Integrating Technology Into Health Care
What Will It Take?

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TECHNOLOGY IS IN PART RESPONSIBLE FOR INCREASing health care costs; however, new technology platforms, especially those from consumer electronics, have the potential to both decrease costs and increase the efficiency and quality of care. The benefits of electronic health records (EHRs) are well documented, yet their introduction has been greeted with reluctance and sometimes resistance. Indeed, current usage rates are quite low.[1] Similarly, personalized health records (PHRs) for consumers, such as Google Health and Microsoft HealthVault, also have not achieved their predicted uptake. As such, Google shut down Google Health as of January 1, 2012, because "it is not having the broad impact that we hoped it would. . . . We haven't found a way to translate that limited usage into widespread adoption in the daily health routines of millions of people."[2]

In addition to studying health information technology in its current state, what future conditions will be necessary to promote widespread adoption and use? To fit into the lives of clinicians, technology must optimize the 3 major components of a clinician's time: time spent with patients, time spent on documentation, and time spent on continuous learning. Similarly, to fit into the lives of patients, technology must help patients do the jobs that they perceive as high priority in their lives.[3] For example, many patients perceive financial health and other concerns as more pressing jobs to be done than physical health. To date, neither EHRs, controlled by clinicians, nor PHRs, controlled by patients, have been designed to integrate satisfactorily into the lives of users.

Many existing EHRs have unwieldy designs. Although the user interface has shifted from a 3-dimensional paper chart to a limited 2-dimensional screen, data are still organized by what a clinician would write on a paper chart to capitalize on the user's experiential knowledge. Most EHRs force clinicians to navigate through a maze before getting to the desired data field. As such, documentation often is more time consuming with EHRs than with paper records, which means that clinicians have less time for patient interaction or for continuous learning. Moreover, existing EHRs offer little innovation in output. Most available output is similar to paper records—a large amount of information in linear text format—and offers little connection, saliency, clinical insight, or prioritization to the user. Few attempts have been made to generate intuitive and useful trending of patient data, such as weight and height. Similarly, laboratory data and tests are populated into EHRs without linkages to the original test order.

As such, data in current EHRs are not easily searchable or retrievable at the point of care, or even for quality-related data abstraction. Furthermore, the electronic files are logged and filed like paper records. Reviewing a patient's files can be painstaking, with important clinical information often hidden in the sea of data. For most clinicians, retrieving digestible and up-to-date information about the patient from the EHR is difficult in the time allotted for a clinic visit. Yet, should anything go wrong with the patient, the EHR can be sieved through by others, such as medical informaticians or attorneys. Thus, EHRs have become expensive versions of paper logs, with increased liability for practitioners and health care organizations but without concurrent improvements in the efficiency of care.

In this current form, there is little return on investing in EHRs. Costs are passed down to health care organizations in terms of dollars, clinicians in terms of time, and consumers in terms of face-time with clinicians, with few improvements in utility. Large EHR systems resemble mainframe computers, for which the cost of purchasing, implementing, and maintaining a system far exceeds the value it currently provides. It is common for major hospital systems to spend half a billion dollars on EHRs that users still find unhelpful to their day-to-day practices; for smaller organizations, investment in such expensive systems is prohibitive.

Similarly, as therapeutic advances reach patients, PHRs are expected to promote shared decision making and patient engagement in the era of consumer technology. Motivating patients to adhere to recommended treatment regimens is the "the last mile" of health care delivery. Volpp and Das[4] have suggested that 40% of premature deaths in the United States are attributable to individual health-

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related behavior. Although many interventions have been developed to promote healthy behavior and adherence to treatment (eg, appointment reminders and incentives, patient diaries, social support), roughly half have failed in their attempts to change patient behavior.[5] To achieve sustained behavioral change, it is critical to understand what patients want to do for themselves—the job they want to get accomplished.[3] In other words, achieving good or better health is a job that can take on unique meanings and priorities for different patients. Tapping into patients' motivations for these health care jobs can make interventions more specific, affordable, and effective. For many patients who are obese, addicted to tobacco, or have coronary artery disease, becoming healthier is not a job that they prioritize—until they become sick.[3] At present, PHRs only act as a shadow medical record, in which patients can download or enter their clinical information from existing records. These records rarely address patient motivation and can hardly move health care jobs to a higher priority in patients' daily lives.

For EHRs and PHRs to become effective tools for clinicians and patients, they must merge into an all-in-one record, in which each party has control over updating a separate part. Moreover, for technology to play a truly integral role in health care, less expensive and more nimble systems must be created to integrate with larger systems, in the context of cloud computing, where each access point is like an on-ramp to an information super highway.

Consumer technology provides clues for improving EHRs and PHRs. First, individual systems must be simplified (such as iPads that are easy enough for grandparents to use), with only critical information presented at the point of care for each patient. The user interface could be individualized with modules designed for the patient's most relevant clinical conditions, with additional modules made available as standardized templates. Second, interfaces must create a more cohesive user experience. For example, for a patient with diabetes, hemoglobin A_{1c} levels, medication regimens, and complications should be easily documented and visualized in a single module. To create a sense of continuity and temporal sequence, conversation threads between each visit could be created so that clinicians can more easily track dose responses to medications, patient outcomes, and costs. Patients could also enter their perceptions of the effectiveness of care as participants in the system. These vertical, longitudinal online conversations could be horizontally aggregated across patients in a population to assess health care outcomes and costs. Creating a better user experience could also include the ability to capture data using technologies such as natural language processing (eg, Siri in iPhones), smarter data entry with predictive text offered by T9, iTap, and LetterWise, and other inputs such as digitally transmitted data, drawings, photographs, and videos. The data output should be a concise multimodal presentation (resembling a well-trained senior resident), with clinical insights highlighted along the way and evidence to support each pertinent point.

Expert systems and decision tools like IBM's Watson are on the horizon, and information technology will gain exponentially greater computation power in the next decade. Future EHRs and PHRs must support more timely and continuous patient data entry to inform such expert systems, such as adverse effects from medication or common complications of treatment. To accomplish this, the future all-in-one record will need to fit into patients' daily lives by offering features that are engaging, portable, understandable, and actionable. This all-in-one system can be designed as separate modules that feed into the patient's entire data repository, similar to different entry points on a freeway. Only by making individual access modules simpler, while integrating the whole system in the information cloud, can physicians and patients begin to connect the dots and see relationships in data to strengthen bidirectional patient care.

To achieve this ambitious goal, designers, clinicians, engineers, and psychologists will need to work together on the heuristics of empowering and engaging patients and clinicians in the system. This will include adding saliency to the data and highlighting important data elements with visuals such as stars or colors. Moreover, social support features, such as the "like" feature in Facebook, are important aspects of engagement for patients and clinicians. Patients who feel supported are more likely to continue their positive health behavior and clinicians who like each other practice better together. Together, this integration will close the gap between clinicians and patients and finally allow them to be part of the same health care system.

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