Medical Xpress

Researchers develop ventilator costing less than $300

March 27 2020

Rice University staff, students and partners have developed an automated bag valve mask ventilator unit. Working at Rice's Oshman Engineering Design Kitchen, from left: Dr. Rohith Malya, engineering design technician Fernando Cruz and supervisor Danny Blacker. Credit: Brandon Martin/Rice University

Rice University and Canadian global health design firm Metric

Technologies have developed an automated bag valve mask ventilation unit that can be built for less than $300 worth of parts and help patients in treatment for COVID-19. The collaboration expects to share the plans for the ventilator by making them freely available online to anyone in the world.

Faculty and students went into overdrive several weeks ago when requests began pouring into the university seeking plans for an early prototype developed in 2019 by Rice engineering seniors.

That team, which called itself Take a Breather, designed and built a programmable device able to squeeze a bag valve mask. These masks are typically carried by emergency medical personnel to help get air into the lungs of people having difficulty breathing on their own. But the masks are difficult to squeeze by hand for more than a few minutes at a time.

Dr. Rohith Malya, an assistant professor of emergency medicine at Baylor College of Medicine, an adjunct assistant professor of bioengineering at Rice and associate of the Rice 360° Institute for Global Health and a principal at Metric Technologies, recognized the need to automate the masks not only for emergencies where hospital ventilators are in short supply but also for developing nations where such equipment is not available at all.

The first criterion certainly applies now, with a global shortage of ventilators threatening the population as the novel coronavirus spreads.

Rice University staffer Danny Blacker holds a bag valve mask. Rice staff, students and partners have developed an automated bag valve mask ventilator unit that can be built for less than $300 in parts and helps critically ill COVID-19 patients. Credit: Jeff Fitlow/Rice University

Rice administrators, staff and students quickly gathered to see how quickly they could develop a more robust prototype built primarily of 3-D-printed and laser-cut parts. Their solution, designed and prototyped within a week, is a reconfiguration of the original rack-and-pinion device and designed to be not only medical grade, but also inexpensive enough to be considered disposable.

The small team worked in the Brown School of Engineering's Oshman Engineering Design Kitchen (OEDK), where the original project came

together last spring. The OEDK is usually hopping at this time of year as Rice senior engineering students race to finish their capstone design requirements. With students hunkered down and taking their classes online, the facility provided a quiet refuge for the ApolloBVM team as it worked around the clock to build the device.

The Department of Defense is one of the groups interested in ApolloBVM. The U.S. Navy invited several institutions to submit proposals to develop a low-cost, mechanical ventilation support system that can be rapidly produced with widely available resources.

"This is as simple as it can get, with all readily available parts," said Danny Blacker, the OEDK's engineering design supervisor.

Rice University's Danny Blacker holds a laser-cut part of the ApolloBVM unit created at Rice's Oshman Engineering Design Kitchen. The automated bag valve

mask ventilator could help critically ill COVID-19 patients. Credit: Jeff Fitlow/Rice University

The prototype uses an Arduino board to facilitate programming that allows users to adjust the rate of air delivery to the lungs of patients depending on their conditions, but the team expects a custom integrated circuit will eventually be available to replace the board at a lower cost. The device will also employ feedback sensors that help fine-tune the flow of air to the lungs, as well as motors of the same type that power 3-D printers for hours on end.

In its documentation, the team characterizes ApolloBVM as a "high-acuity limited-operability (HALO) ventilator solution with an a priori design to produce volume- and pressure-cycled ventilation that includes positive end-expiratory pressure and the inclusion of enriched oxygen sources."

Malya inspired the Rice project two years ago after seeing families try to keep critically ill loved ones at the Kwai River Christian Hospital in Thailand alive by bag-ventilating them for hours on end. He expects the new ApolloBVM to serve that purpose eventually, but the need is now worldwide.

"This is a clinician-informed end-to-end design that repurposes the existing BVM global inventory toward widespread and safe access to mechanical ventilation," Malya said, noting that more than 100 million bag valve masks are manufactured around the world each year.

"The immediate goal is a device that works well enough to keep noncritical COVID-19 patients stable and frees up larger ventilators for more critical patients," added Amy Kavalewitz, executive director of the

OEDK.

Malya said the name is a tribute to Rice's history with NASA and President John F. Kennedy's famous speech kicking off the nation's efforts to go to the moon.

"This project appeals to our ingenuity, it's a Rice-based project and it's for all of humanity," he said. "And we're on an urgent timescale. We decided to throw it all on the table and see how far we go."

Provided by Rice University

Citation: Researchers develop ventilator costing less than $300 (2020, March 27) retrieved 18 September 2024 from https://medicalxpress.com/news/2020-03-ventilator.html