

## VIEWPOINT

# Can Mobile Health Technologies Transform Health Care?

**Steven R. Steinhubl, MD**

Scripps Translational Science Institute, La Jolla, California.

**Evan D. Muse, MD, PhD**

Scripps Translational Science Institute, La Jolla, California.

**Eric J. Topol, MD**

Scripps Translational Science Institute, La Jolla, California.



Supplemental content at [jama.com](http://jama.com)

**There is substantial enthusiasm** for the concept of mobile health (mHealth), a broad term typically used to describe the use of mobile telecommunication technologies for the delivery of health care and in support of wellness. In 2011, US Secretary of Health and Human Services Kathleen Sebelius referred to mHealth as “the biggest technology breakthrough of our time” and maintained that its use would “address our greatest national challenge.”<sup>1</sup> This level of exuberance for mHealth is driven by the convergence of 3 powerful forces. First is the unsustainability of current health care spending and the recognition of the need for disruptive solutions. Second is the rapid and ongoing growth in wireless connectivity—there now are more than 3.2 billion unique mobile users worldwide—and the remarkable capability this brings for the bidirectional instantaneous transfer of information. Third is the need for more precise and individualized medicine; a refinement in phenotypes that mandates novel, personal data streams well beyond the occasional vital sign or laboratory data available through intermittent clinic visits.

But there are multiple obstacles to the acceptance and widespread utilization of mHealth technologies. Foremost are the complexities of the health care system, especially the current drivers of reimbursement. In addition, clinicians are concerned about the possible further weakening of the patient-physician relationship and the possible increase in their workload. Also, and somewhat paradoxically, the unbridled enthusiasm of the mHealth technology development community, coupled with consumers’ appetite for alternative health and wellness resources, can create challenges to the appropriate use and validation of mHealth technologies. For example, there are tens of thousands (estimates vary between 30 000 to more than 90 000) health care-related apps available for download, in contrast to the US Food and Drug Administration estimate of the approximately 100 it has reviewed. This lack of oversight is worrisome and contributes to the increasingly high likelihood of useless and possibly even dangerous apps being downloaded by unsuspecting consumers.<sup>2</sup>

When such a high level of interest and promise coexists with such a paucity of evidence, there is potential for hype to dominate the discussion around mHealth. To move beyond that, in this Viewpoint we offer examples of how mHealth technologies can transform health care by addressing inefficient practices and challenges faced by consumers and clinicians in the current system.

## mHealth and the Consumer

mHealth could benefit ambulatory individuals in 2 general ways: (1) allow them to more easily and reliably self-

diagnose their acute symptoms, and (2) enhance monitoring, tracking, and communication of various biometric information (eg, blood pressure, glucose levels, spirometry values, oxygen saturation) for individuals with chronic medical conditions, enabling greater engagement and partnership in their care. Widespread implementation of mHealth technologies, in their totality, can improve consumer convenience by potentially ensuring better control of chronic conditions and by allowing for more rapid diagnosis and treatment of common acute conditions. Simultaneously, the number of unnecessary visits to physicians’ offices and emergency departments potentially could be substantially decreased, reducing health care costs.

## Management of Acute Conditions

Approximately 34% of all physician office visits are related to an acute condition, and care for up to a quarter of all patients presenting to emergency departments could have been managed in the ambulatory care setting.<sup>3</sup> Innovative mHealth devices exist for all of the most common acute conditions (eTable in the Supplement) and have the potential to allow individuals to forgo an office or emergency department visit through safe, effective, and informed management from home.<sup>4</sup>

Viral respiratory tract infections are the most common acute illness, with an estimated total economic cost of \$40 billion annually in the United States alone.<sup>5</sup> Because of the limited role of laboratory investigations and radiologic studies, individuals with symptoms of upper respiratory tract infection are an ideal cohort for home diagnostics and triage. For example, a thermometer-enabled smartphone that monitors temperature, tracks associated symptoms, connects with the patient’s local digital community to see how many others in a school or workplace have similar symptoms, and allows the sharing of that information with a clinician could provide the information necessary to guide whether further evaluation is needed. For individuals for whom measuring temperature alone may not provide adequate information, innovative devices under development could provide biometric information previously available only at a medical facility. In the near future a specific viral etiology of an infection may be identifiable via smartphone-based point-of-care diagnostics.

A host of other acute conditions could be addressed through novel technologies. For example, otitis media might be diagnosed using a smartphone-based otoscope and urinary tract infections using at-home urinalysis, and people with palpitations or dizziness could receive intermittent or continuous electrocardiographic monitoring. All of these devices have the potential to provide the analytic, tracking, and trans-

**Corresponding Author:** Steven R. Steinhubl, MD, Scripps Translational Science Institute, 3344 N Torrey Pines Ct, Ste 300, La Jolla, CA 92037 (steinhub@scripps.edu).

[jama.com](http://jama.com)

JAMA December 11, 2013 Volume 310, Number 22 2395

Copyright 2013 American Medical Association. All rights reserved.

[www.manaraa.com](http://www.manaraa.com)

mission capability to allow for the elimination of millions of unnecessary office and emergency department visits.

### Management of Chronic Conditions

More than half of all adults in the United States have at least 1 chronic medical condition and account for 90% of health care spending.<sup>6</sup> The health care system is not well designed for the management of chronic conditions, as exemplified by the lack of success in adequately addressing the most common chronic condition, hypertension.

