Perspective

COVID-19 response in low- and middle-income countries: Don't overlook the role of mobile phone communication

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A B S T R A C T

Estimates of health capacities in the context of the coronavirus disease 2019 (COVID-19) pandemic indicate that most low- and middle-income countries (LMICs) are not operationally ready to manage this health emergency. Motivated by worldwide successes in other infectious disease epidemics and our experience in Sub-Saharan Africa, we support mobile phone communication to improve data collection and reporting, communication between healthcare workers, public health institutions, and patients, and the implementation of disease tracking and subsequent risk-stratified isolation measures. Programmatic action is needed for centrally coordinated reporting and communication systems facilitating mobile phones in crisis management plans for addressing the COVID-19 pandemic in LMICs. We summarize examples of worldwide mobile phone technology initiatives that have enhanced patient care and public health outcomes in previous epidemics and the current COVID-19 pandemic. In addition, we provide an overview of baseline conditions, including transparency about privacy guarantees, necessary for the successful use of mobile phones in assisting in the fight against COVID-19 spread.

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Introduction

The coronavirus disease 2019 (COVID-19) pandemic illustrates the importance of public health response strategies for timely outbreak control. The failure of well-resourced countries such as the United States of America and the United Kingdom to adequately contain this pandemic highlights the complexity of large-scale containment measures and raises concerns for the impact of this disease in low- and middle-income countries (LMICs), where fragile health systems, competing priorities, poverty, and crowding affect the capacity to manage health emergencies (Agyeman et al., 2020). Indeed, a recent analysis of health security capacities in the context of COVID-19 showed that many LMICs are not operationally ready to prevent, detect, or control an outbreak (Kandel et al., 2020). In fact, public health measures useful in other settings can negatively impact disadvantaged people in LMICs. For example, many migrant workers

found themselves without jobs after the announcement of the lockdown in India, compelling them to unexpectedly return home on crowded trains and buses with implications for transmission (Pulla, 2020).

The rapidly increasing access to mobile phones and smartphone technology among healthcare staff and citizens provides huge potential for public health workers, frontline clinicians, and institutions to communicate and act swiftly in the setting of rapidly changing COVID-19 guidelines (Wallis et al., 2017). In this article, reflecting on worldwide initiatives as well as our experience at Tygerberg Hospital (TBH) in the Western Cape Province of South Africa, we discuss three ways in which mobile phone communication can help support patient care and disseminate information during the COVID-19 pandemic.

Share data, protocols, and information on referral pathways between healthcare professionals in hospitals and communities

Since 2010, the World Health Organization (WHO) has made several calls to scale-up affordable and practical health

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technologies in less resourced settings (WHO, 2015; WHO, 2017). Today, mobile apps are used widely, thus enabling healthcare workers to use their smartphone to share information with and request opinions from specialists, public health institutions, and governmental agencies. In addition, these apps allow individuals and groups with different roles and responsibilities to communicate rapidly. During the COVID-19 pandemic and during epidemics of other infectious diseases, such as diphtheria and measles, medical groups from TBH, the second largest hospital in South Africa, have successfully used broadcast groups to rapidly communicate key issues and guidelines. Group members include medical, nursing, security, administrative, and laboratory staff, as well as the ambulance service, disaster management experts, and

provincial public health officials. Communication is overseen by a medical manager and excludes patient-identifying details.

Medical facilities in LMICs are generally spread over several buildings in large areas. These facilities operate like villages, with thousands of medical personnel units working together on any given day. A sudden increase in patients requires localized reorganization and rapid communication between staff members and facilities to effectively handle emergency situations while receiving continuously updated information on relevant protocols. Local referral for acute care and clinical review can be conducted through free apps, such as Vula Mobile (vulamobile.com), a healthcare app that connects primary healthcare workers with on-call specialists in South Africa. This start-up is now supported by

Table 1
Examples of useful mobile phone communication in disease management in low- and middle-income countries.

