ZEROING IN ON ZIKA

Latin America and Canadian scientists are working on a portable diagnostic technology that could be a game-changer in the battle against diseases such as Zika.

POSTED BY BRIAN BANKS ON JULY 25, 2018

Zika. Dengue. Yellow Fever. Chikungunya.

In the developed world, these mosquito-borne infections are the stuff of fearful headlines, graphic images and stories of outbreaks in far-away lands.

But in rural and low-income areas of Latin America, where these pathogens are endemic, they're a clear and present danger.

Yet the viruses' presence in these regions is only part of the problem. Compounding the threat is the fact that diseases such as Zika and dengue are hard to isolate and tell apart without sophisticated testing in labs located in just a handful of large urban centres. That leads to long delays between disease outbreaks and their diagnosis and treatment.

"You want to be able to contain an outbreak as soon as you can," says **Keith Pardee, Canada Research Chair** in synthetic biology and human health and an assistant professor at the Leslie Dan Faculty of Pharmacy at the University of Toronto. "But right now, when someone has symptoms of infection, those samples are put on ice and transported to larger centres. In outbreaks, that infrastructure can be overwhelmed or basically just isn't in the right place."

Pardee's solution? He's leading the development of a portable diagnostic technology that can distinguish different diseases — and different strains of those diseases — as accurately as the current laboratory gold standard, yet is easily deployed to the site of an outbreak, requires no sophisticated equipment or technical knowhow to run and yields results in hours, not days or weeks.

His team is now midway through a three-year **project** jointly funded by the International Development Research Centre and Canadian Institutes of Health Research to refine the technology and begin field-testing and trials with three national research labs in Brazil, Ecuador and Colombia. This project is focused specifically on Zika but Pardee says the technology can be easily adapted to target dengue, Chikungunya, yellow fever, Ebola or even HIV.

The science of synthetic biology underlying this work is cutting edge, involving CRISPR gene editing and programmable gene circuit-based sensors extracted from cells and freeze-dried for non-refrigerated transport. But the application is incredibly simple. A nurse or doctor merely has to take a prick of blood or a urine sample from a patient, put a drop on a microchip cartridge and insert it in a small, portable machine. Within hours, a paper readout changes colour — think litmus paper or a pregnancy test — to indicate the presence or absence of the virus.

"In Brazil, few Zika cases are laboratory-confirmed because the lack of resources and the fact current diagnostic technology

Darius Rackus, a member of Keith Pardee's lab at the University of Toronto, assembles portable diagnostic equipment that will be used to test for Zika and other diseases in South America. (Photo: Pardee Lab, University of Toronto)

is expensive and requires special equipment," says Lindomar Peña, a principal investigator in the virology department at the **Oswaldo Cruz Foundation** in Rio de Janeiro, one of Pardee's partners in Latin America.

Peña's lab was one of the first to detect Zika in Brazil in 2016 and report its related neurological and developmental defects. He says he is "thrilled" to be working with Pardee and his peers at Ecuador's National Institute of Public Health Research and El Bosque University in Colombia, calling it "a great opportunity" to overcome their current diagnostic limitations.

The first phase of their joint work, which is expected to be running at full capacity in August, is focused on comparing the accuracy of Pardee's technology with the gold-standard diagnostic process on patient samples gathered in affected areas. Samples are processed using small portable computers built by two research assistants in Pardee's lab. That data is then uploaded to the cloud so Pardee can compile and analyze it. A low-end industrial version of the same computer would cost at least $15,000, says Pardee, but "we built ours for $300 to $350."

The project's second field phase, slated to start in January, will see the portable devices taken out of the labs and into the countryside "This box, if you put a battery on it, can run for nine hours," says Pardee. "So you could literally have it in your car and do this anywhere."

By the time the project ends, Pardee hopes to have screened 3,000 patient samples in the lab and done 100 to 200 tests in the field. "For it to become a certified diagnostic technology there's still quite a bit of work to do," he says. "But we're on the road to that."

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READING AS THINKING

1. a) Skim the article and highlight key words. Sort the words into themes below.

b) Using as many keywords as possible, write the main message that the writer is trying to share.

2. What would you say is the biggest barrier to diagnosing mosquito-borne infections in rural and low-income areas of Latin America? Justify your answer.

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3. Give some possible reasons why test labs are located mostly in urban centres.

a) Explain the benefits of a portable diagnostic technology that can distinguish different diseases in Latin America.

4. b) Explain how this technology could benefit Canada.

5. Why are so few Zika cases laboratory-confirmed in Brazil?

6. Suggest some reasons why Keith Pardee's team was able to build portable computers that could process the samples for only $300-$350 when the same industrial version cost at least $15,000.

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7. Pardee's research is supported by the International Development Research Centre and Canadian Institutes of Health Research. Discuss the importance of partnerships and give an example from your own life.

8. In the article, Keith Pardee says, "For it to become a certified diagnostic technology there's still quite a bit of work to do. But we're on the road to that." What work do you think is ahead?

Think-Pair-Share

Think

1. Pick a mosquito-borne infection other than Zika. Find out where in the world the outbreaks for that particular disease occur and why they occur there in particular.

