Northampton native helped create device that allows one ventilator to treat two patients

NORTHAMPTON — Timothy "Tim" Foldy-Porto's spring break illustrated that "genius loves company," even in times of quarantine.

Unable to return to Yale University after the start of spring break, the Northampton native holed up in his bedroom and turned his attention to addressing coronavirus-related ventilator shortages facing hospitals around the world.

In the last 10 days of March, Foldy-Porto, a physics major, and former

schoolmate Brian Beitler designed, created and tested the Vent Multiplexor, a plastic device that connects to a ventilator, allowing a single machine to treat two patients.

"We've created a plastic piece that's completely static," Foldy-Porto, 22, said. When used in conjunction with the electronic information on the ventilator, he said, "the doctors know how much airflow each patient is getting, whereas before, they would just be going into this process blind. We've created a measurement device."

The Vent Multiplexor has been granted Emergency Use Authorization by the Food and Drug Administration, and, on April 7, the device was successfully used at Yale-New Haven Hospital to treat two critically ill COVID-19 patients, who had different lung characteristics and required different treatments.

What's groundbreaking about the device is that it allows physicians to control and monitor airflow, in addition to delivering two distinct, simultaneous treatments with a single ventilator, explained Dr. Peter Kahn, a physician and the chief medical officer of Vent Multiplexor LLC, the company co-founded by Foldy-Porto and Beitler.

"You can measure and control the amount of air that multiple patients are getting. You can (treat) two different people who have very different lungs, and you can measure how much air they're getting and make adjustments individually," Beitler, 23, said.

"What the Vent Multiplexor allows physicians to do is to provide the best form of ventilator-splitting, given the pandemic," Kahn said.

He noted that this device has the power of reassurance for health care settings where the number of COVID-19 patients may outnumber available ventilators.

"If you think about it, it really allows almost an instantaneous doubling of ventilator capacity in a pandemic," Kahn said.

Putting physics to the test

The same week that Foldy-Porto and Beitler rapidly developed the Vent Multiplexor, the standard of respiratory care — one patient for each ventilator — was tested across the globe, as doctors in Italy and New York City documented other methods of splitting ventilators.

On Friday, March 20, Foldy-Porto was on a group call with Yale engineering faculty and students, brainstorming ways to help frontline health care workers.

Beitler, a Yale graduate and current second-year medical student at Yale School of Medicine, noted that simply splitting a ventilator's airflow does not guarantee equal volumes of air to each patient. A new way to split airflow and volume was needed.

"I started putting pencil to paper and playing around with the math," Foldy-Porto said. "If someone had assigned this as a homework problem, I think it would have been doable. I worked on it for an hour or two and then came up with a good solution."

The key to the device is its Venturi tubes, hour-glass shaped cylinders that are also used in jet propulsion. The shape of the cylinders alters the air pressure, which allows a physician to manually direct individualized volumes of airflow to each patient.

The next day, Foldy-Porto called up Beitler, who had hospital access to test prototypes.

"That first week was super intense," Foldy-Porto said. "I have a 3-D printer at

my house. Basically for a week straight, me and Brian were in a development cycle."

"I would test the prototypes (using) a ventilator in the hospital until late at night, and, as I was testing, he would make adjustments to the model in real time. It would be like 1 or 2 a.m., and he'd start the next print," Beitler said, adding that Foldy-Porto would schedule his sleep around printing the prototype overnight.

Each day, Foldy-Porto drove to Hartford to deliver a tweaked prototype to Beitler, who tested the device on a special, calibrated ventilator at Yale-New Haven Hospital. There, Beitler met Kahn, who immediately got behind the project.

Within days, the duo had a viable prototype in hand, and the hospital was abuzz with their creation. The pair co-founded their own company, and, with the help of a lawyer, the Vent Multiplexor was ushered into the patent process.

On April 15, the FDA granted the Vent Multiplexor Emergency Use Authorization, adding it to a list of medical devices designed or repurposed to act as ventilators and breathing support during the pandemic. Vent Multiplexor LLC estimates that the current price of its device is under $300.

Currently, Vent Multiplexor is being manufactured, and the company is moving towards distribution, Foldy-Porto said, adding that the whole experience has left him feeling accomplished.

"At the end of the day," Beitler said, "it's been an exhausting experience that has been incredibly reward ing."