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## Cough into my smartphone

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*Photography:*

*Video:*

Drawing on a lifetime of innovative research conducted across several countries, Associate Professor Udantha Abeyratne of the University of Queensland has developed technology capable of diagnosing respiratory conditions underlying coughs. His remarkable user-friendly smartphone app analyses respiratory sounds and could save the lives of millions with diseases like pneumonia who are misdiagnosed every year.

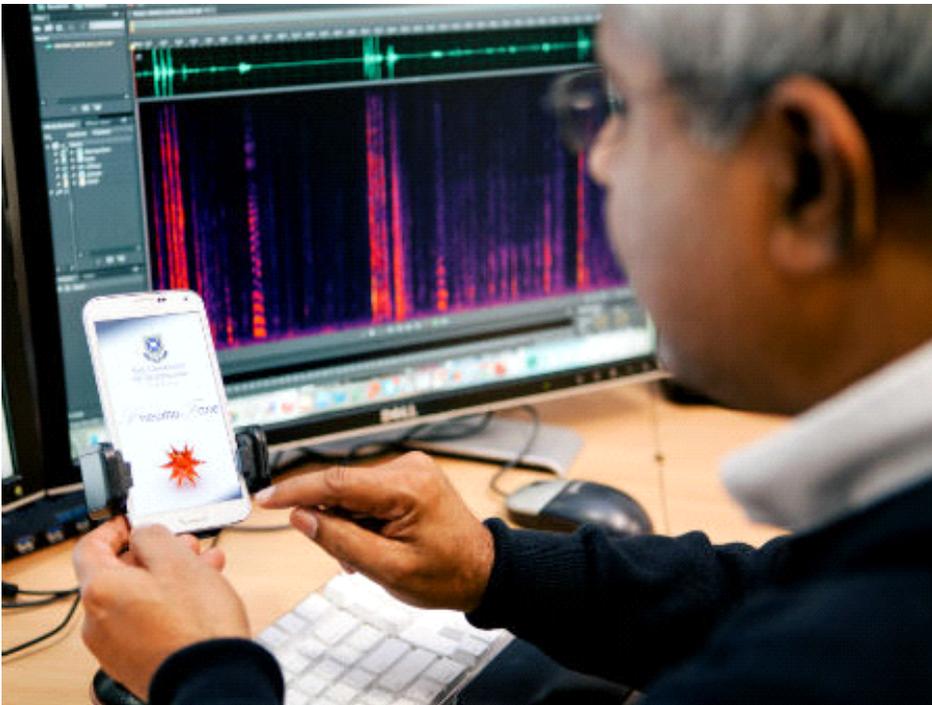
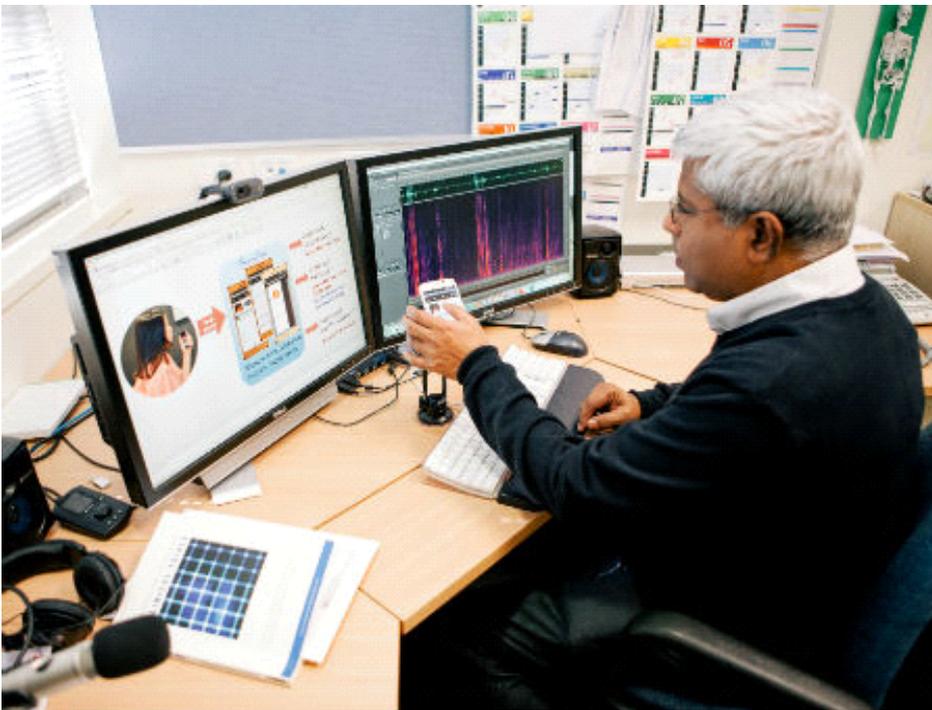
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Associate Professor Udantha Abeyratne has led one of those lives that defy simple summary. He describes himself as a Sri Lankan-Australian but shies away from labelling himself a “global citizen”.

