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Dr. Versha Prasad
M.B.B.S., M.B.A. (Gold Medallist), Assistant Professor University Institute of Health Sciences, C.S.J.M. University Kanpur, Uttar Pradesh, India

Correspondence
Dr. Versha Prasad
M.B.B.S., M.B.A. (Gold Medallist), Assistant Professor University Institute of Health Sciences, C.S.J.M. University Kanpur, Uttar Pradesh, India

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Understanding future of health system with the need of implementation of digital technology

Dr. Versha Prasad

Abstract
As stated by the Institute of Medicine: "It is widely believed that health IT, when designed, implemented, and used appropriately, can be a positive enabler to transform the way care is delivered. Designed and applied inappropriately, health IT can add an additional layer of complexity to the already complex delivery of health care, which can lead to unintended adverse consequences, for example dosing errors, failure to detect fatal illnesses, and delayed treatment due to poor human–computer interactions or loss of data". In fact, health information technologies (HIT) have the potential to increase the performance of delivered services, increase health care quality, save costs and involve patients as effective partners of their own health care. Digital health is having a profound effect on health systems, changing the balance of power between provider and patient, enabling new models of care, and shifting the focus of health systems toward client-centered health care within low- and middle-income countries. Though many of these changes are just being felt due to resistance by organizations and individuals reluctant to change the status quo, the explosive growth of digital technology globally means that these changes are inevitable. We can expect to see increasing use of telemedicine for remote diagnostics and treatment, protocol-driven health care to improve quality of care, and better access to goods and services through changes in the organization of transportation and delivery services. Data will become central to health systems, whether big data and artificial intelligence tools for surveillance, planning, and management or "personalized data" in the form of universal electronic record systems and customized treatment protocols.

Keywords: digital health, health systems technology.

Introduction
The use of digital technology in health care delivery has the potential to provide a needed breakthrough in achieving access to high-quality care to everyone no matter where they live. This commentary looks at how digital technology is changing the landscape of health delivery in low-income countries and what the implications are for achieving universal health coverage within the next decade.

Current health care delivery models are largely based on a top-down medical model, driven by the World Health Organization, with doctors and nurses as the purveyors of knowledge and the arbiters of care. Care is primarily accessed through health facilities whether at the hospital or in the community, and information is delivered primarily by medical personnel. Although lip service is given to the need for client-centered care the reality remains that services are primarily designed for and by the medical establishment with little regard for the convenience or needs of the client/patient. The problem with this model is that it is difficult to expand to meet the growing needs of the population who want more convenience, better information, and better access to care where and when they want it.

Health care in this regard is not unique. We have seen the disruption of taxi and hotel systems by businesses such as Uber and Airbnb and of commercial sales by Amazon and Alibaba. Access to digital technology through the use of smartphones has fundamentally

changed who the dominant players are in these fields and how we access services. We are seeing a shift in the balance of power from the traditional vendors to a new digital model whereby services are made more accessible and more flexible depending on the needs of the consumer. In health care we are beginning to see these same changes. Medical information is available online or through telemedicine and medicines can be delivered to homes through online pharmacies. Patients have access to their own medical records and may communicate with their providers using email or online portals rather than needing to visit a facility. Access no longer means physical access; for many purposes, it can mean virtual access through telecommunications. In high-income countries, these changes are being driven by the need to lower (or at least limit growth of) costs, whereas in low-income countries the driver is the poor access and quality of the care that is delivered and the explosion in access to digital technology.

This digital revolution is not limited to wealthier countries. According to the Global System for Mobile Communications, there are over five billion unique digital phone subscribers reaching an estimated two thirds of the global population, including 2.27 billion monthly active Facebook users in 2018 [1]. The highest growth of digital technologies is now in low-income countries, where according to the Pew Research Center, 84% of people in developing and emerging economies own a cell phone compared to 90% of people in the United States and *people in emerging and developing nations are quickly catching up to those in advanced nations in terms of access to technology* [2]. And beyond the growth in numbers of users, digital technology is having a greater impact on the lives of the poor in low-income countries. A recent project in Zanzibar, Tanzania, has shown how the use of digital technology has been able to significantly increase the ability of women to access safer delivery services [3]. In India, Uganda, and Tanzania, ambulance services focused on the use of digital protocols and access have replaced the largely nonexistent public system. In South Africa, two million young women have access to accurate information about sex, health, and motherhood through a national online service run by the government [4]. In addition to these health programs, digital technology is being used to create new and more transparent markets for farmers, virtual learning platforms for education, and easy and inexpensive digital banking services throughout Africa and Asia. What does this mean for health care?

