

Introduction

Home Telehealth (HT) technology provides a telemedicine tool for patients to take an active role in the management of their chronic diseases. HT works by allowing patients to transmit vital health data from their home to physicians' offices and, in turn, receive health coaching from their providers based on the clinical data they transmit.

In many ways, HT is similar to traditional remote patient monitoring (RPM), but the inclusion of interactive capability may offer the opportunity to generate benefits for a much wider population of chronic disease sufferers, including those with cardiovascular conditions, diabetes and chronic respiratory diseases.

Generally, the HT system consists of a hub device containing the communications and interactive/audio/video capabilities and wireless peripheral device that collects physiologic data.

As instructed by the device, the patient uses the peripherals, including blood pressure cuffs, pulse oximeters, weight scales and blood glucose meters, to obtain vital signs. The device may also ask patients multiple choice health questions to gather additional information about their health status and behaviors. These data are then transmitted via the base station to the clinicians. These data can be stored in clinical information databases for later analysis or used to offer real-time health coaching and interventions, as created by a health care professional or automatically generated by a computer algorithm.

Some devices include audio and video conferencing capabilities, allowing remotely located health care professionals to interview, observe and educate the patient, as well as assist in the use of the peripherals or other medical devices. Advanced devices also have the ability to show full-motion video, which can be used to provide patient education.

Selected Technologies

Health Buddy

Bosch

- Simple four-button device
- No audio or video
- Peripherals: stethoscope, scale, blood pressure meter, glucose meter, pulse oximeter



Genesis DM

Honeywell HomMed

- Two-way audio
- Peripherals: stethoscope, scale, blood pressure meter, glucose meter, pulse oximeter, thermometer, PT/INR meter, peak flow meter



Health Guide PHS6000

Intel Corporation

- Video-capable touch screen
- Two-way audio and video
- Peripherals: blood pressure, glucose meter, ECG, scale, peak flow meter



TeleStation

Philips

- Two-way audio
- Peripherals: scale, blood pressure meter, glucose meter, pulse oximeter, rhythm strip recorder



LifeView

American TeleCare (ATI)

- Video-capable touch screen
- Two-way audio and video
- Peripherals: stethoscope, scale, blood pressure meter, glucose meter, pulse oximeter, thermometer, PT/INR meter



Ideal LIFE Pod

Ideal Life, Inc.

- Inexpensive system of communications hub and peripherals
- No audio or video
- All interactive capability is contained in peripherals: blood pressure meter, glucose meter, scale pulse oximeter, peak flow meter, pedometer, chair scale



Targeted Medical Conditions

The treatment of chronic diseases cost Massachusetts \$8.1 billion in 2003.¹ In addition to these direct costs, each year chronic diseases reduce Massachusetts' economic efficiency by \$34 billion. Worse, this problem will grow to a \$62 billion drag on yearly productivity by 2023.

Nationwide, almost half of all Americans (133 million people) live with at least one chronic condition, and care for people with chronic diseases accounts for more than 75 percent of the nation's \$2 trillion in total medical care costs.²

Telemedicine approaches may not be appropriate for all 133 million Americans suffering from chronic disease, but recent estimates suggest a sizeable portion may benefit. The Veterans Health Administration (VHA) estimates that 75,000, or around 50 percent, of its total patient population could be cared for with home telemedicine technologies by 2011.³ Additionally, Home Telehealth, with its interactive capabilities, offers the potential to positively impact a broader segment of the chronic disease population compared to traditional remote patient monitoring (RPM), which has been shown to be effective primarily for the most serious chronic disease patients, including those suffering from heart failure.

Current Availability

Despite the relatively large number of HT technologies available in the marketplace, the current installed base of HT devices remains quite small, particularly in light of the immense target population of chronic disease sufferers. For example, interviews with representatives from Ideal Life, Inc. and American TeleCare, Inc. indicated installed bases of 2,000 and 500 devices, respectively.