“But I have a global focus, I want to develop medical technology that can have an impact around the world.”

Back in 2009, Abeyratne was working on technology to facilitate sleep apnoea being diagnosed more efficiently. Traditionally, such a diagnosis involved a time-consuming and expensive overnight stay in a hospital's sleep laboratory hooked up to various machines. Abeyratne and his team developed a technology that allowed a microphone and recorder, or smartphone app, to record and automatically analyse a patient's snoring and breathing while they were asleep in their own bed.

While the University of Queensland's commercialisation arm, UniQuest, was taking that technology, named 'Snore Sounds', to market, Abeyratne learnt the Bill and Melinda Gates Foundation was launching a 'Grand Challenges in Global Health Explorations' initiative to encourage innovative solutions to complicated health challenges. The worldwide competition was hotly contested, and only three per cent of applications were

funded.

In announcing Abeyratne's success, the foundation singled out his proposal as an example of a "... creative new idea.. that may change the ways we tackle the hardest health problems". Abeyratne was funded to "equip mobile phones and MP3 players with microphones to record cough and sleep sounds, which could then be screened to diagnose pneumonia."

"They call pneumonia the forgotten disease. It shocked me to discover a million children under five still die from it every year," says Abeyratne. "Most of them are in the developing world and part of the reason they die is poor access to diagnostics."

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## A globetrotting academic career

Raised in Sri Lanka, he embarked on a globetrotting academic career after completing an undergraduate degree in engineering in his native land. He then pursued postgraduate studies in Japan and the United States, culminating in a PhD in biomedical engineering from Drexel University, Philadelphia. After working in the US and Singapore he arrived in Australia in 2002 planning for a three-year stint at the University of Queensland's School of Information Technology and Electrical Engineering. His research interests were in "developing innovative technologies for the diagnosis and treatment of sleep apnoea and respiratory diseases, medical instrumentation and signal processing."

"I deeply admire all the countries I've studied and worked in but it is no surprise that Australia was where I decided to make my home," Abeyratne says. "It's a safe, peaceful country with friendly people and a good place to raise children. It has an excellent university system and the University of Queensland, in particular, encourages its researchers to pursue research that has impact in the wider community."

Abeyratne is also pleased to be working in a nation that "punches above its weight" in commercialising medical research. "People are quick to associate Australia with primary industries such as mining and agriculture but this country also has an educated workforce and sophisticated technical capabilities. It's no

surprise it's generated companies such as [bionic ear manufacturer] Cochlear and [world's leading sleep apnea treatment provider] ResMed.”

## A common cough and a simple solution

Inquiring about a cough is the most common reason people visit a doctor<sup>[1]</sup> and there are hundreds of millions of people who suffer from asthma, bronchitis, chronic obstructive pulmonary disease and whooping cough. The market for technology allowing individuals, or their doctors, to quickly and easily identify the cause of a cough would seem to be vast.

Despite the vote of confidence from the largest private foundation in the world, developing a cough-diagnosing technology was no simple matter. The most immediate problem Abeyratne faced was sourcing more funding.

“I’m often keen to embark on ambitious projects and do not shy away from unorthodox approaches when needed,” he says. “One problem with the funding systems of many countries is they are more comfortable funding research that only presents a modest risk. So convincing funding agencies to take higher research risk is no easy task.”

