Mobile-phone microscope detects eye parasite

Tool demonstrates new thinking for diagnostic technologies in remote locales.

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A device that mounts on a mobile phone is used to diagnose African eye worm at a clinic in Cameroon.

To diagnose diseases in people living in remote locations, clinicians have traditionally preferred a low-tech approach because battery-powered electronic devices can be too delicate and fussy for clinics in the developing world. But now that mobile phones have penetrated almost every corner of the globe, that aversion is eroding rapidly.

In a study in *Science Translational Medicine* on 6 May, bioengineer Daniel Fletcher of the University of California, Berkeley, and his colleagues give one example of how mobile phones may change medicine in far-flung areas. They describe a camera-phone microscope and app that can immediately detect the presence of the African eye worm parasite *Loa loa* in a blood sample.[1]

An endemic problem in Central Africa, *L. loa* grows into a worm that wiggles into the tissue of the eye. The worms are even more problematic when they are picked up along with two other parasitic nematodes, *Onchocerca volvulus* (which causes river blindness) and *Wuchereria bancrofti* (which can cause severe limb swelling). This is because one drug typically given to treat those two other parasites, called ivermectin, can cause serious side effects such as brain swelling if a person is also infected with *L. loa*.

Co-parasitism of this kind is common, says infectious-disease specialist Isaac Bogoch of the University of Toronto, Canada. Quickly finding out whether patients infected with *O. volvulus* or *W. bancrofti* also have *L. loa* in their blood is important for deciding whether ivermectin can be safely administered. By converting a phone into a microscope, clinicians have a portable way of checking blood samples.

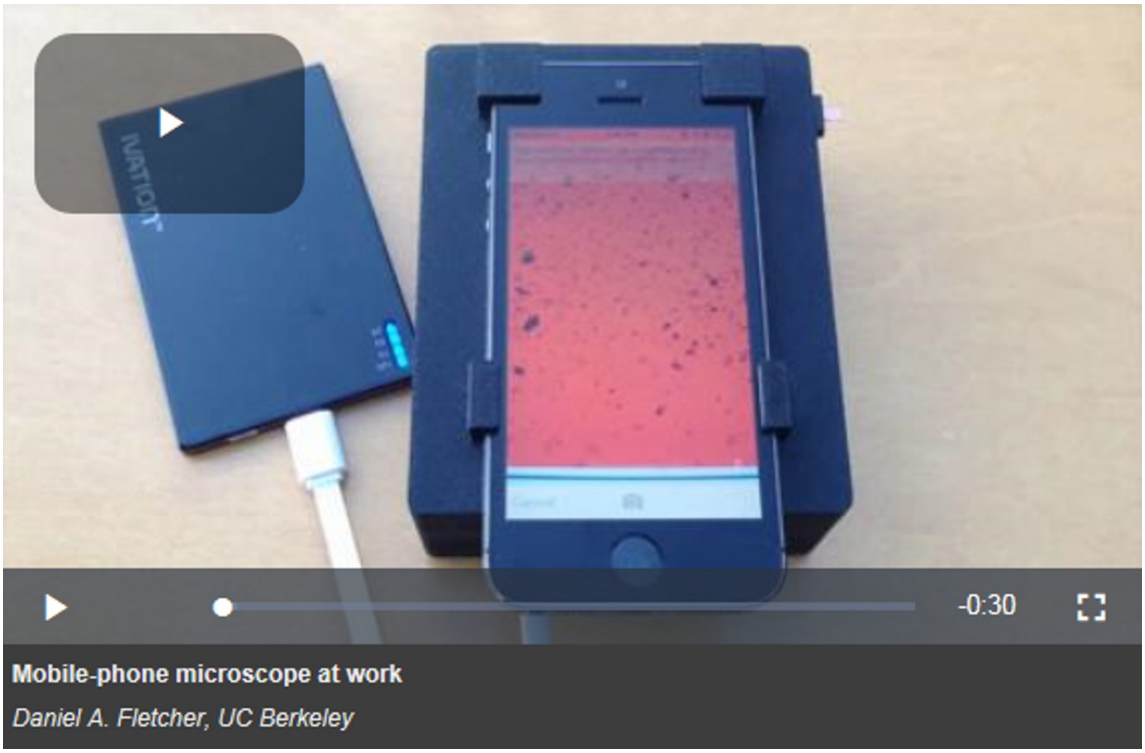
A closer look

Mobile-phone microscopes are not new — they can be bought online and have appeared as nifty science-fair projects. And their use in difficult public-health settings has also been proposed previously: in 2009, Fletcher showed with a different group of colleagues that a mobile-phone microscope they designed could identify the bacteria that cause tuberculosis[2]. Other mobile-phone microscopes are being tested to look for infection by blood flukes[3].

But as Samuel Sia, a biomedical engineer at Columbia University in New York, points out, earlier models were not a big improvement

over a traditional microscope for use in the field because all they did was magnify. “You’d have to collect a specimen, smear it, stain it and dry it on a slide. Sure, if you have a microscope you can look at it, but what about all those other steps?”

The latest invention by Fletcher and his team, by contrast, avoids that rigmarole — it requires simply loading a blood-containing capillary onto a 3D-printed plastic case containing a lens. The plastic shell slides over an iPhone, aligning the device's lens to its camera.



An app on the phone then takes a video of the magnified blood sample and uses an algorithm to look for movements in the fluid that match up with characteristics of *L. loa*. Based on this, the app accurately counts how many parasites are present. It has to be used around midday, during the brief period when *L. loa* typically are active but the other two nematodes are not.

This application could be modified to diagnose other parasitic infections, says Fletcher. Researchers are already working on phone software to detect soil-transmitted helminths such as hookworm and whipworm.

Devices like these have encouraged more engineers and clinicians to embrace diagnosis tools based on consumer electronics, says Sia. But first the devices must be shown to work in the field. A large experiment to test the *L. loa* detection system will get under way this year.

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References

1. D'Ambrosio, M. V. *et al. Sci. Transl. Med.* **7**, 286re4 (2015).
2. Breslauer, D. N., Maamari, R. N., Switz, N. A., Lam, W. A. & Fletcher, D. A. *PLoS ONE* **4**, e6320 (2009).
3. Ephraim, R. K. D. *et al. Am. J. Trop. Med. Hyg.* http://dx.doi.org/10.4269/ajtmh.14-0741 (2015).