Mobile phones offer heart lifeline

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The final prototype: the microphone of a hands-free kit fixed at the base of an egg-cup using blue-tack. A rubber o-ring and a plastic transparency are fixed to the other end to ensure a good seal with the chest.

Technology that turns low-cost mobile phones into sophisticated stethoscopes could save thousands of lives in poor countries.

The kit, developed by Oxford University and South African researchers, enables people to record and analyze their own heart sounds using a mobile phone microphone.

Patients then send the recordings to medics who can remotely monitor their condition.

The idea came from a conversation between Thomas Brennan of Oxford University's Department of Engineering Science and Bongani Mayosi of the University of Cape Town about how to reduce the numbers dying of

tuberculous pericarditis: a condition affecting up to 2% of TB patients where the lining of the heart becomes infected.

"About 40% of people die post-diagnosis, largely because the onset of symptoms is insidious and they can't get into the clinic before it's too late and they die of cardiac arrest," Thomas tells me.

"We discussed various ideas of being able to remotely monitor their heart in a low-cost way to pick up early signs of deterioration. The idea of using the phone's microphone as a stethoscope to analyse and record heart sounds came after seeing the iPhone app iStethoscope, and I wondered if we could do something similar using low-cost phones."

As half of all Africans own a mobile phone the number of patients who could potentially benefit was enormous.

Thomas teamed up with Gari Clifford of Oxford's Institute for Biomedical Engineering (IBME) who had worked with Katherine Kuan, a student at MIT, on listening technology for smart phones. They extended that work to enable low-cost phones to effectively capture and analyse the resultant phonocardiogram (PCG) recordings to assess the feasibility of the project.

"The original idea was that a person could use their own phone to record their heart sounds," Thomas explains "and that any phone would be able to make an adequate heart sound recording at little or no cost using readily available objects, from which heart rate and abnormal heart sounds could be detected."

Before they could create a device a number of technical challenges had to be overcome: low-cost phones are designed for voice so they had to deal with distortion introduced by the phone, signal processing techniques were needed to identify a poor recording and ask the user to

try again, and algorithms had to be developed that could reliably identify heart rate and heart sounds.

"The biggest challenge was in assessing the feasibility of the device," Thomas comments. Between January and April 2011 the team ran a clinical trial, in partnership with Groote Schuur Hospital, Cape Town, to compare two mobiles - a Nokia 3110 Classic and an iPhone 3G - with the £400 3M Littmann Electronic Stethoscope.

They collected phonocardiograms from 150 volunteers with a range of cardiac conditions using the Littmann, the iPhone, and the Nokia 3100 Classic. The trial showed that the Nokia actually out-performed the Littmann in estimating heart rate, although it had to discard more low signal quality recordings.

After these promising results the team are pressing ahead with the next stage of the project:

"Alongside a MSc student, David Springer - who worked with me in developing the algorithms - we're developing an Android application to record and process the heart sounds recordings," Thomas tells me.

"The next step is to expand the scope of the device to see if it can be used as a screening tool for patients with heart disease, particularly rheumatic heart disease, which has a particularly high prevalence in southern Africa."

Provided by Oxford University