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## FORGING A NEW FRONTIER IN 3D PRINTING DURING COVID-19 PANDEMIC

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# Q&A with Albert S. Woo, MD

## *Forging a New Frontier in 3D Printing during COVID-19 Pandemic*

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RIMJ MANAGING EDITOR

**ALBERT S. WOO, MD**, Director of the Lifespan 3D Printing Lab at Rhode Island Hospital, leveraged resources at Lifespan and university and private organizations to address the shortage of personal protective equipment (PPE), a project that is ongoing, particularly when it comes to N-95 masks.

Dr. Woo, who is also the Director of the Craniofacial Program and Chief of Pediatric Plastic Surgery at Hasbro Children's Hospital, responded to questions from RIMJ on this vital turn in 3D print medical manufacturing no one could have foreseen prior to the pandemic.

**RIMJ: What gave you the idea of making Personal Protective Equipment (PPE) in the Lifespan 3D Printing Lab?**

**DR. WOO:** To be honest, I had no idea of the degree of interest in the use of 3D printing technology for personal protective equipment. As a plastic surgeon, most of the work that we have done with 3D printing has been focused on the creation of anatomic models for use in planning and performing surgical reconstructions. However, with the onset of the COVID pandemic, reports started arising around the world of certain individuals utilizing 3D printing technology to assist with certain critically needed parts that might not have been commercially available due to supply shortages. After forwarding an article about the use of 3D printing to the hospital administration in mid-March, I was shocked by the outpouring of interest by the hospital asking how I might be able to help with predicted supply shortages. This was the first step into a whirlwind journey into 3D printing for production of PPE.

**RIMJ: What is the current timeframe/progress for the Lifespan 3D Printing Lab on making other PPEs, such as respirator shields, N-95 masks?**

**DR. WOO:** Based on the interest in 3D printing, we started exploring how to use this technology to help with critical supply shortages. We initially explored the idea of using 3D printing to help with face shields for health care providers. There are a number of plans available, including those by Prusaprinters.org and Budmen.com. Such shields are widely being made by people with 3D printers across the country. After discussions with the hospital, it became clear that they had much greater needs, as Rhode Island Hospital was already able to find local manufacturers to create the shields for hospital workers. We therefore began exploring other options and also began recruiting collaborators.


The August 2019 issue of RIMJ featured an article about Dr. Woo's 3D Printing Lab. http://www.rimed.org/rimedicaljournal/2019/08/2019-08-15-cont-boyajian.pdf.

Pediatric Ophthalmologist **Melissa Simon, MD**, wearing a clip-on shield created by Dr. Woo's 3D Printing Lab, designed to give full-face protection and fit over a binocular indirect ophthalmoscope.

### Need for protection for anesthesia, critical care and emergency room staff

An interesting project that became very urgent was the need for protection for anesthesia, critical care and emergency room staff when intubating or otherwise performing very high-risk procedures on COVID-positive patients. When doing so, they use powered air-purifying respirators (PAPRs) and the specific model that the hospital provided included disposable masks. Due to the COVID pandemic, this mask supply became dangerously low. To help with this, we established a collaboration with Professor **CHRISTOPHER BULL**, a Brown University engineering professor who heads the Brown Design Workshop. With the assistance of the hospital, we were able to obtain the necessary supplies to manufacture these critical disposable shields ourselves using traditional engineering practices.

### N-95 shortages

The project that has taken the greatest amount of time, however, has been the development of a mask to combat the N-95 shortage that has been plaguing health care providers around the world. After weeks of design and iteration, we have designed a mask that we feel fulfills this need. The collaborations have been extensive, including other physicians, **DR. THOMAS N. CARRUTHERS** (a vascular surgeon), the Brown Design Workshop, **MEGAN BILLINGS** (an engineer at Kineteks) and multiple partners who have printed models for us. These are currently being manufactured by volunteer Brown undergraduate and medical students and are currently made available to Rhode Island Hospital staff. Unfortunately, as the design is currently under patent filing, I cannot disclose the details of the device.

We have also developed strong collaborations with Professor **BRENNAN PHILLIPS** at URI, who has been spearheading efforts to produce ventilator filters and splitters, another possible need for the state.

### Ophthalmology

While in the midst of this, I was approached by **DR. MICHAEL MIGLIORI**, Ophthalmologist-in-Chief at Rhode Island Hospital, to help with a critical need to protect our ophthalmology colleagues as they examine potential COVID patients. You might remember that the physician who was labeled a whistleblower in China and eventually passed away from COVID was an ophthalmologist as well. This case highlights the increased risk that these physicians face when caring for some of these patients. Based on our experience above, it was an easy process for us to borrow from some of our other efforts to create several specialized shields for our doctors when they are using some of their equipment. It is a pleasure to have played a small part in helping colleagues whom I have such strong respect for.

**RIMJ: What other organizations are you partnering with?**

**DR. WOO:** We have multiple collaborators: Brown University, particularly the Brown Design Workshop and Brown Bioengineering (multiple individuals), Dr. Carruthers (Brown Physicians, Inc), **DR. AUDOEN MADDOCK** from Women & Infants, Megan Billings (Kineteks), Brennan Phillips (URI), Lifespan [with the support of **DR. LATHA SIVAPRASAD** (CMO), and **DR. JOHN MURPHY** (Interim President of RIH). Our efforts would also not have been successful without the express support of President **CHRISTINA PAXSON**, Provost **RICHARD LOCKE**, and Dean **JACK ELIAS** of Brown, who provided special permission for our student volunteers to assist in this process.

**RIMJ: Do you have the necessary supplies to create PPE?**

**DR. WOO:** Yes, Lifespan has been generous with providing the necessary supplies to manufacture our masks by hand. Our greatest challenge has been trying to mass manufacture these devices. We hope to find additional support from local manufacturers to help with this process.

**The potential is incredible as this technology continues to expand beyond simple printing of plastics into metals and even bioprinting. This technology is truly the wave of the future.**

**RIMJ: Who is designing and executing the work in the Lifespan 3D Lab?**

**DR. WOO:** Myself and **JOSEPH CROZIER**, who coordinates the activities of the 3D Printing Lab. **KATHERINE WESTROM** has been instrumental in the training and dispensing of masks to hospital personnel.

**RIMJ: How did you personally first become interested in 3D printing?**

**DR. WOO:** This is a long story. As a craniofacial surgeon, I have always been interested in 3-dimensional imaging and happened to head the Craniofacial Imaging Lab at Washington University in St. Louis. It was an easy transition from there to actually printing our imaging and I found myself one of the founding co-directors of the 3D Printing Lab at Washington University. With my relocation to Rhode Island Hospital, I continued my pursuits of 3D printing and we were one of the first centers in the country to obtain a Stratasys J-750 printer.

**RIMJ: Beyond its present capabilities, what applications/potential do you foresee in using 3D printing in the future?**

**DR. WOO:** As you know, we have done our best to try to make the medical community in Rhode Island aware of the use of medical 3D printing technology and published a paper in the August 2019 issue of the RIMJ. I think that the field of medical 3D printing is very much in its infancy as few physicians have looked into exploring the possibilities of this technology in their own practices. In short, the potential is incredible as this technology continues to expand beyond simple printing of plastics into metals and even bioprinting. This technology is truly the wave of the future. ❖