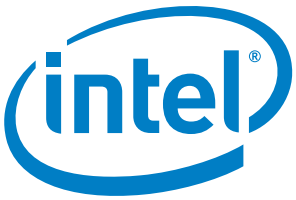


White Paper

Intel Digital Health Group

Personal Health Systems

The Emergence of Personal Health Systems: Designing Technology for Patients and Clinicians

Executive Summary

The ability to monitor patients from a distance, using electronic devices to record and send measurements of patients' vital signs, has been a mainstay in the use of medical technology for years. But the needs and expectations of patients with chronic conditions and of healthcare professionals who care for those patients have changed considerably since remote patient monitoring devices were first introduced. To fulfill these needs, emerging technologies must go far beyond simply monitoring standard vital signs, or just adding new technical features. Instead, they must be able to address the needs of patients as people—connecting patients, caregivers, physicians, nurses, and others in an integrated, systematic, and interoperable way that has not been done on a broad scale.

Fortunately, telehealth technologies are evolving to provide both patients and healthcare professionals with real-time, interactive, data-rich health management systems that can engage both patients and their care management teams more fully in the treatment of their conditions. And just as important, research that focuses more clearly on how people interact with technology has led to a more comprehensive and coordinated approach to designing technology systems.

This paper explores the ways in which the next generation of telehealth technology can help satisfy the needs of patients in the years ahead, a time that will be marked by significant growth in the number of people who live with chronic conditions. This technology will be particularly useful in working with the chronically ill because it can be used to create a more integrated approach to patient care through the inclusion of all the key people involved, from the patient and their physician, to their nurse, family caregiver or other healthcare professionals.

Introduction

Most healthcare settings, such as hospitals and physicians' offices, and the procedures that take place there are designed to meet the needs of patients with acute conditions. The goal is to fix something that is broken or to cure something that is infected or diseased. Many technologies have been developed to achieve these ends, from medicines and diagnostic devices to surgical techniques that have saved and extended countless lives.

As a generation of baby boomers gets older, however, one of the greatest challenges facing healthcare systems around the world is how best to take care of the growing numbers of people with chronic conditions. Technology will certainly play an important role here. It will go far toward realizing its true potential if it is used to meet the needs of the populations it serves. Acute care needs will always be with us, and we will always be developing technologies to better meet those occasions. Now, however, we face a great wave of chronic care needs, and we must configure our technology to address this new set of challenges.

What are the needs of chronic care patients? And how should technology be configured to meet those needs? In other words, how should we design our technology to best help patients with chronic conditions? Because chronic conditions are ongoing and usually not curable, the technology that supports care for patients with these conditions should be adapted to the fact that they require monitoring over a long term, during which an ongoing stream of information is created that will need to be reviewed and analyzed. These conditions also require implementing a plan for a daily regimen to manage the condition, and that will require patient and caregiver education. The technology that supports this will have to perform a number of separate yet important functions. The most important function of all that this technology provides may lie in its ability to integrate and coordinate the streams of information that are coming from many different sources, such as the following:

- Vital sign information from patient to physician or nurse
- Health regimen information from healthcare provider to healthcare provider (physician to nurse and vice versa)
- Information from healthcare provider to patient (and vice versa)
- Healthcare information from healthcare providers to family members or other care providers (and back again)
- Educational information from a third-party vendor to the patient

These streams of information are much more involved than simple vital sign information that characterized an earlier generation of remote patient monitoring. To understand where the technology is going, it will be useful to see where it's been.

Background: Telecommunications Technologies in Health and Medicine

More than 100 years ago, telecommunications technologies were employed in medicine as a new tool in fighting disease, improving health, and in taking advantage of medical experts who may have been hundreds of miles away from the affected patient. Originally, technologies such as the telephone or radio were used to transmit basic health information about patients at a distance from the physicians who were following their case. These technologies were used in the diagnosis or treatment of acute episodic situations, such as life-threatening injuries on the battlefield, or at combating infectious diseases, such as leprosy or malaria. Later, medical professionals incorporated video technologies into treating patients at a distance, and they came to diagnose and treat both acute and chronic conditions.