Abeyratne managed to secure some grants and arrange scholarship funding for several PhD students as well as a post-doctoral fellow to continue the work. Drawing on his wide-ranging earlier research in medical instrumentation, machine learning and mathematical algorithm writing, Abeyratne and his team set about coming up with technology capable of recording and analysing cough sounds.

“We wanted to identify the characteristics of various types of coughs,” he says. “For instance, in pneumonia the tiny air sacs in the lung are filled with fluids, which has an identifiable impact on the airflow while breathing, the velocity of the air that is expelled during coughing, and the nature of sounds that cough makes. In asthma, tiny airways are inflamed thus obstructing airflow and changing the nature of a cough.

“What we did was to develop mathematical features that can capture such changes and train a machine classifier to categorise coughs. Our methods can also use easy to obtain information such as fever, breathing rate and the existence of runny nose.”

## Fine tuning the algorithms

Abeyratne’s cough-diagnosing technology, known commercially as ResApp, is still about 18 months from coming to market but early testing has proved promising. A clinical study conducted in Indonesia involving 91 patients demonstrated 96 per cent accuracy in diagnosing pneumonia. Another larger clinical study involving a wider range of respiratory conditions is now underway at the Joondalup Health Campus and the Princess Margaret Hospital, both in Perth, Australia . This will allow further fine tuning of the algorithms ResApp uses to identify pneumonia. It will also allow it to diagnose other common respiratory conditions, such as bronchiolitis, croup, asthma and upper respiratory tract conditions.

Once regulators such as the US Food and Drug Administration approve the use of ResApp, its impact should be nothing short of game changing. “Even in the developed world, diagnosing pneumonia conclusively is not as straightforward as it may seem,” notes Abeyratne.

“The current method involves a doctor listening to lung sounds using a stethoscope, and collecting other information such as breathing rates and body temperature. To confirm a suspected case of pneumonia, X-rays are often ordered, but CT and laboratory tests may also be needed”. In many areas of the world, even basic facilities and trained physicians are not readily available. I’ve seen figures suggesting accurate diagnosis could cut the pneumonia mortality rates of children by up to 40 per cent.”

UniQuest has licensed the technology to a spinoff company called ResApp Health Ltd which was recently listed on the Australian Stock Exchange.

ResApp Health CEO Tony Keating plans to have a telemedicine product on the market within 18 months, telling the media, "We are first commercialising [Prof. Abeyratne's technology] through a telehealth consultation setting... you will essentially have a Skype call with your doctor, who will then ask you to cough... and then on the doctor's screen, at his end, he would get a clinically-accurate diagnosis."<sup>[2]</sup>

"ResApp technology is expected to be available in multiple formats within a few years and be able to diagnose a broad spectrum of respiratory illnesses when released," says Abeyratne. "I'd predict it will be among the frontier technologies that result in telemedicine taking off in the near future. Telemedicine will help reign in health care expenses and allow medical professionals to use their time more effectively.

"We're just at the start of the smartphone coming into its own as a diagnostic device. They have the necessary computing power, increasing number of sensors required to collect data, and a high penetration in the society, even in the developing world."

Science is now moving so fast that Abeyratne is unwilling to speculate as to what breakthrough medical technologies he'll be seeking to create in the years to come. "I wouldn't dare to imagine what I'll be working on in 20 years time," he says. "All I can predict is that humans will live longer and healthier lives. Medicine will be more patient-centred and individuals will be vastly empowered to take control of managing both chronic and acute diseases irrespective of where they live.

"Consumer devices will play a central role in the diagnosis and monitoring of illnesses. The thought that the technology we are creating today may play a vital role in the future in saving millions of lives throughout the world really excites me."

Find out more about [ResApp Health](#).

[1] <http://www.cdc.gov/nchs/fastats/physician-visits.htm>

[2] [http://www.pulseitmagazine.com.au/index.php?option=com\\_content&view=article&id=2567:resapp-to-target-telehealth-with-respiratory-diagnostic-app&catid=16:australian-ehealth&Itemid=328](http://www.pulseitmagazine.com.au/index.php?option=com_content&view=article&id=2567:resapp-to-target-telehealth-with-respiratory-diagnostic-app&catid=16:australian-ehealth&Itemid=328)