



How can innovative uses of technology be harnessed to improve medication adherence?

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“Studies have shown consistently that 20–30% of medication prescriptions are never filled, and that on average 50% of medications for chronic disease are not taken as prescribed, despite evidence that medical therapy prevents death and improves quality of life.”

Technology will be a powerful tool to address one of the most significant public health problems – medication nonadherence. Poor medication adherence is prevalent and dramatically effects individual and population-level health. Nonadherence has been estimated to cost the US healthcare system US\$100 billion annually in direct costs [1]. Studies have shown consistently that 20–30% of medication prescriptions are never filled, and that on average 50% of medications for chronic disease are not taken as prescribed [2], despite evidence that medical therapy prevents death and improves quality of life [3–5]. There has been growing interest in leveraging technology, whether it be mHealth, interactive voice response (IVR) or electronic medical records, to improve medication adherence.

mHealth devices & medication adherence

mHealth is the use of mobile technology as a healthcare delivery method. mHealth is unique, in that it uses a ubiquitous technology, mobile phones, and is utilized even among underserved populations. In the USA, more than 87% of the population uses a mobile phone [6]. There are over 285 million wireless subscribers in the USA alone [101].

mHealth has distinct advantages: it reaches across geographic boundaries; can

be delivered directly to people; is inexpensive; and is easy to use. This affords an easily disseminated model of care that is cost effective. The use of mHealth interventions has the capacity to interact with the individual with much greater frequency, and in the context of the behavior, at a convenient time for the patient. The use of mHealth provides the potential to also deliver health behavior interventions tailored to a person's baseline characteristics, such as disease, demographic, as well as frequently changing behaviors and environmental contexts [7].

“There has been growing interest in leveraging technology ... to improve medication adherence.”

In a recent review, ten studies were identified that evaluated the use of mobile technology to improve treatment adherence [8]. Of these, only two addressed medication adherence but focused on HIV treatment adherence. Specifically for hypertension, a review of randomized clinical trials showed that reminder systems, apart from mailed postcard reminders, improved patient adherence in most studies [9]. Given the substantial use of technology for measuring medication adherence [10] and the availability of smart pillboxes for

improving adherence [11], it is surprising that more work has not been published examining the impact of mHealth on medication adherence. Perhaps, while there are increasing developments of this technology, much of this work is not being published or disseminated in peer-reviewed clinical journals.

In a systematic review of text messaging as an intervention for disease prevention and management, focused more globally than just medication adherence, the majority of studies found evidence for short-term effects on behavior changes or clinical outcomes related to disease prevention and management, such as smoking cessation, self-monitoring of blood glucose levels, weight loss and decrease in hemoglobin A_{1C} [12].

IVR & medication adherence

IVR telemonitoring interventions have been shown to improve adherence to medications for chronic diseases. IVR technology is a computer-based telephone system that initiates calls, receives calls, provides information and collects data from users. Patients often interact with these automated systems to get clinic appointments and/or refill prescriptions. Studies with IVR have demonstrated improvements in medication adherence and intermediate outcomes (e.g., diastolic blood pressure and hemoglobin A_{1C}) [13–16].

Electronic health records & medication adherence

In addition to the potential of mHealth and IVR to improve medication adherence, the ability to use electronic health records to systematically collect, organize, access, analyze and better understand health information is expected to help improve medication adherence. It is expected that the use of health information technology, through better connectivity among patients, their providers and the healthcare system, can help improve medication management and monitoring of quality metrics. The use of health information technology and electronic prescribing provides a significant opportunity to measure and improve medication adherence at the point of care and to identify nonadherence. Medication reconciliation may be one of the significant results of the use of electronic medical records by providing a means for members of an individual's healthcare team to retrieve information to reconcile medications across the care continuum – during transitions of care, hospital admissions and hospital discharges [17].

In summary, tools such as mHealth, including IVR, text messaging and electronic medical records, are increasingly being used to empower patients, their providers and the healthcare system to play a more active role in managing their medication. These tools may provide electronic reminders and track medication adherence. However, as indicated above, and in an additional recent study evaluating technology-based interventions, mobile phone reminders and in-home electronic technology used to communicate reminder messages have shown mixed results [18]. Significantly more work is needed to better understand the role of technology in improving medication adherence. For example, further work is needed to determine successful models of reimbursement and integrating these technological advances into the healthcare system. Opportunities for providers to monitor medication adherence will be necessary, given that three measures of medication possession ratios have already been made into Centers for Medicare and Medicaid Services quality measures (e.g., cholesterol, diabetes and ACE inhibitor medications).

“Significantly more work is needed to better understand the role of technology in improving medication adherence.”

As we previously reported, current trials suggest that increasing automated reminders will complement, but not replace, the benefits seen with in-person communication for medication adherence [18]. However, given the public health consequences of poor medication adherence, the role of technology is likely to play an increasingly important role to facilitate improved healthcare outcomes. Further work is warranted to determine the best ways of implementing and using these technological advances to improve medication adherence.

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