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By [Rick Merritt](#)

[EE Times](#)

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Cancun, Mexico - Researchers in Europe and the United States are planning multimillion-dollar projects to deliver such electronically enabled remedies as molecular therapy and wearable monitoring systems tailored to the individual patient.

"We are headed toward an era of personalized medicine in which we can target specific ailments down to cells and the proteins expressed by those cells," Roderic Pettigrew, the director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB), said in a keynote at the annual conference of the IEEE Engineering in Medicine and Biology Society here last week.

Putting its weight behind the trend, the U.S. National Institutes of Health this week will roll out a national molecular library in an effort to accelerate development of drugs and nanoscale agents.

Meanwhile, the European Union is in the final stages of negotiating a \$16 million research initiative to help establish the nascent field of wearable health monitors.

The NIH library will act as a repository "for some of the hundreds of thousands of molecules the pharmaceutical industry screens" for their potential in identifying target agents used to track or treat diseases, NIBIB's Pettigrew said. Such agents are key as new medical imaging techniques help

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physicians peer deeper into cellular and molecular activity to discover and treat diseases at ever-earlier stages in ways tailored to the individual patient.

For example, researchers are using functional magnetic-resonance imaging techniques to display real-time images in heart tissue damaged in cardiac arrest, so that custom gene or stem cell therapy could be used to repair the specific tissues. Other imaging technologies raise the possibility of peering inside a cross-section of a blood vessel to see and treat early signs of plaque buildup that could lead to a heart attack, said Pettigrew in his keynote.

"These are invaluable tools in unleashing the secrets of biological systems and diseases to understand how they work," he added.

Nevertheless, huge advances in imaging are still needed for a host of applications, such as identifying which segments of the brain need to be stimulated to treat Parkinson's disease. Surgeons now use a trial-and-error system that can require hours in the operating room. "Currently, the [imaging] tools we have are too insensitive by a factor of a thousand," Pettigrew said.

For its part, NIBIB, now in its second year of operation, is gearing to reach out to industry while setting up its first internal research projects. "We anticipate having an industry summit in the not-too-distant future to ask how we can more effectively bring discoveries to the patient in a timely fashion," said Pettigrew. In its next fiscal year, NIBIB plans to fund internal research for the first time, focusing on work not being conducted by industry or academia. To date, the fledgling institute has spent all its R&D funds, totaling nearly \$280 million this year, on external projects.

Europe dons sensors

The European wearable-monitors project, meanwhile, could include companies such as Ericsson, Nokia and Philips. As many as 17 papers at the conference described prototype systems that typically use low-power sensors, handheld devices and wireless local-area or wide-area networks.

"The new means for health monitoring has the potential to significantly reshape the provision of health care, assigning new responsibilities for the medical-device maker, the health practitioner and the patient," said Andreas Lymberis, scientific officer in the European Commission's Information Society directorate. The EC is negotiating with private companies for funding three new projects: Philips' My Heart system, a follow-on to Smartex's Wealthy garment and a project that uses a mask to detect neural stress based on facial expressions.

Wearable systems aim to provide broader health care coverage while reducing costs for monitoring diabetes, cardiac problems,

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Parkinson's, high-risk pregnancies, stress and other conditions. But today's systems still face huge hurdles in terms of costs, power consumption and difficulty of operation by unskilled patients. "This represents 10 years' work," said Lymberis.

The My Heart project aims to use wearable systems to monitor, diagnose and treat cardiac ailments such as arrhythmia. The 45-month project involves a vertically oriented group of textile, electronics and medical companies and could begin as early as January, said Josef Lauter, a principal scientist with Philips Research.

Lauter also described R&D work at Philips on a belt-worn cardiac sensor. The credit-card-size device monitors and analyzes data and communicates alarms over the 900-MHz cordless-phone band while dissipating an average of just 300 microamps. The project is going through government approvals and marketing analysis now and could become commercial within two years, Philips said.

Separately, Rita Paradiso of Smartex (Prato, Italy) described a prototype garment with piezoresistive sensors and electrodes made from stainless steel and painted copper wires, knitted together with more traditional materials. The so-called Wealthy system can include sensors for movement, respiration, heartbeat, pulse and temperature. The Wealthy system is not expected to see commercial use. But lessons from the project will feed into the EC initiative in wearables, Paradiso said. "The next project will be huge by comparison to the Wealthy system, and it will be much more product-oriented," she said.

Working within the confines of existing manufacturing technology used in the garment industry is one big inhibitor to creating wearable systems, said A. Tognetti, a researcher from the University of Pisa, Italy. He presented work on creating gloves with built-in sensors using rubber with micro-dispersed carbon elements and plastic actuators built up from dielectric elastomers, forming a spring in a double-helix arrangement. "The actuators still require significant work," Tognetti said.

Researchers in France, meanwhile, have developed a system that uses glovelike netting to place electrodes on the palm of a hand and a connector on the back to create a "smart glove."

Like many of the monitoring systems detailed at the conference, the Ericsson MobiHealth system, now entering field trials in Europe, is based on a PDA that uses cellular networks to communicate to remote physicians and Bluetooth to link to sensor networks on the body. The system will be used to track about 25 patients with a variety of conditions for three months, wrapping up in February.

A system developed by Kansas State University uses a combination of Bluetooth and the IEEE 1073 medical communications standard to link sensors with a data logger and a PC. The researchers say they may submit enhancements to the 1073 standard based on their work.

And their interest is piqued by the Zigbee low-cost, low-bandwidth wireless scheme, said Steve Warren, associate professor for electrical and computer engineering at Kansas State (Manhattan, Kan.). Indeed, the Zigbee Alliance recently formed a medical task group that will publish next year a Zigbee profile for medical devices.

Wearable health-monitoring systems are "moving from a clinical lab setting to the field, with a range of applications," said Paolo Bonato, director of the motion analysis lab at Harvard Medical School's Spaulding Rehabilitation Hospital. "It is still difficult" to predict their growth, he said, "but in research the growth will be exponential for the next five years."

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