West Nile virus prediction model protects human health, empowers communities

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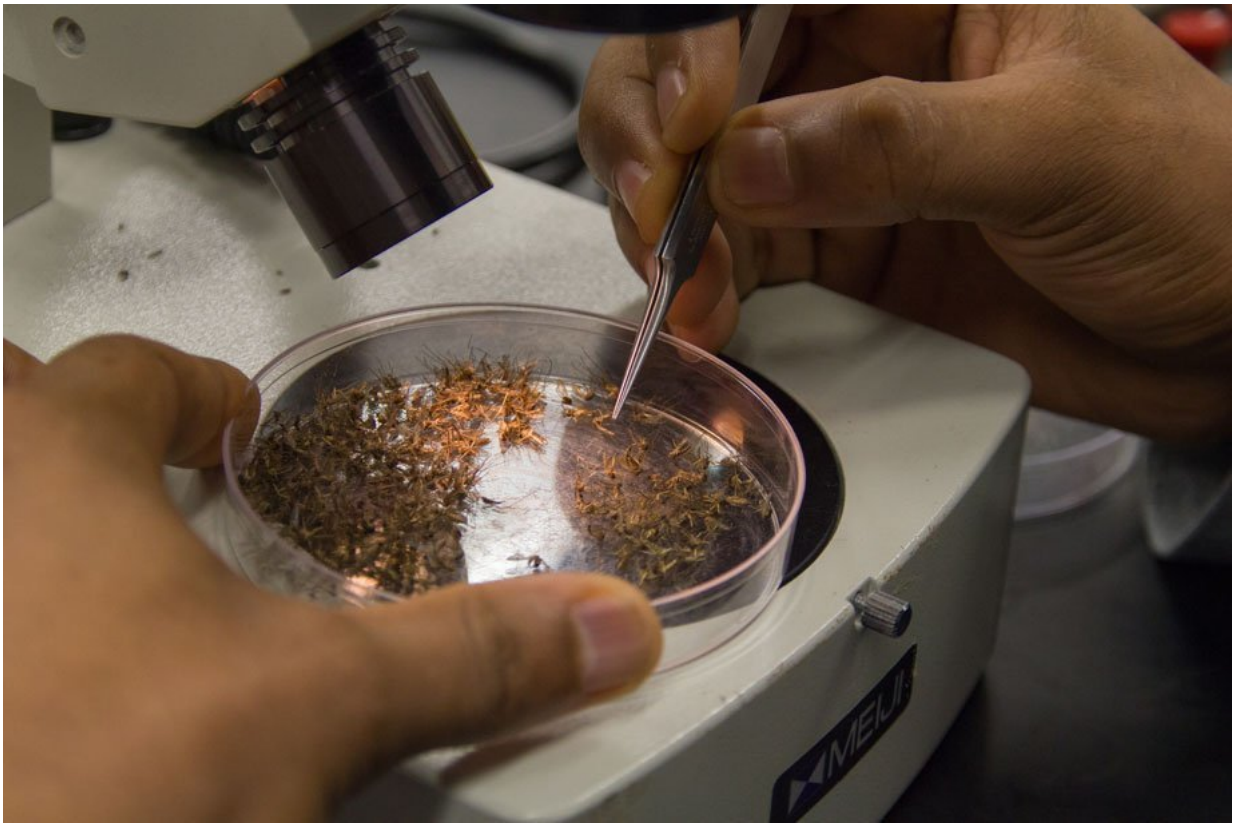

The Brookings city mosquito crew collects the traps and bring them to SDSU, where undergraduates Haileselassie Tefera and Priscilla Simon Heliso sort them by species and then send the West Nile virus-carrying Culex tarsalis to the South Dakota Public Health Laboratory to determine whether they are positive for the virus. Credit: South Dakota State University

A reliable means of predicting disease risk and communities engaged in controlling mosquito populations are helping South Dakotans get a handle on West Nile virus. It did not happen by chance.

"It was the vision of the South Dakota Department of Health that got all the players together 15 years ago," explained South Dakota State University mosquito expert Michael Hildreth, a professor in the Department of Biology and Microbiology, College of Natural Sciences. Hildreth credited State Epidemiologist Lon Kightlinger, now retired, for getting the ball rolling and the state legislature for providing funding for mosquito surveillance and control.

In 2008, Hildreth began working with Michael Wimberly, then a senior scientist at the Geospatial Sciences Center of Excellence at SDSU, who began developing a model to predict the risk of West Nile virus using environmental data from Earth-imaging satellites. The model also incorporates mosquito surveillance data and the number of human West Nile virus cases. This research has been funded by the National Institute of Allergy and Infection Diseases and NASA.

The optimized West Nile prediction model has now been handed over to the S.D. Department of Health and Joshua Clayton, who became state epidemiologist last November. Clayton earned his bachelor's degree in biology from SDSU and his master's and doctoral degrees in epidemiology from the University of Michigan.

Empowering communities

"This project has gone from basic research to empowering communities which are now vested in combating West Nile virus," Hildreth said. Cities have largely taken over the task of collecting mosquitoes, separating the species that carry West Nile virus and sending them to the S.D. Public Health Laboratory to determine whether they are positive

for the virus. Sioux Falls and Aberdeen now do their own virus testing.

Weekly updates on West Nile virus are available to the public and city officials on the Mosquito Information system (MIS) website at mosquito.sdstate.edu through support from the S.D. Department of Health, the Centers for Disease Control and Prevention and a grant from the NASA Applied Science Public Health and Air Quality Program. In the future, the prediction results will be available on the S.D. Department of Health website, and the mosquito abundance data will stay on the MIS website.

Predicting virus risk

"The prediction model assumes at the beginning of each season that it will be an average year," Hildreth explained. Weather and environmental data gathered through Earth-imaging satellite data then push that estimate higher or lower. Wimberly and his team found associations between West Nile virus and temperature, precipitation and humidity.

"At the beginning of the season, the potential error margin is fairly high, but as the weather data come in it becomes clearer," Hildreth continued. "Once we start seeing the mosquito data, that tightens up the prediction."

West Nile virus originates in the bird population but is transmitted to humans through the Culex tarsalis mosquito, he explained. After the mosquito bites an infected bird, the virus must incubate in the mosquito before it can be transmitted to humans. Community mosquito surveillance crews work with the S.D. Department of Health to determine when and how many mosquito pools test positive for the virus. These data are added to environmental data from NASA to make the West Nile virus risk predictions.

The two-man Brookings City mosquito surveillance crew begins trapping

mosquitoes in mid-May and wraps up in September, according to Josh McClain, head of mosquito control for the city of Brookings. However, postdoctoral fellow Justin Davis, who has been helping develop the model for three years, said the mosquito surveillance timeline can be shortened to mid-June through mid-August without affecting the accuracy of the model. "This will help communities reduce mosquito trapping and testing costs," he noted.

"What this model does is notify the public of the risk level assuming no preventive measures are taken," Clayton said. "The crux of the story is the translation of research into something to protect public health."

Provided by South Dakota State University