



## Into Practice

# A mobile health infrastructure to support underserved patients with chronic disease



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## ARTICLE INFO

*Article history:*

Received 2 August 2013

Received in revised form

20 December 2013

Accepted 23 December 2013

Available online 5 February 2014

*Keywords:*

Diabetes

Text message

SMS

Chronic disease

Mobile health

Safety net

## ABSTRACT

**Background:** Chronic diseases are the global leading cause of death, but the US health system is poorly designed to support patients with chronic disease. Underserved patients report high rates of cell phone use and interest in using mobile technology for health care. A mobile health infrastructure may help transform health care delivery for underserved patients with chronic disease.

**Problem:** This study assessed the feasibility of integrating mobile health infrastructure with clinical information systems and the electronic medical record (EMR) to support patients with chronic disease through automated, bidirectional text messaging.

**Goals:** Three priority areas of chronic disease management were targeted. Existing self-management support was expanded, and new support for laboratory test scheduling and medication management was created.

**Strategy:** Adult patients ( $n=135$ ) with diabetes selected preferred content and scheduling for self-management message prompts. Outreach messages were sent to patients overdue for laboratory tests and medications. Manual review of pharmacy and laboratory outreach data was conducted for quality assurance. Focus groups were held to solicit patient perspectives.

**Results:** Patients sent over 6500 response messages with response rates of 53.7% (blood sugar), 48.8% (step counts), and 31.9% (blood pressure). Laboratory data integration was achieved, but pharmacy data gaps required ongoing manual review. Focus group participants reported improved self-management and information awareness.

**Implications:** HIT was used to address dependency on visit-bound disease management in a novel, low-cost way. Use of a mobile health infrastructure was feasible. Text messaging solutions may mitigate barriers to access and enhance support for patients with chronic disease.

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## 1. Background

Chronic diseases are worldwide killers.<sup>1,2</sup> In the US, 70% of deaths and 78% of health care expenditures are due to chronic disease.<sup>3,4</sup> Nearly half of Americans have one chronic disease and a quarter have two or more, but the design of the US health system is poorly suited for chronic disease management.<sup>5–7</sup> Competing demands limit providers' ability to manage chronic disease during the standard 20-min clinic visit.<sup>7–9</sup> Racial and ethnic minorities and low-income and uninsured adults experience significantly higher chronic disease prevalence and disparities in receiving recommended treatment when compared to white, higher-income, and insured adults<sup>5,10–13</sup>;

these same groups also encounter significantly higher barriers to health care access, rendering visit-focused chronic disease management insufficient for their needs.<sup>8,9,12,14,15</sup>

Health information technology (HIT) can reduce chronic disease costs and improve outcomes.<sup>16–20</sup> Consumer-focused health informatics solutions have been associated with better management of chronic disease outside the clinic, including improvements in blood pressure, glycemic, and asthma control.<sup>20–27</sup> Cell phone technology is widely available and frequently used for health purposes: 85% of American adults own cell phones, of whom 31% use their phones to obtain health information – a near 100% increase in 2 years.<sup>28</sup> Of US cell phone owners, 80% have used text messaging.<sup>28</sup> Text message-based diabetes management has been associated with improved glycemic control<sup>29</sup> and with patient reports of increased health information awareness and social support.<sup>30</sup> Cell phone ownership and use for health information are significantly higher among Latinos and Blacks than

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among whites,<sup>28,31,32</sup> indicating the potential of this technology to help overcome disparities in chronic disease management.

## 2. Organizational context

These issues were examined in a pilot study designed to demonstrate the feasibility of using mobile health infrastructure in an urban safety net setting to improve chronic disease management for adult patients with diabetes.

