Anti-mosquito fabrics for malaria prevention

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Mortality cages with mosquitoes next to an air sampling device for the spatial repellency study at the National Institute of Hygiene and Epidemiology in Hanoi, Vietnam. Credit: Duke-NUS Medical School and the National Institute of Hygiene and Epidemiology in Hanoi

Malaria causes almost a half-million deaths every year worldwide. While the majority of people affected by this mosquito-borne parasitic

infection are in Africa, a smaller percentage of cases are also found in Southeast Asia. This is the only region where the most common malaria parasite, *Plasmodium falciparum,* has shown confirmed resistance to a widely used combination drug therapy. However, we may now have another solution to counter these hard-to-eliminate parasites. A study led by Duke-NUS Medical School (Duke-NUS) scientists has found that treating fabric with an insecticide, transfluthrin, can incapacitate and kill mosquitoes found in Vietnam that transmit malaria to humans.

Together with a global team of scientists from the University of Massachusetts at Amherst, the National Institute of Hygiene and Epidemiology in Hanoi, and the Naval Medical Research Unit TWO, Duke-NUS published findings in the *Malaria Journal* earlier this year that show tremendous promise toward the prevention of malaria, as adapting these findings in the usage of mosquito nets and repellents could serve as an effective protection against malaria infection.

"Many studies have been conducted on spatial repellents, but they often focus on single mosquito species, are conducted in the field with unknown mosquito populations, or compare multiple species separately. Our team from the University of Massachusetts at Amherst, the National Institute of Hygiene and Epidemiology in Hanoi, and the Naval Medical Research Unit TWO team developed a controlled study for testing the ability of an airborne insecticide, called transfluthrin, to incapacitate or repel Anopheles dirus and Anopheles minimus, the two primary malaria vectors in Vietnam. Our findings showed that both species are sensitive to transfluthrin, but Anopheles dirus was more susceptible," explained Dr. Ian Mendenhall, Principal Research Scientist from the Emerging Infectious Disease (EID) programme at Duke-NUS, who led this study.

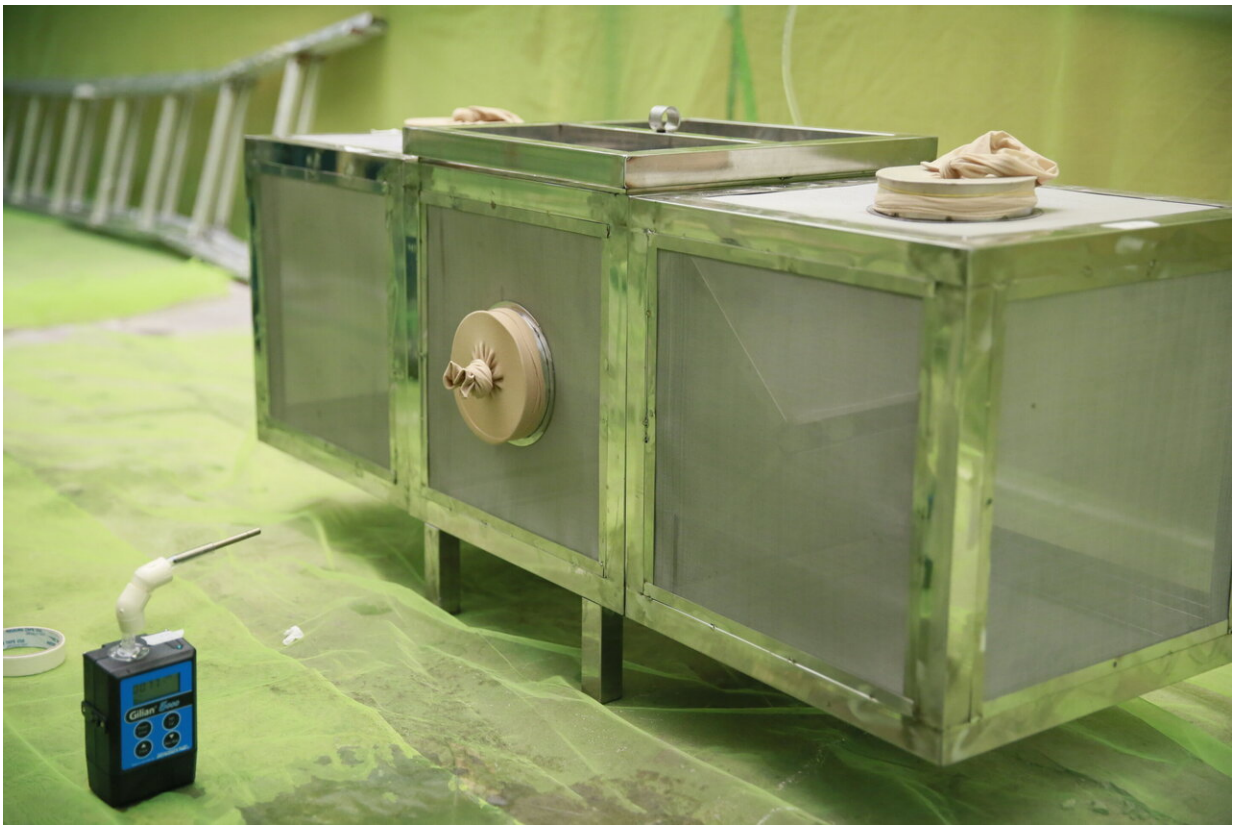
Dr. Ian Mendenhall preparing the taxis cages inside the testing enclosure at the National Institute of Hygiene and Epidemiology in Hanoi, Vietnam. Credit: Duke-NUS Medical School and the National Institute of Hygiene and Epidemiology in Hanoi