The majority of HT devices currently in use are part of pilot or demonstration projects. Examples include:

- Health Buddy: The Health Buddy technology is currently being used by the Department of Veterans Affairs in 50 different health management programs across 18 Veterans Integrated Service Networks. The technology is also being used in the Medicare High Risk Demonstration project with approximately 1,000 patients in California.
- LifeView: Centura Health at Home, Colorado's largest health care system, is currently offering HT to 167 Medicare members with heart failure, COPD and diabetes.

User Satisfaction/Provider Satisfaction

HT technologies must be accepted and used by patients in order to realize improved health and cost-effectiveness outcomes.

- In a study of congestive heart failure patients who used the Health Buddy, 90 percent approved of the device. Moreover, "almost all" participants reported that information

¹ Massachusetts Office of Health and Human Services, Division of Health Promotion and Disease Prevention. Quick Facts. Accessed from <http://www.mass.gov/?pageID=eohhs2homepage&L=1&L0=Home&sid=Eeohhs2>

² National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control (2009). Chronic Disease Overview. Accessed December, 2008 from <http://www.cdc.gov/nccdphp/overview.htm>.

³ Darkins, Adam et al. Care Coordination/Home Telehealth: The Systematic Implementation of Health Informatics, Home Telehealth, and Disease Management to Support the Care of Veteran Patients with Chronic Conditions. *Telemedicine and e-Health*, December, 2008, 1118-1126.

relayed by the device had caused them to increase their diet and medication compliance, and had given them confidence about managing their disease.⁴

- Using data from 42,460 surveys administered through HT devices, the VHA found that, on average, patients were satisfied with HT services 86 percent of the time.⁵
- 100 percent of doctors who participated in a separate 2000-2002 VHA study, the Rural Home Care Project, felt that HT was a benefit to their patients and indicated they would have referred other patients to the program.⁶
- Evidence from several studies shows that the technology reduces travel time and expenses for both patients and clinicians (for home visits), which is likely to enhance satisfaction.

Clinical Outcomes

HT technology promotes improved clinical outcomes by providing patients with a means to actively monitor their condition. As patients' focus on their condition helps to improve their health status, they are at reduced risk for emergency room visits and hospital readmissions. The data described in this report reflect the potential for positive impact of HT on patient wellness, demonstrated through secondary outcomes such as reduced ED visits, hospitalizations and length of stay and increased survival rates. Improved patient wellness could also be demonstrated through primary outcomes such as lower blood glucose, cholesterol, weight, or blood pressure. However, these data have not been widely reported.

Reduction in Emergency Department (ED) visits

- In a study of 40 in-home patients conducted by Roanoke Chowan Community Health Center (RCCHC), those who used the Health Buddy HT over a six-month period had 69 percent fewer ED visits compared with the previous six months.⁷
- A pilot study for the LifeView device found a 100 percent reduction in ED visits over a six-month period with the use of HT.⁸
- In a yearlong study of 791 chronic disease patients who used the Health Buddy system through the VHA, a 40 percent reduction in ED visits was achieved.⁹

Reduction in hospitalizations and hospital readmissions

- The largest study of HT to date, conducted by the VHA over an 18 month period, found a nearly 20 percent reduction in hospital admissions for the HT study group, compared to a 4.6 percent decrease in the entire VHA (non-telemedicine) population.
- The RCCHC study noted a 71 percent reduction in hospitalizations with the use of HT over approximately one year. In real terms, prior to the use of HT technology, the 40

⁴ Bigelow, J et al. Patient Compliance With and Attitudes Towards Health Buddy (2000). *RAND Monograph Report*. Accessed May, 2009 from http://www.rand.org/pubs/monograph_reports/MR1232/.

⁵ Darkins, Adam et al. p. 1122.

⁶ Kobb, R et al. (2003). Enhancing Elder Chronic Care Through Technology and Care Coordination: Report from a Pilot. *Telemedicine Journal and e-Health*, 9 (2).

⁷ Britton, Bonnie (2008). Telehealth Unbound: From Home Health Care to Population Based Care. Program Abstracts from the 13th Annual American Telehealth Association Meeting on April 7, 2008 in Seattle, WA. Available from <http://media.americantelemed.org/confi/2008/presentations.htm>.

