This $100 CPAP prototype could save lives in Uganda and India

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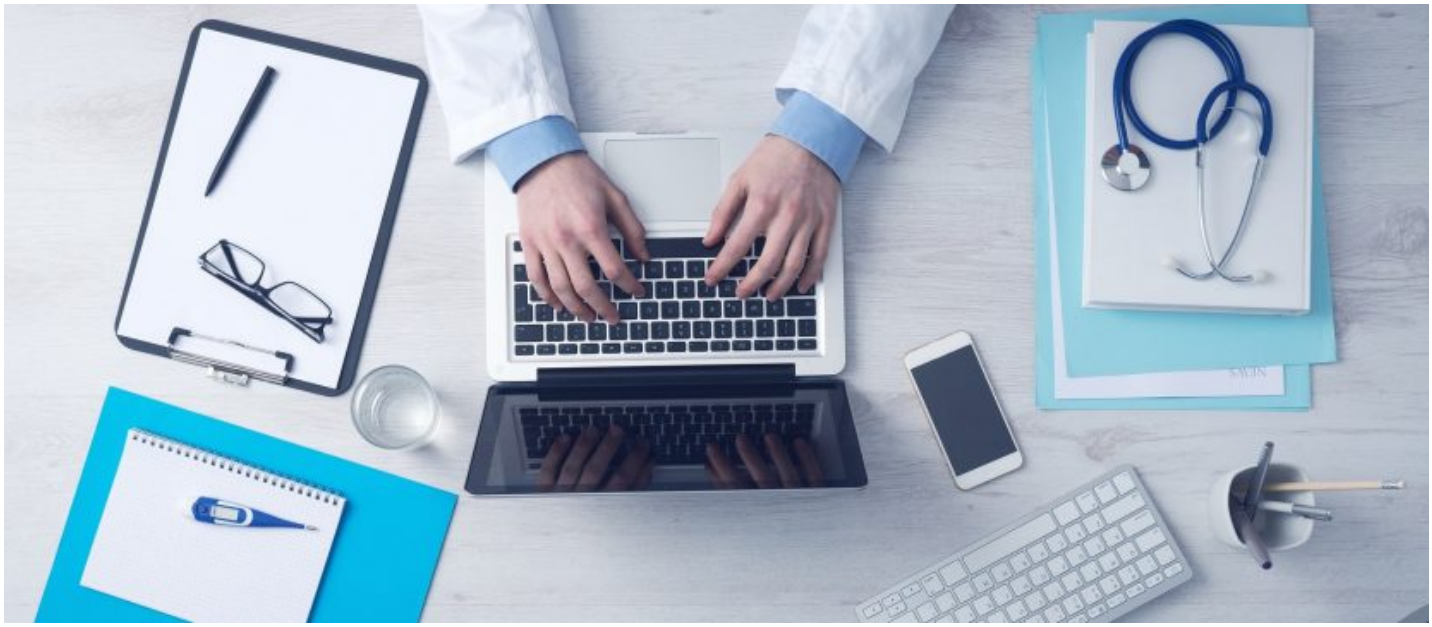

How do you build medtech on a budget? Ryan Carroll has an idea or two. The MGH researcher has developed a CPAP prototype that could save lives in Uganda and India. It can be assembled in 45 minutes—and costs around $100.

CPAP stands for Continuous Positive Airway Pressure. It's a medical device that supports people who aren't able to breathe on their own. Carroll's prototype, which he calls Simple CPAP, is modeled after the "bubble CPAP," a device for infants with respiratory distress syndrome. Every year, about 3.3 million infants die within the first 28 days of life, according to the World Health Organization. Almost all of these deaths occur in low and middle-income countries, particularly in Africa and South Asia.

One of the earliest prototypes of MGH researcher Ryan Carroll's CPAP device.

"Our idea was to take something vetted in the '70s and build a basic model of it," said Carroll, an MGH physician based in Mbarara, Uganda.

