BBC NEWS

Coronavirus: 3D printers save hospital with valves

By Zoe Kleinman
Technology reporter, BBC News

16 March 2020

Coronavirus pandemic

A 3D-printer company in Italy has designed and printed 100 life-saving respirator valves in 24 hours for a hospital that had run out of them.

The valve connects patients in intensive care to breathing machines.

The hospital, in Brescia, had 250 coronavirus patients in intensive care and the valves are designed to be used for a maximum of eight hours at a time.

The 3D-printed version cost less than €1 (90p) each to produce and the prototype took three hours to design.

Italian journalist Nunzia Vallini put the hospital in touch with Isinnova chief executive Cristian Fracassi after discovering the original supplier was unable to supply new valves quickly.

He and mechanical engineer Alessandro Romaioli raced there to see the valve for themselves - and three hours later, returned with a prototype.

"They tested it on a patient and they told us that it worked well and so we ran again back to our office and we started to print new valves," Mr Romaioli told BBC News.

The pair then joined forces with Lonati, another local 3D-printer company to meet the demand, since Isinnova has six printers and the devices take about an hour each to print.

They are working for free, but they do not plan to release the design publicly.

The valves are about 10cm (4in) high and 3cm in diameter

"The valve has very thin holes and tubes, smaller than 0.8m - it's not easy to print the pieces," Mr Fracassi said.

"Plus you have to respect not [contaminating] the product - really it should be produced in a clinical way."

Nevertheless, a second hospital had now got in touch, requesting more valves.

"We haven't slept for two days," he said.

"We're trying to save lives."

03-16-20 | CORONAVIRUS CRISIS

These Good Samaritans with a 3D printer are saving lives by making new respirator valves for free

As Italy's hospitals have run out of equipment, one hospital is making its own using 3D printers and local expertise.

BY KRISTIN TOUSSAINT 3 MINUTE READ

As more and more patients are hospitalized with COVID-19, resources at health facilities are being strained. That's why flattening the curve is so important, so that there's not a sudden influx of patients and then a shortage of beds or vital equipment. In Italy, which moved too late to limit exposure, this has already happened: Hospitals in the north of the country are overwhelmed, and running out of space and equipment, causing the death toll to spike. But when one Italian hospital ran out of valves for crucial respiratory machines, local manufacturers stepped in to 3D print replacements.

It started with a call from Nunzia Vallini, a journalist at *Giornale di Brescia*, a newspaper in Brescia, a provincial capital in northern Italy. On Friday, she explained to Massimo Temporelli, founder of the digital manufacturing lab FabLab, the problem she had learned about: A hospital in Chiari, a small city near the capital, was running out of valves for reanimation devices—also called resuscitation devices or respiratory machines—which help patients breathe by mechanically ventilating their lungs. The company that supplies these valves couldn't send replacements in such a short time, and people were dying.

[Photo: courtesy Michele Faini]

Temporelli, who is based in Milan, eventually reached out to Cristian Fracassi, founder and CEO of engineering company Isinnova. Fracassi then contacted Michele Faini, an expert in 3D print manufacturing and a research and development designer at Lonati SpA, a manufacturing company in Brescia. The two have collaborated before, and they worked together to design the valves, which help mix oxygen with air and are an important part of the respirator system.

The hospital supplier didn't want to give these manufacturers information about the valves' design, Faini told *Fast Company* by email, but they were able to reverse engineer the design themselves. Though this was the first time Lonati SpA has printed something for the medical sector, Faini says the company's SLS 3D printers can print with PA12, a material that can be sanitized and used for biomedical purposes.

[Photo: courtesy Michele Faini]

"We were ready to print the valves in a couple of hours, and the day after we had 100 valves printed," Faini says. Fracassi had also brought a 3D printer to the hospital and printed out a few valves there.

Patients with COVID-19 at the Chiari hospital are now able to breathe thanks to these 3D printed valves. As the coronavirus pandemic spreads, though, other hospitals may be at risk of similar shortages. Gerrit Coetzee, a San Francisco-based design engineer, put out a call on the blog Hackaday for designers and engineers to design an open-source ventilator, which he describes as "the device that becomes the decider between life and death" for COVID-19 patients, and which are in short supply.

