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INTERIEWER: Hello, and welcome to “We Roar.” With coronavirus still going strong, we’ve been asking Princetonians everywhere to share how they’re thinking through crisis, how their expertise can help find solutions, and how working together can make a difference. In this episode, we hear about the critical shortage of ventilators worldwide, and how a group of physicists, doctors and others, scramble to fill the gap — for $30,000 less than the usual price tag.

CRISTIANO GALBIATI: My name is Cristiano Galbiati. I’m a professor of physics at Princeton University. When the pandemic started, I was in Italy — where I do most of my research. And I was spending a lot of time in front of the TV, learning what was happening from the news. And I was really shocked by the intensity of the pandemics in Italy. The rate of mortality was very high — as high as it happened during the Influenza of 1918.

And I immediately realized, given what the TV was telling us, the important deficit of ventilators in Italy. Ventilators provide a basic life support function for patients that are affected by a variety of situations or illnesses. Ventilators are essential, for example, for life support of patients affected by ARDS — Acute Respiratory Distress Syndrome. The COVID-19 virus induces a form of ARDS which is especially vicious and harmful to patients.

So ventilators are real life-saving tools, and there was a terrible shortage of them. So I was really shocked by this news. And I said, we must find a way to push the oxygen in the lung of the patients here in Italy and elsewhere, and to try to alleviate these terrible problems brought forward by the COVID pandemics. We need to do something about it because myself, my colleagues in our field, we do a lot of special projects with many specialty gases. And so I did a very few basic experiments to try and see if it was possible, indeed, to devise a system that could essentially be the core of a very simple, cheap and effective ventilator.

And so we found a way to develop a system that was very basic but had the promise of being very, very effective. So that’s how the ventilator project started. On March 21, I was working on this project with my closest collaborator when we first made a very important decision: that we needed to work together with industry. So we established contact with a company in nearby

Milan that had the ability and the capabilities and the intention to bring forward this technology and develop it with a very rapid pace.

And the day after, we started reaching out to international collaborators. We reached out to the Italian Institute of Nuclear Physics, we reached out to Professor Art McDonald, who is a Princeton former faculty member and Nobel Prize in physics. And the day after, on March 24, we started spreading the news around anesthesiologists. And we ended up involving many anesthesiologists in the COVID wards of Italy, but also many of them in the US and Canada.

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Those were very frantic days during the pandemics, where a lot of people had a lot of time to devote to the project because of the shutdown of other activities. And so we started organizing very large calls — with typically over 100, 150 participants — where we collected suggestions from many of these doctors that turned out to be extremely usable, full and profitable.

It was an extremely quick project in the first phase. It was 35 days to the demonstration of performance that was requested by FDA. And then 42 days to the approval by the Food and Drug Administration. They believe it's the fastest approval on record for FDA from concept to issuance of the approval itself. And this was possible because of the enthusiastic involvement of tens, if not hundreds, of researchers — some of them in person, most of them remotely through Zoom connections. And that is what made the project possible and very, very successful.

So this ventilator is very basic and is very sturdy, very reliable, has no moving parts inside, and therefore, is built for long-term reliability, and was approved for continuous use by the FDA through the Emergency Use of Authorization for use up to 30 days. So it's especially suitable for the treatment of the specific form of ARDS which is induced by the COVID-19 virus.

In addition, this ventilator was designed to be built from a limited number of electromechanical parts. There is a limited numb— set of valves and pressure regulators that are tightly packaged into a single fluidics block, which is controlled and regulated by an intelligent control board whose behavior is programmed by the best physicists — experts in data acquisition controls — around the world.

So the cost of the ventilator, when you take into account all the elements that are necessary for the introduction in the market, is a cost that is in the range of $5,000 to $6,000 — US dollars. And this is a cost which is significantly lower than other, more complex ventilators — lower by a factor of five to six.

Production is starting in Italy and in Canada. And there are several countries in which ventilators are either signed for delivery under contracts or in advanced discussions. These countries include certainly Canada, Saudi Arabia and Armenia and Mexico. And there are many inquiries from at least another 20 countries between South America, Asia, Middle East and Africa.

So there is a lot of interest because unfortunately, this pandemics is not yet done. And some of the nations that are going to be possibly targeted either in the immediate future or in the fall want to prepare themselves for the possibility of offering the best care for their own patients.

My greatest hope for the next year is that these ventilators may see a very significant deployment around the world, and that they may be able to be used a lot and to be used for people that have that a need for them. And my greatest hope is that these efforts may contribute to save as many life as possible. So I think it's going to be very important to be able to provide the best care while the pandemic is ongoing, and at the same time, to try and push the research to find as soon as possible a very strong remedy, like a vaccine, for fighting this virus in all the populations around the world.

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