

## Chapter 2

# From Telemedicine to Telehealth to eHealth: Where Does mHealth Fit?

### Overview

Diabetes, high blood pressure (BP), and other chronic diseases can cut years from a person's life and reduce the quality of life during those years. Sadly, despite the state of our medical knowledge, these diseases are on the increase in the USA, fueled by the growing obesity epidemic among children. Treatment for chronic diseases accounts for a significant portion of our health-care dollars and has hidden costs to individuals and to the system. Chronic care is by definition long term, often lifelong, and often involves complex self-care protocols that are difficult and time consuming for patients, especially children and the elderly, to follow. Because the consequences of changes in relevant health markers can be life threatening in some chronic illnesses, the supervision of self-care by a trained clinician is essential. For example, a rise in blood glucose for a diabetic can signal the need for additional insulin. If the insulin is not administered in time, the person can become unable to deliver the needed treatment independently. Remote monitoring, tracking health data from afar, can help doctors and nurses intervene when needed to save lives, prevent hospitalization, and decrease costs associated with inpatient care.

When the field of telemedicine (literally, "medicine at a distance") emerged more than 40 years ago, it was principally focused on providing diagnostic and health monitoring services to patients living in remote or rural areas. Early telemedicine programs were predominantly hospital-based, and telemedicine effectively expanded the market area it served and increased referrals to the sponsoring hospital. The most widely used data transmission technology at that time was hard-wired telephone lines, with some opportunities for video interfaces. For patients, the greatest benefits of early telemedicine programs were reduced travel time and costs, and access to specialist consultation services not available locally. Technology innovations supporting high-speed communications and more robust computer processing coupled with reform initiatives have enabled the migration of telemedicine over the past decade to a mainstream health-care delivery mode supporting a broader array of health-care services and benefits for both providers and individuals (Galewitz 2012; Brown 2013). Data from a *Hospital & Health Networks* survey has shown

that 70% of the “most wired” US hospitals offer some form of telehealth (Jackson 2011; Page 2011).

Currently, there are two drivers for the rapid expansion and adoption of computer-based health-care products and services—the availability of affordable technology and the changing health-care delivery environment. Since the necessary technology has been available for some time, why has technology alone been insufficient to drive significant industry changes? The short answer is “money.” Prior to health-care reform, there was little financial incentive for providers to develop telemedicine beyond its basic remote monitoring programs unless it served a specific organization strategic goal. But money is a powerful motivator in health care. Newly implemented readmission penalties for providers serving Medicare and Medicaid patients are expected to drive hospitals to develop telehealth programs that monitor and manage postdischarge treatment to prevent unplanned readmissions. And, as health-care delivery is distributed more fully along the continuum of providers and facilities, these applications will diffuse more broadly as well.

As this chapter will show, remote monitoring of important health indicators such as BP and blood glucose and transmission of relevant information are key elements of telemedicine services that can be well met by mHealth apps. Current technology makes this type of monitoring easier and more convenient than early systems and expands the process from one-way information transmission to information exchange between patient and provider. mHealth products will help to transform telemedicine from a provider-driven tool serving selected patient populations to one that facilitates patient engagement and empowerment across the continuum of health-care services.

### *What Is Telemedicine?*

For this book, we will rely on a modification of the definition developed by the American Telemedicine Association (ATA), which defines telemedicine as

the use of medical information exchanged from one site to another via electronic communications to improve a patient’s clinical health status. Telemedicine includes a growing variety of applications and services using two-way video, email, smart phones, wireless tools and other forms of telecommunications technology (ATA website).

