

How Smartphone Technology is Changing Healthcare in Developing Countries

Jonathan Mayes¹, Andrew White¹, Matthew Byrne¹, Jasper Mogg¹

¹Newcastle University.

It is widely recognized that technology can improve the health of populations in countries around the world. Smartphone technology is at the forefront of innovation in low, middle and high-income countries. Due to the falling price of the smartphone, and the United Nations (UN) commitment to make Internet access available in the least developed countries by 2020, soon smartphones will be available to all. This technology has already improved the doctor-patient interaction, reducing costs and improving care for patients. The benefits range from cheaper, quicker medical education to point-of-care ultrasound. This article explores the most recent developments, discusses future applications of smartphones and investigates how people's lives in developing countries are being altered by this technology.

Introduction

The importance of technology in healthcare is becoming increasingly evident. Resolution 60.29 of the World Health Assembly commented that Health Technologies are “indispensable for effective and efficient prevention, diagnosis, treatment and rehabilitation of diseases.”² The smartphone can play a central role in making this resolution a reality and is becoming more accessible for millions around the world.

In 2014, the World Health Organization (WHO) launched its second Global Health Initiative, calling for affordable and practical technology for low- and middle-income countries.³ The UN development goal 9c aims to deliver “universal and affordable access to the Internet in the least developed countries by 2020.”⁴ This may sound like an ambitious objective, but the plummeting price of the smartphone is making it a real possibility.

Nearly a billion smartphones were sold during 2013, with most shipping to emerging markets: 283 million in China, 125 million in India, 47 million in Brazil and 46 million in Indonesia.^{5,6} Government schemes in Ghana and Malaysia have also enabled consumers to purchase smartphones. Ghana has a 20% decrease in tax for smartphones and Malaysia has developed a rebate scheme for low-income youths, enabling many to purchase smartphones.^{32,33}

The uptake and usage of smartphones is unprecedented. More people are using smart phones and taking an active interest in personalized healthcare. Using this data and the opportunities smartphones present are crucial.

Improving Communication and Training for Healthcare Professionals

Smartphones encourage doctors to collaborate and enable quicker communication between health services. This apparent “health communication” is an emerging field and one of increasing importance to nearly every aspect of health and medicine as a profession.⁷

Rapid developments in cloud-based storage systems promote collaboration and sharing of files on mobile devices.⁸ Healthcare professionals have instant access to images and test results whenever they require. It is important that these applications have had rigorous security checks as to uphold patients’ right to confidentiality.

Social networking connects doctors, students and patients globally. It can be used to share knowledge, to provide feedback and to increase health awareness. However, the appropriateness of the communication platform and the type information the doctor is able to reveal needs to be considered to ensure the boundaries of doctor-

patient interaction do not become blurred. The General Medical Council has released guidance related to this.⁹ Doximity, a social network designed exclusively for doctors, has 400,000 registered physicians.¹⁰ It aims to promote professional communication and networking, which allows doctors to collaborate on rare cases and share insights into the medical world.

The WHO estimates the world needs an additional 12.9 million skilled health professionals including midwives, nurses and doctors by 2035.¹¹ Learning conducted via electronic media (e-learning) can partially fulfill this shortfall. Universities, government health agencies, NGOs and private companies are investigating how best to embrace this technology. The University of Washington’s Department of Global Health is leading the way for distance learning in low-resource settings. Their Dept. of Global Health E-Learning Program (eDGH), which began in Kenya and Haiti, now runs in 30 countries.¹² The program’s flagship course “Clinical Management of human immunodeficiency virus (HIV)” reaches over 1000 healthcare students globally each year.

Being able to use tablets and smartphones in the training of doctors can help to train more healthcare professionals in low and middle-income countries. Greater numbers of doctors and nurses being trained means better care for patients around the world.

E-learning, cloud-based technologies and social networking facilitate the training of medical professionals and improve the communication between professionals. This may speed up administration and improve services for patients but does not involve patient participation or their interaction.

Cooperation to Improve Care

Smartphone technology is aiding patient management as well. iWander is an app which that monitors Alzheimer’s patients through a small GPS tracking device.¹³ iWander involves a discrete monitoring device located in a watch which can, upon evaluation, provide several different courses of action from directing the patient home to performing a group call to emergency services and the caregiver.

In an interview with the BBC, Sir Bruce Keogh, Medical Director of the NHS, stated, “the hospital of the future is in the home.”¹⁴ Integrating wireless sensors into everyday objects has enabled medical data to be generated and stored on our smartphones. Soon, wristwatches that continuously and passively monitor blood pressure and vital signs will become the norm.¹⁵ Other wearable monitors currently under development include contact lenses that check

glucose levels or eye pressure, necklaces for 24-hour ECG monitoring and headbands that have integrated electroencephalography sensors.^{31,30,27}

These devices allow patients greater control over the investigations into their health they receive. The smartphone allows patients to track their health and gives greater control in the doctor-patient relationship. It is a manifestation of the shift of patient empowerment and shared decision-making.

Reducing Healthcare Costs

Smartphone technology is inclusive. Although it may seem much of this technology is aimed at higher income countries, developing countries are keeping up with incredible innovation and creativity.

In India, 60 million people have type 2 diabetes, 36 million have hepatitis B and 2.6 million have HIV.^{16,17} Investigating, monitoring and managing large numbers of patients is incredibly complex. To tackle this problem, an Indian public health doctor has created the Swasthya Slate or “Health Tablet.” Funded by the Public Health Foundation of India, this technology is viewed as the future of medical investigations in primary care and rural areas of India.¹⁸ It is a portable diagnostic device that can record blood glucose, hepatitis B status, HIV status and 30 other diagnostic tests. This means doctors can diagnose, monitor and treat patients’ chronic illnesses at the point of care.