3D printing, which has already been used in the medical field for everything from creating custom, affordable prosthetics to printing surgical tools to personalizing pills, could be key to making ventilators available everywhere. And the collaboration needed to create such a design would help everyone fare better in this pandemic. Faini noted how collaboration was crucial to creating these valves. They knew they had to act quickly, because people could die without the respirators. "I hope that all the people understand that we have to work together [to] stop this pandemic," he says. "All of us have to stay safe and have to use our skills to help [those] who need it."

Right now, these manufacturers aren't sharing their 3D blueprints for this valve because it's ultimately safer, and better, to get these valves directly from the manufacturer. The original pieces work better than the 3D printed ones, they explain in a Facebook video, because the intricate designs and small holes are difficult to 3D print. The fact that these valves are used for medical purposes means they also need to be created in clean environments, handled only with gloves, and sterilized—not something anyone with a 3D printer can do. They don't intend to completely bypass the manufacturer, but, they say, the situation in Brescia was extreme, and they did what they could to help out in an extraordinary circumstance.

7 NEWS BOSTON

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MARCH 16, 2020

Hundreds of 3D printing specialists offering to produce vital hospital supplies amid coronavirus outbreak

3D Printing Media Network

Frank O'Laughlin

(WHDH) — Hundreds of design engineers from across the world have offered to donate their 3D printing skills and equipment to help produce vital hospital supplies amid the evolving coronavirus pandemic.

A public document titled "3D Printer Crowdsourcing for COVID-19" is quickly gaining steam on Twitter, garnering nearly 200 signatures from people who are willing to share their 3D printers, talent, or design expertise with hospitals that are experiencing supply shortages linked to the COVID-19 response effort.

A Bostonian is among the many who are eager to assist in the production of respirators, valves, masks, and other essential materials, according to the document.

A hospital in Italy was able to save the lives of many coronavirus patients by 3D printing valves on reanimation devices.

"Additive manufacturing may be able to play a role in helping to support industrial supply chains that are affected by limitations on traditional production and imports. One thing is for sure though: 3D printing can have an immediate beneficial effect when the supply chain is completely broken," a post on 3D Media Network said. "That was, fortunately, the case when a Northern Italian hospital needed a replacement valve for a reanimation device and the supplier had run out with no way to get more in a short time."

The coronavirus has killed more than 6,500 worldwide, according to an estimate from Johns Hopkins University.

michal Naka @michalnaka · Mar 16, 2020

Replying to @michalnaka

Do you have 3D printers, talent, or design expertise that you are willing to share w/ hospitals during the COVID-19 pandemic? Please submit your info in the form below!
forms.gle/nJ5cqAa81DTZfY…

We will make the responses a public google sheets page for folks to view!

3D Printer & Talent Crowdsourcing for…

Hi there - We are crowdsourcing a list of folks who have 3D printers that are willing to use them to print medical parts for

docs.google.com

michal Naka
@michalnaka

Here is the public database of people from around the world who have 3D printers and/or skills they are willing to donate:
docs.google.com/spreadsheets/d…

3D Printer Crowdsourcing for COVID-19 (Re…

Form Responses 1 Timestamp,Email Address,Name,City,Country,Do you have a 3D Printer?,Do you have any design or engineering

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74 9:33 AM - Mar 16, 2020

64 people are talking about this

3D printer saves ten Italian coronavirus patients' lives by producing a replacement valve for a broken ventilator in just a few hours after the hospital's supplier falls short

By IAN RANDALL FOR MAILONLINE
PUBLISHED: 17:50 GMT, 16 March 2020 | **UPDATED:** 17:52 GMT, 16 March 2020

A 3D printer saved ten **coronavirus** patients' lives by producing a replacement valve for a broken ventilator in just a few hours after the hospital's supplier fell short.

