Expert sounds alarm as mosquito-borne diseases become a global phenomenon in a warmer, more populated world

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Anopheles gambiae mosquito, feeding on blood. Credit: James Gathany, Centers for Disease Control and Prevention

The geographical range of vector-borne diseases, especially diseases

such as malaria and dengue, that are transmitted by mosquitoes, has expanded rapidly over the last 80 years, with over half the world's population now at risk. Spurred on by global warming and urbanization, mosquito-borne disease outbreaks are set to spread across currently unaffected parts of northern Europe, Asia, North America and Australia over the next few decades.

In a new research review to be given at this year's ESCMID Global Congress (formerly ECCMID) in Barcelona, Spain (27-30 April), ICREA Professor Rachel Lowe, who leads the global health resilience group at the Barcelona Supercomputing Center in Spain, will discuss the changing global threat of vector-borne disease and the critical importance of improved surveillance and early warning systems to tackle this now almost global phenomenon.

"Global warming due to climate change means that the disease vectors that carry and spread malaria and dengue can find a home in more regions, with outbreaks occurring in areas where people are likely to be immunologically naive and public health systems unprepared," warns Prof. Lowe. "The stark reality is that longer hot seasons will enlarge the seasonal window for the spread of mosquito-borne diseases and favor increasingly frequent outbreaks that are increasingly complex to deal with."

Previously, dengue (spread by mosquitoes that bite during the day) was largely confined to tropical and subtropical regions because freezing temperatures kill the mosquitoes' larvae and eggs, but longer hot seasons have enabled dengue to become the most rapidly spreading mosquito-borne viral disease in the world.

Nine of the 10 most hospitable years for dengue transmission have occurred since 2000, allowing mosquitoes that carry dengue to invade 13 European countries, with local spread of disease seen in France, Italy,

and Spain in 2023. The number of dengue cases reported to the WHO has increased eight-fold in the last two decades, from 500,000 in 2000 to over 5 million in 2019.

Prof. Lowe will explain how her recent research on climate extremes in the Caribbean found that drought conditions followed 4–5 months later by warmer-than-usual temperatures and excessive rainfall increases the chances of dengue outbreaks.

"Droughts and floods linked to climate change can lead to greater transmission of the virus, with stored water providing additional mosquito breeding sites. Lessons from previous outbreaks underscore the importance of assessing future vector-borne disease risks and preparing contingencies for future outbreaks," she emphasizes.

Projections suggest that if global warming can be limited to the ambitious goal of 1°C, the population at risk of malaria and dengue is expected to increase by an additional 2.4 billion people by 2100, relative to 1970-1999. However, if the current trajectory of high carbon emissions and population growth continues, double the number of additional people—4.7 billion—will be affected by dengue and malaria by the end of the century.

Infectious disease outbreaks in the aftermath of El Niño and extreme climatic events like severe floods, prolonged droughts, tropical cyclones, and dangerous heat waves are on the rise. As Prof. Lowe explains, "El Niño events that occur every 2-7 years cause hotter and wetter weather, providing ideal conditions for water-borne and mosquito-borne disease outbreaks, allowing disease-carrying insects like the Aedes aegypti and Aedes albopictus mosquitoes, which spread the viruses that cause Zika and dengue, to proliferate."

The Zika pandemic that emerged in Brazil in 2015 reflects the El Niño

connection—months of warmer-than-average temperatures helped fuel the spread of the virus that infected 1.5 million people. The current El Niño is now one of the strongest on record, catapulting it into rare "super El Niño" territory.

Prof. Lowe warns, "With climate change seeming so difficult to address, we can expect to see more cases and possibly deaths from diseases such as dengue and malaria across mainland Europe. We must anticipate outbreaks and move to intervene early to prevent diseases from happening in the first place. Efforts need to focus on enhancing surveillance with early warning and response systems similar to those seen in other parts of the world, to more effectively target finite resources to the most at-risk areas to control and prevent disease outbreaks and save lives."

By combining disease-carrying insect surveillance with climate forecasts, researchers are developing ways to predict when and where epidemics might occur and direct interventions to the most at-risk areas in advance. One such project, being led by Prof. Lowe, is using a powerful supercomputer to understand how the climate and disease transmission are linked to predict mosquito-borne disease outbreaks in 12 countries.

"By analyzing weather patterns, finding mosquito breeding sites with drones, and gathering information from local communities and health officials, we are hoping to give communities time to prepare and protect themselves," explains Prof. Lowe. "But ultimately, the most effective way to reduce the risk of these diseases spreading to new areas will be to dramatically curb emissions."

More information: Presentation 3672-2 'Monitoring the effects of climate change on the distribution of infectious diseases' at the ESCMID

Global Congress (formerly ECCMID), taking place at 0900H AM Barcelona local time on Sat 27 April

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