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Control strategy for Dengue, malaria increases risk of West Nile virus

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Mosquitoes infected with the bacteria *Wolbachia* are more likely to become infected with West Nile virus and more likely to transmit the virus to humans, according to a team of researchers.

"Previous research has shown that *Wolbachia*—a genus of bacteria that live inside mosquitoes—render mosquitoes resistant to pathogen infection, thereby preventing the mosquitoes from infecting humans with the pathogens," said Jason Rasgon, associate professor of entomology, Penn State. "As a result, researchers are currently releasing *Wolbachia*-infected mosquitoes into the wild as part of a strategy to control Dengue virus. They also are investigating *Wolbachia* as a possible control strategy for malaria."

Expecting to find that *Wolbachia* would block infection by West Nile virus in the same way that it blocks Dengue virus, Rasgon and his colleagues—which include researchers at the University of Maryland, the New York State Department of Health and the State University of New York at Albany—injected the *Wolbachia* bacteria into adult female *Culex tarsalis* mosquitoes. They then allowed the *Wolbachia* to replicate inside the mosquitoes and fed the mosquitoes a meal of blood that was infected with West Nile virus.

"We were surprised to find that *Wolbachia* infection did not block West Nile virus in this mosquito," Rasgon said. "Instead, these mosquitoes had significantly higher West Nile virus infection rates seven days after they we fed them the infected blood. In other words, *Wolbachia* infection

allowed the mosquitoes to become infected with West Nile virus faster than our controls."

The results will appear today (July 10) in *PLOS Neglected Tropical Diseases*.

"Our results point to a previously unforeseen complication—the possibility that mosquitoes rendered resistant to one pathogen by *Wolbachia* infection might become better vectors of an alternative pathogen," Rasgon said.

According to Rasgon, the team suspected that *Wolbachia* could enhance some pathogens within mosquitoes.

"Multiple studies suggest that *Wolbachia* may enhance some *Plasmodium* parasites in mosquitoes, thus increasing the frequency of malaria transmission to rodents and birds," he said.

But, he added, the team did not suspect that *Wolbachia* would enhance mosquito infection with the human pathogen West Nile virus.

"In this study, we were surprised to find that *Wolbachia* infection enhances, rather than suppresses, mosquito infection by West Nile virus," Rasgon said.

The team also found that West Nile virus enhancement in the *Wolbachia*-infected mosquitoes occurred in conjunction with the suppression of genes associated with the mosquitoes' anti-viral immune response. According to Rasgon, the researchers plan to conduct additional experiments to determine the exact mechanism of *Wolbachia*-based West Nile virus enhancement in *Culex tarsalis*.

"This is the first study to demonstrate that *Wolbachia* can enhance a

human pathogen in a mosquito," Rasgon said. "The results suggest that caution should be used when releasing *Wolbachia*-infected mosquitoes into nature to control vector-borne diseases of humans."

Provided by Pennsylvania State University