When the term “telemedicine” entered our vocabulary several decades ago, the health-care industry operated very much in a medical model of “sick care,” and the concept was used to describe information transmitted for diagnosis or treatment of specific conditions. As our medical model has grown more inclusive of managing health as well as managing disease treatment, the term “telehealth” has emerged and the terms are used interchangeably, just as we use medicine and health in our daily language. The distinction is not precise; both refer in general to using telecommunication devices to transmit information related to health care. As our focus is explaining how mHealth applications can extend and add value to information and services delivered through telecommunication devices and computers, we prefer

**Table 2.1** Services provided via telehealth. (Source: American Telemedicine Association website [www.americantelemed.org/](http://www.americantelemed.org/))

Service	Description
Primary care and specialist referral services	May involve a primary care or allied health professional providing a consultation with a patient or a specialist assisting the primary care physician in rendering a diagnosis. This may involve the use of live interactive video or the use of store-and-forward transmission of diagnostic images, vital signs, and/or video clips along with patient data for later review
Remote patient monitoring, including home telehealth	Uses devices to remotely collect and send data to a home health agency or a remote diagnostic testing facility (RDTF) for interpretation. Such applications might include a specific vital sign, such as blood glucose or heart ECG or a variety of indicators for homebound patients. Such services can be used to supplement the use of visiting nurses
Consumer medical and health information	Includes the use of the Internet and wireless devices for consumers to obtain specialized health information and online discussion groups to provide peer-to-peer support
Medical education	Provides continuing medical education credits for health professionals and special medical education seminars for targeted groups in remote locations

the “telehealth” label. Thus, we propose to modify the ATA definition as *the use of information exchanged from one site to another via electronic communications to monitor, maintain, or improve an individual’s health status*.

The ATA website, [http://www.americantelemed.org/learn\\_](http://www.americantelemed.org/learn_) lists an array of services considered telehealth that include transmission of published health information, continuing medical education programming, patient portals, and call centers for real-time clinician consultations. The services typically provided using a telehealth model fall into four broad categories. Table 2.1 lists and describes each of the four categories.

So many information-based services are labeled telehealth by virtue of the digital transmission factor that it is necessary to make the distinction that the technology itself, while a necessary element, does not constitute a telehealth application. Generally speaking, health information technology (HIT) enables telehealth, which is the actual delivery of a health-related service from one site to another site remote from the first.

In addition to categorizing the types of services provided, the ATA has classified the most commonly used design models for telehealth programs. *Networked programs* link tertiary care hospitals and clinics with outlying clinics and community health centers in rural or suburban areas. The links may use dedicated high-speed lines or the Internet for inter-site communication links. The ATA estimates

the number of existing telemedicine networks in the USA at about 200, providing connectivity to more than 3000 sites.

*Point-to-point connections* use private high-speed networks. This type of system is used by hospitals and clinics that deliver services directly or that outsource specialty services to independent medical service providers. Examples of outsourced services include radiology, stroke assessment, mental health, and intensive care services. *Monitoring center links* are the model of choice for cardiac, pulmonary, or fetal monitoring and for care and services provided to patients in their home. Often regular landline telephones or wireless connections are used to communicate directly between the patient and the center although some systems use the Internet. *Web-based e-health patient service sites* provide direct consumer outreach and services over the Internet. Under telemedicine, these include those sites that provide direct patient care.

### ***Impact of Health-Care Reform: The Affordable Care Act (ACA)***

The market for remote monitoring technology, especially for home telehealth care and disease management, is predicted to reach US \$ 295 million by 2015. And, as the market for telemedicine grows, it is expected to shift away from traditional services toward consumer-focused products, too. Some experts anticipate that growth will also occur in remote monitoring of intensive care units (ICUs). The eICU is seen as a viable way to reduce costs and respond to physician and nurse shortages associated with staffing ICUs 24/7 (Caramenico 2012). However, these applications can be costly—eICU units can cost US \$ 6–8 million to establish, not including staff salaries.

The ACA creates a variety of financial incentives for hospitals with Medicare patients to use remote monitoring. For example, patients with chronic diseases such as congestive heart failure (CHF) are expected to increase significantly, especially with the trend toward an aging population, and facilities with extensive inpatient stays and readmissions are being penalized by new reimbursement programs. Thus, the ability to remotely measure the patient's weight, BP, and oxygen levels to monitor changes and ultimately reduce or avoid hospital admissions becomes a driver for hospitals under ACA incentives (Lowes 2013).

