Dr. Azad Mashari- Toronto General Hospital

Dr. Mashari is an assistant professor at the Department of Anesthesia and Pain Medicine at University of Toronto; Staff cardiovascular anesthesiologist and critical care physician at the Peter Munk Cardiac Center, Toronto General Hospital. He is also the Director of the Lynn and Arnold Irwin Advanced Perioperative Imaging Lab (APIL) which focuses on the translation of imaging and distributed manufacturing technologies into medical education and clinical practice.

Dr. Mashari collaborates closely with Glia inc, a company developing regulatory approved, open-source medical devices in partnership with academic and industry partners. He has also worked on developing high-efficiency volatile anesthesia delivery systems, and other ventilator related device development since the start of the pandemic.

Tell us about your work contributing to the COVID-19 crisis work at your hospital and in your community.

All our work at APIL during the COVID pandemic has been in close collaboration with Glia, my colleagues at the department of Anesthesiology and Pain Management at Sinai Health System/University Health Work, and dozens of teams and individual within UHN, U of T, Ryerson U, Toronto Public Library, and private sector collaborators. The work has been supported by the Toronto General and Western Hospital Foundation as well government funded innovations funds. I put that up front because without that support and collaboration nothing would have happened.

Prior to the pandemic our lab was the largest hospital-based 3D printing and distributed manufacturing facility in Toronto (and likely in the country as a whole as far as I know). All work is commercially compliant open-source. Our projects to date include face-shields, safe ventilator splitting system, last resort ventilator BVM HALO, aerosolizing minimizing non-invasive ventilation mask developed in collaboration with General Dynamics Land Systems. As well as a reusable N95 face mask that can be manufactured in scale on site using distributed manufacturing techniques, and a modified snorkel mask PAPR device that can be manufactured on site using distributed manufacturing techniques (a more detailed list of projects and sources available on page 2)

The design, prototyping and distributed manufacturing capacity that we had at UHN, thanks to support from the foundation and our department was crucial to our ability to launch these projects, form effective collaborative partnerships and move these projects forward rapidly.

What are you most proud of achieving?
I am most proud of being a part of such amazing teams at various levels, from our core R&D team at APIIL, to my department and practice association, University Health Network, University of Toronto and the all the public and private sector partners that could mobilize such massive resources of expertise, material and spirit, so rapidly.

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Do you have any highlights of the hospital and staff contributions you’d like to share?

Our lab is based in the hospital and visitors have not been allowed in the building. This included all our external collaborators, which led to numerous parking lot exchanged of packages that must have looked mighty suspicious to any on-lookers. At one point one of the engineers from Promation, Alex Sakuta and I were trouble shooting the ventilator out of the back of his van in front of the hospital with laptops and respiratory monitors and extension cords going into the building.

Those are the humorous parts. The most impressive was the number of people who were willing to drop everything else and work around the clock, weekday or weekend to turn things around unbelievably fast, from prototypes, research protocols and ethics approvals, to complex data collection, keeping printers running 24/7 for the first few weeks. In normal times this work would have taken well over two years.

Additions Details of Toronto General Hospital’s Projects to Date:


2. Safe ventilator splitting system (Cerberus: https://apil.ca/cerberus/). Cerberus was developed over a 4 week period from a rough design in a 1994 paper by our colleague Joe Fisher. The system was rigorously refined, tested on the bench and in animal models, and has now undergone extensive human factors testing as well. 40 units are being assembled at UHN for emergency use. They will allow one ventilator to be used for two patients, but allows customized settings for each patient (except respiratory rate which is shared) without the risk of cross infection. First report has already been published (links on website above). Second study is about to be submitted for evaluation. With support of team from U of T Comp Sci we were able to make a simulator for the system to facilitate rapid training and improved safety:

3. Last resort ventilator BVM HALO (Bag Valve Mask, High Acuity Low Operability Ventilator: https://apil.ca/bvm-halo-vent/) Refining a design based on MIT’s E-vent prototype, went through 3 iterations of prototyping and testing in 3 weeks. Device is being further refined to meet HC requirements for emergency ventilation with support from Promation and Bruce Power.

4. An aerosolizing minimizing non-invasive ventilation mask (https://glia.org/aerosol-reducing-mask/) developed in collaboration with General Dynamics Land Systems (London ON) and Glia. Based on a modified firefighters mask. Interim Health Canada approved. Currently undergoing clinical trials and FDA and full HC approval process. Supported by a UHN / SHS AMO grant. We are working with the team at Sioux Lookout Meno Ya Win Health Center, which is the main referral center for all the remote communities in North Western Ontario, as well ORNG to evaluate the use of the devices in remote nursing stations and for air and land transport.

5. A reusable N95 face mask that can be manufactured in scale on site using distributed manufacturing techniques. As part of this we have created a CSA compliant (not formally certified) testing facility that allows on-site fit and filtration testing of mask including commercial elastomeric masks. Current device dramatically outperforms disposable N95s. Report submitted for publication. (Led by Dr. William Ng)

6. A modified snorkel mask PAPR device that can be manufactured on site using distributed manufacturing techniques. Report submitted for publication. Manufacturing 200 for local stockpile at UHN. (Led by Dr. Ludwik Fedorko)

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