It was only in the 1970s, however, that pioneers like Dr. Kenneth Bird came to see medicine-at-a-distance in a comprehensive way, and it was only then that the term "telemedicine" was first applied to a systematic approach to healthcare in which the physician was at some significant distance from the patient. A few years after the term "telemedicine" was coined, the term "telehealth" came to be applied to health communications and information technology that took advantage of computer networks and eventually the Internet to improve healthcare. In living memory, we have seen the emergence of telemedicine, its transformation and expansion into telehealth, and the creation of an entire field of transformative technologies that help connect patients, healthcare professionals, healthcare data, and educational materials that are situated at significant distances from each other.

Telehealth technologies can now be found in the home, where they can help monitor a patient recovering from an acute condition or a patient who is living with a chronic condition, such as diabetes, asthma, chronic obstructive pulmonary disease (COPD), or heart failure. These technologies are now becoming a more sophisticated, integrated, and systematic approach to healthcare that can be personalized to each patient's medical

needs. So while its full potential for helping people with chronic conditions is yet to be realized, important advances are being made that will allow it to respond more appropriately to the developing healthcare landscape.

The great change that is coming to telehealth stems from our ability to build on existing technologies in a systematic and integrated manner. This approach to the design will allow the technology to be more responsive to both the particular patients' conditions and to the information needs of healthcare professionals, because it can be customized for both. Perhaps the greatest advance in home telehealth, however, lies in the potential for transforming current telehealth solutions by providing integrated solutions that improve and enhance the social connections among all the players in a patient's care team. By supporting and improving social connections, the patient and care team will be able to take a more proactive role in addressing the patient's needs through the use of telehealth devices and systems. This new generation of telehealth technology will constitute a personal health system—an integrated approach to the technology that will focus on including the extended care teams, that will include internet portals for caregiver and family members, that will allow for fully customized content options, and the full integration of home sensor technologies. These new personal health systems will be much more than just a connection between a patient and a caseworker, but a true health portal to address all the patient's health and health information needs.

Addressing and meeting the needs of this chronically ill population will be one of the main challenges facing healthcare in the coming years, especially as that population grows. For older or chronically ill patients, a number of issues arise, such as the coordination of care across multiple healthcare professionals or the coordination of care for multiple comorbidities. Responding to these needs will take place within an environment that places a priority on patients' concerns and the particular combination of conditions affecting them. There is an important flip side to patient-centered care: there will also be a greater stress on patients, their families and caregivers to assume a greater role in identifying and articulating their healthcare concerns and interests; it will also mean that more patients will be expected to play a bigger role in managing their own healthcare. Technologies that can improve and enhance social connectedness will be at an advantage in this environment. Our ability to connect all the care team members to each other suggests a profound impact on how we view and care for people with chronic conditions.

The Unmet Needs of Patients with Chronic Conditions

Chronic conditions, such as diabetes, chronic heart failure, and chronic obstructive pulmonary disease (COPD), are now the most common problems in healthcare. The statistics about the increase of those with chronic illness are staggering: Eight-hundred and sixty million people worldwide suffer from one or more chronic condition. As of 2000, for example, 45% of Americans had at least one, and 23% had two or more chronic conditions. (Anderson 2003) In Europe, chronic conditions account for up to 86% of all deaths. (WHO 2006)

Based on these figures, it is not surprising that chronic illness is becoming a critical focus for the healthcare industry world wide. The focus is not only on the needs of the patient, but it is also on the needs of those who provide care for the patient, such as the clinicians, caregivers, and family members. While it may be appropriate for people with chronic conditions to visit their physicians several times a year, this doesn't always happen at the right time or with the ideal frequency.