The US health care safety net is the source of care for patients with little or no health insurance. It encompasses health delivery systems and providers who share a mission of caring for patients regardless of ability to pay,<sup>33</sup> and includes organizations such as health departments, public hospitals, and federally qualified health centers (FQHCs). Safety net patients predominantly include racial and ethnic minorities, children and the elderly, people with disabilities, and other groups with low income or socioeconomic status.<sup>34–36</sup>

Denver Health (DH), an integrated health care delivery system, is the primary safety net for patients in Denver, Colorado. The system includes a 525-bed acute care hospital with a Level I trauma center, Denver Public Health, and 15 school-based clinics and 8 FQHCs distributed throughout Denver neighborhoods. Study participants were recruited from 2 FQHCs: Westside Community Health Center (Westside) and Webb Center for Primary Care (Webb). Over 115,000 patients receive primary care at DH, with over 350,000 clinic visits annually. Half of DH patients are uninsured, and 65% live below 185% of the federal poverty level. Sixty percent represent racial and ethnic minorities, and 25% speak a native language other than English.

DH developed its technology infrastructure over almost two decades and has extensive experience with HIT-supported patient care. Integration between the electronic medical record (EMR), clinical systems such as those for pharmacy and laboratory services, and multiple disease registries assists providers with improving patient care at the point of service. A recent infrastructure addition is the Patient Relationship Management (PRM) software platform. The PRM system was originally designed to support patients with diabetes through automated text messaging for appointment reminders and to prompt for and collect patient-reported blood sugar measurements. A previous pilot study demonstrated the potential of this approach.<sup>30</sup>

## 3. Personal context

The project team expanded the PRM infrastructure with funding through the Agency for Healthcare Research and Quality's

Multiple Chronic Conditions Research Network (Grant R24 HS 019453-01). The team was led by a primary care physician who also serves as the leader for DH's diabetes collaborative and who had previous experience with integrating DH's diabetes registry and the EMR. Other team members contributed multidisciplinary expertise in health informatics, nursing, health services research, and public health (Table 1). Together, these individuals formed a committed, experienced project team with both the necessary knowledge and the drive to pursue continued improvement in chronic disease management through mobile technology.

## 4. Problem

The team's challenge was to expand text message-based support for chronic disease management and to integrate the PRM platform with clinical systems as data sources and with the EMR to deliver patient-reported measurements automatically to providers at the point of care. The team discussed measures of success and identified clinical domains for inclusion in program design and infrastructure development. Additional input came from DH leaders and key stakeholders about parallel and competing organizational priorities and what information systems and architecture were best suited for integration.

Three areas of chronic disease management were targeted as priorities. Existing self-management support was expanded, and new support for laboratory test scheduling and medication management was created and implemented. Patient response rate to text message prompts for home measurements was the primary outcome; a secondary outcome was the percent of responses correctly formatted by patients and thus automatically handled by the PRM system. Process outcomes included PRM capacity to successfully prompt for multiple self-management measurements on varying schedules, to identify patients overdue for laboratory tests and statin cholesterol medications and to automatically transfer patient self-reported measurements to the EMR. The Colorado Multiple Institutional Review Board approved the study prior to patient enrollment.

## 5. Strategy

A 9-month pilot study ending April 30, 2012 explored the expanded infrastructure's feasibility to engage adult patients with diabetes through text message prompts. Eligible patients were on the diabetes registry, over 18 years old, spoke either English or

**Table 1**  
Project team composition and expertise.

Project role/title	Background and multidisciplinary expertise
Principal investigator	Primary care physician with expertise in general internal medicine and chronic disease management; leader of DH's diabetes collaborative; health informatics experience through project-based integration of a diabetes registry with the EMR
Director, medical informatics	Primary care physician who oversees clinical information technology system selection, design, and implementation activities at DH
Director, public health informatics	Primary care physician who provides technical and clinical leadership for Colorado's health information exchange and regional health information organization projects
Nurse case manager	Registered nurse with experience in telephone-based diabetes management
IT project manager	Certified project management professional with public health expertise; oversaw coordination of project activities with DH's eHealth Services (eHS) department processes and personnel.
Physician champion	Primary care physician champion and provider educator with strong interest in chronic disease management
Chief quality officer	Primary care physician with chronic disease management and quality improvement research experience
Director, quality improvement research	Primary care physician with chronic disease management and quality improvement research experience
Director, community outreach and patient navigation	Research and program implementation experience in creating and testing national best-practice models of care
Health services researchers	Two health services researchers, both with previous IT industry experience and current expertise in public health, quantitative and qualitative methods and analyses, and research project coordination
EMC software development team	Team of health IT industry consultants who contributed practical system design, software development, implementation and integration skills.

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