Applied Solutions for Pandemic-Spurred Problems

As a university with a large, comprehensive healthcare system, Jefferson has been on the front lines of the pandemic. The situation has required that everyone become a creative problem solver: faculty, staff and students have stepped up to analyze problems as they emerge and develop solutions for an array of issues. It has been a high-pressure demonstration of applied research and development in real time, and a potent example of how the University is spurring a convergence of disciplinary perspectives to address new and evolving challenges.

"Applied science uses in-depth inquiry to rigorously analyze problems and then develop and test answers," says **Ron Kander, PhD**, associate provost of applied science. "Our researchers, students and designers worked hard to understand how COVID-19 changed our work and our lives, and have come up with innovative solutions to overcome these obstacles."

Here are examples of innovations developed to address pandemic-driven challenges.

A Smart Ventilator Splitter

From the pandemic's outset, the nation's too-limited supply of mechanical respirators became a critical concern. These machines typically helped individual patients move filtered air into and out of their lungs—with each device serving one patient at a time. That prompted bioengineer and visiting professor **Alessandro Napoli, PhD**, and **Mijail Serruya, MD, PhD**, assistant professor of neurology, to develop a device that would permit each respirator to serve three patients simultaneously. Their computer-controlled three-way "ventilator splitter" had a digital control panel that would monitor and control the airflow parameters of each patient's lungs; and the lines in and out of the machines had filters for each patient's separate airflow.

Rethinking Surgical Gown Design

Standard surgical gowns do not fully address problems caused by airborne viruses. For example, a widely used type of plastic gown effectively repels fluids; but the tie closure in the back leaves workers feeling exposed. On the other hand, the alternative nylon gown has full front-and-back coverage but is not as water repellant—and is more expensive. Responding to caregivers' requirements, **Anne Hand**, associate professor of fashion design, developed a prototype for a new gown that combined the best qualities of the existing versions. Her gown model provided better full-body coverage and functionality, and could be made with a lockstitch sewing machine, simplifying production and reducing cost.

Negative-Pressure Masks for Oral Procedures

During the pandemic, oral, dental and nasal surgeries can present infection risks to surgical staff performing the procedure. Therefore, a team led by **James Evans, MD**, professor of neurological surgery and otolaryngology, developed a patient-worn mask that uses negative airway pressure to safely exhaust air exhaled by the patient during the procedure. The respirator mask fits snugly around a patient's face, but has a specially designed opening that allows caregivers to pass instruments through.

Bridging Isolation

Patients' social and physical isolation is one of the unfortunate side-effects of the pandemic. Recognizing the importance of human connection during a crisis, an interdisciplinary team of faculty and students undertook the JeffersonSCREEN project: developing a novel physical screen/intervention that enables "mask-less visual connections" between patients and their caregivers, family and visitors. "The product that has been designed and is now being prototyped reflects the knowledge and skills of the unique collection of professional disciplines in our university," observes **Michael J. Leonard, MAEd, MSEd**, dean of the School of Design and Engineering. "We've brought textile designers and textile engineers, industrial designers and architects together to address practical challenges defined by an array of clinicians and caregivers." ■

A COVID-19 Vaccine with Few Logistical Hurdles

One of the challenges posed by the first COVID-19 vaccines to be approved for wide-scale use is logistical: the RNA-based Pfizer and Moderna vaccines require deep-freeze storage and must be used within a relatively short period after they are manufactured. That is a particular problem for less-developed nations and for populations remote from ultra-cold storage facilities.

Researchers at the Jefferson Vaccine Center are working to overcome those and other logistical challenges by leveraging one of their previously developed vaccines. Their COVID-19 vaccine candidate, CORAVAX™—which will soon enter Phase I/II clinical trials—can undergo long-term shelf storage at 4 degrees Celsius, and its freeze-drying formulation has been used with a similar vaccine for Ebola virus.

The vaccine's development was led by **Matthias Schnell, PhD,** Jefferson Vaccine Center director and professor and chair of microbiology and immunology. "CORAVAX™ incorporates a portion of the SARS-CoV-2 spike protein into a 'carrier' formula—a killed-rabies vaccine—that has already been demonstrated to be safe and effective," Dr. Schnell explains. "At least 20 manufacturing facilities around the world are already producing 100 million doses of that vaccine annually—and we'd simply be adding one small component to the formulation.

Because the underlying vaccine is already being widely manufactured, CORAVAX™ could be quickly produced and distributed to serve global needs. "In addition," Dr. Schnell adds, "the production process is relatively low-cost, which will be an important factor where billions of doses may be needed." The Jefferson Vaccine Center is also working on a new version of CORAVAX™ for the emerging Delta variant of SARS-CoV-2.