⁸ Denholm, Erin (2008). Telemedicine in Healthcare: Be Ready for the Future. Webinar Series: Healthcare Moves Home. *Health Tech*. Available from http://www.healthtech.org/content/webinar_healthcaremoveshome.

⁹ Meyers, M et al (2002). Virtually Healthy: Disease Management in the Home. *Disease Management*, 5 (2), 87-94.

patients under study accounted for 38 hospitalizations, or 216 bed days. With the use of HT, the group had 11 hospitalizations or 42 days in hospital.¹⁰

- A Tufts Medical Center study of 188 heart failure patients over a 90-day period following the initial hospital stay found that hospitalizations related to heart failure were reduced by 72 percent with the use of HT. Hospitalizations for other cardiovascular conditions were reduced by 63 percent.¹¹

Reduction in hospital length of stay

- In addition to the reduction in the number of hospitalizations, the VHA study also found a 25 percent reduction in the number of bed days.¹² A separate, yearlong study found a reduction of 60 percent in hospital bed days.¹³

Better survival rates

- In the Trans-European Network Homecare Monitoring Study, which was carried out by a consortium of twelve European medical centers and Philips Medical Systems, survival rates were substantially better for patients receiving RPM compared to usual care (27 percent greater for RPM patients).¹⁴

Figure I: Selected HT Study Findings

Study	n =	Survival/ Mortality	Decrease in Hospitalization	Decrease in ED Use
Trans-European Network Homecare Monitoring Study	426	15% increase in survival	34%	--
Roanoke Chowan Community Health Center	40	--	71%	69%
Specialized Primary and Networked Care in Heart Failure II	188	no statistical difference	72%	--
Veterans Health Administration	17,025	--	19.74%	--
Meta Analysis-Health Buddy	238	69% decrease in mortality	--	69%

¹⁰ Britton, Bonnie (2008).

¹¹ Brookes, Linda (2005). SPAN-CHF II: Specialized Primary and Networked Care in Heart Failure II. In Weintraub AJ, Kimmelstiel C, Levine D, et al. *A multicenter randomized controlled comparison of telephonic disease management vs automated home monitoring in patients recently hospitalized with heart failure: SPAN-CHF II trial*. Program and abstracts from the 9th Annual Scientific Meeting of the Heart Failure Society of America, Boca Raton, Florida.

¹² Darkins, A. et al (2008).

¹³ Meyers, M et al (2002).

¹⁴ Philips Medical Telemonitoring Services (2003). TEN-HMS Study Demonstrates Clinical and Financial Efficacy of Home Telemonitoring. Accessed December 2008 from <http://www.medical.philips.com/goto/telemonitoring>.

Financial Analyses

Cost of technology

The cost of HT technology is split into two portions: device costs and service fees. One-time device costs include the purchase of all required devices including the main appliance (or base unit) and any additional peripherals (blood pressure monitors, scales, etc.). The cost of HT devices varies substantially based on the level of sophistication. Advanced devices, including the Intel Health Guide which includes two-way audio, a larger viewing screen and memory capacity, and video capture capability, are likely to cost several thousand dollars. The ATI LifeView device costs \$5,500-\$6,500 per unit and has a large screen and memory capacity, as well as video capture. At the lower end of the cost spectrum, the LIFE Pod costs approximately \$100 per device and includes a base station without a video screen, as well as peripheral devices such as a scale and glucose meter.

HT technologies also incur ongoing service fees, usually billed on a monthly basis. This cost covers the use of the IT systems which collect, manage and disseminate data collected from patients. This often includes access to web-based tools and integration with electronic medical records. For example, Ideal Life charges \$20 per month for use of its LifePod system.

Overall, the costs of HT technology must be considered inclusive of device and service fees, and over an extended period of time. According to an estimate by the VHA, the cost of care coordination/home telehealth is around \$1,600 per patient, per year.

Business model

Multiple business models exist for the broader commercialization of HT. The most commonly cited model includes selling the devices to health plans, provider groups or integrated health care systems. This model is most effective in addressing the upfront costs of the devices due to the comparatively substantial capital budgets of payers and providers compared to individual consumers, but it requires the demonstration of a positive and timely return on investment for the technology. This business model currently dominates the market.