Purpose	Examples	Disease	Advantage of mobile phone communication	Reference
Information-sharing between healthcare professionals	Induction is an app where free secure TeamSpaces, subscribed to a local hospital or regional telephone directory, can be created.	N/A	Communicate with direct and group clinical messaging via a central inbox, upload key PDF documents, such as protocols, and link to important websites.	induction-app.com
	The use of portable smartphone EEG technology administered by minimally trained healthcare workers allowed remote specialist interpretation for children with poorly controlled epilepsy in a low-income hospital site in Sub-Saharan Africa.	Epilepsy	Use of a valuable diagnostic test that was previously unavailable in a particular setting creates the possibility for appropriate treatment alteration.	Williams et al. (2019)
	Vula Mobile: a free app that connects, for example, primary healthcare workers who work in rural areas directly with medical specialists in urban centres across South Africa.	N/A	Better health care for patients in under-resourced areas and stronger links between different levels of South Africa's health services.	vulamobile.com
Disease surveillance	Cell phone SMS text and voice messaging for community Ebola virus disease syndromic surveillance led to a higher number of case reporting compared with traditional surveillance systems in Sierra Leone.	Ebola virus disease	Ability to monitor a large number of susceptible people at the same time at relatively low cost with more effective and timely case reporting.	Jia and Mohamed (2015)
	Healthcare workers in South Africa can notify patients with communicable diseases, such as malaria, tuberculosis, and human rabies, electronically through the Notifiable Medical Conditions app.	Communicable notifiable medical conditions	Rapid activation of contact tracing teams and real-time reporting of infectious diseases to local, district, provincial, and national health authorities, facilitating timely communication amongst personnel at various healthcare levels.	nicd.ac.za
	A mobile phone emergency reporting system was set up to monitor outbreaks of infectious diseases in earthquake-affected areas in China. The number of cases reported using mobile phones accounted for more than half of the total cases reported weekly.	38 types of infectious disease	Increased reporting of cases, even in settings with poor infrastructure, allowing healthcare workers to move with relocated people while continuing to report cases.	Yang et al. (2009)
	The South African government collaborates with cell phone network operators to access the geo-location of positive COVID-19 cases to identify their contacts.	COVID-19	Contact-tracing via cell phones allows for faster, more efficient, and large-scale contact-tracing when compared with manual contact-tracing.	www.thesouthafrican.com/news/government-tracking-mobile-phones-curb-covid-19, Ferretti et al. (2020)
Communication with patients and communities	Video-observed therapy or SMS reminders are alternatives for directly observed therapy that are associated with comparable rates of treatment success.	Tuberculosis	Fewer clinic visits, improved treatment outcomes.	Alipanah et al. (2018)
	An SMS-based system facilitated reporting of HIV test results from a central laboratory to healthcare workers in a rural health centre. Also, mothers of infants who were tested for HIV were contacted via mobile phone to inform them when results were available.	HIV	Shorter turnaround time for clinics and patients to receive test results and therefore earlier diagnosis of HIV infection and enrolment into care.	Sutcliffe et al. (2017)
	South Africa's Department of Health has instituted a WhatsApp support line to communicate with the public on COVID-19-specific concerns.	COVID-19	Direct availability of a reliable response to individual concerns prevents the spread of fake news and reduces public anxiety.	sacoronavirus.co.za

EEG, electroencephalogram; N/A, not applicable; SMS, short message service.

the South African National Department of Health and is being rolled out across all nine provinces. In most African countries, intensive care unit (ICU) beds and personnel trained in critical care are limited to tertiary hospitals. Up-to-date information on the availability of ICU beds in the nearest tertiary hospital can be shared daily in designated mobile phone groups. This facilitates the expeditious transfer of patients and judicious use of ambulance services (Salman et al., 2020). Finally, in many LMICs, community health workers are integral in the primary healthcare system, as they liaise between communities and healthcare facilities. These community workers are generally based in small hospitals in underserved areas. Often, they will be the first point of contact for ill people in the community, stressing the importance of keeping them informed on containment measures, case definitions, the spread and clinical characteristics of disease, and referral pathways.

Previous studies have shown that the successful use of mobile phone interaction between community health workers and hospital-based physicians can address health issues related to maternal and child health, family planning, infectious diseases, and trauma (Braun et al., 2013; Anstey Watkins et al., 2018; Feroz et al., 2020). In addition, having clinical guidelines on mobile phones, in a structured interactive workflow, can reduce community health worker errors in diagnosis and management by more than one third (Florez-Arango et al., 2011).

Cell phone messaging can enhance surveillance and tracking of disease spread

Monitoring cases as COVID-19 spreads appears crucial in order to contain the impact of the pandemic, to facilitate rapid implementation of isolation measures, to perform epidemiological research on the origin and spread of the outbreak, and to communicate the characteristics of high-risk patients. Collecting data can be difficult in rural areas where infrastructure and communication channels are limited. By supporting direct communication between frontline workers and program managers, mobile phones can be a game-changer (Table 1). In addition, if inadequate laboratory capacity requires clinical case definitions of suspected cases, rapid and clear communication between clinicians and public health agencies is central to effective monitoring.

Cell phone messaging technology was effectively used for community epidemic surveillance in peripheral health facilities during the Sierra Leone Ebola virus epidemic (Jia and Mohamed, 2015) and for rabies surveillance in Tanzania (Mtema et al., 2016). Further, the dispatch of mobile phones led to a functional infectious disease surveillance system after the Sichuan earthquake in China (Yang et al., 2009). Whenever possible, mobile

phones with global positioning system capacity can be used to integrate coordinate data to track cases at a high spatial resolution. Contract-tracing has been used for several infectious disease outbreaks, including the Ebola epidemic (Sacks et al., 2015). Both China and South Korea have achieved sustained COVID-19 epidemic suppression while using mobile phone apps aimed at instantaneous digital case- and contact-tracing for restrictions on movement and recommendations on risk-stratified quarantine. A mathematical simulation study suggested that a mobile app is the best way to implement fast and efficient contact-tracing in the COVID-19 pandemic (Ferretti et al., 2020). The South African government has recently partnered with cell phone companies to track mobile location data to trace contacts of an infected person for possible testing and quarantine (Table 1).

