Using genomics to track malaria in the US

December 20 2023, by Thomas Locke

Credit: Chokniti Khongchum from Pexels

For the first time in 20 years, locally transmitted cases of malaria have been reported in the U.S.

Jane Carlton, Ph.D., a biologist and director of the Johns Hopkins Malaria Research Institute, is working to decode the genomes of the parasites that have infected individuals in the U.S. to determine their origin. In this Q&A, Carlton discusses what this work can tell us about the recent cases along with the role of climate change in malaria infections, the global fight against the disease, and the risks of contracting malaria in the U.S.

What was so unique about malaria transmission in the US this past summer?

Over the summer, there were cases in Texas, Florida, and Maryland. The last time we had local transmission—where a person who has not left the country in many months is infected with malaria—was in 2003. What probably happened in these locally transmitted cases is that the Anopheles mosquito bit an infected person who had recently traveled and brought the parasites back with them; then the parasites developed in the local mosquito, and that mosquito bit another person and transmitted the parasites.

These locally transmitted cases are different from the approximately 2,000 cases that we get in the U.S. every year from travelers.

What is the risk of transmission to the general public?

It is exceedingly low. I think we want to try and avoid any sort of scaremongering. There were very few cases.

How did you and your team get involved?

We were contacted by the Maryland Department of Health to sequence the parasites of an infected individual to try and track down where the parasite that infected this person came from. We obtained a sample of blood from this individual, extracted the DNA sequences using high-throughput machines, then sequenced the genome. Using comparative genomics, we try to compare it to all of the other genomes of parasites from around the world.

What is the difference between genetics and genomics?

Genetics is the study of genes. Genomicists, instead of looking at one or two genes, will look at all of the genes that make up what we call a genome. Many genomicists will decode the DNA of different organisms and then study those to see what proteins those genes are producing, and what characteristics—like eye color, disease, or predisposition—they might have.

Genomics is part of a series of -omic technologies and approaches, which include proteomics, metabolomics, and transcriptomics. These approaches use new methodologies to look at all of the proteins in a cell or organism, and then use high-performance computational algorithms to try to identify patterns of those particular molecules.

Why is it important to get that big, comprehensive picture of malaria?

Both the parasite genome and the mosquito genome are very important because each of those represents a unique fingerprint. You can characterize the disease that's caused by that particular parasite and also track the parasites and the mosquitoes.

Malaria parasites, for example, in parts of Ethiopia or India are different from each other, but those malaria parasites in India are similar to each other. If you don't know the origin of a malaria parasite, you can track it back to where it might have come from by comparing it with lots of different genomes of malaria parasites throughout the endemic world.

Can genomics help us understand if there's a connection between these recent malaria cases?

Absolutely, especially for the seven cases which were found in similar counties in Florida. Could there have been several mosquitoes in the same area that were infected from a single individual and then spread out and infected other individuals? If there should be any other cases, for example, in Texas or Maryland, then we would also be able to see if they're genetically related.

Do you think climate change will make these events more likely to happen?

People automatically assume that hotter temperatures will result in more mosquitoes and that malaria prevalence is going to increase. That's not necessarily the case because the malaria parasite will only grow and develop in the mosquito at a specific temperature range. If it gets too hot or too cold, the parasite will not be able to develop in the mosquito and it will die.

What is the global community doing to combat malaria?

There has been a lot of renewed interest in global infectious diseases. For example, organizations had a call to action for scientists like myself in the early 2000s, for us to pivot toward trying to develop better methods for eradicating malaria. That term "eradication" had not been on the malaria agenda for many years.

Other fantastic initiatives that have come forward over the past 20 years are things like the National Institutes of Health's International Centers of Excellence for Malaria Research. I'm the director of one of those centers in India. A colleague of mine here, Bill Moss, is the director for one in southern Africa, Zambia, and Zimbabwe. Those initiatives are funding big centers in malaria-endemic countries and providing funds for capacity building and training the next set of scientists.

The Malaria Research Institute, funded by the Bloomberg Philanthropies, is the premier institute in the U.S. dedicated to malaria research. Our group of researchers are undertaking phenomenal research into the malaria parasite and the mosquito vector that transmits it.

There is also renewed interest because of the pandemic in what sorts of infectious diseases people may contract as a result of how easy and common globalization has made it to travel.

Provided by Johns Hopkins University Bloomberg School of Public Health