The second model is a consumer-focused strategy; the device is sold directly to the target patients as a traditional over-the-counter medical device. This model removes the need to demonstrate return on investment for health care payers, but it puts pressure on manufacturers to sell devices at low prices to attract price-sensitive consumers. Manufacturers described this business model as a future option.

Finally, a third business model has been suggested for the diabetes target population. The cost of the devices and the monthly service fee are waived and revenue is collected through the cost of the disposable glucose testing strips. This requires a proprietary design allowing only strips made by the device manufacturer to be used in the system. This approach is likely limited to diabetes patients and requires low-cost devices and service fees to ensure reasonable per-unit costs for disposable strips.

Costs of the condition treated

The medical care costs of people with chronic diseases account for more than 75 percent of the nation's \$2 trillion medical care costs.¹⁵ In Massachusetts, chronic diseases cost the economy \$34 billion each year, including \$8.1 billion in medical care costs for the most common diseases (cancers, diabetes, heart disease, hypertension, stroke, mental disorders, and pulmonary conditions).¹⁶

Financial benefits/return on investment (ROI)

HT technology is perceived as cost effective for two reasons. First, it reduces hospital costs. A meta-analysis of three programs using the Health Buddy technology showed that patients who used the device to manage heart failure experienced a decrease in hospitalizations and emergency room visits (for all types of illnesses), reducing average annual costs from \$11,549 to \$3,263.¹⁷ The RCCHC study found a similar reduction in hospital charges; hospital charges for the 40 patients followed prior to the use of telehealth amounted to \$1,240,506 over six months, compared to charges of \$229,919 during six months of HT use, an 81 percent reduction.¹⁸

Second, HT can reduce the need for intensive home health service and institutional care services, such as 24-hour monitoring at a nursing home. The VHA estimates that the cost of comprehensive home health services for chronic disease patients, known as home-based primary care (HBPC) in the VHA system¹⁹, is approximately \$13,121 per patient per year and the cost of nursing home care averages around \$77,745 – high costs compared with the \$1,600 per-year cost for HT.

An analysis of the Trans-European Network Homecare Monitoring Study resulted in an ROI of 2.1 (i.e. each dollar invested resulted in \$2.10 in benefits) for the home telemonitoring program compared with similar services through a nurse telephone support program. The ROI was calculated as hospitalization cost saved per patient divided by the additional cost of telemonitoring per patient over a 240-day study period.²⁰

Barriers to Adoption

Lack of clinical and financial outcomes

The primary barriers to the broader adoption of HT are related to the lack of financial and clinical outcomes data and issues related to the reimbursement models for this technology. Among fee-for-service plans, there is no coverage for the purchase of HT devices and no reimbursement for the ongoing monitoring service fees. The one exception is for patients living in rural areas that may be eligible for federal funding for telemedicine. For most users, a capitated or per-member, per-month (PMPM) fee structure will be required to support the use of the technology.

¹⁵ National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control (2009).

¹⁶ Massachusetts Office of Health and Human Services, Division of Health Promotion and Disease Prevention. Quick Facts. Accessed May, 2009 from <http://www.mass.gov/?pageID=eohhs2homepage&L=1&L0=Home&sid=Eeohhs2>

¹⁷ Health Hero Network (2000). Clinical and Financial Analyses of Programs in Congestive Heart Failure. Accessed December 2008 from https://www.healthhero.com/papers/studies/Meta-Analysis_CHF_Outcomes.pdf

¹⁸ Britton, Bonnie (2008).

¹⁹ VHA Home Based Primary Care (HBPC) is provided by an interdisciplinary team of practitioners including nurses, social workers, physicians, therapists and dietitians. The services provided are more intense and frequent than traditional models of home health service provision and are intended for patients with complex, chronic, progressive diseases.

²⁰ Philips Medical Telemonitoring Services (2003).

The majority of current users of HT technology are large private insurers or large employers who have chosen to cover the technology and service. From the perspective of the manufacturers, each of these relationships has to be separately negotiated, requiring substantial time and cost.