A New World of Health Care

Recent work by the World Health Organization has described at least 12 functions that digital technology is providing in health and is currently developing a set of recommendations for all countries on its use [5]. In brief, these functions include providing better and more direct information to everyone about health and illness; providing direct support to health workers and supervisors regarding the diagnosis and treatment of patients; providing verifiable and searchable records about births, deaths, and health encounters; and providing health managers at every level with operational and strategic information about drug availability, finances, and human resource management. Impacts on these functions will fundamentally change the delivery of health care in ways that we may not fully anticipate, but what is very clear is that disruption is coming. The following five elements describe how we believe that digital technology will change health care delivery and society.

Access to Internet-Based Information Will Be Universal

This global access to the Internet will mean that information can no longer be controlled by a single body, whether governmental or professional. Increased use of social networks will provide more peer-to-peer information and access to publicly available Web-based health information will provide people with a wide range of information. Although the quality of information will not be uniformly excellent, the availability of diverse types of information will change the role of health workers from being the primary source of health information to facilitators who help individuals navigate the deluge of information that is available. This is already true in most wealthy countries but will become more universal.

The first point of inquiry about health will no longer be a health worker but rather the Internet or direct-to-consumer information by groups such as Momconnect in South Africa or the Ananya in India [6, 7]. The role of the primary health care worker will change; no longer the primary purveyor of information about wellness and illness, these workers will become guides to existing information, helping patients connect to useful and accurate information sources that are freely available. As in the United States where patients no longer ask their doctor what is wrong, they will come to seek care with a preconceived idea of their own diagnosis, which may or may not be correct. Health workers will necessarily become more sophisticated about what information is available to clients to help them navigate the world of almost unlimited health information.

Health Workers Will Be Digitally Supported

Today's model of care relies on the proper training of health workers, who are taught to diagnose and treat patients and communicate with them about their illness and wellness. Yet we know that though training is very important in delivering quality services, it is not sufficient for delivery of high-quality care, and the use of decision support for clinical algorithms or pathways is increasingly being recognized as an important adjunct to quality improvement and is being recommended for use by the World Health Organization.

Every health worker will have a digital tool that helps him or her with diagnosis and treatment as well as communication to the client/patient. This can be in the form of checklists for routine care such as antenatal visits, decision support for diagnosis of illness, and video or graphic counseling messages from the provider directly to the client. Numerous studies have shown the advantage of using decision support, video counseling, and digital supervision strategies to improve quality [8, 9, 10]. Though many of these strategies are in their infancy, they are increasingly being adopted by countries as core components of their health strategies.

Training will also be changed by technology. Training that today means face-to-face lectures and interactions will increasingly be replaced by distance learning, with the training customized to the needs of the student/health worker and the specific situation of the work. It will not be seen as a one-time effort but a continuous stream of training updates for each health worker. There will remain a need for face-to-face training (consider learning to perform surgery,

for example) but the basic idea of continuous training will supplant the current training model. The content of the training will also change so that health workers, rather than trying to memorize every symptom and its meaning, will learn to navigate the digital world and use decision support and other tools to make better clinical decisions [11]. Communications will also be changed as the use of video, animation, and graphics replaces the verbal advice that health workers provide (or at least should provide) to the client/patient.

Supervision in health care will also change. Supervision will not be the once-a-year unstructured visit by a supervisor but automated feedback to the provider and managers on what is happening, what the problems are, and suggested solutions. Today's adversarial and judgmental relationship between supervisor and supervisee has the opportunity to be replaced by a shared need to improve performance with pay for performance and other shared incentives in place. Accurate real-time data about health workers' performance will be available not only to supervisors but to their supervisors and to program managers as well. It will be provided in a format that is easy to interpret and will suggest corrective measures for problems that are recurrent.