Ventilators — or respirators — provide patients with oxygen when they are unable to breathe on their own, such as can result in severe coronavirus cases.

Spare valves for the vital intensive care machine were running out on Friday at the Chiari hospital in the town of Iseo, in northern **Italy**'s Lombardy region.

A collaboration between 3D printing experts and local business owners came to the rescue, however — rapidly fabricating the replacement parts.

Scroll down for video

A 3D printer saved ten coronavirus patients' lives by producing a replacement valve for a broken ventilator in just a few hours after the hospital's supplier fell short. Pictured, engineer Christian Fracassi, left, and colleague seen here with the 3D printed valves

'As you know in northern Italy the COVID-19 emergency is very serious,' industrial engineer Marco Silvestri of the University of Parma told **Fabbaloo**.

To date, Italy — the country in Europe most severely impacted by coronavirus — has counted 24,747 individual cases and 1,809 deaths.

'New resuscitation departments equipped with machinery to ventilate patients are being set up with great urgency,' Professor Silvestri added.

'Thanks to 3D printing, people are compensating for the lack of spare parts.'

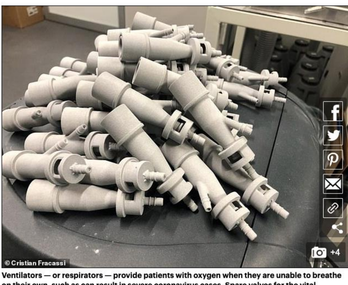
'There are patent and validation issue in using these non-original spare parts, but when it is a matter of hours to avoid people dying, it's time to make exceptions.'

Doctors at the Chiari hospital, located near a region of Italy that has been particularly hard-hit by the coronavirus outbreak, raised the alarm on March 13 after it became clear their supplier would not be able to provide new ventilator valves in time.

They reached out to Nunzia Vallini — editor of the Giornale di Brescia, a local newspaper — who approached physicist and 3D printing expert Massimo Temporelli.

The duo began seeking someone local in possession of a 3D printer that could be taken to the hospital to reproduce the much-need spare valves for the ventilator.

Christian Fracassi, a local engineer and business owner, rose to the occasion, bringing his printer to the hospital and — within a matter of hours — succeeded in redesigning and printing a replacement part for the intensive care machine.



Ventilators — or respirators — provide patients with oxygen when they are unable to breathe on their own, such as can result in severe coronavirus cases. Spare valves for the vital intensive care machine were running out on Friday at the Chiari hospital in the town of Iseo, in northern Italy's Lombardy region. Pictured, some of the 3D printed replacement valves

The initial replacement parts were made by so-called filament extrusion — in which a plastic wire is melted and deposited layer-by-layer to make up the desired object — by Mr Fracassi on site at the hospital.

Additional valves were later printed from the same template by the local manufacturing firm Lonati SpA, using a slightly different process in which a laser is used to melt and fuse a powder together to build up successive layers of an object.

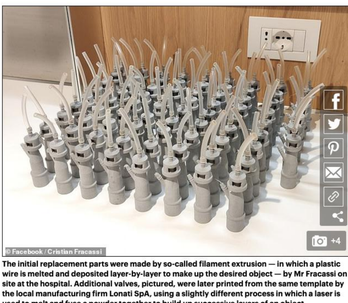
According to the Italian newspaper **La Stampa**, the company that manufacturers the valves refused to supply Mr Fracassi and his associates with the specs for the original valve designs — and warned them off of trying to reproduce the part.

'I have lawyers who are evaluating the matter,' Mr Fracassi told the news outlet TPI.

'I am not dealing with it personally because I prefer to devote myself to [the 3D designs].'

'There were people in danger of life, and we acted. Period,' he added.

'We have no intention of profiting from this situation. We are not going to use the designs or product beyond the strict need that forced us to act.'



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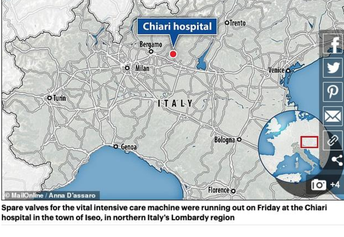
Some have criticised the engineers for producing valves that have not passed the customary safety certifications before being used.