It is expected that home health agencies and primary care provider networks will be primary users of HT technology, applying it to home-based patients. In 2008, 17 percent of home care agencies were using some type of HT system (the percentage of systems which were interactive was not reported).²¹ However, most HT technology requires substantial upfront acquisition costs, out of reach for many agencies, and the data on ROI are limited. A substantial portion of the savings from HT comes in the form of reduced hospitalizations, the financial benefits of which largely accrue to the insurers. In addition, the current home health reimbursement system does not incentivize better outcomes in order to defray the cost of implementing telemedicine technologies. As a result, many home health agencies are concerned that the cost of the technology and monitoring service outweighs the savings generated by fewer home visits by nurses.

Information technology infrastructure

Another barrier to the broader application of HT is that electronic medical records (EMR) are a prerequisite for its use. While the prevalence of EMR systems is increasing and is likely to accelerate with additional government funding, smaller primary care practices are currently unlikely to have such technology. Without an EMR, the data gathered by the HT system can not be collected, analyzed and used by practitioners. Some HT manufacturers have developed third-party data hosting solutions, but challenges to incorporating the data into day-to-day clinical practice remain.

Cultural resistance

Thus far, little physician resistance has been noted in the literature, although the technology represents a shift in professional practices. Training will be required to aid physicians in incorporating HT technology into their existing workflows and clinical activities. There is similarly little evidence of patient resistance to the technology, though the small sample sizes and pilot project nature of the existing studies leave open the possibility for patient resistance in broader uses of the technology.

Legal and licensure barriers

Finally, while nearly all telemedicine technologies face some legal and licensure barriers, HT technology is best suited to support existing chronic disease management activities by providers and not to provide new, inter-state models of care. As such, cross-border licensure and practice issues are not likely to be a major factor in the near future. However, as larger, multi-state integrated care networks begin to implement HT, legal and licensure issues may become more prominent over the long-term.

²¹ Harvath, B (2009). Case Studies for Successful Innovation: Tools for Evaluating Strategies and Technologies. San Francisco: Health Technology Center.

Conclusion

The personal and financial costs of chronic disease in the United States and in Massachusetts are well known. There is much to gain from a more proactive, efficient chronic disease management strategy.

In disseminating HT to the Massachusetts market, policymakers should bear two factors in mind. First, socioeconomic status is a notable indicator of chronic disease; obesity, in turn, is the leading cause of diabetes and other chronic conditions. In 2005, 22.1 percent of Massachusetts adults with annual incomes of \$25,000 or less were obese, while only 14.2 percent of adults with annual incomes of \$50,000 or greater were obese. HT technology may be able to address this disparity – thus reducing the incidence of chronic disease – if it can be included as part of enhanced chronic disease management within the MasHealth program.

Second, as part of the Healthy People 2010 Initiative, Massachusetts has established objectives for reducing the prevalence of obesity. Specifically, the state aims to reduce the proportion of adults who are obese from 17 percent to 15 percent. HT could offer the necessary support for Massachusetts to reach this goal. Partnering with large entities like the VA or the Center for Connected Health could enable the dissemination of HT to a large portion of the Massachusetts population.

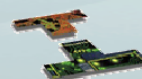
At the national level, where the prevalence of chronic disease is even greater than in Massachusetts, HT is an extremely promising solution for managing and reducing illness. As HT technologies become increasingly affordable, the opportunities for widespread dissemination will increase. Demonstration projects in Massachusetts could provide additional evidence of feasibility for widespread state or federal adoption. Widespread adoption will depend greatly on payment system reforms to make telehealth technologies, including HT, reimbursable. In May 2009, the Medicare Telehealth Enhancement Act (H.R. 2068) was introduced in the U.S. House of Representatives. If passed, this bipartisan bill would expand Medicare reimbursement criteria for telehealth and authorize \$30 million in grants for new and existing programs.²²

²² Lauer, G (2009, May 8). Medicare Telemedicine Bill Could Change Landscape. *iHealthbeat*. Accessed May 2009 from <http://www.ihealthbeat.org/Features/2009/Medicare-Telemedicine-Bill-Could-Change-Landscape.aspx>.

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