Regulator keeps vaccines at right temperature

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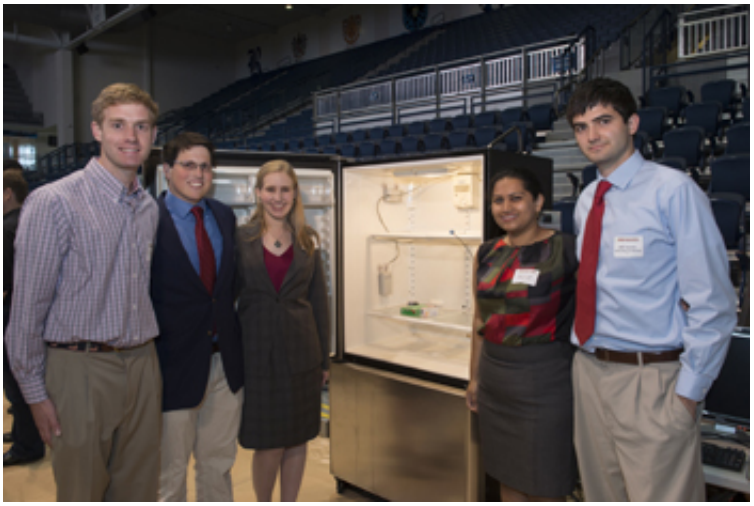

A team of Rice University seniors built a system to control the temperature in standard refrigerators used for vaccine storage. From left: Max Chester, Josh Mrozack, Amanda Walborn, Anisha Kunder and Andres Martin de Nicolas. Credit: Jeff Fitlow

Rice University students have created a way to help health care workers track vaccines and keep them at a safe temperature.

The SAFE Vaccine senior engineering design team, working at the request of Dr. Patrick McColloster, an associate professor of family and community medicine at Baylor College of Medicine, assembled a device to regulate the temperature of any standard refrigerator to keep it within a range that's safe for vaccines. Their invention also tracks vaccine

stock, usage and expiration dates and, as a result, takes a load of paperwork off the backs of nurses.

A 2011 study by McColloster determined that many refrigerators in Houston medical facilities were freezing vaccines. While freezing doesn't necessarily destroy them, the vaccines are less effective once they thaw.

Installing laboratory-standard refrigerators would solve the problem, McColloster said. "But average physicians are not going to have these. They wouldn't be able to afford them."

Many of these physicians are part of the massive Centers for Disease Control and Prevention (CDC) Vaccines for Children program that serves millions each year. "When I did the study, I initially thought this was an idiosyncratic problem here," McColloster said, but noted the federal Department of Health and Human Services' inspector general issued a report in 2012 that found refrigeration problems nationwide.

"The problem isn't that the vaccines are wasted or thrown away because of improper temperature management," said Amanda Walborn, a member of the SAFE Vaccine team. "It's that the vaccine gets damaged and nobody knows it. And it gets administered anyway."

Walborn and her bioengineering teammates, Anisha Kunder and Josh Mrozack and electrical engineering students Max Chester and Andres Martin de Nicolas, found the rudimentary temperature controls in standard refrigerators make it hard to keep vaccines within the mandated range of 2 to 8 degrees Celsius.

Vaccine refrigerators are opened and closed many times during the day, and nurses often turn the thermostat down to compensate, McColloster found.

"They set it to the lowest setting to keep it cold enough," Martin de Nicolas said. "But if they leave it there overnight and during weekends, the temperature will drop too much. It's very easy to overlook."

McColloster approached the team's adviser, Maria Oden, director of the Oshman Engineering Design Kitchen, to see if Rice students could build a better system.

"He wanted us to build a fridge," Martin de Nicolas said. "But we decided that instead of reinventing the wheel, we would deal with existing equipment and control it better."

Their more practical solution involves sensors placed inside the refrigerator wired to a controller mounted on the outside. The controller monitors the temperature and adjusts it to a fine degree by literally turning the power to the refrigerator on and off as needed. Ultimately, they plan to link the sensors and controller wirelessly.

The heart of the system is a Raspberry Pi, a complete computer that costs only $35 and can output data to a monitor and be programmed with a keyboard and mouse.

"Generally for this sort of control system, we'd use a microcontroller rather than a full CPU," Mrozack said. He said the computer they're using is "much easier for prototyping and programming."

The computer was flexible enough to allow the team to incorporate the vaccine-tracking system that prints bar code stickers for every box in a refrigerator. When nurses remove vaccines for use, they scan the box and the system prints the necessary paperwork.

Martin de Nicolas and Chester plan to stay on after graduation to prepare a functional prototype for testing this summer. They also plan to develop

a power backup system that McColloster said will be especially useful in areas prone to brownouts and blackouts.

"I've been working on this type of problem for 20 years," said McColloster, who sees potential for the device in developing countries as well. "Thank God (for) this program with Dr. Oden."

Provided by Rice University