

TINY cancer detection device proves effective in Uganda testing

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Doctoral student Ryan Snodgrass heats up the TINY diagnostic device using sunlight at the AIDS Healthcare Foundation-Uganda Cares Clinic in Masaka, Uganda, in 2017. The energy stored from the sun negates the need for electricity, which may be unreliable in such locations. Credit: Cornell University

Its name is an acronym used to convey its size, but researchers at Cornell Engineering and Weill Cornell Medicine are hoping their hand-held cancer detection device's impact in the developing world is anything but

small.

About half the size of a lunch box, the Tiny Isothermal Nucleic acid quantification sYstem (or TINY) has shown promise as a point-of-care detector of Kaposi sarcoma-associated herpesvirus (KSHV) in resource-limited settings such as sub-Saharan Africa. Early testing has resulted in about 94 percent agreement with traditional methods, with results being generated in a matter of hours instead of weeks.

Developed by a team led by David Erickson, the Sibley College Professor of Mechanical Engineering, and Ethel Cesarman, M.D., professor of pathology and laboratory medicine at Weill Cornell Medicine, TINY met its goals in the first round of funding from the National Institutes of Health. The team is planning expanded testing over the next several years.

Results of the team's field testing of the device in 2017 in Uganda are detailed in the paper, "A Portable Device for Nucleic Acid Quantification Powered by Sunlight, a Flame or Electricity," published Sept. 11 in *Nature Biomedical Engineering*. Ryan Snodgrass, doctoral student in the Erickson lab, and Andrea Gardner, researcher technician at Weill Cornell Medicine, are first and second authors.

Kaposi sarcoma (KS) is a cancer that develops in lymph or blood vessels, and usually appears as lesions on the skin, inside of the mouth or internally. There are four types of the disease; epidemic, or AIDS-associated, KS is the most common in sub-Saharan Africa and is AIDS-defining. That means when someone with the HIV virus is diagnosed with KS, they officially have AIDS.

Early detection leads to better outcomes, but that's not always possible in the developing world, where pathological testing can take one to two weeks. "There's a problem with being able to diagnose it there,"

Erickson said. "A number of things look like KS ... and the time it takes for a traditional diagnosis, one to two weeks, makes it tough."

TINY has shown the ability to generate results in approximately 2½ hours.

Now in its third generation, TINY performs loop-mediated isothermal amplification (LAMP) for nucleic acid quantification. That requires heating the sample to 154 degrees, which necessitates a power source.

One of the main benefits of TINY: It can collect and store heat generated from electricity, the sun or even a Bunsen burner, and will function even during temporary power disruption, of which three occurred during testing in Uganda. TINY's power flexibility is important because in many sub-Saharan African countries healthcare facilities lack access to reliable electricity.

For the study, Erickson's team collected biopsy samples from 71 patients in Uganda suspected of having KS and tested the samples with TINY as well as via quantitative polymerase chain reaction (qPCR), the current standard for nucleic acid quantification. Agreement between TINY and qPCR was 94 percent (67 of 71), and the team showed that all disagreement stemmed from assay limitations and not TINY capability.

Not only can TINY be carried to remote locations for point-of-care use, it could also be valuable in clinics and hospitals where electric power can be unreliable. "Both applications can enable nucleic acid diagnostics to reach more of the population in [low- and middle-income countries]," the group concluded in its report.

"As a pathologist who knows how difficult it can sometimes be to diagnose KS," Cesarman said, "it is very exciting to collaborate with engineers that invented a brilliant new device that makes it so easy to

support or discard a diagnosis of KS in less than three hours from the time a biopsy is taken."

Future work on TINY will include expanding testing to more locations in Africa, South America and the U.S., and developing a commercialization plan. The group has applied for patent protection through Cornell's Center for Technology Licensing.

Erickson and Cesarman began work on this device approximately five years ago. "Where we are now," Erickson said, "is beyond the best-case scenario I could have envisioned when I wrote the proposal."

And Snodgrass, who's been to Uganda twice testing TINY, said it's "very rewarding to build a device, take it there and see it used on real patients."

More information: Ryan Snodgrass et al. A portable device for nucleic acid quantification powered by sunlight, a flame or electricity, *Nature Biomedical Engineering* (2018). [DOI: 10.1038/s41551-018-0286-y](https://doi.org/10.1038/s41551-018-0286-y)

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