The case for greater focus on mosquitoes, ticks in epidemiology

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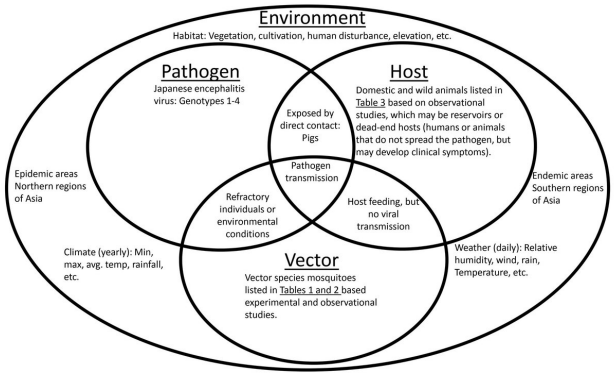

In a new article in the Annals of the Entomological Society of America, researchers at Kansas State University and the U.S. Department of Agriculture recommend the adoption of an enhanced "epidemiologic triad" for vector-borne diseases -- i.e., those spread by insects and related arthropods, such as mosquitoes and ticks. This depiction, using Japanese encephalitis virus as an example, demonstrates that controlling the vector is as important as controlling the pathogen or treating the hosts. "Rather than focusing on managing diseases at the host or pathogen level, we suggest the focus should be at the environmental and vector levels, an approach known as integrated vector management, or IVM," says Natalia Cernicchiaro, DVM, MS, Ph.D., assistant professor in the Department of Diagnostic Medicine and Pathobiology at Kansas State and senior author on the report. "Management strategies applied at these levels tend to be more sustainable and effective." Credit: Annals of the Entomological Society of America

The textbook approach to managing disease outbreaks focuses on three factors—pathogen, host, and environment—but it leaves out one critical component in the case of afflictions such as Zika, malaria, and Lyme: the insect or arthropod responsible for transmission to humans.

The emergence of the mosquito-borne Zika virus captured the world's attention in 2016, and likewise the continued rise of tick-borne Lyme disease in the United States has highlighted the need for robust response capabilities to vector-borne disease. The classic "epidemiologic triad," however, is due for a revision in the case of infections spread primarily by insects and related arthropods, and a new report in the *Annals of the Entomological Society of America* proposes a new version that better reflects the complexities of managing vector-borne diseases.

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Ana Oliveira, DVM, M.S., lead author on the report and currently a research consultant and collaborator at Kansas State, first proposed the enhanced epidemiologic triad in her thesis work. Rather than considering vectors to be a subset of the environment, the new model puts equal emphasis on vectors, pathogens, and hosts in the spread of vector-borne disease, all within the wider influence of their common environment.

"We consider that by adopting this version of the triad, which highlights the role of the vector in vector-borne disease transmission, the public health community would shift their focus into increased vector surveillance and pesticide resistance testing, which are vital parts of any integrated vector management plan," says Cernicchiaro. "Similarly, involvement and education of the community through citizen science are essential to increase the individual's role in preventing mosquito and tick bites."

Oliveira and colleagues point to the case of Japanese encephalitis as an important example of the need for adequate integrated vector management strategies. Japanese encephalitis affected approximately 68,000 people, mostly under the age of 14, in 2011, primarily in Asia and the western Pacific region. According to the U.S. Centers for Disease Control and Prevention, those infected can develop inflammation of the brain, leading to headache, high fever, disorientation, coma, tremors, and convulsions, and about one in four cases are fatal. Humans, however, are considered a "dead-end" host for the Japanese encephalitis virus; it doesn't spread from human to human. Instead, the Japanese encephalitis virus is transmitted to humans exclusively by mosquitoes that become infected after biting "reservoir" hosts such as pigs and birds.

The researchers say they hope that greater appreciation for the role of vectors in disease transmission will lead to more sustainable management methods that are cost-effective and reduce unnecessary pesticide use.

"Vector-borne diseases are complex in nature. A simple schematic does not capture the transmission dynamics; however, too complex a diagram would lose the visual connections that are applicable to all arthropod-transmitted pathogens. As such, we hope this version of the triad will be more widely adopted for describing the epidemiology of vector-borne diseases," says Cernicchiaro.

More information: "Japanese Encephalitis Virus: Placing Disease Vectors in the Epidemiologic Triad," *Annals of the Entomological Society of America* (2018). DOI: 10.1093/aesa/say025