Smartphone technology has aimed to decrease the price of everyday medical devices. Kenek O2 is a pulse oximeter that connects to smartphones.¹⁹ The combined cost of a smartphone and pulse oximeter is \$65, which is 1/100th of the cost of a normal oximeter.²⁰ Even a smartphone compatible ultrasound machine has been developed.²⁶ This has revolutionized point

of care ultrasound (POCUS). Using this device, doctors can place central lines, guide injections, diagnose emergencies quicker and scan pregnant women in remote areas. POCUS is an excellent example of the developing world leading technological innovation. Doctors in developing countries such as Ethiopia, Indonesia, Sierra Leone and Kosovo quickly recognized the importance of POCUS.²¹ They applied this safe, revolutionary technology in remote settings, resource scarce environments and emergency situations.

The power and intuitive nature of smartphones encourages innovation. World-leading technology is available at a fraction of the cost, and all are making the most of the opportunity.

Examples Of Current Uses In Developing Countries

In the Tanzanian village of Shirati, Dr. Buire Changi, chief medical officer, is in charge of a 200-bed hospital.¹ He frequently diagnoses skin conditions such as Kaposi’s sarcoma and candidiasis in HIV positive patients. Despite his experience, Dr. Changi may need a second physician to confirm his findings. His patients need to be triaged and some referred to a larger hospital. The decision to seek a second opinion is crucial. If Dr. Changi chooses to refer the patient, it is an expensive five-hour bus journey to the Mwanza regional hospital.

He uses First Derm, a mobile app that enables him to use a smartphone-connected dermatoscope to take photographs of his patient’s skin lesions.¹ These photos are then reviewed by a consultant in Dar es Salaam and the patients are triaged. Though the patients may still have an uncomfortable five-hour journey to Mwanza, they are referred with confidence that the journey is worth the

discomfort.

In the future, smartphone technology could prove vital in dealing with difficult scenarios that may emerge in the developing world. Consider the implication of such technology in a situation similar to the outbreak of Ebola across West Africa in 2013. A future government may possess the technology to track people’s mobile phones to gather information about movement patterns, isolating high-risk areas enabling the government to channel resources accordingly. Point-of-care testing can detect the Ebola virus in a single drop of blood. Virus control could be rapidly restored, and an epidemic is prevented.

Smartphone technology is already widely used in healthcare and has growing recognition across all medical fields. It promotes global interaction, improves care and reduces healthcare costs. If encouraged alongside a wariness of potential dangers, smartphone technology will continue to revolutionize global health and change the world.

Complications

At last count, there are over 229 apps in dermatology alone.²² Many apps, such as Dr. Changi’s in Tanzania, serve as educational resources and communication devices. However, the pharmaceutical company Bayer has also invested in a free app with similar properties.²³ The app is aimed at children but constantly informs the user about Bayer’s topical steroid Desonate. If one of the purposes of an app is to generate profit, can the information the app provided be deemed impartial and valid? A systematic review of 103 self-management apps for asthma concluded that none provided combined reliable, comprehensive information about the condition with supportive tools for self-management and some were even considered to be unsafe.³⁴ Embracing technology but also remaining cautious and skeptical about the information it presents is key for all users and healthcare professionals alike.

Over 100,000 healthcare apps are already available.²⁵ These apps are available to anybody with a credit card and a smartphone. The rapid emergence of these apps has led to further concerns surrounding some of the ethical pillars of healthcare. A survey of 144 public and private healthcare leaders revealed that the biggest concerns for healthcare included the fear that “people may misinterpret their own data and make poor decisions” and unease regarding “data privacy risks.”²⁴ These concerns may reflect the failure of privacy and security laws surrounding the collection and management of user’s data by mobile-health apps to adapt.³⁵ Some users of these apps may be in danger of assuming the health information they choose to share will be handled with the same ethical rigor that a healthcare professional would. Governing bodies and doctors must be vigilant and seek to educate users about the possible dangers.

Attempts have been made to regulate health-related smartphone technology. In the U.S., medical apps that present a real risk

“While the gold standard of care (e.g. catheterization for acute ST elevation MI or pacemaker placement for complete heart block) may not be available in resource-poor settings, Electrocardiograms (ECGs) may still assist in making correct diagnoses.”

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to patients if they do not work as intended need to be approved by the Food and Drug Administration.³⁶ However, there is controversy surrounding which apps need to go through the accreditation process before they are distributed to the public.³⁷ Similarly, in the EU, the CE certification or *Conformité Européenne* marks products that comply with relevant EU legislation.³⁸ In the UK, the NHS went a step further and launched a health app pilot site in 2013 to review and recommend apps against a defined set of criteria.³⁹ However, an independent assessment of 79 apps certified as clinically safe and trustworthy by the NHS Health Apps Library revealed that 89% of the apps transmitted information to online services and concluded there were “systematic gaps in compliance with data protection principles.”⁴⁰ The Health Apps library is currently being upgraded to improve its vetting process, highlighting the need for a consistent and reliable accreditation system that alerts consumer to possible deficiencies and dangers within the apps. Until a system is in place that requires developers to rectify these vulnerabilities before the technology can be released, education will continue to be the first and foremost line of defense.

Conclusion

This article examines a fraction of possibilities that smartphone technologies present to change healthcare around the world. The smartphone's ever expanding sphere of influence could enable it to become the future of global health.

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