

Mobile Health Technology for Personalized Primary Care Medicine



Current primary care delivery models often revolve around a series of episodes, rather than functioning as a continuum. Patients make serial visits to a clinic, where clinicians collect discrete and isolated health data. These single data points, collected where patients spend little “life” time, are compared with the patient’s history and analyzed to make presumptive diagnoses and care recommendations. This model neglects significant amounts of potentially meaningful data from patients’ daily lives and results in less-informed treatment and scheduling of follow-up visits. Lack of meaningful data further blinds clinicians to patients’ health outside of the clinic and can contribute to unnecessary emergency department visits and hospitalizations.

Personalized care through mobile health technologies inspires the transition from isolated snapshots based on serial visits to real time and trended data. By using technologies from cell phones to wearable sensors, providers have the ability to monitor patients and families outside of the traditional office visit. The ability to objectively “see” a patient’s biological, behavioral, environmental, and social environment in “real time” can allow for higher level of analytics, such as predictive modeling, to occur. These data analytics could provide notifications to primary care providers of a deterioration in a patients’ health status, which would allow for more appropriate office visit scheduling. Scheduling visits in response to real-time data allows individualized interventions and medication adjustments when the patient needs it most.

Mobile devices, notably smartphones and other wearable sensors, can collect this real-time health data from the patient directly, as well as indirectly from their family or care takers. Moreover, mobile health technologies overcome geographic barriers faced by rural patients, allowing increased provider access.¹ These same technologies are beginning to transcend socioeconomic barriers to care.¹ This new, continuous stream of data has the potential to yield new insight into disease processes and can enhance our

understanding of the longitudinal effects of care delivery, medications, and health behaviors.²

Increasing access to mobile technology platforms may be especially useful for complex chronic illnesses, including diabetes, obesity, and cardiovascular disease. These are illnesses for which behavior change becomes a daily, if not hourly, undertaking that involves multiple overlapping factors with strong social influence.³ Self-management is integral to control diseases such as diabetes, for which patients currently provide 99% of their own care.⁴ Effective self-management by patients requires: (1) real-time information on their health status and behaviors and; (2) ongoing health professional facilitation of the patient as they monitor and perform self-care. However, accurate and timely information for these activities are notably absent from the current healthcare system.⁵ Providing real-time data would facilitate patients and their care providers to better understand illness dynamics, develop adaptive approaches to improve health outcomes, and deliver personalized care when it is most needed.⁶

NEW MODELS OF CARE DELIVERY FOR MOBILE HEALTH

The bombardment of health data will require new models of care delivery with advanced computing capabilities and analytic tools to filter and present information in a meaningful way. The full potential of mobile health technologies will require automation and a care team approach. This will require 2 levels of monitoring and real-time interaction by the clinic. The first level will be automated algorithms that allow a clinic computer to guide the patient to collect correct data and, within specific parameters, to take health-related actions. This will circumvent any concerns of the need for increase in personnel time to analyze and respond to the data.

The second level of monitoring and real-time interaction will use personnel in the event that abnormal data points are not able to be corrected by the automated algorithm. For example, healthcare team members would be notified if data, such as blood glucose levels, are consistently out of a target range or inconsistently reported. The healthcare team will become involved when a nurse or similar level provider interprets the data and triages the patient appropriately.

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If this team member cannot resolve the issue, a higher-level provider is then contacted to analyze the data and intervene. This process of care facilitates escalation of any problem up the ranks and is similar to what is already practiced frequently.

Although resources are limited, this team-based approach complements the nationwide shift toward the Patient-Centered Medical Home model, which focuses on multidisciplinary care teams. With the integration of mobile health data for chronic disease management, Patient-Centered Medical Homes could conceivably integrate and appropriately allocate data monitoring to members of the medical team.⁷

These data facilitate communication among providers, patients, and patient care teams through collection and exchange of patient-generated data. This supports providers' decision-making on tests and treatments, and allows for an ongoing conversation with patients about their health.⁸ Ideally, this will empower patients to better manage their conditions. Already, affordable care organizations around the country are adding mobile health technology such as these to their patient services and the Patient-Centered Medical Home.⁹

CHALLENGES

Although integration of mobile health data into practice may have the potential to enhance care delivery and improve patient outcomes, increased provider workload and burden remains a serious concern among many practitioners. Clinicians will benefit from collaboration with the informatics community to understand how to present this "fire hose" of data most efficiently at the point of care. Integrating real-time data into primary care practice presents challenges with not only acting on the data appropriately but also in dealing with the velocity and quantity of data—also known as "big data."

Data also are ultimately only as useful as their quality. Invalid data and noise may derive from such sources as the incorrect fit of a home wireless blood pressure cuff or a patient's family member stepping on a wireless scale. Further, the intended recipient of a health provider's digital communication may never receive the transmission. Potential usability issues compound these quality concerns. Mobile health devices must be charged and interoperable with multiple phones, different versions of operating systems, wireless routers, and other interfaces. They must also be acceptable and usable for patients across the age spectrum and for both those who are computer savvy and those who are not.

Among all other challenges, security remains paramount. Individuals and organizations that are considered covered entities under the Health Insurance Portability and Accountability Act and who transmit health information in electronic form must comply with national standards and future rules to protect the privacy and security of health information. This includes the use of mobile health

technologies and other devices, such as cell phones. To take regulations 1 step further, the US Food and Drug Administration has a public health responsibility for the oversight of mobile medical application and devices. They are currently taking a tailored, risk-based approach and focusing all required reviews on those mobile health technologies that could pose a greater risk to patients.¹⁰

Overcoming barriers to harnessing mobile health technology's promise and developing a solid science will require increased collaboration among physicians and their traditional healthcare teams, including nursing, social work, and public health. These efforts will require further partnership with other, often nontraditional, domains, including engineering, computer science, and the technology industry.¹¹

THE SHIFT TOWARD PERSONALIZED MEDICINE

There has been a rapid growth in personalized medicine, and digital technology has the potential to catapult this movement forward. By gathering real-time data from patients in their homes and work sites, additional insight can be gained into what day-to-day health actually looks like. Although "snapshot" clinic visits will still be important, the ability to see a real-time trend of patients' blood glucose or blood pressure level will change chronic disease management. There are still challenges regarding data validity, collection, privacy, presentation, and overflow that will need to be addressed. However, technology, innovation, and the need to rethink chronic disease management and decrease healthcare costs will drive solutions to these problems. Technology and data without application are of little value.

As mobile technologies and access to the Internet become universal, healthcare systems and private practices will leverage capabilities that allow the transfer of data on a daily and hourly basis. More important, this will reflect the unique environment patients reside in, taking into account the different exposures, stressors, and influences on their disease state. The time is now to integrate models of care delivery capable of deciphering meaningful information from patients' mobile health devices, to enable physicians to deliver true personalized medicine—the right treatment, for the right patient, at the right time.

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