In response, Mr Temporelli told La Stampa that this was true, 'But when there's no time and people are risking their lives, you can't stop because of bureaucracy.'

It remains unclear, however, how the durable the stopgap parts are and whether they would be able to be sterilised and reused without being damaged.

According to Mr Temporelli, other medical facilities — including those located in Pescara, on Italy's eastern coast, and in Sassari, on Sardinia — have already been in contact looking for help addressing their valve shortages as well.



Spare valves for the vital intensive care machine were running out on Friday at the Chiari hospital in the town of Iseo, in northern Italy's Lombardy region

greenMe

Germana Carillo VIVERE SALUTE & BENESSERE 16 Marzo 2020

Non ci sono più valvole per la rianimazione a Brescia: questo ingegnere le stampa in 3D!

All'ospedale mancano le valvole per un dispositivo di rianimazione e il fornitore non può darle rapidamente, ma arriva la stampa 3D ad aiutare e a salvare vite umane. Succede a Chiari, nella provincia di Brescia, il cui nosocomio, in piena emergenza coronavirus, era quasi rimasto senza le valvole per un macchinario utile a chi si trova in terapia intensiva.

A raccontare questa storia a lieto fine è *Massimo Temporelli*, giornalista e imprenditore esperto in innovazione, scienza e tecnologia. Come dice in un post sui social, a lui si era rivolta *Nunzia Vallini*, direttrice del Giornale di Brescia, col quale Temporelli collabora per la divulgazione nelle scuole della cultura Industry 4.0 (tra cui la stampa 3d).

> *La Vallini lo aveva informato di un'urgenza. "in un ospedale di Brescia le valvole per uno strumento di rianimazione stavano finendo e il fornitore non poteva fornirgliele in tempi brevi. Sarebbe stato un danno incredibile, alcune persone forse avrebbero perso la vita. E dunque, mi chiedeva: è possibile stampare 3d questa valvola?".*

In un attimo, un giro di idee e telefonate e il miracolo è avvenuto: l'ingegnere *Cristian Fracassi*, con la sua azienda e il suo team, ha portato una **stampante 3D** direttamente in ospedale e in poche ore ha ridisegnato e poi prodotto il pezzo mancante.

Secondo gli ultimi aggiornamenti il sistema funziona e ad oggi 10 pazienti sono accompagnati nella respirazione da una macchina con la valvola stampata 3D.

E allora, forza, avanti così!

Fonte: Massimo Temporelli pagina Facebook

REUTERS

HEALTH NEWS MARCH 16, 2020 / 7:56 PM / 4 DAYS AGO

Italian start-up 3D prints valves to help coronavirus patients

Elvira Pollina

3 MIN READ

MILAN (Reuters) - Italian Cristian Fracassi heard about the shortage of valves used in respirators at his local hospital by word of mouth.

A staff of the Italian start-up Isinnova company shows valves produced with a 3D printer for hospitals are seen near the northern Italian city of Brescia, in Chiari Italy March 15, 2020. CRISTIAN FRACASSI/Handout via REUTERS

The founder of Isinnova, a startup with a staff of 14 people, offered his company's services to help ease the shortfall of equipment that has been in huge demand since the coronavirus outbreak struck Italy.

"We were told the hospital was desperately looking for more valves. They're called Venturi valves and are impossible to find at the moment, production can't keep up with demand," said Fracassi, a 36-year-old engineer.

Named after Italian 18th century physicist Giovanni Battista Venturi, the valves connect oxygen masks to respirators used by coronavirus patients suffering from respiratory complications.

Italy is battling the world's worst outbreak of coronavirus outside of China. So far 2,158 people had died of the 27,980 who have contracted the disease in the country in less than a month.

Its healthcare system is under strain due to the mounting number of patients requiring intensive care facilities.