Mario Gutierrez, executive director of the Center for Connected Health (CCH) Policy, suggests that the ACA is creating the “perfect storm” for expansion of telehealth as a delivery mode. In his opinion, expanded insurance coverage will increase service demand to an extent that cost control will require virtual patient engagement (Bowman 2013).

### ***Telehealth Research***

Research in the early telemedicine era had a strong focus on cost effectiveness and patient satisfaction, and results were inconsistent among studies. Generally speaking, clinical outcomes differed among the various programs as did cost savings,

and patients typically based “satisfaction” on the ease of use and personal time and money savings. Using the *Journal of Telemedicine and Telecare* as an industry indicator, the volume of research on patient satisfaction appears to have declined in recent years. Possibly, the pervasiveness of computers in an individual’s work and personal life make computer-assisted health care more acceptable and satisfaction is a less relevant concept than when the technology was unfamiliar to many people. Conversely, the number and variety of applications seems to be increasing. Again, the pervasiveness of computers in business and society, and the advent of mobile computing, are easy explanators for this observation. Research topic trends aside, robust research offers important information to guide product development and to establish care protocols.

The Whole System Demonstrator (WSD) program, sponsored by Britain’s Department of Health, is the largest randomized control trial of telehealth and telecare in the world. The intent of the study was to quantify the impact of telehealth to inform investment decisions in programs that could enable people to live independently and to take control and be responsible for their own health and personal care. Data collected for this study showed that remote monitoring decreased patient deaths by 45 %, reduced emergency visits by 15 %, and reduced associated costs for health-care services. As a result of these findings, Britain’s Department of Health embarked on a project known as 3 Million Lives to install remote monitoring devices in the homes of 3 million patients (Britain’s Department of Health 2011).

A Swedish study found that mobile phones provide a fast and safe method of reporting pain postoperatively in real time. This finding is important because early pain management is a key factor in treating postoperative pain to prevent postoperative emergency department visits and also in reducing the risk of developing a chronic pain syndrome that can affect the quality of life and prove costly in recurrent treatment. However, because the study sample was small (37 participants), further studies are required to better inform policy (Stomberg et al. 2012).

A recent telehealth study found that 7 % of US physicians are using videoconferencing chats with patients, and they use them more often for routine follow-up visits than for urgent care or acute care conditions. This approach is less costly and more convenient for patients, which leads to improved patient satisfaction with the overall encounter. It is also a clear shift toward using telehealth technology for the convenience of local patients, in contrast to the earlier model of providing specialty services to remote patients. The study also found that psychiatrists and oncologists are more likely to use video chats than other physician specialties (Manhattan Research 2011). In these specialty areas, the need for quick response to patient needs may be a key driver over convenience.

According to a 2013 study, follow-up telephone calls to postambulatory surgery patients can safely substitute and be as effective as face-to-face visits in selected low-risk cases. From the patient perspective, this telehealth approach decreased travel time and expense while improving patient satisfaction. From the provider perspective, the telehealth calls freed up time in clinics to see new patients (Hwa and Wren 2013).

Because less than 50% of patients with high BP in the USA have their BP under control, telehealth represents a practical and cost-effective method to improve BP management for these patients. A 12-month study conducted by researchers at HealthPartners Research Foundation in Minnesota used home telemonitoring combined with actual pharmacist case management via phone conversations to improve BP management. Home BP monitoring, in which patients routinely measure and transmit their BP measurements, was found to improve patient satisfaction too. Home monitoring offers advantages over face-to-face traditional office visits in which misclassifications often result from white-coat hypertension, a situation where the patient's BP increases simply because it is being measured in a clinical setting, which causes anxiety in some patients (Margolis et al. 2013).