Communication with patients and communities

The mobility and popularity of mobile technologies mean that most people always have their mobile phone with them. This allows for interventions that claim people's attention when most relevant. Previous examples include mobile phone-based communication for HIV and tuberculosis diagnosis and management (Free et al., 2013; Sutcliffe et al., 2017; Alipanah et al., 2018; Gross et al., 2019). While many initiatives have been developed regionally, there are also examples of country-wide initiatives, particularly in antenatal care. The Healthy Pregnancy, Healthy Baby Text Messaging Service (Wazazi Nipendeni) in Tanzania, Kilkari and mMitra in India, Aponjon in Bangladesh, and MomConnect in South Africa are examples of initiatives sending health information messages to more than one million pregnant women through mobile phone networks (Peter et al., 2018). The mHealth Assessment and Planning for Scale Toolkit, established through a collaboration between the United Nations Foundation and the WHO, is specifically aimed at facilitating successful scaling up of mobile health products for long-term sustainability (WHO, 2015).

During the evolving COVID-19 pandemic, TBH personnel have used mobile phone applications to communicate health messages on social distancing, cough etiquette, and hand hygiene. Also, short videos sent to patients awaiting test results explain self-isolation. In addition, Voice over Internet Protocol (VoIP), using public WIFI, allows for calls to inform patients about test results without using mobile data. Further, messages discouraging irrational behaviour may counteract fake news. The messages are often sent by a healthcare provider known to the recipient, which likely increases their impact and limits misinformation and stigmatizing of patients. Since many healthcare workers in LMICs communicate with their (chronic) patients via mobile phone messages, this route can now also be used to remotely monitor patients for acute and

Table 2
Checklist of required regulations, attitudes, and practices for mobile phone-based communication to become part of the COVID-19 response system.

Healthcare professionals/hospitals
Create multidisciplinary designated mobile phone groups, including medical staff and non-medical staff (such as administrative, security, and laboratory)
Delivery of mobile phones to healthcare workers without their own devices
Ensure access to public WIFI
Periodic mandatory disinfection of mobile phones
Obtain informed consent of patients for sharing of health information via mobile phone data
Government/public health agencies
Create adequate legislative and regulatory frameworks to effectively address threats related to privacy and data protection
Transparency on app-specific privacy guarantees by using a scoring method to assess and compare app privacy policies
Generate possibilities for the scale-up delivery of interoperable healthcare information systems to safely exchange mobile phone data
Patients/general public
Provide user feedback on specific apps to healthcare workers/institutions
Transparency on shared use of mobile phones
Adequate and swift disclosure of COVID-19 status when using (contact-tracing) apps

chronic conditions, particularly when combined with video conferencing. However, the appropriateness of the communication platform and the type of information the doctor can share must be considered, to ensure that boundaries of doctor–patient interaction do not become blurred (Table 2).

Conclusions

In conclusion, it is evident from these three examples that mobile phones have helped healthcare workers in LMICs in data collection and reporting, organization of their workflow, and communication with other healthcare workers, public health institutions, and patients. Therefore, we recommend that crisis management plans to deal with the COVID-19 pandemic in LMICs strongly consider incorporating a centrally coordinated reporting and communication system using mobile phones (Table 2). This may require the delivery of mobile phones to healthcare workers without their own devices. Access to public WIFI may be a limiting factor. Other challenges include ethical concerns around patient privacy and consent and concerns regarding equipment maintenance (Ferretti et al., 2020). Familial sharing of phones and the possibility that individuals own multiple SIM cards or mobiles can affect the accuracy of information-sharing and lead to privacy issues. Also, there are concerns related to the possible leakage of medical information via contact tracing apps. The purpose of an automated decentralized contact tracing system is to identify contacts of a COVID-19 case, inherently requiring at least a limited amount of personal information potentially vulnerable to unauthorized access (Bengio et al., 2020). A scoring method or scale to objectively assess app privacy could be a key tool for systematically comparing apps and make decisions on their use in specific settings (Benjumea et al., 2020). Finally, careful precautions must be taken to avoid mobile phones themselves being a vector for virus transmission, since previous data show that respiratory viruses, including for example influenza virus, are found on up to 38% of healthcare workers' mobile phones (Pillet et al., 2016). The safe use of mobile phone devices and protecting personal health information transmitted over mobile phones is essential, as is ensuring that we utilize every resource available in settings where the preparedness to respond to outbreaks is relatively weak.

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Conflict of interest

All the authors have no conflict of interest to declare.

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