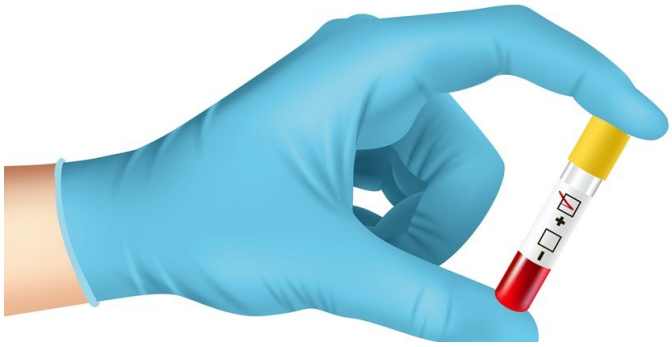
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ASIA EDITION

Singapore researchers combines climate and virus surveillance to predict dengue outbreak risk two months in advance

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By combining climate information with disease surveillance, advanced modelling and high performance computing, researchers can better understand how climate variability influences dengue dynamics





The study, led by Emilie Finch (London School of Hygiene and Tropical Medicine) and Rachel Lowe (Barcelona Supercomputing Center, and Visiting Professor at NUS Saw Swee Hock School of Public Health) and developed in collaboration with Singapore's National Environment Agency, presents a forecasting model that captures the complex interplay between climate and changes in circulating dengue viruses to predict dengue outbreak risk in Singapore.

Dengue outbreaks are becoming increasingly common and explosive across the world, posing a major public health challenge in regions such as Southeast Asia. Rising global temperatures and changes in rainfall patterns under climate change have accelerated the spread of dengue, with 2024 witnessing a historic peak of 14 million dengue cases reported globally alongside the warmest year on record. Early warning systems incorporating climate information offer the potential to mitigate the impact of dengue outbreaks and inform public health response.

Singapore's National Environment Agency has pioneered the use of information on the prevalence of dengue serotypes - the four mosquito-borne dengue viruses that can cause disease - to understand dengue transmission patterns. This new research, now published in Nature Communications, showed that incorporating information about different dengue serotypes enhanced the predictive ability of a forecasting model beyond climate data alone. Using over 20 years of data, the research

team showed that the risk of a dengue outbreak was highest during El Niño conditions and in the first few years following a change in the dominant dengue serotype circulating in the population.

The authors also used their model to estimate the impact of releases of Wolbachia-carrying mosquitos (Project Wolbachia) on dengue transmission. Since 2016, Singapore's National Environment Agency has been studying a novel suppression strategy where male mosquitos carrying Wolbachia - a bacterium found naturally in many insect species - are released to suppress the Aedes aegypti mosquito population in the community and reduce dengue transmission. Using their modelling approach, the research team estimated that around 28% of dengue cases expected in 2023 were averted due to expanded Project Wolbachia releases in 2022.

Looking ahead, the research team plans to compare the performance of this model with other dengue forecasting model, and explore how it could be applied to other geographic contexts.

This work demonstrates how interdisciplinary collaboration across computational modelling, climate science and public health can help to mitigate disease outbreaks in an era where rapid climate change is leading to unprecedented extreme events.

"In this dengue prediction framework, we jointly account for the impact of climate and changes in circulating dengue serotypes, which we can use as a proxy for changes in population immunity. This allowed us to disentangle the effects of climate and serotype changes on dengue transmission in Singapore and improved our ability to predict outbreaks up to two months ahead."

Dr Emilie Finch, currently a postdoctoral researcher at the Pathogen Dynamics Unit, University of Cambridge and visiting researcher at the BSC's Global Health Resilience group said "This prediction model, which captures complex climate and virus circulation patterns, is novel and will be a valuable addition to the National Environment Agency's repertoire of tools for risk assessment that informs decision-making in our continuous efforts to protect public health."

Associate Professor Ng Lee Ching, Group Director, Environmental Health Institute, Singapore's National Environment Agency and adjunct faculty at the National University of Singapore's (NUS) Saw Swee Hock School of Public Health. He said ,"By combining climate information with disease surveillance, advanced modelling and high performance computing, we can better understand how climate variability influences dengue dynamics. This integrated approach allows us to anticipate outbreaks weeks in advance and provide actionable early warnings that support public health decision-making in a changing climate."