Studies of telemonitoring interventions for patients with chronic diseases have increased within the past decade. Moreover, the evidence produced by these studies has become more and more important to a wide range of policy makers, clinicians, insurers, and other key health-care stakeholders. Despite the importance of this research, little formal assessment of these studies in the aggregate has been conducted. One recent study of methodological quality calls into question the research methods used. There appeared to be a lack of scientific rigor used in evaluating the claims of reduced costs and improved quality for home telemonitoring (Kitsiou et al. 2013).

### *The VA Story*

A total of 289 hospitals made the *Hospitals & Health Networks* 15th annual “most wired” list, including the Veterans Administration (VA) hospital network. Moreover, the VA, which is the nation's largest health delivery system, with 152 medical centers and 1400 outpatient clinics and other facilities, was recognized for taking technology “beyond the four walls of the hospital” and for ambitiously using telemedicine to assure that veterans get care as close to home as possible, and often at home (Weinstock 2013).

So far, the biggest use of telemedicine has been by the military and the VA (Baum 2012). In fact, the VA has used home telehealth services to manage chronic conditions at an unprecedented scale when compared with other health services organizations (Broderick and Lindeman 2013). And, the VA uses aggressive approaches to increase the number of veterans who benefit, such as the Federal Ruling issued on March 06, 2012 that waived co-payment charges to veterans for home video telehealth services (VA Final Ruling 2012). This exemption opens the telehealth program to all veterans, including those who previously could not afford to participate because of co-pay barriers.

The US Department of Veterans Affairs signed a 5-year, US \$ 28.8 million contract with AMC Health, a New York-based provider of telehealth solutions and services. VA telehealth programs reach approximately 500,000 veterans and are expected to extend that number to 800,000 by the end of 2013. A total of 1.3 million consults were reported for 2012. AMC Health represents an outcomes-based approach to telehealth that aligns with the VA's telehealth goal to actively engage

patients so they proactively self-manage chronic conditions (AMC Press Release 2013). In addition, the VA is committed financially to expanding its telehealth programs into other areas, including palliative care and dementia care. In April 2011, the VA awarded US \$ 1.38 billion in national contracts for home telehealth devices and services over a 5-year period. Well over 90,000 veterans were expected to enroll in its home telehealth program by the end of 2012 (Broderick 2013b).

The VA's commitment to telemedicine is long-standing. Since the 1990s, information and communications technologies, including telehealth, have been at the center of system-level transformation to furnish continuous, coordinated, and comprehensive primary and specialty care for its veteran population. The VA Office of Telehealth Services houses a program called Care Coordination Home Telehealth (CCHT), established in 2003 targeting chronic conditions such as diabetes and hypertension and posttraumatic stress disorder (PTSD). CCHT uses remote monitoring devices in veterans' homes to communicate health status and to capture and transmit biometric data, which is monitored remotely by care coordinators, who are usually nurses or social workers, but can also include physicians, pharmacists, dietitians, and occupational therapists (Broderick 2013b).

Promising results from program efforts have been reported, including reduced hospital admissions and high rates of patient satisfaction. Decreases in health resource utilization were largest in highly rural settings (50.1 %) and urban locations (28.2 %), and patient acceptance was high, with only 10 % of patients declining participation in telehealth home services (Broderick 2013b). The technologies used most in CCHT are messaging and monitoring devices (85 %), videotelemonitors (11 %), and videophones (4 %). The messaging devices ask patients questions that assist in monitoring their health status. Monitoring devices record vital sign data. Videophones and videotelemonitors are used in audio-video home consults (Broderick 2013b).

In 2011, American Well teamed with the VA to provide online behavioral health services to patients in Minnesota and remote oncology consultations to patients in Nebraska. These types of collaborations are decreasing facility-level costs to the benefit of the system as a whole. A single VA hospital in rural Oregon saved more than US \$ 88,000 in travel expenses alone during the FY 2011 by shifting 3224 patient encounters from traditional face-to-face visits to telehealth services (Cerrato 2012).

