



feature story

06 July 2006 08:00 AM (GMT -05:00)

Home as the Hub of Health Care

BY KATHY KOWALENKO

Many in government and society are banking on driving down the cost of health care with portable medical monitoring devices for the home and electronic medical records for the doctor's office and hospital. Much headway has been made on the monitors and on the software and hardware of e-medicine systems, but many policy issues remain. It's not certain, for example, how to safeguard the confidentiality of the medical information from unauthorized people or hackers. Nor is it known who will foot the bill for converting paper records to electronic files. And yet to be developed are the host of standards needed for the devices and the record systems themselves.

To get a handle on the technical work under way and to air the thorny policy issues, the IEEE cosponsored the First Transdisciplinary Conference on Distributed Diagnosis and Home Healthcare (D2H2). The meeting, held from 2 to 4 April, in Arlington, Va., brought together major players from academia, government, and industry, including the Institute of Bioengineering and Nanotechnology of Singapore, Kaiser Permanente, Microsoft, the University of Washington, the U.S. Army, and the World Health Organization.

"Health care is shifting from a central, hospital-based system to a patient-centered system, where patients will be the manager and owner of their health information," IEEE Fellow Yongmin Kim said when he kicked off the meeting as the conference's program chair. "This shift will improve the quality of care for the patient, increase the productivity of health care professionals, and engage patients in their treatment."

Kim is the Simpson Endowed Chair in Bioengineering at the University of Washington, in Seattle, as well as president of the IEEE Engineering in Medicine and Biology Society, one of the conference's sponsors.

MEDI MONITORS Routine tests such as electrocardiograms and blood workups performed at medical facilities can each cost hundreds of dollars. The costs quickly add up for those with chronic medical conditions, such as diabetes, whose state of health must be constantly monitored. But a large number of portable medical devices for the home are expected to cut those costs by letting patients take their own readings.

The miniature monitors come in various shapes—from the size of a credit card to models that look like personal digital assistants (PDAs) to those that stand on wheels. Other monitors are being developed that can be sewn into wearable garments such as ones being tested by a team of IEEE members from North Carolina State University, in Raleigh. IEEE 1994 President and Fellow Troy Nagle, Senior Members Paul Franzon and Edward Grant, and Member John Wilson, along with others from the university, described their work in a paper at the conference.

The team is incorporating small sensors and electronic components into comfortable, washable clothing. The monitoring devices are a combination of bioelectrodes, biosensors, microphones, and mechanical sensors. The

monitoring devices are a combination of electrocardiogram, accelerometer, microphone, and mechanical sensors. The sensors measure physiological parameters related to the patient's health. Wired or wireless connections provide power and control signals to the sensors and send measurements to a data-gathering unit embedded in the garment. There the analog data is converted to digital data that can be transmitted to an information logger, such as a PDA, located somewhere in the house. The data is then transferred to a master database located in a doctor's office or a remote hospital data network and eventually recorded in the patient's medical records.

All the monitoring devices work in a similar fashion: they transmit their data to a central server, and the readings then become part of the patient's medical chart. The process of producing the patient's chart is totally automated. But there are other benefits to an electronic medical record. Errors caused by illegible handwriting are eliminated, and a patient's data can be accessed from anywhere. Indeed, several speakers at the conference touted improved communication between patients and the health care system.

Intermountain Healthcare, Kietra Corp., McKesson Corp., and Microsoft were some of the companies that described their electronic medical record-keeping software at the conference. Besides automating the process of producing a patient's medical record, the goal of all the record-keeping systems is the same: to allow patients access to their medical records and to perform specific tasks from their home computer, including scheduling a doctor's appointment, checking test results and the readings of their monitors, e-mailing their doctor a question, and checking a list of their prescriptions.

All that is, of course, easier said than done. It would be possible only if every doctor, laboratory, and hospital throughout the United States used the same system. Right now, only the far-flung facilities of the U.S. Department of Veterans Affairs are doing so, according to Adam Darkins, the agency's chief consultant for care coordination, who presented details about the VA system.

NO TWO ALIKE Instead, each e-medicine record-keeping system is being tailored to the needs of individual doctor's offices, laboratories, and hospitals. And it is not just the hardware that's variable. All the parties involved seem to have a terminology of their own for medical conditions, their own authentication system to identify patients and physicians, and their own security systems for protecting patients' privacy. In turn, each in-home monitoring device uses its own system to transmit information to the medical provider. Not being certain that the various systems can "talk" to each other is a prescription for disaster and the reason why many presenters at the conference called for standards, including ones for common medical terms and interoperability standards, so monitoring devices can work together. Most important, vendors building the e-medical record systems must use a standard security system for protecting patients' medical information.

In the United States, the federal Department of Health and Human Services, in Atlanta, is tackling the standards issue on several fronts, according to John Loonsk, director of the DHHS Office of Interoperability and Standards. He says his office is working with the National Institute of Standards and Technology to review existing medical equipment standards and to plug any gaps in interoperability or in information security. The office also is developing a certification program that establishes privacy and security criteria set out by the NIST that e-medical-record systems must meet. The program is intended to guide medical facilities in picking a secure system, and all that pass the criteria will be listed on a Web site.

U.S. HURDLES APLENTY Many countries—including Denmark, Finland, and Slovenia—have already made the switch from paper medical records, according to Niilo Saranummi, who spoke on "eHealth Interoperability in Europe." He is a research professor at VTT Technical Research Center of Finland and the editor in chief of the *IEEE Transactions on Information Technology in Biomedicine*. But in the United States the transition is likely to be much more difficult. According to a presidential executive order issued in 2004, electronic U.S. medical records are to be a reality by 2014. But there are numerous hurdles to overcome, such as deciding who foots the bill for converting paper records to an electronic format and who pays for the record-keeping system and for the servers to store the data. Should it be the medical facilities, the insurance companies, the government, or the patients?

The conference's keynote speaker, Lee Huntsman, president emeritus of the University of Washington, offered his view: "It's the health care providers who are expected to pay to install, maintain, and operate these systems, but it's the government and insurance companies that are expected to reap 80 to 85 percent of the financial benefit by lowering their health care costs."

The conference's information and presentation materials can be found at <http://emed.icsl.washington.edu/d2h2/>.

To purchase a copy of the conference proceedings, visit http://shop.ieee.org/ieeestore/Product.aspx?product_no=EX1264.



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