

Leveraging Digital Health for Global Chronic Diseases



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Management of chronic diseases requires effective modalities for screening, prevention, and treatment of these conditions. At the core of chronic disease management is the need to effectively use health information for decision-making. In general, when the right information is available to the right person at the right time, the right decisions will likely be made. Digital technologies offer the potential to significantly transform delivery of chronic disease care by putting the power of information in the hands of patients, providers, and decision makers. Beyond the use of computers, mobile technologies, and the internet, digital health also encompasses wearable devices, sensors, Web 2.0 technologies, and genomic data, among others [1].

The global application of digital technologies is increasing, but utilization has not been optimized. Oftentimes, stakeholders who would benefit from these technologies are unaware of their potential to transform care. Further, many potential users get paralyzed by the complexities of implementing digital health systems within already complex health care environments. In this paper, we provide: 1) a high-level overview of some common applications of digital health for chronic disease care that are relevant in the global setting; 2) some guiding principles for adoption of digital health care; and 3) demonstration of a use case of these principles within a resource-limited setting in Western Kenya.

A DIGITAL HEALTH FRAMEWORK APPLIED TO GLOBAL CHRONIC DISEASES

Digital health solutions can be perceived simply as tools that can be leveraged in a multitude of ways for managing chronic diseases. Some of these solutions have a direct effect on the quality of patient care, whereas others are used to strengthen health systems and to improve governance and equity. Simply focusing on the direct clinical effect of digital systems often ignores these other useful effects of digital health solutions.

Figure 1 demonstrates a range of digital health systems that can be applied in global chronic disease management [2]. This framework is based on a generic digital health framework whose key intervention categories include providers, patients, and the health system. Increasingly, digital health systems for public and population health are also being implemented in the global setting, ranging from Integrated Disease Surveillance & Response systems to electronic registries. The current framework excludes some categories of digital health, such as bioinformatics-based

systems, as their adoption remains very low in global health settings.

It should be noted that digital health systems serving similar functions can often be implemented using different technologies. As an example, one can achieve computerized decision support by generating computer-based reminders that are disseminated as alerts within stand-alone or web-based electronic record systems, displayed during a computerized order entry session, transmitted to a smartphone app, or delivered as text messages through a short message service. In fact, robust digital health solutions often incorporate a number of these technologies within the same product. Caution is thus required when describing digital interventions (like mobile health solutions) as if they exist in isolation, as this often misses the multicomponent and integrated nature of the solutions. It should be noted that success of digital health goes beyond the technological product, and is also influenced significantly by how the system is implemented. It is therefore not uncommon for the same system to have highly variable effects on the basis of the implementation context.

POINTS TO CONSIDER

Given the potential complexities in implementing digital health systems for global chronic disease care, we present some guidance on how to navigate through decision-making processes around digital health systems. These points should be used to help reach sound judgment on whether and how to adopt particular digital solutions in managing global chronic diseases.

Clearly define the problem before settling on a digital health solution

Oftentimes, digital health advocates push for a solution before an in-depth analysis of the problem has been done—akin to a hammer looking for a nail. An approach that objectively looks for the best solution for that problem, regardless of whether or not it involves a digital health solution, is the best approach. A digital health solution should only be used when it is clear that integrating the solution makes the most sense given the problem at hand.

Digital solutions should not exist in silos

Digital solutions should easily be able to exchange data and communicate with one another. As an example, patient-level data are often stored within electronic health record

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| Intervention Category | Systems in Category | Digital Health Technologies for Categories | Intermediate Outcomes | Outcomes |
|--------------------------------|---|---|--|---|
| Health System Adequacy | Electronic Health Records Inventory Management Logistics Management Monitoring & Evaluation Systems Supervisory monitoring Financial Management Systems Scheduling | Tracking systems Geo-location systems eFinance Systems In-built M&E functionality Data Analytics systems Supervisory / performance systems | Data Quality Resource utilization (Human, material & financial) Supply chain management (e.g. stock-outs) Remuneration/Fraud rates reduction | Health Outcomes Cost-benefit |
| Provider Performance | Decision Support Continuous Medical Education Point of Care Diagnostics (PoC) Performance Metric Self-monitoring Telemedicine/Teleconsultation Enhanced Counseling Digital Assistance tools | Data collection systems Computerized Decision Support eLearning Systems Point of Care systems Tele-Consultation Systems Counseling Systems Order-Entry Systems ePrescribing | Provider behavior change Care quality by providers Provider efficiency Provider satisfaction Provider retention rates Provider competency | Health Outcomes Cost-effectiveness |
| Patient Knowledge and Efficacy | Patient Self-Management Support Adherence / Reminders Patient Education Social Networking | Patient Decision Support Systems Personal Finance Systems Patient monitoring systems/wearable devices Interactive Voice Response Systems TeleMed & Consultation Systems Pt-focused social media applications | Patient Behavior change Adherence to Care Patient knowledge & self-efficacy Patient empowerment Satisfaction with care | Health Outcomes DALYs |
| Public Health | Disease Surveillance Signal Detection Monitoring & Evaluation Systems Outbreak management | Data collection systems Data analytics Decision Support systems | Case-finding rates Time to disease detection Epidemic modeling adequacy Preventative care rates | Elimination of diseases (e.g. polio) Disease outbreak rates Outbreak severity |
| Population Health | Mass education Mechanisms Wellness Programs Disparity / Equity Monitoring Health Information | Wellness Apps Education Apps Access & Resource Distribution | Population health knowledge | Population Health Indicators Population disease burden |

FIGURE 1. Logic frame for digital health applied to global chronic diseases. Informed partially from work by the mHealth Alliance Evidence Working Group (2014) and the Mitchell-Labrique mHealth logic model [2]. DALY, disability-adjusted life-year; M&E, monitoring and evaluation; PoC, point of care; Pt, patient.

systems, and other digital solutions collecting patient-level data should be able to communicate and share data with the electronic health record systems. This is best achieved by having systems that use standard application programming interfaces, leverage accepted clinical messaging standards like HL7 [3], and use standard terminologies, such as the International Classification of Diseases, Tenth Edition, and the Systematized Nomenclature of Medicine—Clinical Terms, to allow semantic interoperability [4]. It is also essential that individuals should be able to be uniquely identified.

Infrastructure considerations

In many resource-limited settings, significant infrastructure challenges exist, ranging from unreliable electrical supply to poor Internet connectivity. Recognizing the infrastructure needs of proposed digital health solutions is essential for successful implementation. As an example, mobile

applications in many cases need to have the capability to work in both online and offline modes.

Security

Security is important to consider in digital applications deployed in the global setting. Beyond providing requisite physical security, application-level security can include user authentication, data encryption on devices, audit trails, and secure data transmission mechanisms, among others. Systems should offer device-level security, with the ability to remotely lock and wipe data off devices.

Cost-effectiveness

One of the bigger challenges in implementing digital health systems is in proving their cost-effectiveness, especially in settings with limited resources. Approaches to evaluate both cost and effectiveness of the systems, the return on

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