traditional and cutting-edge approaches have led to significant discoveries in the field.

While her research is aimed at better understanding mosquito metabolism in order to develop more effective defenses through that knowledge, Scaraffia still emphasizes the importance of existing mitigation techniques.

"It is important to remind people that prevention and control are key to lowering the risk of getting infected by mosquito bites," she says. "People should use repellents to protect from bites, remove standing water, keep gutters clean, treat ponds with larvicide, dump out plant dishes, do not over-irrigate, and let water penetrate before re-watering."

Complicating matters, according to Scaraffia, is the development of complex resistance mechanisms to insecticides or decreased sensitivity of target proteins. This is one of the factors that has contributed to the emergence and in other cases resurgence of mosquito-borne diseases.

Dengue is justifiably receiving headlines in news coverage due to its increased prevalence, though it's hardly the only mosquito-transmitted disease to be aware of. [Dr. Berlin Londoño-Renteria](#), an assistant professor in arbovirology in the Tropical Medicine Department, is quick to remind people that just last year the U.S. saw local transmission of malaria, another vector-borne disease.

"Malaria and dengue fever are not transmitted by the same mosquito species," Londoño-Renteria adds. "Yet it is important to keep ourselves vigilant and continue efforts to decrease human-mosquito contact and increase/improve detection of cases in travelers."

She sees education of the community as being important, particularly for travelers who might travel into and out of areas where dengue is endemic -- conveniently, the same locations that are popular vacation destinations. Such awareness can help

curb the spread of disease.

But above and beyond simple awareness, Londoño-Renteria advocates for further vaccine development, akin to what the population was able to achieve with the COVID-19 vaccine in a relatively short period of time.

“There are currently two commercially available vaccines but only one is approved for use in the U.S., and only for children ages 9-16 with previous exposure to the virus,” Londoño-Renteria said. “More importantly, no specific, optimized treatment is available anywhere in the world. So hopefully, this is a wakeup call to increase research efforts in therapeutics.”

In addition to testing different methods to measure the level of antibodies against mosquito saliva in humans and animals – making it easier to track and determine transmission dynamics – her lab is also researching vaccines.

The group has focused its efforts on several potential mosquito-saliva-based vaccines, considered “universal vaccines,” that may help the world eventually decrease transmission of several vector-borne pathogens -- including dengue and malaria.

Currently, 2 vaccines to prevent *Plasmodium falciparum* malaria have been approved and recommended by WHO to prevent malaria, but the species that was locally transmitted last year in the US was another important malaria species -- *P. vivax* -- for which the populace doesn't have any available vaccines and is the most prevalent malaria species in the Americas.

In the case of dengue, two vaccines have been approved, but they are not readily available, and their use is restricted to people of certain age and with specific previous immunity to the virus to avoid development of severe disease. Thus, in collaboration with Tulane University, at the US Naval Research Unit – Parasitology Department, Londoño-Renteria’s group has been awarded a project to test a multivalent dengue vaccine candidate using the replicative RNA (LION-repRNA) platform. Testing of such candidates will start in 2025.

“We discovered and approved a treatment for COVID vaccine in less than two years,” Londoño-Renteria said. “I think it is time to do the same for these [mosquito-borne] diseases that are affecting a significant number of people worldwide.”