Between office visits, those with chronic conditions are cared for by case managers and care coordinators, families, friends and the community. To meet the needs of the patients and their caregivers requires a proactive approach that facilitates day-to-day care and ultimately reduces or prevents acute episodic situations. This approach would:

- Deliver accurate, relevant, and timely information to all members of the care team
- Give patients an intuitive, enjoyable, and educational means of communication with their care team (including their families)
- Provide self-management tools for patients to take a more active role in their own care
- Offer communication tools that connect the patient's entire care team for better coordination of care

The value of these benefits is perhaps most apparent when considering what happens in their absence: inaccurate information or information that is out of date can lead to misdiagnosis or inappropriate dosing; unintuitive or unenjoyable means of communication will not be used, and the information that would be passed on will be lost; without tools to help in their own care, patients can become inadvertently noncompliant; and

care that is not coordinated runs the risk of wasting resources through unnecessarily duplicated tests or worse, such as the failure to detect bad reactions between medicines. (Chen 2000)

Today, remote patient monitoring provides both clinicians and patients a way to review health status on a regular basis without requiring an office visit. For many chronic care patients and their health professionals, this approach can represent a much more convenient use of time and resources, and a potentially healthier one as well. For some, such as the frail elderly or those with a compromised immune system, it may mean a significant reduction in the physical risk that comes with traveling to and from the doctor's office. For others, especially the many chronically ill patients who have comorbidities, the importance of tracking the care for multiple conditions and coordinating the communication between many care professionals cannot be overstated. Remote patient monitoring has played a role here, but emerging technologies can now improve on it by helping to coordinate the data streams from remote patient monitoring with information and data from other sources.

The Emergence of New Models: Patient-Centered Care and the Chronic Care Model

New and developing approaches to healthcare are changing how people think about health, illness, and of patients themselves. Two related models that will be in play when considering people with chronic illnesses are patient-centered care and the Chronic Care Model. Patient-centered care is one of the key elements of healthcare improvement that was identified by the Institute of Medicine in its major report on the U.S. healthcare system, Crossing the Quality Chasm: A New Health System for the 21st Century. According to this influential report, patient-centered care entails the coordination and integration of care, as well as the use of appropriate information, communication, and education. Medical decisions should be made with the patient or patient's family present and should be based on the best available evidence. Health systems should also support and encourage cooperation among clinicians. (IOM 2001)

In the context of chronic conditions, one of the approaches that is specifically designed to coordinate and integrate care is the Chronic Care Model, which many physicians have begun to embrace. This model calls for disciplined attention to patients' long-term healthcare needs as a counterweight to the attention typically paid to acute, short-term, and emergency care. As developed by Dr. Edward Wagner, the Chronic Care Model highlights the concerns that a personal health system is designed to address:

- The typical physician's office is designed to respond to acute events rather than to anticipate and even prevent them
- Patients with chronic illness often don't receive enough appropriate information about their condition and they aren't supported in caring for themselves after they leave the doctor's office
- Physicians don't have time to educate patients enough to keep them healthy (Wagner 1998)