Most Health Care Will Be Provided at Home

The current model of health care is that the client/patient must go to a health facility to get any kind of care or even advice. The new model will bring care to the patient rather than the patient to care. Advances in the use of telemedicine and universal access to information and communications will mean that people no longer need to visit a clinic but can ask questions and receive advice and treatment recommendations via telephone or some other device. The use of low-cost digital diagnostic devices that can measure vital signs such as temperature, respiratory rate, oxygen saturation, and blood pressure simply and accurately with nothing more than a smartphone means that the use of telemedicine and at-home treatment will replace most outpatient (ambulatory) visits except for those who are very ill or have complex needs [12]. This is especially important in addressing the global epidemic of chronic disease where home-based disease management is far more effective and inexpensive than the current model of periodic clinic visits. Many models already exist for this type of distributed care where people use telemedicine for frontline care and triage and facility-based care when it is needed [13].

One implication of the widespread use of telemedicine is the need for both electronic medical records and the use of unique ID numbers for each client. When the client/patient is no longer physically present at an encounter, it is important that the provider know both who is on the other end of the phone and what his or her past history is; for example, immunizations, pregnancies, and medications. This does not necessarily mean that there will be a single, universal platform but that there is a record that a remote provider can access. Recent progress in the use of biometric identifiers and simplified electronic medical record systems will mean that this is possible [14, 15]. The Aadhar program in India provides unique identification numbers for all residents in India based on demographic and biometric information. Managed by a statutory body created for this purpose, it has demonstrated the viability and functionality of this concept [16].

Data Will Be Central to Health Systems

It will not be surprising that one of the areas that will be most disrupted by the use of digital technology is its impact on data management and use. At present, few low-income countries have reliable data despite substantial investments in health information systems [17]. Most data are still paper based, kept at the national level only on an aggregate level, and primarily used for reporting on the incidence of specific reportable diseases or numbers of patients seen. This is about to change. The shift to digital data collection systems at the point of care means that data can be collected in a more timely and complete manner, that data quality can be improved, and that health planners have incentives to use the data for planning and management.

The first breakthrough is that collection of data as a by-product of decision support in the hands of health workers will be available in a more timely way. No longer a separate activity from patient care, data entry will be part of clinical care. Data that are collected as part of the diagnostic process will be written to an electronic patient record, making individual records available for immediate analysis and use at any level of the system. At the level of the provider, this will make information available about the patient's history, streamlining the diagnostic process. The use of universal biometric identification will reduce the need for repeating demographic information. Timely information about patient care will provide supervisors and managers with better information about provider performance. Aggregate data can be used for reporting purposes, surveillance, and planning [18]. Disease outbreaks such as diarrheal disease or malaria can be identified in real time by looking for spikes in the reporting of these symptoms.

A second benefit of digital data collection is that we can expect that the quality of the data will be improved. Because data are being entered as part of the delivery of care rather than as a separate data collection process, we are likely to see reductions in data entry mistakes. Errors in data will be more apparent to the health worker as they are used in treatment algorithms and there will be fewer opportunities to simply make up data as overworked health workers try to save time. Automated data quality checks can identify deliberate errors such as entering false records by alerts for records that are entered in a very short time period or have inconsistent entries. Other types of data checks can be introduced to validate the data being entered.

We can expect that more timely and accurate data will lead to improvements in quality of care. Providers themselves can benefit from individual data feedback and their supervisors can use the data for improved supervision. We may see patients using the data to assess the quality of individual providers or provider groups using programs such as Yelp, which is already available in the United States and increasingly being made available globally. This type of crowdsourcing data about providers, facilities, and health systems is likely to grow as more people take advantage of Internet-based rating systems despite potential resistance from providers themselves who may prefer to remain anonymous [19].

At the macrolevel we are already seeing a rise in the mining of data from health records to identify trends in disease patterns, link agricultural data with rates of malnutrition, and similar uses. Artificial intelligence can be used for better diagnostic algorithms for individual care, better planning for personnel and logistics, and better reporting on the quality

of care being delivered by individual providers or individual facilities [20]. If linked to other types of demographic data, it can also be used by non-health organizations for marketing, research, or planning. However, it should be acknowledged that this use of comprehensive data at the individual level can also be used for less noble purposes, as we have seen with the recent sale of data by Google and Facebook for political or commercial purposes, and controlling the use of our data will be one of the major challenges facing health planners of the future [21].