One of every 3 adults in the United States has hypertension, a condition that accounts for 40 million office visits annually, is the single most common diagnosis for an office visit, and accounts for more than \$93 billion in total costs.<sup>7</sup> Despite this, plus the strong association between adequate treatment and lower risk of stroke and myocardial infarction, less than half of individuals with hypertension have their blood pressure under control.<sup>7</sup> Home monitoring is one method to improve blood pressure control and minimize the need for office visits. A new generation of blood pressure cuffs for home use can wirelessly transmit individual readings or long-term trends to a clinician, allowing for rapid feedback and ensuring that patients need make an office visit only when absolutely necessary. In the next several years, innovative devices that can monitor beat-to-beat blood pressure during daily activities could allow for even greater refinement of the diagnosis and treatment of hypertension, potentially allowing individuals to recognize the habits and activities that adversely influence their blood pressure and then to act on that information.

A wide range of mobile technologies have been developed and continue to be devised to better treat the tens of millions of individuals with other chronic conditions, including diabetes and pulmonary diseases such as asthma and chronic obstructive pulmonary disease (eTable in the Supplement). mHealth tools designed around the needs of these populations could lead to greater levels of monitoring and tracking of important biometric information, primarily collected passively, coupled with real-time and personalized feedback when needed and with automated transmission to a patient's physician when desired.

### mHealth and Clinicians

Mobile technologies create the ability to improve patient health and to minimize or even eliminate the need for office visits for the routine management of some of the most common acute and chronic issues. Large cohorts of patients could be tracked passively for any abnormal or concerning readings, which can then be proactively addressed when needed by text message, e-mail, telephone call, and, if significant enough, an office visit. These kinds of changes could revolutionize health care and change the role of clinicians. Although some observers fear this may minimize the patient-physician relationship, instead the changes could reinforce and empower it. By eliminating physicians' unneeded involvement in algorithmic, precision medicine that has little need for extensive training and knowledge, clinicians might be able to spend more time with the patients who need them most in their transformed role as diagnosticians and educators possessing skills that require 4 years of intensive postgraduate education followed by 3 to 8 years of further training and that continue to be refined over decades of practice. In the future, when financial incentives are better aligned with the needs of patients and mobile technologies are embraced, much of the current time demands on physicians could be eliminated because of greater patient self-management and shared care—practice features already associated with greater physician satisfaction.<sup>8</sup>

### Conclusion

mHealth technologies have the potential to change every aspect of the health care environment and to do so while delivering better outcomes and substantially lowering costs. For consumers, mHealth offers the promise of improved convenience, more active engagement in their care, and greater personalization. For clinicians, mHealth could lead to reduced demands on their time and permit them to instead refocus on the art of medicine. Much remains to be done to drive this transformation. Most critically needed is real-world clinical trial evidence to provide a roadmap for implementation that confirms its benefits to consumers, clinicians, and payers alike.

#### ARTICLE INFORMATION

**Published Online:** October 24, 2013.  
doi:10.1001/jama.2013.281078.

**Conflict of Interest Disclosures:** All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Steinhilb reported receiving a research grant from Qualcomm and serving as a consultant for AstraZeneca. Dr Muse reported receiving funding from National Institutes of Health (NIH) grant 8 KL2 TR000110. Dr Topol reported receiving research funding from the Qualcomm Foundation and NIH/National Center for Advancing Translational Sciences grant 8 UL1 TR000109; currently serving on the boards of directors of Dexcom and Volcano and having served on the board of directors of Sotera Wireless; currently serving on the scientific advisory boards of Gilead Sciences Inc, Biological Dynamics, AltheaDX, and Genapsys and having served on the scientific advisory board of Portola Pharmaceuticals; serving as a consultant/advisor for Cypher Genomics (of which he is a cofounder)

and Quest Diagnostics; and serving as editor in chief of Medscape (WebMD).

#### REFERENCES

1. Sibelius K. mHealth Summit Keynote Address. NCI Cancer Bulletin. December 13, 2011. <http://www.cancer.gov/ncicancerbulletin/121311/page4>. Accessed August 31, 2013.
2. Wolf JA, Moreau JF, Akilov O, et al. Diagnostic inaccuracy of smartphone applications for melanoma detection. *JAMA Dermatol*. 2013;149(4):422-426.
3. Centers for Disease Control and Prevention (CDC). National Ambulatory Medical Care Survey: 2010 Summary Tables. CDC website. [http://www.cdc.gov/nchs/data/ahcd/namcs\\_summary/2010\\_namcs\\_web\\_tables.pdf](http://www.cdc.gov/nchs/data/ahcd/namcs_summary/2010_namcs_web_tables.pdf). Accessed August 16, 2013.
4. Steventon A, Bardsley M, Billings J, et al. Effect of telehealth on use of secondary care and mortality: findings from the Whole System Demonstrator cluster randomised trial. *BMJ*. 2012;344:e3874.
5. Fendrick AM, Monto AS, Nightengale B, Sarnes M. The economic burden of non-influenza-related viral respiratory tract infection in the United States. *Arch Intern Med*. 2003;163(4):487-494.
6. Machlin MS, Cohen JW, Beauregard K. Health Care Expenses for Adults With Chronic Conditions, 2005. Agency for Healthcare Research and Quality website. [http://meps.ahrq.gov/mepsweb/data\\_files/publications/st203/stat203.pdf](http://meps.ahrq.gov/mepsweb/data_files/publications/st203/stat203.pdf). May 2008. Accessed October 2, 2013.
7. Centers for Disease Control and Prevention (CDC). Vital signs: prevalence, treatment, and control of hypertension—United States, 1999-2002 and 2005-2008. *MMWR Morb Mortal Wkly Rep*. 2011;60(4):103-108.
8. Sinsky CA, Willard-Grace R, Schutzbank AM, Sinsky TA, Margolius D, Bodenheimer T. In search of joy in practice: a report of 23 high-functioning primary care practices. *Ann Fam Med*. 2013;11(3):272-278.