Transfluthrin is a synthetic insecticide that acts as a spatial repellent, evaporating from treated materials into the surrounding air and is of low toxicity to mammals. The team hung a large piece of transfluthrin-soaked burlap fabric at one end of an outdoor enclosure over nine days. Mosquitoes were placed in two different types of cages for this study. Spray cages were used to monitor mortality and metal-framed cages (taxis cages) were used to examine if mosquitoes were attracted or repelled by the chemical. Mosquitoes were exposed for one hour and depending on the direction of movement toward or away from the

hanging fabric, mosquitoes were classified as being attracted to, neutral to, or repelled by the airborne transfluthrin. Mosquitoes in spray cages were observed for 24 hours for mortality.

The team found that the highest rates of mosquito knockdown and mortality occurred closer to the fabric, at two and four meters away, and were greater at floor level and 1.5 meters height, compared to three meters height. The scientists also found that An. minimus was the more susceptible of the two species to knockdown.

"The results of our study are promising because it shows that spatial repellents can be a relatively inexpensive approach to minimize contact between humans and vectors, driving down transmission rates. There is potential to widely adapt these findings and implement treated bed nets and curtains into an integrated mosquito management program that could help drive down malaria infections," added Dr. Mendenhall.



A taxis cage to monitor repellency of mosquitoes used in the spatial repellency study at the National Institute of Hygiene and Epidemiology (NIHE) in Hanoi, Vietnam. Credit: Duke-NUS Medical School and the National Institute of Hygiene and Epidemiology in Hanoi

"This work being done in Southeast Asia bodes well to better understand disease hosts, such as the Anopheles dirus and Anopheles minimus mosquitoes, and how to counter them. Duke-NUS' EID programme is building up much needed expertise in a world where infectious diseases threaten to disrupt and endanger communities and economies," said Professor Patrick Casey, senior vice dean for Research at Duke-NUS.

The team recommends further studies to understand the different responses of the two species to airborne transfluthrin and its potential

impacts on developing insecticide resistance and disrupting mosquito-biting behaviours.

More information: Martin, N.J., Nam, V.S., Lover, A.A. et al. The impact of transfluthrin on the spatial repellency of the primary malaria mosquito vectors in Vietnam: Anopheles dirus and Anopheles minimus. Malar J 19, 9 (2020). doi.org/10.1186/s12936-019-3092-4

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