Challenges

Though the use of digital technology has the potential to transform and improve the delivery of health care in low-income countries, it also raises many concerns, including how individual privacy and confidentiality will be maintained, who will control both the technology and the data, who will pay for the technology, and how to deal with the inevitable resistance to the changes discussed by those who benefit from the status quo.

Any discussion of electronic health records quickly leads to a discussion of privacy and confidentiality. Though this is not a new concern, because the same issues arise with paper records, the ease of analyzing and reproducing digital data is cause for concern. Recent data breaches by numerous commercial and government enterprises have made it clear that these concerns are real and that data breaches or abuses will become a reality of the digital age. Although we can wish to go back to an era or more privacy and confidentiality, the reality of surveillance cameras on each street corner, tracking location through mobile phone networks, and monitoring credit or debit card transactions has made it nearly impossible to maintain privacy. And as the use of digital cash transfers and Internet purchases grows, control of privacy will become less possible and it is unlikely that we will ever again be able to protect all of our data as was done in the past [22].

Governments have often taken the position that they are the owners of all medical data about their citizens and that the data cannot leave the country and be stored on servers in government ministries. However, few governments have the capacity to maintain these servers or truly understand that data cannot be kept within physical geographic boundaries. Further, recent actions by governments to target vulnerable populations for discrimination and prosecution have caused global concerns about government ownership of personal-level health data. It remains unclear how this challenge will be resolved [23].

At present, technology is being introduced by a wide variety of players. In India, the introduction of Aadhar has been a government-led initiative but control has been ceded to a statutory body [24]. In Zanzibar, technology has been introduced by a nongovernmental organization but ownership is being transferred to the government. In Malawi, the government has been working with funders and consultants to develop a digital health strategy [25]. What is common to these three models and most other examples is that the government has a central role in defining the policies and strategies for digital health, whereas implementation is often led by outside private groups. This approach makes sense for a number of reasons. There is a need for coordination of approaches so that systems that are developed for one application or geographic location can be integrated into a national or regional system. Providing separate digital systems for each disease entity or target population group is neither efficient nor effective, as demonstrated in Uganda where duplication of efforts by a multitude of funders and implementers led to a digital moratorium in 2010 but eventually to a national digital health policy [26]. It is also true that in many countries the government remains the largest provider of health services and thus will need to be included in any national system. However, though government will have a role, most countries will also require substantial input from the private sector. Few governments have the agility and capacity to develop and test emerging digital technologies and are better suited to support rather than manage innovation.

A third challenge relates to the cost of the technology. At present, much of the technological innovation has been funded by outside groups, but there is increasing pressure on governments to provide more funding [27]. In middle-income countries that is being done as governments see the value of digital technology in providing better care to their populations

Part of the funding to support digital health systems will no doubt come from individuals who benefit from the service improvements, and to some extent this is already happening. A number of interesting experiments are underway to make this both feasible and affordable. People in Zanzibar have shown a willingness to pay for transportation for pregnant women in labor, and in India community organizations are being encouraged to create individual savings accounts where some percentage of the interest paid on the savings is used to pay for the system. Other models of mixed payment are being tried around the globe, and it is likely is that mixed models of individual, private, government, and outside funding will fuel the expansion of digital health technology, with substantial variation in the particular model being used.

Of course, one can always hope that the efficiency gains in the use of digital technology will actually offset the additional costs of implementation, but there is not yet any evidence that this is the case, especially when digital technology is in fact replacing a system that is already not sufficiently funded. Though an Uber-like system for emergency transportation may be more efficient than the use of government ambulances, if current spending on ambulance services is already much too low, this will not be a source of savings. The questions then become whether external funding agencies will increase their willingness to continue to fund digital innovation, whether governments in low-income countries will increase their commitment to health spending, and whether private companies will be allowed to gain profits from their innovations. Like so many issues, these remain unanswered questions.

Conclusion

Though there is a growing consensus that digital health will be a positive change in the delivery of health care in low- and middle-income countries, there remain significant challenges to its implementation and growth. As with all disruptive changes, those who benefit from the status quo will resist these changes despite the promise of better access and quality for the consumer. Digital technology will change the balance of power between the provider and the patient, leading to changes in the roles of both government and health care workers. However, the penetration of digital technology across the entire global population will make

these changes inevitable. The role of program planners and managers will be to use these changes for the common good and ensure that they benefit everyone and not only those who can pay for care or control the health care sector.

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