How many days does it take for mosquitoes in Greater Paris to transmit arboviruses?

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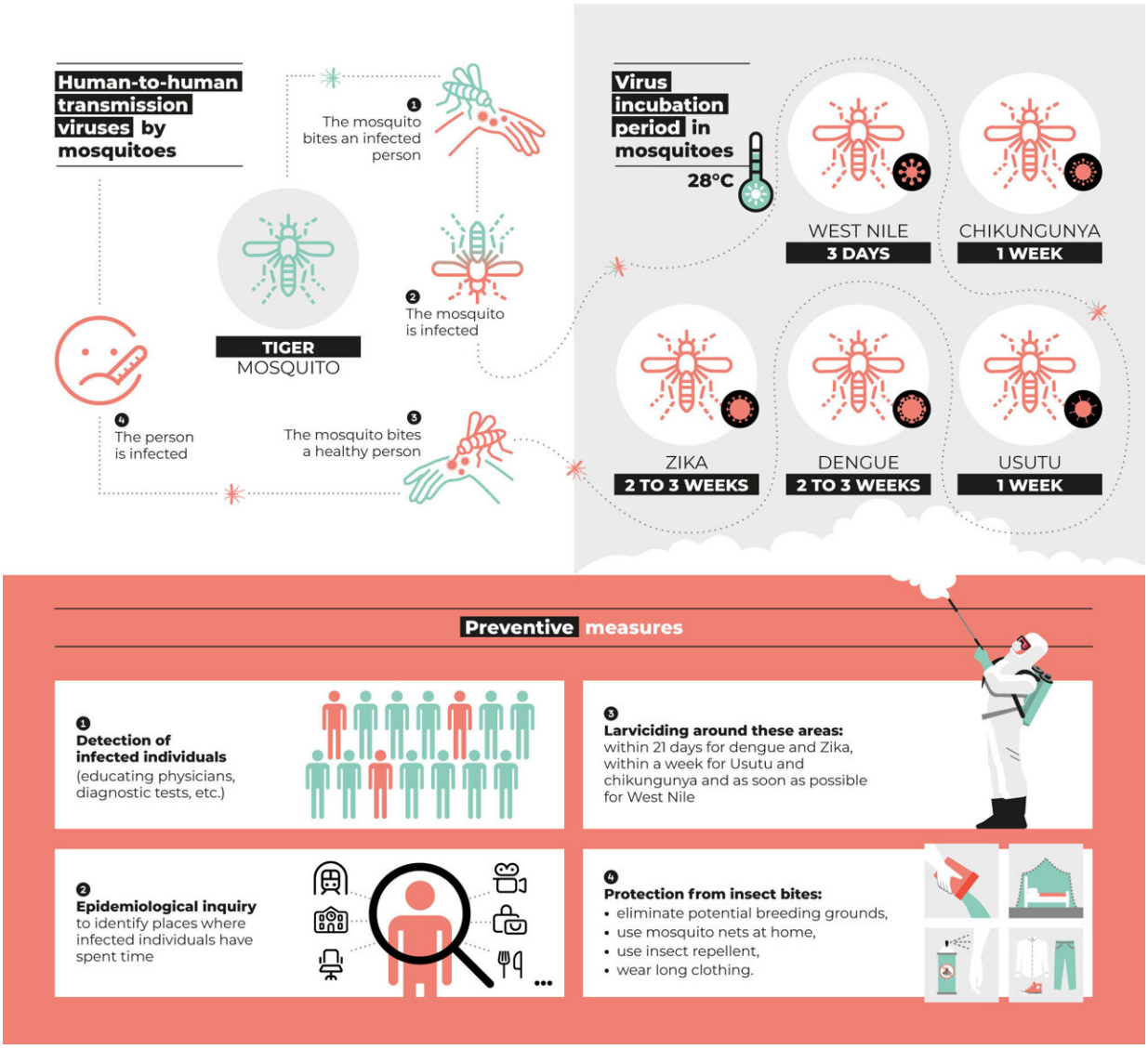

Olympics: how many days does it take for mosquitoes in Greater Paris to transmit arboviruses, and what preventive measures are needed? Credit: Institut

Pasteur

The number of imported cases of dengue in the Greater Paris region increased significantly in the first few months of 2024. In the run-up to the Olympic Games, with huge numbers of international visitors set to come to Paris, especially from endemic dengue countries, scientists say we need to be vigilant.

Scientists from the Institut Pasteur, in collaboration with the Regional Mosquito Control Agency (ARD) and the National Reference Center for Arboviruses (Inserm-Irba), have demonstrated that the tiger mosquito, now present in Greater Paris, is capable of transmitting five viruses (West Nile, chikungunya, Usutu, Zika and dengue) within different time frames ranging from three to 21 days, at an external temperature of 28°C.