Carroll built his very first CPAP at a hackathon hosted by MGH and MIT Hacking Medicine in 2012. When the machine won the $1000 runner-up prize and secured additional funding from MGH Global Health, Carroll and his hackathon teammates, including MGH physician Aartik Sarma, realized they were on to something.

"It's pretty simple to use, but it's not available in large parts of the world," said Sarma, who helped build the first machine in Carroll's apartment.

CPAP machines can cost thousands of dollars. Many require oxygen to run, a commodity that's not always available in low-resource settings. As a result, hospitals in these settings often hack together their own devices. But these devices can be unsafe.

When Carroll moved to Uganda in 2013, he brought the CPAP idea—and one of his four prototypes—with him.

This set in motion a three-year process of refining the machine at Mbarara University of Science and Technology (MUST), where he's program director of the MGH-MUST Collaborative. Carroll and his staff worked closely with Data Santorino's CAMTech Uganda team to develop the machine through lab testing and end-user feedback sessions. Santorino, Director of CAMTech Uganda and AIR machine innovator, and Patrick Ssonko, lab manager and engineer, provided crucial expertise to improve the machine. (Ssonko and Santorino could not be reached for comment before this story went to press.)

Pediatricians working with the CPAP unit at the Mbarara University of Science and Technology. From left to right: Data Santorino, Dorah Nampijja, Catherine Kyakwera and Elias Kumbakumba.

How does the Simple CPAP cut costs? Basically, Carroll buys the inner and outer parts of the machine separately, then puts them together. He also shops locally, when possible. Parts such as the pump, tubing and flow meters are ordered online, in bulk, from Home Depot, Staples and Amazon. Other parts such as water bottles and airtight containers for the humidifier are bought from convenience stores in Uganda. It all comes to about $100, says Carroll, which makes the prototype more affordable than other CPAPs developed for low-resource settings.

But cost is only part of the battle. Carroll wants the Simple CPAP to be just as effective as others. He says the prototype functioned similarly to a proprietary machine during lab tests. But it's all theoretical for now—it hasn't yet been tested on a patient.

Sustainability is another key concern. So Carroll, Santorino and Ssonko have trained Ugandan colleagues to build, maintain and repair the machine. A major challenge for medtech in low resource settings, they have found, is fixing the equipment when it breaks down. Most of the medtech is donated and does not come with a service contract. Low-resource hospitals lack the funding and training to maintain the machinery. So when it breaks down, it sits in storage. "Most [medical hardware] products in Sub-Saharan Africa are donated. They live a short life," he said. "People can show you a graveyard of donated medical hardware that has since become dysfunctional."

A more recent version of the CPAP

Carroll and a team of innovators are now preparing to develop and scale the CPAP with Delhi-based medtech hardware company Lattice Innovations, in a partnership forged last month.

The Simple CPAP may or may not hit the shelves this year. But the team plans to make serious headway. The Lattice Innovations partnership will help finalize the business model, bolster the design and prepare to scale. Over the next four months, the team aims to take the machine from prototype to product, creating a manufacturable design that can be introduced to hospitals in Uganda and India.

"This is an innovation that directly has an impact in saving lives," said Soura Bhattacharyya, CEO of Lattice Innovations, who met Carroll at a CAMTech India hackathon. "It's a very relevant 'bread and butter' technology. It allows people who would have never considered buying a CPAP to purchase one. Smaller hospitals in India that have below 100 beds will finally be able to afford CPAP equipment."

He went on to praise CAMTech's model for global innovation. "There's a lot of focus on in-country innovation," he said. "It's not this idea that we in Boston will build a device and take it to India. It's how do we integrate people who live and work in those countries to come up with this solution. Innovation is something that has to come from people who are facing the challenges every day."

Amy Pollard

Amy Pollard is a candidate for the MA in Communication and International Relations at Boston University. Her interest in health care began with her first trip to Tanzania, where she volunteered at a medical dispensary in a rural village and saw firsthand how access to health care impacts patients. She's excited to learn about health care technology in Boston. She's originally from Seattle and holds a B.A. in English from Saint Martin's University. When she's not writing, she's probably drinking coffee, making tacos or watching Parks and Rec. Follow her @amyannexu.