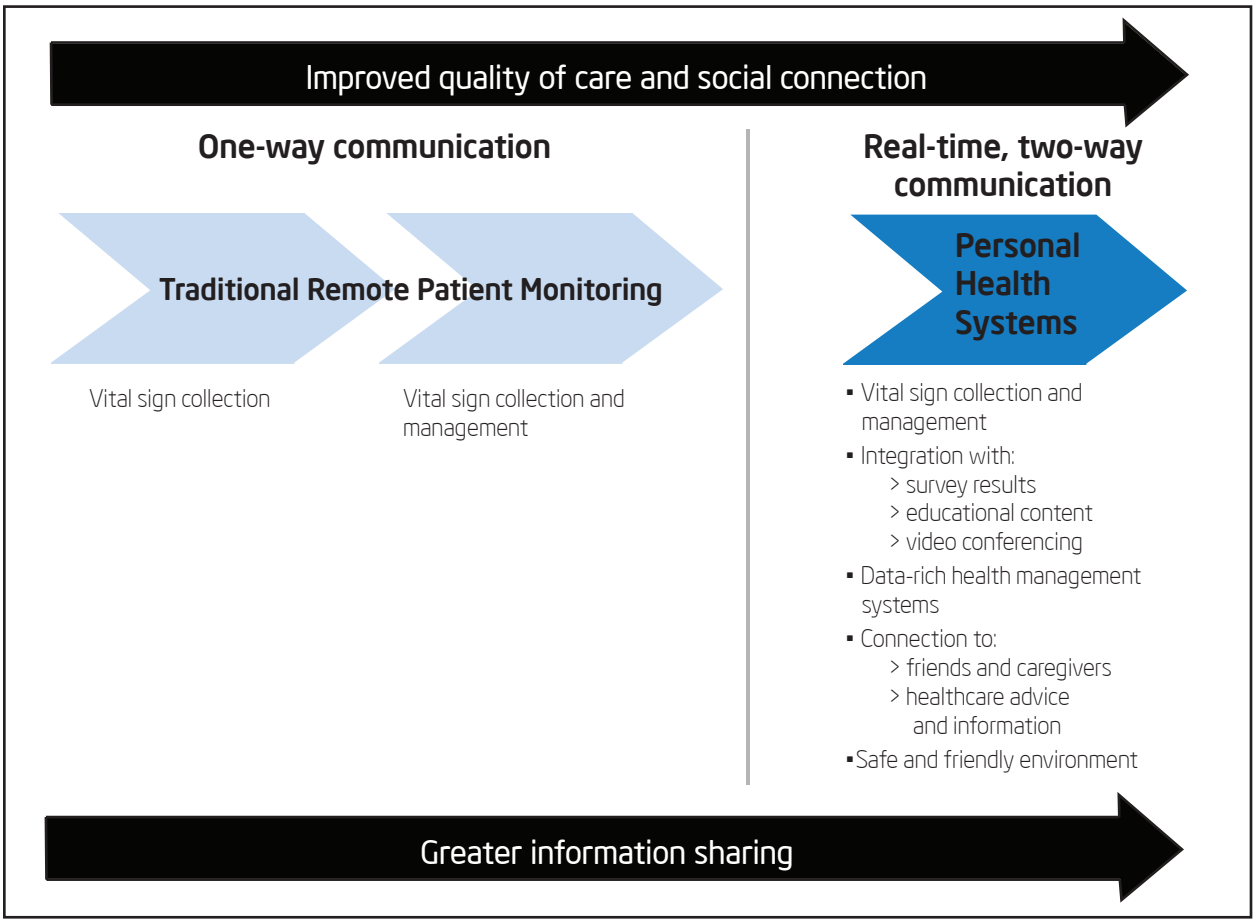
Because personal health systems are designed to connect the healthcare professional with the patient, and vice versa, and with other members of the care team, without the need for any of the parties to be in the same room, or even in the same city, they fit in well with Wagner's model that calls for informed patients who are engaged in productive interactions with a prepared and proactive care team. When it is used systematically, in a way that supports and encourages patient engagement with their own care, home telehealth technology begins to achieve its potential.

For this population, remaining socially connected is important, and so is remaining at home. Most people with chronic conditions would prefer to be treated at home and to remain active and independent for as long as possible. The vast majority of seniors would prefer to receive care at home rather than in a hospital. In one recent study on "aging in place," nearly 90% of seniors who were not living in a nursing home or assisted living facility said that remaining in their home was very important to them. More than half of this group identified potential health problems as the biggest threat to living independently. (PMR 2007)

Evolving Toward a Personal Health System

It is now possible for remote patient monitoring and other telehealth technologies to be used in a far more systematic way. This is especially important for patients with chronic conditions who are looking for telehealth solutions that can mesh seamlessly with the care provided by healthcare professionals, by relatives and friends, and by the care they provide themselves. Such solutions would be able to coordinate the communication among all the members of the care team, making sure that the right information gets to the right person at the right time, whether that is vital-sign information going to a physician, or case management information going to a nurse, or health education material going to the patient.

Building upon data captured from hospital charts and in-home nursing visits, remote patient monitoring can now become a pillar of an interactive personal health system. This next generation of technology, designed for the general population as well as clinicians, would take what is useful and appropriate in remote patient monitoring, in multimedia patient education, data-sharing, or videoconferencing and adapt it for interactive personal health systems. This new category of telehealth technologies, personal health systems, would empower the patient to be involved in his or her own care by providing the means for integrating disparate elements of their care regime: for example, by providing real-time data feedback and education initiatives at 'teachable moments'—those times when patients are actively involved in their health management and are especially responsive to learn something about their health



