Researchers developing cellphone app that detects TB

TB patients have a distinct sounding cough compared to healthy people, and people with other respiratory diseases Stellenbosch University (SU) scientists are developing a mobile application that will be able to distinguish a cough caused by tuberculosis (TB), from non-TB-related coughs.

Source: Institute of Infectious Disease and Molecular Medicine.

This innovation will be used as a screening tool to determine which patients require further testing, thereby fast tracking the TB diagnosis process.

The cutting-edge project, called Cough Audio Triage for TB (Cage-TB), is conducted by researchers in the Clinical Mycobacteriology and Epidemiology (Clime) group in SU's division of molecular biology and human genetics, along with partners in Europe and Africa.

"Mobile-based cough audio classification represents a potential holy grail for triage testing, with no specimens collected and negligible cost. Inexpensive smartphones have high-quality microphones and computational power to analyse audio on-device," says Clime's Grant Theron, the lead investigator on the project.

"The Cage-TB app represents a tremendously exciting opportunity to transform TB diagnosis at scale, ensuring more people are tested, testing itself is done more efficiently, and TB is diagnosed earlier, stopping transmission in its tracks."

TB is one of the deadliest infectious diseases globally, but many cases remain undiagnosed, particularly in low-income communities, due to outdated screening models. Conversely, many people who do not have TB are tested for it, unnecessarily using scarce resources.

Cage-TB project co-ordinator, Daphne Naidoo, says the project will address a critical diagnostic gap in TB. “Cage-TB aims to systematically identify people in need of costly, yet essential, confirmatory testing. The app will transform the process in which potential TB patients are managed upon clinic entry.”

Project funding and origin

The Cage-TB project recently received a funding boost of R20m from the European and Developing Countries Clinical Trials Partnership (EDCTP), which aims to reduce the burden of poverty-related diseases in developing countries through the development of medical interventions.

The research was initiated in 2021 and is based on the Cage-TB team’s proof-of-concept work which found that TB patients have a distinct sounding cough compared to healthy people, and people with other respiratory diseases.

Naidoo stresses that the app will not diagnose TB but will be used for triage. The app will screen patients to establish who is most likely to have TB, and prioritise them for further sputum tests.

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“Currently there is a high level of TB passing through clinics, but these are either picked up too late or completely missed. We want to speed up TB diagnosis by creating a tool that uses the sound of a cough to classify potential TB quickly and inexpensively, providing results at the point of care. This will allow patients requiring further testing to receive adequate attention timeously.”

Research process

The app will make use of algorithms that can distinguish between TB- and non-TB-related coughs. These algorithms are based on soundbites of coughs collected from trial participants.

“The enrolment of patients and the recordings of coughs will take place in South Africa and Uganda. Collaborators in Germany and the Netherlands will assist with ensuring the app is easy to use, and help with gathering feedback on participants’ experiences of the app,” she says.

According to Naidoo, the research is being conducted in two phases: discovery and validation.

“In the discovery phase, data will be collected from a cohort in Cape Town, South Africa, to refine the cough audio signal specific to TB. This involves advanced machine learning methods tailored for TB patient cough audio analysis. The validation phase will use the optimised TB audio signature from the discovery cohort to validate the technology in a broader population in Cape Town and Kampala, Uganda.”

The Cage-TB project is about two-thirds of the way to distinguishing the sound of a TB cough from other types of coughs.

“Currently, we have operational systems running on large computers in the laboratory. The journey involves updating these systems with more data, which is actively being collected to enhance reliability. We will then need to port the laboratory system into a smartphone device,” explains Naidoo.

“We have already achieved a proof-of-concept and a prototype has been developed and successfully tested in a small-scale laboratory environment.

“In the next step, the prototype will be refined with additional data and adequate features, and iteratively tested to increase performance. A first revealing analysis will take place when the revised prototype is integrated into the mobile app, and a larger-scale field experiment will be conducted.”

The research team comprises more than 30 skilled professionals from Stellenbosch University (South Africa), Amsterdam Institute for Global Health and Development (Netherlands), Makerere University (Uganda) and University of Gottingen (Germany), with diverse expertise crucial to the project’s success.