These results highlight the importance of stepping up surveillance of imported cases of arboviruses this summer. The study was published on May 16 in *Eurosurveillance.*

Between January 1 and April 19, 2024, 1,679 imported dengue cases were reported in mainland France, 13 times more than the number reported over the same period the previous year. It is likely that this number will increase during the Olympic Games, as more people come to Paris from countries that are endemic regions for other arboviruses.

The vector for dengue transmission is Aedes albopictus, more commonly known as the tiger mosquito. Arboviruses are transmitted when a female mosquito bites a virus carrier and ingests viral particles.

One particular feature of arboviruses is that they can replicate in

mosquitoes (unlike other viruses such as influenza, which are destroyed when ingested by mosquitoes). The viral particles multiply and spread within the mosquito, reaching the salivary glands in a few days. When the female mosquito bites another human, she injects the virus while taking her blood meal.

The tiger mosquito is now present in 78 départements in mainland France, and this together with other climate change-related factors is facilitating vector-borne transmission.

Scientists from the Institut Pasteur's Arboviruses and Insect Vectors Unit, in collaboration with the Regional Vector Control Agency (ARD) and the National Reference Center for Arboviruses (Inserm-Irba), therefore decided to analyze the ability of Aedes albopictus in Greater Paris to transmit five arboviruses at a temperature of 28°C, which is likely in the region at this time of year, and counted the number of days between initial infection and the possibility of the virus being transmitted through a further mosquito bite.

As well as the dengue, chikungunya and Zika viruses, which we already know can be transmitted by the tiger mosquito, the scientists studied the Usutu and West Nile viruses, which are naturally transmitted by another mosquito species, Culex pipiens (known as the "common mosquito"). Culex pipiens mosquitoes transmit viruses to humans after feeding on birds, which act as viral reservoirs.

Tiger mosquito susceptible to five arboviruses

Working in a BSL3 laboratory, the scientists studied the ability of tiger mosquitoes to transmit these five viruses and determined the extrinsic incubation period required for the virus to reach the mosquito's salivary glands in sufficient quantities to infect a human. At 28°C, West Nile virus needs three days before it can be transmitted to humans by

mosquitoes. The incubation period is three to seven days for chikungunya and Usutu, and 14 to 21 days for dengue and Zika.

This information is crucial to gauge the additional risk represented by the upcoming Olympic Games in Paris, which will see significant intermingling of populations combined with the return of travelers from endemic regions and a season conducive to mosquito proliferation. The findings can also be used to develop suitable control strategies.

"If a case of dengue is detected in the Greater Paris region, we now know that disinsection is required within 21 days. We can use these results to adjust our time frame for action and optimize our approach," explains Anna-Bella Failloux, Head of the Institut Pasteur's Arboviruses and Insect Vectors Unit, who led the study. "Depending on the temperatures we experience in and around Paris this summer, our findings will be essential for adjusting control measures as needed."

What precautions should be taken in the run-up to the Olympics?

Health care professionals are trained to detect the symptoms of arboviruses if people indicate that they have recently been to an endemic country. The difficulty of surveillance is that many cases are asymptomatic: although dengue is a notifiable disease, up to 80% of cases lead to few or no symptoms.

If a diagnosis of one of these diseases is confirmed, an inquiry is carried out by France's Regional Health Agencies to determine where the individuals live or spent time in the days before the diagnosis, so that they can identify the areas where disinsection is needed. Anyone coming back from a foreign trip who experiences fever or aches is advised to see their family physician immediately and indicate the region they recently

returned from.

"The alert system in France is effective. The applicable procedure and measures are already well established because France's overseas territories in endemic regions have provided us with expertise in these diseases and know-how on epidemiological monitoring. My team is affiliated with the Arbo-France network, and we are contacted as soon as an arbovirus is detected," continues Anna-Bella Failloux.

Since 2006, vector control measures in France have led to increased surveillance of tiger mosquitoes between May 1 and November 30 each year.

This involves monitoring mosquito populations in areas where they are likely to be present; disease surveillance coordinated by Santé publique France based on reporting of viruses such as dengue, chikungunya and Zika by health care professionals; and raising awareness among people living in areas where mosquitoes have been reported.

France's Regional Health Agencies (ARS) and their operators are responsible for managing reporting, monitoring the presence of mosquitoes and taking rapid action in response to human cases of infection (vector control).

This research, which focused on mosquitoes in the Greater Paris region for this first study, will soon be extended to the rest of mainland France. Extrinsic incubation periods vary from one tiger mosquito population to the next because of differences in their genetic makeup and in local temperatures.

More information: Chloé Bohers et al, Aedes albopictus is a competent vector of five arboviruses affecting human health, greater Paris, France, 2023, *Eurosurveillance* (2024). DOI:

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