Novel technology could provide a faster, inexpensive way to detect, monitor dengue fever, Zika virus

March 22 2017

Lia Stanciu, a Purdue professor of materials engineering, is developing a faster, less expensive integrated biosensing platform to detect and monitor mosquito-borne diseases. The technology aims to prevent virus outbreaks such as Zika, dengue fever and West Nile virus and their devastating effects. Credit: Purdue University photo / Mark Simons

Purdue researchers are developing an integrated biosensing platform aimed at detecting and monitoring mosquito-borne diseases faster and cheaper than current methods, to aid in preventing virus outbreaks and their devastating effects.

Lia A Stanciu, a Purdue professor of materials engineering, is leading the research and development of the technology. Additional researchers are Ernesto Marinero, professor of materials engineering and electrical and computing engineering; and Richard Kuhn, professor and department head of biological sciences and director of the Purdue Institute for Inflammation, Immunology and Infectious Diseases. Kuhn also led the research team that were the first to determine the structure of the Zika virus.

"Over one billion people around the world suffer from one or more neglected tropical diseases (NTD). These diseases, such as dengue fever, yellow fever and the West Nile virus, are classified as NTDs because they largely affect poor populations in the developing world and are a low public health priority for developed continents like North America and Europe," Marinero said. "NTDs, as well as the Zika virus, are transmitted by vectors such as mosquitoes and ticks. Climate change and an increase in travel are causing these types of diseases to steadily spread around the globe, which increases the need for better monitoring and detection methods to help prevent outbreaks."

Stanciu said that current detection methods for neglected tropical diseases are often time-consuming, expensive and complicated.

"Laboratory techniques that detect viruses aren't very efficient and require patients to go to a hospital and wait some time for their results, which isn't always possible in developing countries," she said. "By the time people realize they need to start monitoring a disease it's often too late and an outbreak has emerged. We want our technology to be able to

be the first to detect and monitor a disease so that preventive measures can be taken to avoid or lessen the effects of devastating outbreaks."

Stanciu, Marinero and Kuhn have developed an amperometric biosensor that utilizes functionalized nanoparticles that specifically bind to the target viruses' DNA or RNA. When the binding occurs there is a change in the device resistance, which the sensor employs to unambiguously detect the presence of the virus. The sensor can then determine whether or not a blood or mosquito sample has the virus and how much of the virus is present. The sensor relies on an agent that will only respond to the intended virus to be detected.

"We've used mosquito samples on our laboratory scale sensor and we've been able to detect the virus showing a high sensitivity rate to low concentrations of the virus," Stanciu said. "We've been especially interested in the dengue and Zika virus because it's the same mosquito that transmits both diseases, so our technology would be able to quickly detect one of those diseases using the same platform."

Marinero said there are many ways in which they plan to further develop their device.

"Our first and foremost goal is to have a point of care, potentially a personal device, which is simple to use. This would allow people to detect the virus promptly without having to go to a hospital, which would have significant impacts in developing countries," he said. "However, we're also working on an autonomous device that is deployable in remote field areas that are difficult to access or difficult to perform in-site detection, to monitor outbreaks in these areas."

The device will operate through a low-power wireless network and will use thin-film rechargeable batteries combined with thin-film photovoltaics to power and harvest energy from the environment to

maintain functionality and performance without human intervention. When a disease is detected in a mosquito sample it will send an alert to health control officials about the potential threat.

Stanciu said they are seeking funding to further develop the technology.

"At this point we're satisfied with our technology meeting its objectives in the lab and we are ready to begin prototyping. Funding will allow us to develop the autonomous capabilities so the device can be deployed remotely," she said. "With the Zika outbreak and other mosquito-borne viruses becoming even more prevalent, we think building a platform of biosensors that uses a chip to detect a variety of viruses in one device can make a real difference in mitigating the spread of such diseases and help people across the globe."

Provided by Purdue University

Citation: Novel technology could provide a faster, inexpensive way to detect, monitor dengue fever, Zika virus (2017, March 22) retrieved 17 July 2024 from https://medicalxpress.com/news/2017-03-technology-faster-inexpensive-dengue-fever.html