The evolution from remote patient monitoring to integrated personal health systems sees overall improvements in the quality of care, enhanced social connectedness, and an increase in the amount of information that can be shared at each stage. The early stages in this evolution are marked by incremental advances as particular technological improvements are introduced. Personal health systems represent an entirely new phase—one in which all previous technological improvements are specifically designed to work together to provide an integrated and adaptive healthcare experience for patients and extended care team alike.

condition. Education programs could include audio and video elements and a greater amount of interactivity and customization to the patient's needs and situation. Personal health systems could also facilitate the family's involvement by providing alerts about a patient's condition or privacy-protected access to the patient's relevant healthcare information. Some of these capabilities are already available, but not in a comprehensive, all-in-one system specifically designed to integrate and coordinate patients' healthcare needs.

In this way, personal health systems could help to tap into the power of the existing connections that often lie unrealized within healthcare. By aiding in the task of getting the right information to the right people at the right time, personal health systems will serve as a resource for a wide range of people, from physicians and nurses to caregivers, patients, and their families, to hospitals, disease management organizations, and health plans. It would also facilitate patient-centered approaches to care by providing educational materials that can help people with chronic conditions to take better care of themselves. By supporting coordination of care, by providing educational tools, by enhancing communication, and by increasing opportunities for social connectedness, personal health systems can increase the power of connections to help people age in place.

Conclusion

Telehealth is on the verge of exciting and 'game-changing' advances, made possible by these technological and design innovations. Because they are designed to be used proactively by patients, healthcare professionals, care managers, family members, and others, new telehealth technologies, such as a personal health system, must meet the needs of all the people who are likely to use them. This means that a personal health system should be easy to use and unobtrusive; personal health systems should be able to provide timely, accurate, and trustworthy information; it should promote the flow of information to all members of a patient's care team; it should provide a convenient medium for communicating appropriate information on a timely basis. For all of the members of the patient's care network, this new generation of telehealth means better care delivered at a patient's home. Higher quality, well-managed, personalized care—that is the desired outcome from the proper integration of personal health system technology into a patient's care plan.

At the core of this benefit is the belief that a two-pronged approach, involving better access to information and greater patient empowerment and engagement, will aid in both medical decision-making and adherence to treatment regimens. In this way and by bringing patients and their caregivers into closer partnership through technological connectedness, the personal health system is poised to become a powerful care management tool.

For more information about Intel in healthcare, visit us at www.intel.com/healthcare.

References Consulted

Anderson GF. Physician, public, and policymaker perspectives on chronic conditions. Arch Intern Med. 2003;163:437–442.
Centers for Disease Control. Social support and health-related quality of life among older adults—Missouri, 2000. NNWR Weekly May 6, 2005; 54(17)
Chen A, Brown R, Archibald N, Aliotta S, Fox PD. Best Practices in Coordinated Care. Health Care Financing Administration. March 22, 2000.
Fierz W. Challenge of personalized health care: to what extent is medicine already individualized and what are the future trends? Med Sci Monit, 2004; 10(5):RA111-123.
Glasziou P, Irwig L, Mant D. Monitoring in chronic disease: a rational approach. BMJ. 2005;350:644–648.
Institute of Medicine (IOM) Committee on Quality of Health Care in America (Institute of Medicine). Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academic Press, 2001.
Moore LG. Escaping the tyranny of the urgent be delivering planned care. Fam Pract Manag. 2006;13(5):37–40.
Naik G. Faltering family M.D.s get technology lifeline. Wall Street Journal. Feb. 23, 2007;A1.
Prince Market Research (PMR). Attitudes of seniors and baby boomers on aging in place. Nashville, TN, 2007.
Richmond JB, Fein R. The Health Care Mess. Cambridge, Mass.: Harvard University Press; 2005.
Showstack J, Lurie N, Larson EB, et al. Primary care: the next renaissance. Ann Intern Med. 2003;138:268–272.
Wagner, EH. Chronic disease management: What will it take to improve care for chronic illness? Eff Clin Prac. 1998 Aug-Sep; 1(1): 2-4.
World Health Organization (WHO). Largely preventable chronic diseases cause 86% of deaths in Europe. Press Release. Copenhagen, September 11, 2006.

0608/KR/HH/PP/1000 Please recycle. 320039-001US