The hospital is in Chiari, near Brescia, a prosperous northern city now in the epicenter of the coronavirus outbreak.

Fracassi and his team were able to replicate the valves using a 3D printer at Isinnova's headquarters.

The company's products range from hi-tech luggage for fashion brand Gucci to a special paint it is currently developing to survive temperatures of 1,000 degrees Celsius.

"When we heard about the shortage, we got in touch with the hospital immediately. We printed some prototypes, the hospital tested them and told us they worked," Fracassi said. "So we printed 100 valves and I delivered them personally."

He said he did not meet a single car as he drove through the streets, an eerie sensation caused by the transport ban in place. At least 10 patients were using equipment containing the valves by the evening.

Fracassi said it cost next to nothing to produce the valves, which weigh around 20 grams each and are made of plastic.

"I'm not going to charge the hospital ... It was the least I could do to help doctors and nurses who work all day long to save human lives."

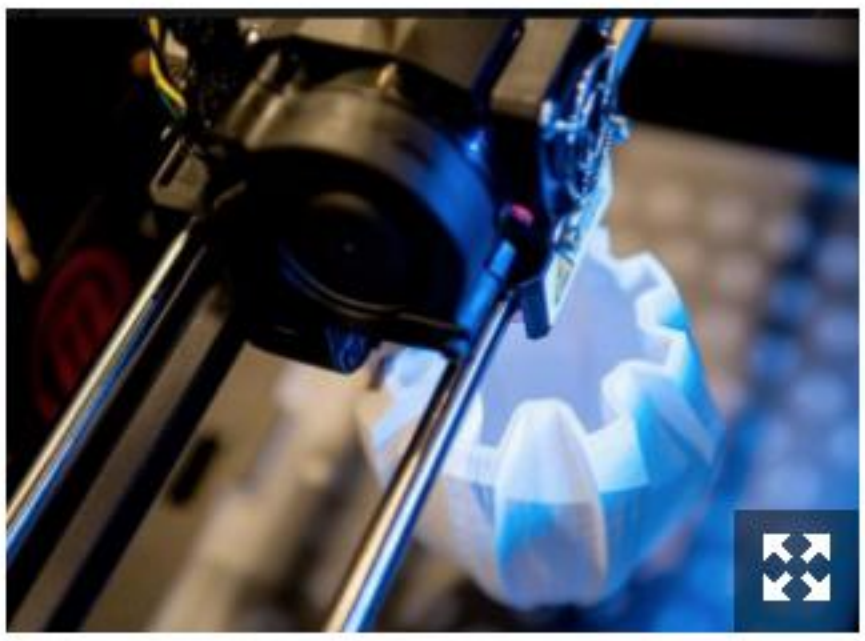
Reporting by Elvira Pollina; editing by Valentina Za and Mike Collett-White

Our Standards: *The Thomson Reuters Trust Principles.*

TECH TIMES

Maker of $11,000 Ventilator Valves Threatens to Sue Volunteers Using $1 3D-Printed Replicas That Just Saved 10 Coronavirus Patients!

17 March 2020, 10:35 pm EDT By Urian B. Tech Times



3D Printed Valve (Screenshot From 3D Printer szerviz Facebook Page)

In a recent news reported by TECHTIMES, Chiara Hospital located in Italy, a 3D printer was able to save the lives of ten different Italian coronavirus (covid-19) patients by being able to produce the unique replacement valve for broken ventilators just after the hospital's supply ran out!

Because of this act of bravery, a medical device manufacturer has saw this and has even threatened to sue the very group of people who volunteered to print the 3D printed valve used to save lives of covid-19 patients in Italy!

The valve being sold by medical device manufacturers versus the volunteer's replicas

The valve which was officially manufactured by the medical device manufacturer costs about $11,000 while the replica which the volunteers made costs only about $1. This just goes to show how expensive the valves are and how the innovators were able to immediately produce a replica to save the lives of those in need but have also forgotten about possible patents and copyrights.

