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FEATURES

Inventive Partners

Clinicians team up with biomedical engineering students for solutions to real-life problems

At BME Design Day, Edie Gurewitsch and graduate fellow Tara Johnson demonstrate the birthing simulator they and their design team created. (Photo: Will Kirk)

Inspiration can strike at the oddest times, observes obstetrician Edie Gurewitsch. She recalls the day in 2002 she underwent a test to assess total body fat. Electrodes wrapped around her arms and legs were attached to a device that measured the percentage of body fat. *I wonder if a device like this could be used in OB research, she mused.*

Gurewitsch, who treats women at high risk for premature births, says the only way to know if childbirth is imminent is by pelvic exam. If the cervix has softened, the birthing process has already begun.

What if, thought Gurewitsch, there were a disposable cervical probe that could detect molecular changes in the cervix way before it palpably softens? It could be a simple office procedure, like a Pap smear. If the probe showed even minimal softening, the doctor could begin treatment earlier and prevent a premature birth.

And so an idea was born. Gurewitsch had little time to pursue it, but she knew someone who might, namely, biomedical engineering professor Robert Allen. Allen teaches a BME course, in which design teams brainstorm with clinicians to invent devices. He encouraged Gurewitsch to post a description of the probe on his students' electronic bulletin board.

Two weeks later, BME undergraduate student Melanie Ruffner responded. She and her team researched the proposal and found a similar device described in a British journal. "Then they came up with a much better design," Gurewisch says. "It blew me away." She wasn't the only one impressed. With the University's blessing, the inventors filed for a patent. The project sparked interest among investors, and the University now has a licensing agreement.

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Inventions like these—targeting a specific medical problem—are part of a trend to engineer novel devices to advance patient care. And they're cropping up in every discipline. Seventy percent of the ideas come from physicians, says Allen; the rest from industry and people who need assistive devices.

This year on May 9, for the first time, the design teams showed off their wares at "Design Day," at the Whitaker BME Institute on the Homewood campus. Among the inventions: a surgical stapler for the aorta and a device that detects acute renal failure.

Often referred to as translational research, the field has an overarching goal, says BME director Murray Sachs, who is stepping down after 25 years at Hopkins. "We want to bring our basic research to the bedside and the marketplace without sacrificing scrupulous scientific investigation."

Freshman Taylor Reese tests the chest closure device he helped design to improve recovery after heart surgery.

Biomedical engineering at Johns Hopkins has a distinguished past, dating back to 1945. Responding to a growing demand for biomedical instruments and imaging, the program has evolved from strictly basic to more applied science. The department's groundbreaking work has not gone unnoticed. For the past 16 years, *U.S. News and World Report* has ranked it the No. 1 biomedical engineering department in the nation.

The four-year BME undergraduate program draws about 120 students each year. The department also offers master's and Ph.D. programs. BME bridges the University's Department of Engineering with the School of Medicine and is housed at the Whiting School of Engineering on the Homewood campus.

When a promising project nears completion, faculty and student inventors, with help from industry liaison Aditya Polsani, file for patents. They've already founded several start-up companies and provided the basis for licensing agreements for the University.

Wilmer ophthalmologist Peter Gehlbach is both inventor and patient. After neck surgery two years ago, Gehlbach found the conventional neck brace difficult to work in. He conceived of a suspension system that would unload stress from the neck and still allow him the ability to rotate the head. While the new brace will be useful in the privacy of the office, a "minimalist" brace is being designed for potential use during actual patient care. Thanks to BME student Greg Kapp and his team, Gehlbach's device now has a patent pending.

Bob Allen, left, models a conventional neck brace while student Greg Kapp shows off his team's rotating version.

Gehlbach, who guest lectures for BME, sees more than just good inventions emerging from these partnerships. "We're connecting engineers to patients. They learn to get out of the lab and connect with people."

Two years ago, students helped Gurewitsch and others design a birthing simulator so that physicians could better judge how much force to use when the baby's shoulders are stuck in the mother's pelvis. It took a pilot study and countless mock deliveries in Allen's lab, using life-size plastic replicas to perfect the model. Now, like the cervical probe, the birthing simulator has a patent.

"I've no doubt these devices will save lives," Gurewitsch says. "But without the design teams, these inventions would probably never have materialized."

—Judy Minkove