Study reveals how deadly tick disease spreads

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Since 2003, the vectoring capacity of the brown dog tick (shown under light microscopy) has spread across the American Southwest and parts of Mexico. Credit: John VandenBrooks, Midwestern University

Findings from a new study are providing important insights into the spread of Rocky Mountain spotted fever, which is transmitted from dogs

to people through ticks. The new data are being used to create models that could help predict, and possibly prevent, future outbreaks.

If not treated within the first five days, Rocky Mountain spotted fever can cause serious organ damage in humans that may lead to death. It can cause serious illness in dogs if not treated during the early stages.

Although the disease is usually carried by the American dog tick or Rocky Mountain wood tick, the brown dog tick was identified as a new vector—or carrier—during a 2003 outbreak in Arizona. Since then, the Rickettsia rickettsii bacteria that causes the disease has spread to brown dog ticks across the American Southwest and parts of Mexico. Although the tick is present across the entire U.S., only those in Arizona and the surrounding regions are known to carry R. rickettsii.

To better understand why the brown dog tick emerged as a new vector, researchers led by John VandenBrooks, Ph.D., from Midwestern University in Glendale, Ariz., performed a detailed analysis of brown dog ticks, canine and human infections, and climatic data in Arizona, New Mexico, California and Mexico.

"Our results indicate that the spread of Rocky Mountain spotted fever involves a combination of factors and that the vectoring capacity of the brown dog tick may be spreading outside of the region," said Kayla Allwardt, a veterinary student in the VandenBrooks lab. "This could put a much larger portion of the country at risk. Identifying the highest risk regions is essential to protecting canine and human health."

Scanning electron microscopy image of the mouth parts of a brown dog tick. Credit: John VandenBrooks, Midwestern University

Allwardt will co-present the new research with veterinary student Nicolette Roe at the American Society for Biochemistry and Molecular Biology annual meeting during the Experimental Biology (EB) 2022 meeting, to be held April 2–5 in Philadelphia.

To carry out the new study, the research team applied what the Centers for Disease Control and Prevention call a One Health approach, which recognizes the interconnection between people, animals and the environment. The researchers collected ticks and dog serum samples from 25 sites for genetic analysis and mapped relevant environmental

factors.

"We found three genetically distinct populations of ticks, which vary in the percentage of ticks that carry the R. rickettsii bacteria," said Roe. "These differences are a major contributor to the variation in Rocky Mountain spotted fever cases we see across the region."

They also found that of the 16 U.S. counties surveyed, two were at high risk for an outbreak, 10 were at medium risk and only four were at low risk. Importantly, they also found high rates of Rocky Mountain spotted fever infection in dogs in areas where no human cases had been reported.

Tick and canine serum collection sites across Arizona, New Mexico, California and Mexico. Credit: John VandenBrooks, Midwestern University

The researchers incorporated the data into a model that can be used to determine where new outbreaks might occur. This could allow resources such as tick collars or prevention kits to be sent to critical areas. They have also been working to incorporate the data into a model that can determine whether a canine vaccine, which would need to be developed, could feasibly stop future spread.

The investigators plan to expand their research to examine more areas across the U.S. to determine how far infected brown dog ticks have spread. This data can then be used to develop more complete models to help predict and prevent future outbreaks.

More information: 2022 ASBMB Annual Meeting: www.asbmb.org/meetings-events/2022-annual-meeting

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