Pair

2. With a partner, choose one of the two mosquito-borne infections that you have researched and develop an informative advertising campaign (print, social media, video, etc.) to make people aware of the portable diagnostic technology and how it works. Adapt your campaign for your market, who are those that live in the regions affected by outbreaks of your chosen infection.

Share

3. Each group can share their campaign with the class.

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ONLINE

1. Using Google Maps, locate Rio de Janeiro in Brazil and explore the city by using Street View and the satellite and map modes. Using the quick facts section and other research tools find the following:

    a. The population
    b. The neighbouring cities
    c. Major bodies of water
    d. The neighbouring countries

2. Familiarize yourself with the Zika virus and its prevention
3. How many Zika cases were found during the 2016 Olympics? Find the answer here.
4. Watch Keith Pardee discuss how the diagnostic test for the Zika virus works.
5. What exactly is a virus? Find out here.
6. Learn about Chikungunya.
7. What exactly is CRISPR gene editing?

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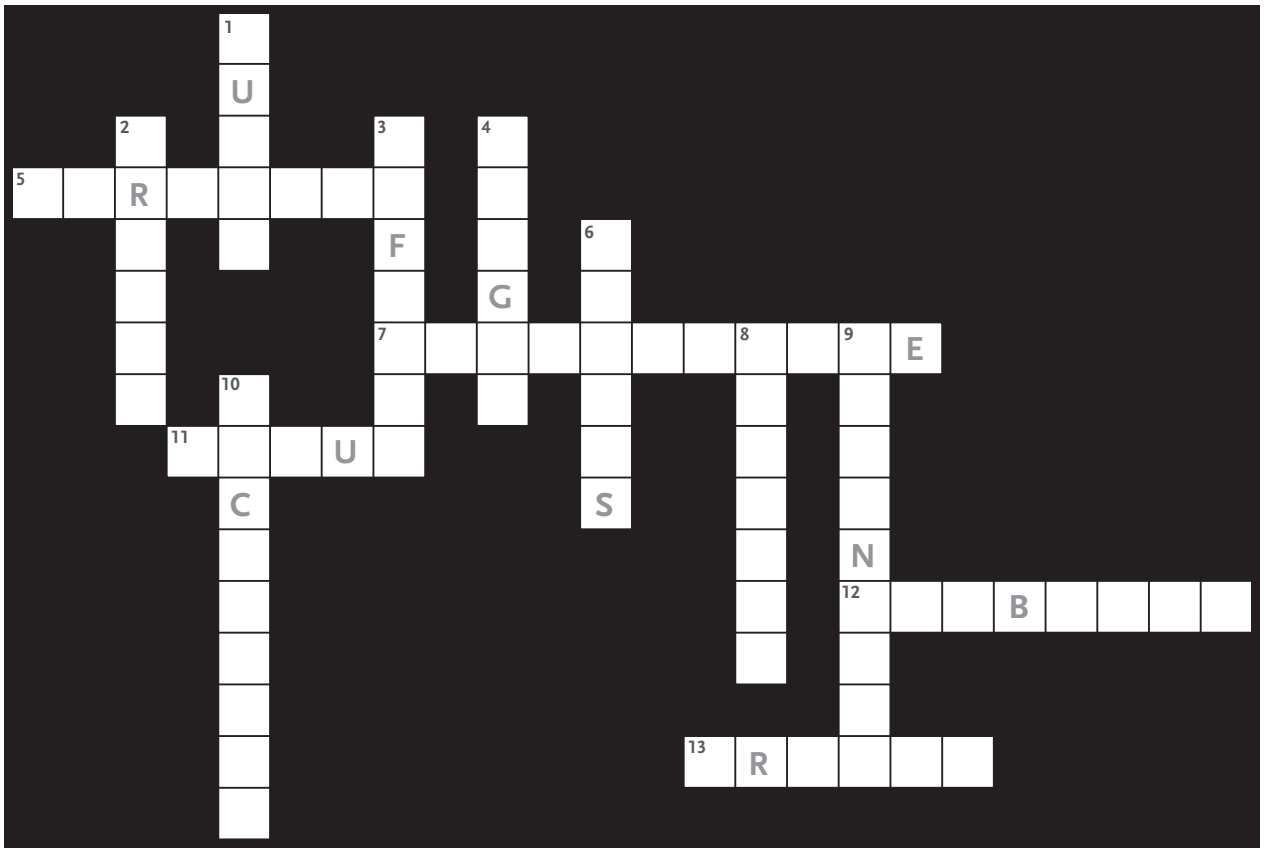

CROSSWORD:

Across

5. Conveniently transported
7. A rural area
11. An infectious microorganism
12. Epidemic
13. A type of gene editing

Down

1. The type of health that Keith Pardee specializes in
2. The country in which Zika was first detected
3. Zika virus causes these
4. A mosquito-borne infection
6. A type of paper that changes colour and is used for testing purposes
8. Specimens
9. Identification of a disease
10. The type of cartridge used for portable diagnosis