8/21/2009

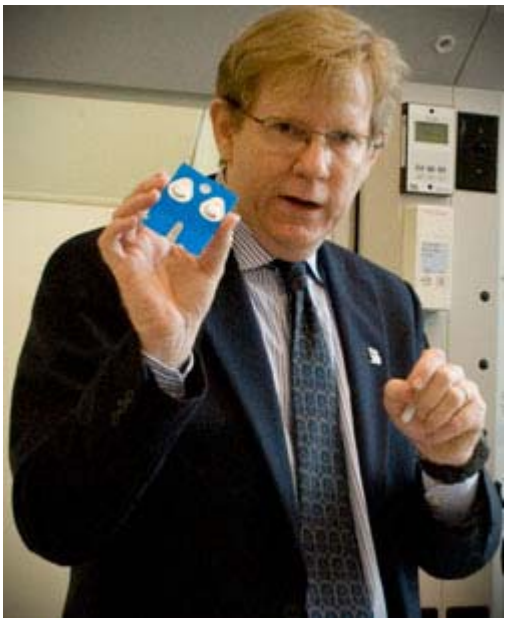
Health care: Helping Africa can pay US dividends

Rice bioengineer finds domestic payoff in designing devices for Africa

BY JADE BOYD
Rice News staff

Technology is often blamed for the rise in U.S. medical spending from 5 percent of the U.S. economy in 1960 to 16.5 percent today. But what if the steady stream of surgical tools, designer drugs and diagnostic gadgets coming out of university laboratories could make health care cheaper -- and save lives in underdeveloped countries at the same time?

It's already happening in Houston's Texas Medical Center, where engineering researchers from Rice University and Austin-based startup LabNow are putting the finishing touches on a toaster-sized machine that's designed to diagnose virtually any disease or medical condition for a fraction of the cost of modern U.S. clinical assays. The machine already works for HIV monitoring and heart-attack screens and will soon be used for various kinds of cancer.



Rice bioengineer John McDevitt is combining the latest technology from microcomputing, nanotechnology and biotechnology to shrink all the functions of a state-of-the-art clinical laboratory onto a microchip the size of a postage stamp.

How is that possible? Because Rice bioengineer John McDevitt designed the device -- starting 10 years ago -- for use in rural Africa.

"Typically the developing world gets the leftovers when it comes to medical technologies," said McDevitt, Rice's Brown-Wiess Professor in Bioengineering and Chemistry. "For HIV immune-function testing, which is one of the most significant humanitarian problems on the planet, we went after Africa first. As a result, the economics make this a no-brainer for use in the U.S. and other developed countries."

McDevitt's lab is all about miniaturization. It combines the latest technology from microcomputing, nanotechnology and biotechnology to shrink all the functions of a state-of-the-art clinical laboratory onto a microchip the size of a postage stamp. These lab-on-a-chip elements contain tiny chambers where "biomarkers"

react with proteins and cells in a patient's saliva or blood. The microchips are mounted on disposable, plastic lab-cards that are slotted into a battery-powered analyzer; the portable instrument shines two LEDs, or light-emitting diodes, at the biomarkers. In response, the biomarkers emit light, giving off more or less, depending on whether the patient is sick and how sick they are.

"There are cheap, disposable tests that can tell whether patients are HIV-positive or not, but in some African countries as much as 30 percent of the population is HIV-positive," McDevitt said. "In these countries, the most vital question for health care providers is not whether people have the disease, but how far it has progressed."

Today, tests like these can be done only with a flow cytometer, a refrigerator-sized device that costs as much as a new car.

"Tens of millions of people need these tests in sub-Saharan Africa, but only about 30 percent of the population is now being served," McDevitt said. The remaining 70 percent of the population is in more rural areas that do not have stable electricity, refrigerators and trained lab personnel needed to run the complicated tests.

LabNow is preparing to field test its analyzer in Africa this fall. It's based on McDevitt's technology, and early tests showed the analyzers work as well as flow cytometers. The analyzers are expected to cost about one-fifth as much as modern flow instruments, and McDevitt said the field tests will determine how well the analyzers work in rural Africa, the place for which they were originally designed.

McDevitt recently moved his laboratory from Austin to Rice University's BioScience Research Collaborative, home of Rice's Department of Bioengineering, one of the top 10 biomedical engineering programs in the nation as ranked by U.S. News & World Report. McDevitt said trials of a test for heart attacks are also slated to begin this fall at the Texas Medical Center's Baylor College of Medicine (BCM). That test, which will be in collaboration with BCM's Dr. Christie Ballantyne, uses biomarkers in saliva to tell whether a patient is having a heart attack.

"Electrocardiograms miss up to 30 percent of heart attacks, delaying treatment for hours until lab tests can be completed," McDevitt said. "Preliminary research found our saliva tests could be a great complementary test to what's already available."

With the new test, paramedics could swab a patient's mouth in the ambulance so ER doctors would know whether the patient was having a heart attack by the time they got to the hospital. They can't do that today. Electrocardiograms can be conducted in the ER and sometimes in ambulances, but the lab tests to catch the missed cases can take several hours.

"Both the rule-in and the rule-out diagnoses are critical," McDevitt said. "Safely moving false alarms out of the ER would have a major impact on U.S. health care costs for chest-pain patients."

McDevitt said the disposable cards used in the saliva-based heart-attack screens are currently made using silicon fabrication methods from the computing industry. These cost about $5 per card, but his laboratory at Rice is testing alternative materials that can be used to produce the disposable cards for just pennies.

Any biomarker that's specific to a type of cancer or other disease can be added to these disposable cards to create a new type of test. McDevitt said because LabNow's analyzer is nearing commercial availability, his lab is transitioning from creating the technology to read the tests to creating the tests themselves.

"Finding and applying biomarkers for these tests is going to be our new focus," he said. "It's akin to creating software for a computer rather than the computer itself. Up to now we've been like Dell computer, but we're going to be the Microsoft of biomarker signatures from here on out."