The innovation was created with good intentions

The only reason the innovation came to life was because of the urgent need for valves when the hospital was treating patients and because of the supply running out, a certain Christian Fracassi as well as Alessandro Ramaioli have decided to offer their 3D printer to manufacture the replicas to save lives.

Read Also: 3D Printer Saves Lives of Italian Coronavirus Patients As Hospitals Run Out of Ventilators ! Here's How

According to Business Insider Italia, the manufacturer was actually approached by the duo in hopes to ask for the valve's blueprints in an urgent attempt to save them time and produce the valves to instantly save the critical covid-19 victims but they were declined and even threatened to be sued for patent infringement!

The brave move saved 10 lives

The duo then proceeded to manufacture the replicas by manually measuring the valves and 3D printing three different versions to see which one worked best.

Read Also: [INACCURATE] 10-Minute Coronavirus Testing Kit Created by Two British Companies Face Controversy

According to Massimo Temporelli who was the one who recruited the duo and is the founder of an Italian manufacturing solutions company named FabLab, this brave move by the duo has saved 10 lives on March 14 which has also opened the way to future possibilities.

Fracassi released a Facebook post explaining the intent behind the replicas

Fracassi said that "[The patients] were people in danger of life, and we acted. Period" to justify their actions and later on made it clear that "we have no intention of profit on this situation, we are not going to use the designs or product beyond the strict need for us forced to act, we are not going to spread the drawing."

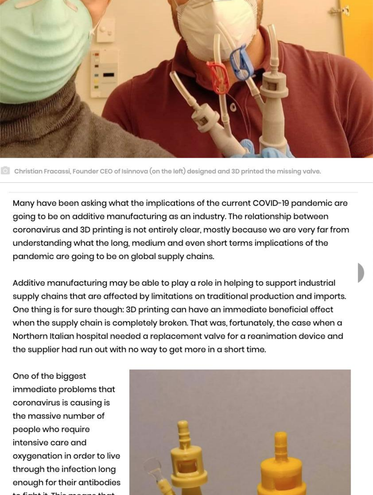
Italy is fighting hard against the coronavirus

Italy already has 31,500 confirmed infected civilians as the death toll reaches 2,500 and is still currently growing. The creation of the replica valve has been a huge step for them as they were able to prevent 10 critical patients from dying and the possibility of maybe more dying from the lack of valves as well.

AM IN THE TIME OF COVID-19 / AM INDUSTRY / MEDICAL

[Updating] Italian hospital saves Covid-19 patients lives by 3D printing valves for reanimation devices

The supply chain was broken, people and 3D printing rose to the occasion

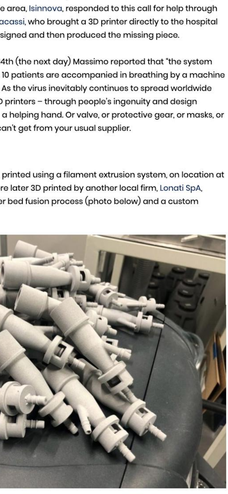


Christian Fracassi, Founder CEO of Isinnova (on the left) designed and 3D printed the missing valve.

Many have been asking what the implications of the current COVID-19 pandemic are going to be on additive manufacturing as an industry. The relationship between coronavirus and 3D printing is not entirely clear, mostly because we are very far from understanding what the long, medium and even short terms implications of the pandemic are going to be on global supply chains.

Additive manufacturing may be able to play a role in helping to support industrial supply chains that are affected by limitations on traditional production and imports. One thing is for sure though: 3D printing can have an immediate beneficial effect when the supply chain is completely broken. That was, fortunately, the case when a Northern Italian hospital needed a replacement valve for a reanimation device and the supplier had run out with no way to get more in a short time.

One of the biggest immediate problems that coronavirus is causing is the massive number of people who require intensive care and oxygenation in order to live through the infection long enough for their antibodies to fight it. This means that the only way to save lives at this point – beyond prevention – is to have as many working reanimation machines as possible. And when they break down, maybe 3D printing can help.



The original valve (on the left) and its 3D printed twin.

