High-quality cancer diagnosis for resource-poor locations

Smartphones have just become a little smarter. A research team at Massachusetts General Hospital (Boston, MA, USA) has turned a standard smartphone into an instrument to diagnose cancer, but without the expense, technology, and pathology expertise required for a diagnostic workup in a well-equipped health facility.

The team's work is based on a combination of light diffraction, molecular immunobiology, and computer science. "The major merit of this device", says Cesar Castro (Massachusetts General Hospital, Boston, MA, USA), co-lead author of the report, "is that it makes rapid, accurate, molecular diagnosis possible for patients and their care-givers wherever they live, such as in rural regions without ready access to health facilities. We will soon be field-testing our device in Botswana, a country with two million people and just a handful of pathologists."

The device consists of a small imaging module clipped onto the smartphone's camera section. The module focuses light from the smartphone through a tiny pinhole onto biopsy samples that have been mixed with micrometre-sized polystyrene beads carrying antibodies against known cancer-related protein markers or DNA sequences. Each bead contains a unique cancer marker. Beads used to differentiate malignant lesions from benign lesions are available from several growing bead libraries.

The light shining on the bead-coated samples produces diffraction patterns—similar to the ripples produced by a stone thrown into a pond—each corresponding to a cell or bead in the sample. These patterns are recorded by an application on the smartphone, which transmits the data to a cloud-based server. The data is reconstructed and returned to the phone for direct on-screen visualisation of bead-coated cells.

Pilot studies for cervical cancer screening have shown that the smartphone device is as accurate as conventional methods, produces results more rapidly, taking less than 45 min for a single assay versus days for traditional pathology, and is cost-effective. Castro says he is "very encouraged" by the response of oncologists and global health researchers: "Our next step will be to submit our work to funding agencies with global perspectives to validate its potential in highly underserved areas."

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For the **study by Im and colleagues** see *Proc Natl Acad Sci USA* 2015; published online April 13. http://www.pnas.org/content/early/2015/04/08/1501815112.full.pdf