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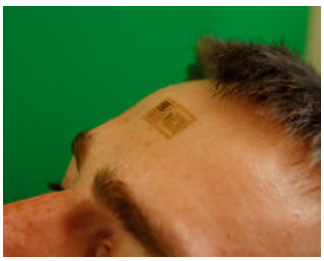
Tracking Vital Signs, Without the Wires

By RANDALL STROSS

CONFINED to their hospital beds, patients can only fantasize about stripping off all the wires that connect them to monitors and bolting for the door.

John A. Rogers/University of Illinois

At the University of Illinois, researchers are working on ultrathin, electronic medical monitors that attach to a patient's skin and transmit data wirelessly.



John A. Rogers/University of Illinois

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A monitor might be mounted on a temporary tattoo, for concealment.

Suppose, however, that all of a convalescent patient's electrode patches were consolidated into a single, nearly invisible and weightless version — as thin as a temporary, press-on tattoo. And suppose that a tiny radio transmitter eliminated the need for any wires tethering the patient to monitoring machines.

"Epidermal electronics" — a term coined by researchers who have produced prototype devices at the University of Illinois at Urbana-Champaign — may enable constant medical monitoring anywhere.

The devices are part of a growing field, called mHealth, that uses mobile technologies. Simpler forms include smartphone apps for patient education or disease management. More complex ones include wireless sensors to monitor vital signs.

"MHealth is managing conditions continuously, so that they don't reach a crisis," says Donald M. Casey, chief executive of the West Wireless Health Institute, a nonprofit research organization in San Diego.

Wireless sensor technology is advancing rapidly. Last year, for example, Corventis, a medical device company based in San Jose, Calif., received Food and Drug Administration approval to market its Nuvant Mobile Cardiac Telemetry System, used to detect arrhythmias. A 2-by-6-inch electronic gizmo on a patient's chest sends an electrocardiogram to a nearby transmitter, which relays it to a central monitoring center.

"Sensors on everyone, including a 60-year-old watching a football game who doesn't know he's at risk for a heart attack, would greatly reduce the chances of a fatal attack," says Dr. Leslie A. Saxon, a cardiologist at the University of Southern California.

One form of the monitoring will be tested on the football field itself. With a grant from the National Football League, Dr. Saxon will study one unnamed N.F.L. team this fall. Each player will wear a monitoring patch for a week.

Not all mobile monitoring technology can transmit data wirelessly. The patches that Dr. Saxon will use, for example, store their data within; the information will be uploaded when the devices are retrieved at the end of the study. In other cases, the technology has been approved only for hospital settings where a doctor is present. But, looking ahead, the promise of epidermal electronics has excited mHealth advocates.

Mr. Casey singled out the work of the University of Illinois researchers, led by John A. Rogers, an engineering professor and a 2009 MacArthur Fellow. Their work on epidermal electronics was published last month in the journal Science. While the monitor patch made by Corventis weighs 1.8 ounces, the ultrathin one created at Illinois weighs only three-thousandths of an ounce.

"If the technology delivers as promised," Mr. Casey says, "then we believe that's when we'll move from sensors on people diagnosed with a disease to literally everybody."

Professor Rogers is a co-founder of MC10, an electronics company in Cambridge, Mass., that is aiming to turn the epidermal monitor prototype into a commercial product in 2013. David A. Icke, MC10's chief executive, said the company's skinlike device consists of tiny components that are physically separated, like electronic "islands." They are connected with squiggles he calls "serpentines," which are designed to bend and absorb strain without breaking. The technology can theoretically be used both inside the body and on the skin.

Electronic monitoring of patients at home could significantly reduce medical costs. A study by the Department of Veterans Affairs and published in 2008 suggests possibilities for savings.

From 2003 to 2007, researchers tracked a large group of patients with serious conditions, including congestive heart failure and chronic obstructive pulmonary disease. Patients who enrolled in a "home telehealth" program were given biometric devices to monitor and record their vital signs. The department said that these patients showed a 25 percent drop in the number of bed days of care and a 19 percent drop in hospital admissions, compared with the time they were not in the program.

In the Veterans Affairs monitoring program, the average cost of $1,600 per patient a year was much lower than the $13,121 spent by the department to provide home-based primary care without the "tele" component. The department also compared the low cost of its telehealth services with the $77,745 per patient a year spent on nursing home care.

DESPITE the promise of big savings, relatively few patients are being monitored with existing technology. Chuck Parker, executive director of Continua Health Alliance, an mHealth industry group, estimates that only 50,000 to 70,000 patients in the United States are monitored today.

One obstacle to wider adoption, Mr. Parker says, is a lack of financial incentives for some major players in health care such as hospitals. Noting that cardiac patients can be monitored at home for a fraction of the cost of occupying a hospital bed, he said hospitals have "some fear about the financial implications" for their own operations.

Chantal Worzala, director of health information technology at the American Hospital Association, took issue with that suggestion. "The vast majority of cardiac patients are over 65 and are covered by Medicare, which pays a fixed amount, regardless of the length of the hospital stay," she said.

It's good that everyone seems to agree: health care reimbursements shouldn't reward maximal use of expensive hospital beds. And, updating Benjamin Franklin's maxim, we might soon say that thanks to epidermal electronics, three-thousandths of an ounce of prevention is worth a pound of cure.

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