The VA has reported reductions in emergency visits and hospital admissions using remote care coordination at its Clarksburg, West Virginia hospital. About 95 % of patients accessing services remotely from the Clarksburg hospital live in rural areas. Increasingly, the VA is using home monitoring for care coordination of patients diagnosed with chronic diseases such as diabetes, CHF, pulmonary disease, or hypertension, and those who are living in Ohio, Delaware, Pennsylvania, or West Virginia are monitored remotely by the Clarksburg facility. Patients routinely send readings from a device that is connected to a wired or cellular phone. A nurse monitors the submissions and makes follow-up calls to patients and a physician when readings are abnormal (Charleston Gazette 2010).



The VA's telehealth program includes home monitoring, video consults, and "store-and-forward" telehealth, which refers to the capturing of digital images, video, audio, and clinical data and storing this information on a computer or mobile device for forwarding at a convenient time to caregivers (AMC Press Release 2013).

### ***Meeting the Needs of Rural and Underserved Populations***

Telehealth has the potential to bring health-care services, especially specialty medical care consults, to rural, remote, and underserved populations in the USA. But if those populations do not have access to affordable broadband services on which mobile technology relies, how will telehealth programs fulfill these expectations? The Federal Communications Commission (FCC) established the Rural Health Care Program 16 years ago, with the goal of securing funding for broadband infrastructure and services for rural and underserved areas. To date, the FCC has fallen far short of this goal. Government oversight has criticized the FCC for lack of progress and failing to adequately develop assessment programs and measurement goals. Meanwhile, the ATA complained that the FCC annually reserves more than US \$ 300 million in funds that could be used immediately to help improve Americans' access to health services and help reduce the cost of health care (Wicklund 2011). Growth markets in telemedicine include both rural and underserved areas. California became a first mover with the Telehealth Advancement Act of 2011 that expanded access to health care in rural areas and inner cities by offering more telehealth services (Telehealth 2011).

The CCH, a nonprofit division of Boston-based Partners Health care system, employed nontraditional interventions aimed specifically at altering behaviors in underserved populations. The center has primarily connected with the underserved through text messaging, mostly because of its simplicity and availability to this population group. Text messaging interventions have focused on prenatal and addiction patients. Prenatal care works well for program evaluation because start and end dates are clearly established. Seventy-two percent of women involved in prenatal programs reported feeling more connected with their OB/GYN physician and the physician practices had better show rates for appointments. The center is in the process of building apps to use for pain management (Perna 2013).

UnitedHealthcare joined with Cisco in implementing its new "Connected Care" program which connects patients in underserved areas with primary care physicians, specialists, and hospitals by using telehealth applications. Physicians conduct virtual patient examinations in real time using a two-way video screen and also interact with the patient and an on-site nurse at the point of care performing the actual medical tests (Keller 2010).

Increasingly, individuals in small rural areas are being treated by doctors and nurses using webcam-enabled telehealth. Approximately 25 % of the US population resides in rural areas that are medically underserved. Furthermore, the need for care will increase as the population ages in remote areas such as South Dakota where the



proportion of people over the age of 65 is 72% higher than in the rest of the USA and is expected to double by 2020 (Abrams 2012).

Avera Health Network, which began in 2009 with a US \$ 13 million start-up grant from the Helmsley Charitable Trust, is believed to have the only long-distance critical care program in the USA and perhaps the world. The nonprofit network provides a range of telehealth services such as high-definition two-way video consulting that make it possible for experts to be available 24/7 in locations throughout the Dakotas (North & South), Minnesota, Iowa, Wyoming, and Nebraska. Four main services provided by the network include eConsult, eICU Care, eEmergency, and ePharm. As of October 2012, Avera Network, based at Avera McKennan Hospital in South Dakota, reported an 18% decrease in ambulance and helicopter transfers to major hospitals, resulting in approximately US \$ 6.6 million saved and keeping health care in local communities (Abrams 2012).