Massimo Temporelli, founder of The FabLab in Milan and a very active and popular promoter of Industry 4.0 and 3D printing in Italy, reported early on Friday 13th that he was contacted by Nunzia Vallini, editor of the Giornale di Brescia, with whom he has been collaborating for several years for the dissemination of Industry 4.0 culture in schools.

She explained that the hospital in Brescia (near one of the hardest-hit regions for coronavirus infections) urgently needed valves (in the photo) for an intensive care device and that the supplier could not provide them in a short time. Running out of the valves would have been dramatic and some people might have lost their lives. So she asked if it would be possible to 3D print them.

After several phone calls to fablabs and companies in Milan and Brescia and then, fortunately, a company in the area, Isinnova, responded to this call for help through its Founder & CEO Cristian Fracassi, who brought a 3D printer directly to the hospital and, in just a few hours, redesigned and then produced the missing piece.

On the evening of Saturday 14th (the next day) Massimo reported that "the system works". At the time of writing, 10 patients are accompanied in breathing by a machine that uses a 3D printed valve. As the virus inevitably continues to spread worldwide and breaks supply chains, 3D printers – through people's ingenuity and design abilities – can definitely lend a helping hand. Or valve, or protective gear, or masks, or anything you will need and can't get from your usual supplier.

[Update 15-3-2020]

After the first valves were 3D printed using a filament extrusion system, on location at the hospital, more valves were later 3D printed by another local firm, Lonati SpA, using a polymer laser powder bed fusion process (photo below) and a custom polyamide-based material.

[Update 16-3-20]

So many – see comments below – have reached out to offer help in producing these parts, both locally and globally. As far as 3dpbm understands, the model for the valve remains covered by copyright and patents. Hospitals may have a right to produce these parts in an emergency (as in this case) but, in order to legally obtain a 3D printable STL file, the hospital that requires the parts needs to present an official request. We will continue to update this article as new information becomes available.

[Update 16-3-2020]

The device in question is a Venturi valve, used for a Venturi Oxygen mask. These are low-flow masks that use the Bernoulli principle to entrain room air when pure oxygen is delivered through a small orifice, resulting in a large total flow at predictable FIO2.

[Update 17-3-2020]

In light of the overwhelming response to this topic and offers to help that we have received, we have created an online Emergency AM Forum as a way to help hospitals, AM companies and makers share ideas and unite to fight the COVID-19 pandemic. You can register to create a new topic. Healthcare professionals will be able to use the *search by radius* function on the right-hand side to find local makers, companies and services that can help. More topics will be added daily.

[Update 18-3-2020]

We have received hundreds of requests for the venturi valve STL file. In this video, Cristian Percassi explains (in Italian) why the STL file has not been shared at this time. The first key reason is that – for the time being – only one hospital had a requirement for about 100 venturi valves and the requirement was fully satisfied with the first production batch. Another hospital may now have a similar need and many hospitals around the world may follow. The correct course of action – Percassi explained – is to always check with the official manufacturer first. If the valves are not available, only in case of a confirmed emergency is it possible to contact a 3D printing service provider and produce a replica. However, a high-end powder bed fusion machine is needed to produce parts that have the necessary accuracy and complexity. Percassi also revealed that, contrary to certain reports, they were never threatened with a lawsuit.

[Update 19-3-2020]

Since the need emerged for venturi valves in ventilators for hospitals around the world dealing with the COVID-19 pandemic, several designers and engineers have started working on creating 3D printable models for them. While there are both copyright issues and medical issues that need to be taken into account when 3D printing any medical product, and a critical one such as a venturi valve, in particular, this case has shown that a life and death situation could warrant using a 3D printable replica. GrabCAD user Filip Kober has now created a model and has made it available for free on the 3D model network. Together with our partners at Shapemode, we have 3D printed it using high accuracy stereolithography technology (see photo below) and the device seems to have proper dimensional accuracy. You can find links to this and all other 3D printable files for useful medical devices in this dedicated section of the Forum. If you use it, please post comments and suggestions for other users.