

# Cardiologist's 'living chip' changes science of disease monitoring

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For patients living with heart failure and other health conditions, blood draws and diagnostic tests are commonplace in order to evaluate their condition. Often, though, chemical or physiologic changes silently cause damage that is not detected until much later.

But what if in the future a tiny device, one the size of a nickel or significantly smaller, could be implanted in the patient to monitor and detect abnormalities, and could then relay data to physicians, or provide therapy on the spot, in real time?

It may sound like science fiction, but this concept is moving toward reality at Physiologic Communications LLC, a biotech company founded by University of Rochester Medical Center cardiologist Spencer Rosero, M.D., who specializes in heart rhythm disorders. The company is developing implantable biosensors – integrating living cells with electronics – to create a "biological chip." When implanted, this chip can detect physiologic and chemical changes with faster, improved accuracy. These more accurate results, retrieved without invasive testing, allow for better and timely response and, the hope is, a healthier patient.

How it works Ultimately, cells specific to the patient can be engineered to live on and function as part of the miniature electronic chip. The wireless biosensor is placed within and around blood vessels and nerves to provide detection and stimulation of the surrounding tissues or organ systems, with the ability to detect changes. A change triggers a message to a wireless device to alert the patient early on about a problem. The

patient can then contact their physician.

For a patient with heart failure, for example, the biosensor could detect a change in blood protein levels at an early stage, prompting the physician to alter medications to correct the problem. Currently, without blood work being done, the patient or physician would not suspect an issue until the patient began having symptoms or underwent pre-scheduled testing at a routine visit. Catching the problem earlier means the patient remains healthier, and greatly lessens the chance of a hospital stay.

The initial application for this technology is expected to involve pharmaceutical companies, which could use the biological chips to test potential drugs in the lab more quickly and accurately. In later generations, the chip ultimately could command implanted devices – for example, a wireless defibrillator/pacemaker or an insulin pump – to take action to correct a detected abnormality. The device would communicate with the living chip in real time, making adjustments as a direct result of the chip's ability to detect changes.

The company's molecular biology team is being led by Bradford Berk, M.D, Ph.D., an internationally known scientist and CEO of the University of Rochester Medical Center. "Cell-based analysis of physiologic functions is a novel approach to monitoring human disease and response to therapy," Berk said. "A key aspect of our approach is integrating the cells in a matrix that promotes normal function and optimal monitoring." Both Berk's laboratory and that of researcher Keigi Fujiwara, Ph.D., will collaborate with Physiologic Communications on the technology.

"21st Century medicine recognizes that individual patients respond differently to diagnostic and therapeutic interventions," Rosero said. "The key to personalizing an individual's care is to improve the manner in which one can detect abnormalities in chemical signals or physiologic

activity in real-time using technology that is minimally invasive. We are on the road to doing this."

Physiologic Communications, created 18 months ago by Rosero, has quickly grown from an idea to a successful start-up venture thanks in part to Excell Partners Inc. The Rochester-based consortium assists young companies with funding from New York state, Cornell University and the University of Rochester, and provided Rosero's start-up with the opportunity to develop a first-generation device. As research progressed, Excell offered additional support that this month resulted in the hiring of two full-time employees to complement an existing multidisciplinary team of scientific, engineering and business experts.

"We believe this technology will change the face of medical monitoring and, ultimately, device therapy for many types of patients," Rosero said.

The company utilizes experts in the fields of molecular biology, clinical cardiology and electrical engineering, and brings together scientists, engineers, physicians and a host of local business leaders from academia and upstate New York industry. The concept has seen strong support from individuals such as Terry Gronwall, an entrepreneur-in-residence at the High Tech Rochester Incubator, who took the lead in assessing Physiologic Communication's success potential and mentoring the researchers in the complicated art of business.

All the resources necessary are found regionally, a fact that excites Rosero. "We don't have to venture farther than our own back yard to find what we need to make this chip a reality," he said.

The University of Rochester Medical Center's Office of Technology Transfer, which assists University researchers in developing new inventions, immediately saw the promise in Rosero's idea and enlisted the assistance of High Tech Rochester.

"This type of product is referred to as a 'disruptive technology,'" said John Fahner-Vihtelic, deputy director of the Office of Technology Transfer. "It has the potential to change the way things currently are being done. When this chip is fully developed, it will impact the way patients are monitored, and the way they receive therapy. It will supercede what is already out there."

If there is a perfect path for a start-up company to take, Physiologic Communications has found it, Fahner-Vihtelic said. It's the path down which the Office of Technology Transfer hopes it can direct other University researchers with promising ideas.

"Over the past five years we've amassed a group of Rochester experts in the areas of business-building," Fahner-Vihtelic said. "These are local people who work with High Tech Rochester and other entities to offer their advice in the areas of business-plan writing, marketing surveys, legal counsel and anything else an entrepreneur needs to develop a successful business. By using these Rochester experts, the researcher doesn't have to spend time learning those aspects of business-building – he or she can stay at the desk or workbench, continuing to develop the technology and not worrying about the day-to-day aspects of trying to get the company going."

The benefits of a high-tech start-up business and the jobs it creates are far-reaching, Fahner-Vihtelic said. The addition of two such positions at Physiologic Communications, one of which was filled by an individual who relocated from Florida, will undoubtedly have a positive impact on Rochester.

"Our economy recently has seen downsizing and layoffs," he said. "What Rochester needs are new businesses in high technology. Those are the kind of start-ups that will attract employees from elsewhere to our community."

Source: University of Rochester Medical Center

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