Telehealth gives hospitals the opportunity to provide specialty medical care that is cost effective and convenient to rural patients. In sparsely populated western states such as Washington, travel time for specialty care at an urban medical center can take up to 10 hour round trip. In addition, telemedicine can build referral patterns for transport of critical patients. Especially important is that telemedicine services can improve clinical outcomes for discharged patients, which contributes to a hospital's effectiveness ratings and reimbursement and contributes to sustainability and growth (Page 2011).

## ***The Business of Telehealth***

In addition to the partnerships forged in meeting the needs of the rural and underserved populations, opportunities for business development and relationships exist in other health markets. The development of many personal use mobile health apps are conceptualized around the device itself such as cell phone or tablet. The question has become, *What can we do now that the consumer has a smartphone?* Meanwhile, the evolution of telemedicine represents using the mobile device as a means to solve a variety of problems, including decreasing costs, increasing access to care and services for patients, and ultimately improving the quality of care and health status. Smart clothing that integrates wearable electronic sensors into clothing is in the works for remote patient monitoring (RPM). With a smartphone, the individual often is required to manually enter the data, whereas smart clothing would track and report vital signs automatically—without needing the wearer to do anything. John Vu, CEO of Misfit Wearables, a core start-up company that looks to integrate wearable sensors into everyday clothing is realistic about the challenges of developing smart clothing, including battery life and complete invisibility. But the savvy CEO also sees the potential impact of smart clothing on remote monitoring (Farr 2013).

In 2012, Sprint launched a new gateway device with the veteran home monitoring company Ideal Life of Toronto, Canada. The product is similar to what Verizon and Qualcomm offer, a series of at-home remote monitors for BP, weight, glucose

readings, mobility, and other vital sign data. Data are collected from monitors using wireless technology and stored in a cloud database that can be accessed by physicians and caregivers. Alerts are sent when readings exceed normal ranges. Well-designed home monitoring systems make integrating remote monitoring data easier for a hospital or other care provider (Jackson 2012).

In 2011, Walgreens partnered with the IT giant Cisco to furnish telehealth and on-site clinical services for more than 40,000 Cisco employees and their family members at the company headquarters and the Cisco campus in North Carolina. Walgreens will run Cisco's LifeConnections health center, the brick-and-mortar clinic at the company's headquarters in San Jose and also provide telehealth services, including virtual physician visits, at the North Carolina campus. Both Cisco and Walgreens have previous telehealth collaborative experience. Cisco is already involved in a joint effort with the health insurer UnitedHealth Group. The two created a nationwide network to enable video medical imaging, audio communication, and health record information to be exchanged between health-care providers and patients from remote locations such as retail stores and office settings. Cisco and UnitedHealth Group successfully tested the telehealth program in a pilot study with more than 300 Cisco employees in San Jose over a 7-month period in 2009 (Mearian 2011).

Physician entrepreneurs are in the telehealth game as well. A 37-year-old cardiologist with an MBA founded Telemed Ventures and became CEO of Smart Care Doc, a telehealth business with the goal of providing affordable health care in areas underserved by providers (Baum 2012). However, most companies involved in telehealth are venture-backed start-ups. Walmart had a poor experience in their 2005–2007 efforts, and if (when) Walmart gets involved in telehealth in a big way, it will probably be with an established health-care partner. The struggles with telehealth are not unique to Walmart as many plans of the large, established insurers such as UnitedHealthCare and Blue Cross have also struggled with telehealth services (Cannon 2012). The critical question for entrepreneurs, investors, and insurers is whether pilot projects and partnerships, which can be successful at the local level, will translate effectively and profitably to a much larger national scale.

## ***Benefits, Disadvantages, Challenges, Barriers, and Opportunities***

### **Benefits**

According to the ATA, the growth enjoyed by telehealth ventures to date has occurred because of four main drivers—access to needed services, cost savings, improved quality, and patient interest. From its inception more than 40 years ago, telehealth applications have been promoted for their ability to bring health-care services to patients in distant locations. Not only does telehealth improve access for patients but it also allows physicians and health facilities to expand their reach, beyond their own offices. Given the provider shortages throughout the world—in

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