

## Healthcare at Home (Part II)

**A major trend in medicine is to move treatments and monitoring out of the hospital or even the doctor's office and either attach them to the patient or enable it to be done in the home. Of course, this relies on medical device technology in order to make it possible. In this month's Perspectives feature, we asked the industry what device designers could do to aid this effort and what technologies would help to enable it.**

**How will medical device design continue to aid the shift in healthcare from the hospital to the home and what technologies will play the largest roles in this effort?**

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### **Paul Nickelsberg**

*President, Orchid Technologies Engineering and Consulting Inc.*



The migration of hospital quality medical devices into home use continues at a rapid pace. Clearly certain hospital grade devices such as x-ray imaging equipment have no place today in home healthcare. However, equipment such as portable defibrillation devices has made the transition from hospital-only applications to general in-home use. Some enabling technologies which have made this transition possible include lightweight energy systems, high performance low power microcontrollers, and internet communications. Lightweight energy systems permit a level of portable care never before thought possible. High performance microcontrollers make it possible for home-based equipment to run complex algorithms. The algorithms used in defibrillation equipment are extremely complex as it is tasked with the safe application of therapy to an unconscious patient.

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### **Kyle Lotring**

*Medical Device Analyst, Nerac*



A primary driver in the evolution of medical device design is the demand for faster, more convenient healthcare coupled with the desire to reduce the length of hospital stays without adversely affecting patient outcomes. One key area of interest involves devices that facilitate in-home patient monitoring, not only post-operatively, but as an elective, pre-emptive measure as well. Current technology exists in the form of Holter monitors and wireless telemetry devices, but advances in wireless capabilities have led to new avenues of innovation.

By 2025, an estimated 164 million Americans will require treatment for chronic diseases and of those, a majority will be cardiac-related. Postoperative wireless monitoring from cardiac rhythm management devices already is becoming more prevalent as device makers and healthcare providers realize the value of detecting the possibility of adverse events before they occur. Based on the success of these devices—especially in remote locations where consulting a clinician is difficult—more patients, primarily for older individuals, are choosing to monitor vital signs electively.

For them, a device records data and transmits it to a base unit, which then sends it to a PC, mobile phone, or PDA belonging to a family member, staff at a living facility, or an attending physician. Within seconds of seeing the beginnings of an adverse event, appropriate action can be initiated, offering peace of mind to family and care givers, and conceivably leading to decreased healthcare costs.

In the near future, wearable monitoring devices in which biosensors are integrated into garments should make these devices less obtrusive and further drive the technology's adoption. What remains to be seen is a strong case for reimbursement for elective home monitoring, especially in a tight economy. Who pays how much for a device can be just as important—if not more so—as how well it works.

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**Steven A. Dean**

*Medical Marketing Director, Texas Instruments*



In 2009, we can expect several discrete pieces of the ecosystem puzzle to come together, providing exciting telemedicine innovations in device interoperability, wireless connectivity, employment of body sensor networks (BSN), data security, data storage, and data management systems for easy point-of-care service.

U.S. healthcare spending is roughly 17% of the nation's gross domestic product and growing. Telemedicine offers a viable solution for the U.S. market to help reduce costs, as well as reach millions needing diagnosis and treatment in remote locations, who will be able to utilize the same technologies.

Other than the obvious interoperability challenges of such systems, one of several issues facing the medical device manufacturers, as well as the U.S. economy, is acceptance and adoption of these technologies. The reimbursement climate needs to enable caregiver payment for remote monitoring, diagnosis, and eventual therapy delivery. Interoperability trials of these very ecosystems must be conducted, proven effective, and followed by a favorable reimbursement model to drive adoption.

Technologies such as BSNs to capture appropriate biological data are at the heart of leading this change. These ultra low-power technologies employ leading edge semiconductor technologies incorporating programmable analog sensing circuits, microcontroller functions, low-power memory functions, as well as ultra low-power wireless communication functions. Envision consuming such little energy while providing ECG sensing functions for up to five days, or simple body temperature functions for a year, operating from 'printed batteries' taking the form of a common adhesive bandage (also referred to as 'digital plaster.')

Healthcare providers in hospitals, managed care organizations, and group practices can save millions per year by using an electronic-based constant measurement telemedicine system. This will not only reduce costs but improve the quality of care through constant and instantaneous patient monitoring.

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**Dan Edwards**

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Two unprecedented forces are at work in healthcare: 1. Costs must be reduced or national budgets will implode; 2. Consumers are engaging in preventative health where previously only reacting to actual illness. The global market for home healthcare devices is set to grow by more than 9% from 2007 to 2012 with the market exceeding \$70 billion in 2012.\*

Alternative settings include: ambulatory surgery centers, retail clinics, physicians' offices, the workplace, and consumers' homes. Considering each alternative site, two factors present themselves: the availability of skilled staff to conduct/supervise care, and the buyer of the product or service. When you reach the in-home level, the consumer (not a patient) is the target for the sale with no medical professional anywhere in sight. There are limits to what care can migrate to the home; surgical intervention cannot be accomplished in the home, but chronic disease (accounting for ~75% of U.S. healthcare costs) can be prevented and treated in the home setting.

Sagentia forecasts that the migration will be enabled by non-invasive diagnostics (sensors, algorithms, etc.), web-based services, and wireless communications. Industrial design, branding, and voice of the customer-led innovation top the list of skills that medical device companies are short of. The common theme is "feedback." The opportunity for at-home devices is in monitoring health and in driving the behaviors of preventative health. Both of these have direct benefits for the payers; money spent now will save money in the future.

\*Source: Global Markets Direct, December 2008

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### **Paul Errico**

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Cutting-edge technology developed by semiconductor companies is enabling the design of reliable, portable, affordable consumer medical devices, which are benefiting millions of people around the world. Consumer medical products support health and wellness initiatives by providing people with the freedom and mobility to manage and treat diseases outside of the hospital setting. Standard communication interfaces defined by industry alliances such as Continua will ensure interoperability of home healthcare devices and enable measurements taken at home to be transported to caregivers for interpretation. Diagnostic tests performed in laboratory and clinic measurement assembly lines will be performed with low-cost, low-power, highly sensitive "sample to answer" instruments that provide rapid, highly accurate diagnostic results. User-friendly, affordable life saving products such as automatic external defibrillators will also support the shift from hospital to home. Clearly, semiconductor companies are focusing on medical device designs that promote health and wellness initiatives, which keep people out of the hospital.

Additionally, the semiconductor industry is paving the way for the advancement of consumer medical devices, which are saving countless lives and greatly reducing healthcare costs. Semiconductors are the technological building blocks that make many of today's portable medical devices possible: signal processing blocks between sensors and computing digitize and drive transducers; products, such as analog-to-digital converters, enable low power, high accuracy systems; high performance, low power, low-cost secure embedded processing enables compact, battery-powered medical diagnostics and monitoring outside the clinical environment; and micro-electromechanical systems (MEMS) products, such as three-axis accelerometers, are upgrading patient activity monitoring. By developing innovative ICs, semiconductor companies are improving the quality of healthcare for patients worldwide. Medical design engineers creating the latest consumer healthcare systems aimed at disease management, health and wellness, and drug delivery are using semiconductors as the foundation of inventive products that will change lives.

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